User Guide for the ETS

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Contents

1 Introduction

The ETS, the European Transport Solver, is a new code for solving the 1-D transport equations in the core. It is based on a modular approach, with each module using CPOs (Consistent Physical Objects) to communicate with other modules.

The ultimate goal is to use the scientific workflow engine, Kepler, to implement workflows using the ETS. At the moment, though, the workflows are implemented using a wrapper written in Fortran.

Two ETS workflows are implemented, plus an additional workflow for testing equilibrium codes.

The workflows are

test_solver used for testing the solvers based on an analytic solution using the Method of Manufactured Solutions

eq_ets_test which implements a workflow involving the ETS, (optionally) an equilibrium code, transport coefficients coming from the database or from transport models from IMP4, source coefficients from the database

eq_test runs the equilibrium codes `bdseq`, `helena`, `helena2` and `emeq`.

neo_test compare neoclassical modules

2 Obtaining the code

In order to obtain the ETS, you need to have an account on the EFDA ITM Gateway machine. If you do not have such an account, contact the task Force Leader, Par Strand (elfps@chalmers.se), explaining why you need access.

Once you have an account on the Gateway, request access to the code via the EFDA ITM Portal (http://portal.efda-itm.eu/) by following the GForge tab, following the projects link to the ETS, and requesting access.

Once you have access to the code, it can be checked out of SVN using

```
svn co http://gforge.efda-itm.eu/svn/ets
```

to access the whole repository, or

```
svn co http://gforge.efda-itm.eu/svn/ets/trunk/ETS
```

to access just the trunk version of the ETS.

Section E (page 52) contains the instructions used at the Code Camp in March 2010 to lead the participants through obtaining, compiling and running the code.

3 Compiling the code

The following description assumes that the user is in the `trunk/ETS` directory.

A number of compilers are supported for compiling the ETS, and for each supported compiler option a configuration file is present in the subdirectory `config`. For a number of the compiler options, versions are present with the suffix `_UAL` and with the suffix `_UAL.local`. The `_UAL` suffix indicates that it will use the pre-compiled UAL library available on the Gateway. The `_UAL.local` suffix indicates that it will compile much of the UAL higher level software as well as the ETS. A list can be found in `config/README`.

Config option	Description
g95	g95 on a 64 bit system
g95_32	g95 on a 32 bit system
g95_mac	g95 on a Mac
gfortran	gfortran on a 64 bit system
gfortran_32	gfortran on a 32 bit system
gfortran_mac	gfortran on a mac
GRID	g95 on a GRID system
GW	pgf95 on the Gateway (default)
Intel	Linux Intel compiler (32 bit) (called as /opt/intel/Compiler/11.0/083/bin/ia32/ifort)
JET	pgf95 at JET
lf95.debug	using lf95 with comprehensive debugging switched on
linux.Fujitsu	Lahey-Fujitsu compiler (called as f95f)
linux.Fujitsu.debug	Lahey-Fujitsu compiler (called as f95f) (with debugging options)
linux.ifort64	Linux Intel compiler (64 bit) (called as ifort)
linux.Intel	Linux Intel compiler (32 bit) (called as f95i)
linux.Intel64	Linux Intel compiler (64 bit) (called as f95i)
linux.Nag	Nag compiler (called as f95n)

To change the default compiler to, for example, the g95 compiler:

```
echo "SYS=g95" > obj/SYS
```

On the Gateway, if one is planning to use the Portland Group compiler, one should use the latest version. At the time of writing, this can be achieved by doing

```
module unload openmpi/1.3.2/pgi-8.0 compilers/pgi/8.0
module load compilers/pgi/10.2 openmpi/1.4.3/pgi-10.2
```

Compilation uses gnu make using the `Makefile` to provide the targets.

Before compiling the code for the first time, the user should

```
make depend
```

to establish the dependencies information. This should also be done when new depencies are introduced (adding a module use statement to a source file, for example), and after updating the code from the repository (`svn update`).

To compile and run the standard test case, the command is

```
make
```

This compiles and runs the analytic `solver_test` program. It will also indicate if the results are different from a saved version of the results.

Running

```
make help
```

will give a list of common entry points in the `Makefile`.

Section E (page 52) contains the instructions used at the Code Camp in March 2010 to lead the participants through obtaining, compiling and running the code.

4 Running the code

As mentioned earlier, three workflows are possible and these are described in the following sub-sections.

4.1 test_solver

UAL	Optional
Makefile entry point	`solver_test`
Input files	`ets_analytics.xml`
Output files	files in `data/OUTPUT/`, if compiled with the UAL option, UAL files
Required files	`ets_analytics.xsd`
Main program source file	`src/test/solver_test.F90`

Flag	**Description**
parameters	GLOBAL: parameters for solver_test
output	BLOCK: specify output CPO options
shot	shot number
run	run number
db	output database format (mdsplus or hdf5) [default: mdsplus]
dims	BLOCK: specify the dimensions
nrho	NRHO, number of radial points
nion	NION, number of ions
nimp	NIMP, number of impurity types
nzimp	MAX_NZIMP, number of impurity ionisation states
solver	BLOCK: specify parameters for the solver
solver_type	choice of numerical solver
sigma_source	option for origin of Plasma electrical conductivity: 0: plasma collisions; 1: transport module; 2: source module
tau	TAU, time step [s]
amix	AMIX, mixing factor
convrec	PRECISION
ntime	NTIME, number of time points
nsol	Number of analytical example
boundary	BLOCK: specify parameters for the boundary condition
psi_bnd_type	Type of boundary conditions CURRENT
ni_bnd_type	Type of boundary conditions ION DENSITY
ti_bnd_type	Type of boundary conditions ION TEMPERATURE
te_bnd_type	Type of boundary conditions ELECTRON TEMPERATURE
vtor_bnd_type	Type of boundary conditions ROTATION

4.2 eq_ets_test

The program "ets_eq_test" implements, in Fortran, a workflow showing all of the key ingredients:

- ETS to solve the transport equations
- EMEQ to solve the equilibrium
- externally provided sources (currently from a pre-created input file read via the UAL)
- externally provided transport coefficients (currently from a pre-created input file read via the UAL or from ETAIGB and NEOWES from IMP4)

Still to come in 2009 (hopefully) are

- neutrals
- impurities
- pellets
- sawteeth
- NTMs

This framework is likely to be replaced by Kepler workflows.

The main program, `eq_ets_test` requires data in the database which it reads via the UAL. These are written with a separate program `prepare_input_cpos`.

4.2.1 prepare_input_cpos

UAL	Optional
Makefile entry point	`prepare_input_cpos`
Input files	XML input file (name passed as argument)
Output files	ascii version of CPOs and UAL files
Required files	None
Main program source file	`src/write_cpo/prepare_input_cpos.f90`

To run `prepare_input_cpos`:

```
make prepare_input_cpos ARGS=PREPARE_INPUT_CPOS_XML/prepare_input_cpos_1.xml
```

The input for `prepare_input_cpos` is an XML file such as:

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <dimensions>
    <nrho>      100      </nrho>
    <nion>        1      </nion>
    <nimp>        0      </nimp>
    <ntheta>    101      </ntheta>
  </dimensions>

  <output>
    <shot>        4      </shot>
    <run>         1      </run>
  </output>

  <global>
    <time>      0.0      </time>
    <R0>        6.2      </R0>
    <B0>        5.3      </B0>
    <A0>        2.0      </A0>
    <Ip>      6.0e6      </Ip>
    <Rgeo>        0      </Rgeo>
```

```
  </global>

  <equilibrium>
    <equilibrium_ext>  </equilibrium_ext>
    <el>        1.0      </el>
    <tr_u>      0.0      </tr_u>
    <tr_l>      0.0      </tr_l>
  </equilibrium>

  <coreprof>
    <coreprof_ext>  </coreprof_ext>
    <zn>        1.0      </zn>
    <amn>       2.0      </amn>
    <zion>      1.0      </zion>
    <ni>
(1-x^2)*(1.0E20-5.0E19)+5.0E19
    </ni>
    <ti>
(1-x^2)*(1.0E3-5.0E2)+5.0E2
    </ti>
    <te>
(1-x^2)*(1.0E3-5.0E2)+5.0E2
    </te>
    <vtor>
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
    </vtor>
    <jpar>
(1-x^2)*(1.0E6-0.0E0)+0.0E0
    </jpar>
    <qsf>
(1-x^2)*(1.0-3.0)+3.0
    </qsf>
  </coreprof>

  <coretransp>
    <coretransp_ext>  </coretransp_ext>
    <sigma>
2.0e7
    </sigma>
    <ne_diff>
0.0 1.0 0.0
    </ne_diff>
    <ne_conv>
0.0 0.0 0.0
    </ne_conv>
    <ni_diff>
0.0 1.0 0.0
    </ni_diff>
    <ni_conv>
0.0 0.0 0.0
    </ni_conv>
    <te_diff>
1.5
    </te_diff>
    <te_conv>
0.0
    </te_conv>
    <ti_diff>
1.5
    </ti_diff>
    <ti_conv>
0.0
    </ti_conv>
    <vtor_diff>
1.0
    </vtor_diff>
    <vtor_conv>
0.0
    </vtor_conv>
  </coretransp>
```

```
  <coresource>
    <coresource_ext>  </coresource_ext>
    <j>
0.0
    </j>
    <sigma_src>
0.0
    </sigma_src>
    <qe_exp>
5.0e4
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
5.0e4
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
5.0e19
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

  <coreimpur>
    <coreimpur_ext>  </coreimpur_ext>
    <imp_zn>                 </imp_zn>
    <imp_amn>                </imp_amn>
    <nz>
    </nz>
    <diff>
    </diff>
    <conv>
    </conv>
  </coreimpur>

</parameters>
```

Flag	**Description**
parameters	GLOBAL: parameters for eq_ets_test
dimensions	BLOCK: specify the dimensions
nrho	NRHO, number of radial points
nion	NION, number of ions
nimp	NIMP, number of impurity types
nzimp	NZIMP, array of impurity ionisation states
ntheta	NTHETA, number of points in theta
nneut	NNEUT, number of the neutrals
ncomp	NCOMP, array of components for each neutral
	continued

continued	
Flag	**Description**
ntype	NTYPE, array of types for each neutral
output	BLOCK: specify output CPO options
shot	shot number
run	run number
global	BLOCK: specify global options
time	Time in the equilibriun CPO [s]
R0	R0, reference R [m]
B0	B0, vacuum B ar R0 [T]
A0	A0, minor radius [m]
Ip	Ip, plasma current [A]
Rgeo	Rgeo, geometric axis of plasma [m]
rho	expression giving the relative weighting of points in rho
equilibrium	BLOCK: specify parameters for the equilibrium CPO
equilibrium_ext	Reference CPO for equilibrium in the form USER/DEVICE/VERSION/SHOT/RUN or SHOT/RUN; not used if blank
el	Ellipticity
tr_u	Upper triangularity
tr_l	Lower triangularity
coreprof	BLOCK: specify parameters for the coreprof CPO
coreprof_ext	Reference CPO for coreprof in the form USER/DEVICE/VERSION/SHOT/RUN or SHOT/RUN; not used if blank
zn	NION list of nuclear charges [units of proton charge]
amn	NION list of atomic masses [amu]
zion	NION list of charge states [units of proton charge]
ni	NION list of expressions giving the ion desities as a function of a normalized radial coordinate [/m$\hat{3}$]
ti	NION list of expressions giving the ion temperatures as a function of a normalized radial coordinate [eV]
te	expression giving the electron temperature as a function of a normalized radial coordinate [eV]
vtor	NION list of expressions giving the ion toroidal velocities as a function of a normalized radial coordinate [m/s]
jpar	expression giving the parallel current density as a function of a normalized radial coordinate [A/m$\hat{2}$]
qsf	expression giving the safety factor as a function of a normalized radial coordinate []
coretransp	BLOCK: specify parameters for the coretransp CPO
coretransp_ext	Reference CPO for coretransp in the form USER/DEVICE/VERSION/SHOT/RUN or SHOT/RUN; not used if blank
	continued

continued	
Flag	**Description**
sigma	expression giving the parallel conductivity as a function of a normalized radial coordinate [???]
ne_diff	3 expressions giving the electron particle diffusivities [m$\hat{2}$/s]
ne_conv	3 expressions giving the electron pinch velocities [m/s]
ni_diff	NION * 3 expressions giving the ion particle diffusivities [m$\hat{2}$/s]
ni_conv	NION * 3 expressions giving the ion pinch velocities [m/s]
te_diff	expression giving the electron thermal diffusivity [m$\hat{2}$/s]
te_conv	expression giving the electron thermal pinch velocity [m/s]
ti_diff	NION expressions giving the ion thermal diffusivities [m$\hat{2}$/s]
ti_conv	NION expressions giving the ion thermal pinch velocities [m/s]
vtor_diff	NION expressions giving the ion toroidal velocity diffusivities [m$\hat{2}$/s]
vtor_conv	NION expressions giving the ion toroidal velocity pinch velocities [m/s]
coresource	BLOCK: specify parameters for the coresource CPO
coresource_ext	Reference CPO for coresource in the form USER/DEVICE/VERSION/SHOT/RUN or SHOT/RUN; not used if blank
j	expression for j as a function of a normalized radial coordinate [A/m$\hat{2}$]
sigma_src	expression for sigma as a function of a normalized radial coordinate [????]
qe_exp	expression for the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp	expression for the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
qi_exp	NION expressions for the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp	NION expressions for the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
qz_exp	NIMP,MAX_NZIMP expressions for the explicit part of the impurity heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qz_imp	NIMP .LT. MAX_NZIMP expressions for the implicit part of the impurity heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
si_exp	NION expressions for the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp	NION expressions for the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??]
sz_exp	NIMP,MAX_NZIMP expressions for the explicit part of the impurity particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
sz_imp	NIMP,MAX_NZIMP expressions for the implicit part of the impurity particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??]
ui_exp	NION expressions for the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
	continued

continued	
Flag	**Description**
ui_imp	NION expressions for the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
coreimpur	BLOCK: specify parameters for the coreimpur CPO
coreimpur_ext	Reference CPO for coreimpur in the form USER/DEVICE/VERSION/SHOT/RUN or SHOT/RUN; not used if blank
imp_zn	NIMP list of nuclear charges [units of proton charge]
imp_amn	NIMP list of atomic masses [amu]
nz	NIMP * MAX_NZIMP expressions giving the impurity ion desities as a function of a normalized radial coordinate [/m$\hat{3}$]
diff	NIMP * MAX_NZIMP expressions giving the impurity ion particle diffusivities [m$\hat{2}$/s]
conv	NIMP * MAX_NZIMP expressions giving the impurity ion pinch velocities

In this case the calculation is done with 100 points in ρ, only one ion species is considered, the data is written to shot 4, run 1 and the initial profiles are described by simple functions of x where x is a normalized ρ.

To run this case

```
make prepare_input_cpos ARGS=PREPARE_INPUT_CPOS_XML/prepare_input_cpos_1.xml
```

Another exampler for 4 ion species is:

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <dimensions>
    <nrho>      100      </nrho>
    <nion>        4      </nion>
    <nimp>        0      </nimp>
    <ntheta>    101      </ntheta>
  </dimensions>

  <output>
    <shot>        4      </shot>
    <run>         6      </run>
  </output>

  <global>
    <time>      0.0      </time>
    <R0>        6.2      </R0>
    <B0>        5.3      </B0>
    <A0>        2.0      </A0>
    <Ip>      6.0e6      </Ip>
    <Rgeo>        0      </Rgeo>
  </global>

  <equilibrium>
    <equilibrium_ext>  </equilibrium_ext>
    <el>        1.0      </el>
    <tr_u>      0.0      </tr_u>
    <tr_l>      0.0      </tr_l>
  </equilibrium>

  <coreprof>
    <coreprof_ext>  </coreprof_ext>
```

```
    <zn> 1.0 1.0 2.0 2.0 </zn>
    <amn> 2.0 3.0 3.0 4.0 </amn>
    <zion> 1.0 1.0 2.0 2.0 </zion>
    <ni>
((1-x^2)*(1.0E20-5.0E19)+5.0E19)/2
((1-x^2)*(1.0E20-5.0E19)+5.0E19)/2
((1-x^2)*(1.0E20-5.0E19)+5.0E19)/100
((1-x^2)*(1.0E20-5.0E19)+5.0E19)/10
    </ni>
    <ti>
(1-x^2)*(1.0E3-5.0E2)+5.0E2
(1-x^2)*(1.0E3-5.0E2)+5.0E2
(1-x^2)*(1.0E3-5.0E2)+5.0E2
(1-x^2)*(1.0E3-5.0E2)+5.0E2
    </ti>
    <te>
(1-x^2)*(1.0E3-5.0E2)+5.0E2
    </te>
    <vtor>
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
    </vtor>
    <jpar>
(1-x^2)*(1.0E6-0.0E0)+0.0E0
    </jpar>
    <qsf>
(1-x^2)*(1.0-3.0)+3.0
    </qsf>
  </coreprof>

  <coretransp>
    <coretransp_ext>  </coretransp_ext>
    <sigma>
2.0e7
    </sigma>
    <ne_diff>
0.0 1.0 0.0
    </ne_diff>
    <ne_conv>
0.0 0.0 0.0
    </ne_conv>
    <ni_diff>
0.0 1.0 0.0
0.0 1.0 0.0
0.0 1.0 0.0
0.0 1.0 0.0
    </ni_diff>
    <ni_conv>
0.0 0.0 0.0
0.0 0.0 0.0
0.0 0.0 0.0
0.0 0.0 0.0
    </ni_conv>
    <te_diff>
1.5
    </te_diff>
    <te_conv>
0.0
    </te_conv>
    <ti_diff>
1.5 1.5 1.5 1.5
    </ti_diff>
    <ti_conv>
0.0 0.0 0.0 0.0
    </ti_conv>
    <vtor_diff>
1.0 1.0 1.0 1.0
    </vtor_diff>
```

```
    <vtor_conv>
0.0 0.0 0.0 0.0
    </vtor_conv>
  </coretransp>

  <coresource>
    <coresource_ext>  </coresource_ext>
    <j>
0.0
    </j>
    <sigma_src>
0.0
    </sigma_src>
    <qe_exp>
5.0e4*(1-x^2)^4*8
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
5.0e4*(1-x^2)^4*8/2
5.0e4*(1-x^2)^4*8/2
5.0e4*(1-x^2)^4*8/100
5.0e4*(1-x^2)^4*8/10
    </qi_exp>
    <qi_imp>
0.0 0.0 0.0 .0
    </qi_imp>
    <si_exp>
5.0e19*(1-x^2)^4/2
5.0e19*(1-x^2)^4/2
5.0e19*(1-x^2)^4/100
5.0e19*(1-x^2)^4/10
    </si_exp>
    <si_imp>
0.0 0.0 0.0 0.0
    </si_imp>
    <ui_exp>
0.0 0.0 0.0 0.0
    </ui_exp>
    <ui_imp>
0.0 0.0 0.0 0.0
    </ui_imp>
  </coresource>

  <coreimpur>
    <coreimpur_ext>  </coreimpur_ext>
    <imp_zn>                 </imp_zn>
    <imp_amn>                </imp_amn>
    <nz>
    </nz>
    <diff>
    </diff>
    <conv>
    </conv>
  </coreimpur>

</parameters>
```

The following example includes two impurity species:

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <dimensions>
    <nrho>      100      </nrho>
    <nion>        1      </nion>
```

```
    <nimp>        2      </nimp>
    <nzimp>    8 10      </max_nzimp>
    <ntheta>    101      </ntheta>
  </dimensions>

  <output>
    <shot>        4      </shot>
    <run>        10      </run>
  </output>

  <global>
    <time>      0.0      </time>
    <R0>        6.2      </R0>
    <B0>        5.3      </B0>
    <A0>        2.0      </A0>
    <Ip>      6.0e6      </Ip>
    <Rgeo>        0      </Rgeo>
  </global>

  <equilibrium>
    <equilibrium_ext>  </equilibrium_ext>
    <el>        1.0      </el>
    <tr_u>      0.0      </tr_u>
    <tr_l>      0.0      </tr_l>
  </equilibrium>

  <coreprof>
    <coreprof_ext>  </coreprof_ext>
    <zn>        1.0      </zn>
    <amn>       2.0      </amn>
    <zion>      1.0      </zion>
    <ni>
(1-x^2)*(1.0E20-5.0E19)+5.0E19
    </ni>
    <ti>
(1-x^2)*(1.0E3-5.0E1)+5.0E1
    </ti>
    <te>
(1-x^2)*(1.0E3-5.0E1)+5.0E1
    </te>
    <vtor>
(1-x^2)*(-2.0E4-0.0E0)+0.0E0
    </vtor>
    <jpar>
(1-x^2)*(1.0E6-0.0E0)+0.0E0
    </jpar>
    <qsf>
(1-x^2)*(1.0-3.0)+3.0
    </qsf>
  </coreprof>

  <coretransp>
    <coretransp_ext>  </coretransp_ext>
    <sigma>
2.0e7
    </sigma>
    <ne_diff>
0.0 1.0 0.0
    </ne_diff>
    <ne_conv>
0.0 0.0 0.0
    </ne_conv>
    <ni_diff>
0.0 1.0 0.0
    </ni_diff>
    <ni_conv>
0.0 0.0 0.0
    </ni_conv>
    <te_diff>
1.5
```

```
    </te_diff>
    <te_conv>
0.0
    </te_conv>
    <ti_diff>
1.5
    </ti_diff>
    <ti_conv>
0.0
    </ti_conv>
    <vtor_diff>
1.0
    </vtor_diff>
    <vtor_conv>
0.0
    </vtor_conv>
  </coretransp>

  <coresource>
    <coresource_ext>  </coresource_ext>
    <j>
0.0
    </j>
    <sigma_src>
0.0
    </sigma_src>
    <qe_exp>
5.0e4
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
5.0e4
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
5.0e19
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

  <coreimpur>
    <coreimpur_ext>  </coreimpur_ext>
    <imp_zn>  8.0     10.0   </imp_zn>
    <imp_amn> 15.9994 20.180 </imp_amn>
    <nz>
1e17 1e17 1e17 1e17 1e17 1e17 1e17 1e17 1e17
1e17 1e17 1e17 1e17 1e17 1e17 1e17 1e17 1e17 1e17
    </nz>
    <diff>
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
    </diff>
    <conv>
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
    </conv>
  </coreimpur>
```

```
</parameters>
```

4.2.2 eq_ets_test

UAL	Optional
Makefile entry point	`eq_ets_test`
Input files	UAL files or ascii version of CPOs, `eq_ets.xml` and, depending on options, `input_etaigb.xml`, ...
Output files	UAL files, files in `eq_ets_data/OUTPUT/`
Required files	`eq_ets.xsd`
Main program source file	`src/test/eq_ets_test.f90`

The input file is "eq_ets.xml" and has an associated schema "eq_ets.xsd".

An example input file is

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <input>
    <shot_in>              4     </shot_in>          <!-- shot number -->
    <run_in>               6     </run_in>           <!-- run number -->
    <interpol>             1     </interpol>         <!-- interpolation index -->
    <time_dep_input>       0     </time_dep_input>   <!-- 1 implies time dependence in input data -->
  </input>

  <output>
    <shot_out>             5     </shot_out>         <!-- shot number -->
    <run_out>             62     </run_out>          <!-- run number -->
    <tau_out>         1.0d-1     </tau_out>          <!-- output frequency -->
  </output>

  <dims>
    <nrho>                50     </nrho>             <!-- NRHO,  number of radial points -->
    <neq>                100     </neq>              <!-- NEQ,   number of equilibrium points -->
    <nion>                 4     </nion>             <!-- NION,  number of ions -->
    <nimp>                 0     </nimp>             <!-- NIMP,  number of impurity types -->
    <max_nzimp>            0     </max_nzimp>        <!-- MAX_NZIMP, number of impurity ionisation states -->
  </dims>

  <solver>
   <solver_type>           3     </solver_type>      <!-- choice of numerical solver -->
   <sigma_source>          0     </sigma_source>     <!-- option for origin of Plasma electrical conductivity: 0: plasma
    <tau>             1.0d-1     </tau>              <!-- TAU, time step [s] -->
    <amix>            1.0d-0     </amix>             <!-- AMIX, mixing factor -->
    <convrec>         1.0d-4     </convrec>          <!-- PRECISION -->
    <ntime>              100     </ntime>            <!-- NTIME, number of time points -->
    <nsol>                 2     </nsol>             <!-- Number of analytical example -->
    <ext_transport>        0     </ext_transport>    <!-- call external transport routines -->
  </solver>

  <boundary>
    <psi_bnd_type>         2     </psi_bnd_type>     <!-- Type of boundary conditions CURRENT -->
    <ni_bnd_type>          1     </ni_bnd_type>      <!-- Type of boundary conditions ION DENSITY -->
    <ti_bnd_type>          1     </ti_bnd_type>      <!-- Type of boundary conditions ION TEMPERATURE -->
    <te_bnd_type>          1     </te_bnd_type>      <!-- Type of boundary conditions ELECTRON TEMPERATURE -->
    <vtor_bnd_type>        1     </vtor_bnd_type>    <!-- Type of boundary conditions ROTATION -->
  </boundary>

</parameters>
```

where

input parameters describing the input options

- **shot_in** shot number for the initial conditions and for the continuing time-dependent values for the equilibrium, sources and transport, unless other models are used (default 4)
- **run_in** run number for the initial conditions and for the continuing time-dependent values for the equilibrium, sources and transport, unless other models are used (default 1)
- **interpol** interpolation option as described in the UAL documentation (default 1)
- **time_dep_input** a flag indicating whether there is any time-dependence in the input data: a 0 indicates not, and a 1 indicates that there is (default 0)

output parameters describing the output options

- **shot_out** output shot number (default 5)
- **run_out** output run number (default 2)
- **tau_out** time intervals at which output should occur [s] (default -1 indicating same as tau)

dims setting dimensions for the problem

- **nrho** number of radial points (default 50)
- **neq** number of equilibrium points (default 100)
- **nion** number of ions (default 1)
- **nimp** number of impurity types (default 1)
- **nzimp** number of impurity ionisation states (default 1)

solver setting some solver and physics options

- **rhon** effective minor radius [m] (default 2.0)
- **solver_type** choice of numerical solver (default 3)
- **sigma_source** option for origin of Plasma electrical conductivity: 0: plasma collisions; 1: transport module; 2: source module (default 1)
- **tau** time step [s] (default 0.1)
- **tau_inc** time step increment factor if ITERATIONS ¡ ITER_INC (default 0.0, *i.e.* not used)
- **tau_dec** time step decrement factor if ITERATIONS ¿ ITER_DEC (default 0.0, *i.e.* not used)
- **iter_inc** ITERATION limit to cause increase in time-step (default 0, *i.e.* not used)
- **iter_dec** ITERATION limit to cause decrease in time-step (default 0, *i.e.* not used)
- **tau_min** minimum TAU, time step [s] (default 0.0, *i.e.* not used)
- **tau_max** maximum TAU, time step [s] (default 0.0, *i.e.* not used)
- **amix** mixing factor (default 1.0)
- **convrec** convergence criterion (default 1e-4)
- **ntime** number of time points (default 100)
- **nsol** Number of analytical example (default 2)
- **ext_transport** call external transport routines if set to 1 (default 0, *i.e.* no external transport module used)
- **add_transport** additional diffusive transport coefficient for the external transport module (default 0.0)

boundary setting boundary conditions

psi_bnd_type Type of boundary conditions CURRENT (default 2)

ni_bnd_type Type of boundary conditions ION DENSITY (default 1)

ti_bnd_type Type of boundary conditions ION TEMPERATURE (default 1)

te_bnd_type Type of boundary conditions ELECTRON TEMPERATURE (default 1)

vtor_bnd_type Type of boundary conditions ROTATION (default 1)

Flag	**Description**
parameters	GLOBAL: parameters for eq_ets_test
input	BLOCK: specify input CPO options
shot_in	shot number
run_in	run number
interpol	interpolation index
time_dep_input	1 implies time dependence in input data
output	BLOCK: specify output CPO options
shot_out	shot number
run_out	run number
tau_out	output frequency
dims	BLOCK: specify the dimensions
nrho	NRHO, number of radial points
neq	NEQ, number of equilibrium points
nion	NION, number of ions
nimp	NIMP, number of impurity types
nzimp	NZIMP, array of impurity ionisation states
nneut	NNEUT, number of the neutrals
ncomp	NCOMP, array of components for each neutral
ntype	NTYPE, array of types for each neutral
solver	BLOCK: specify parameters for the solver
rhon	boundary value of rho
rho	expression giving the relative weighting of points in rho
solver_type	choice of numerical solver
sigma_source	option for origin of Plasma electrical conductivity: 0: plasma collisions; 1: transport module; 2: source module
tau	TAU, time step [s]
tau_inc	time step increment factor if ITERATIONS .LT. ITER_INC
tau_dec	time step decrement factor if ITERATIONS .GT. ITER_DEC
iter_inc	ITERATION limit to cause increase in time-step
iter_dec	ITERATION limit to cause decrease in time-step
tau_min	minimum TAU, time step [s]
	continued

continued	
Flag	**Description**
tau_max	maximum TAU, time step [s]
amix	AMIX, mixing factor
convrec	PRECISION
ntime	NTIME, number of time points
time0	Start time [s]
nsol	Number of analytical example
ext_equil	call external equilibrium: 0: none, 1: BDSEQ, 2: EMEQ, 3: HELENA
augment_equil	if 1 add psi(R,Z), B(R,Z) using splines
ext_source	call external source routines: if 2, call combine_source
ext_transport	call external transport routines: if 2, call combine_transport
add_transport	additional diffusive transport coefficient
startup	BLOCK: specify parameters for the startup
prof_flag	Flag for primary current quantity: 1-PSI, 2-Q, 3-JPAR
j0_flag	Flag for negative current density: 0-allowed, .GT. 0-cut off
q0_flag	Flag for q0
boundary	BLOCK: specify parameters for the boundary condition
psi_bnd_type	Type of boundary conditions CURRENT
ni_bnd_type	Type of boundary conditions ION DENSITY
ti_bnd_type	Type of boundary conditions ION TEMPERATURE
te_bnd_type	Type of boundary conditions ELECTRON TEMPERATURE
vtor_bnd_type	Type of boundary conditions ROTATION
experimental	BLOCK: specify experimental options
option	option #: 0: disabled
ncolumns	number of columns
evolution_labels	labels of the evolving quantities
evolution_data	values of the evolving quantities

4.3 eq_test

UAL	Optional
Makefile entry point	`eq_test`
Input files	Depending on which equilibrium codes are used, `input_helena.xml`, `input_bdseq.xml`
Output files	
Required files	Depending on which equilibrium codes are used, `helena_schema.xml`, `bdseq.xsd`
Main program source file	`src/test/eq_test.F90`

Section E (page 52) contains the instructions used at the Code Camp in March 2010 to lead the participants through obtaining, compiling and running the code.

4.4 neo_test

UAL	Optional
Makefile entry point	`neo_test`
Input files	CPOs read eith from database or from ascii version
Output files	`neo.dat neowes.dat`; after running `GNUPLOT/neoclassical`, `neoclassical.ps` is produced
Required files	None
Main program source file	`src/test/neo_test.F90`

5 Visualizing the results from the code

Visualizing the results is done by a combination of methods. The primary method if the UAL is not being used is using `gnuplot`. To visualize data written via the UAL, `python` is used.

After running the analytic test case, the comparison between the calculated and analytic results can be visualized by running

```
GNUPLOT/compare.gnuplot
```

The results are present in the file `compare.ps` as a series of frames, or batched in groups of a 100 in `compare.100.ps` (figure 1).

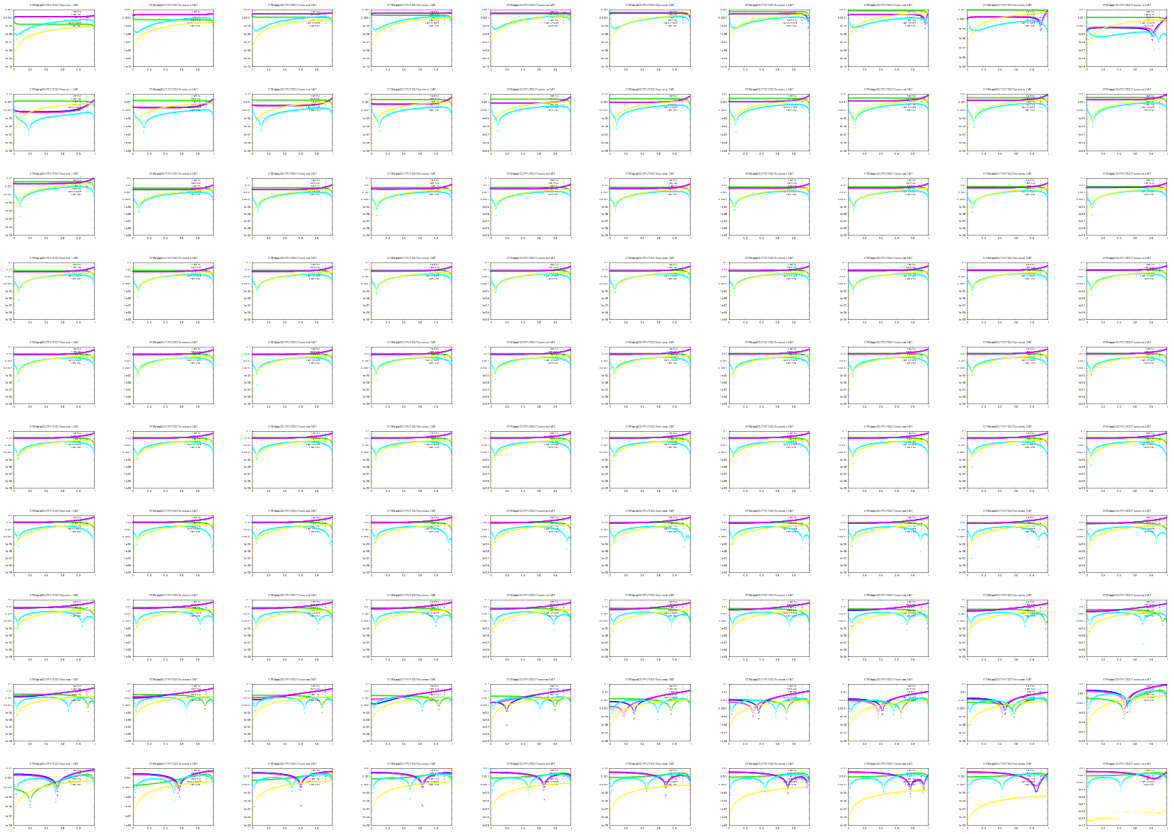

Figure 1: Comparison between analytic and computational result

For plotting the UAL results, a number of scripts have been created. These all rely on having the python UAL bindings functioning.

The following typically take at least two arguments, the "shot" number and the "run" number. They also take additional arguments (before the shot number and run number),

-u USER to change the USER for reading the UAL data (default `$USER`)

-d DEVICE for changing the DEVICE name (default `$TOKAMAKNAME`)

-v VERSION for changing the UAL version (default `$DATAVERSION`)

-t TYPE for specifying the TYPE of file for the resultant plot (default verb!ps!)

-f FILENAME for specifying the FILENAME of the resultant plot output (default something like `xxxx_SHOT#_RUN#.$TYPE`)

-s SLICE for specifying the SLICE number (default `NONE`)

Available commands (all in `diagnostics`) include:

diagnostics/run_plot_ne plot the ne profile

diagnostics/run_plot_te plot the te profile

diagnostics/run_plot_ti plot the ti profile

diagnostics/run_plot_psi plot the psi profile

diagnostics/run_plot_q plot the q profile

diagnostics/run_plot_zeff plot the zeff profile

diagnostics/run_plot_coresource plot the core sources

diagnostics/run_plot_coretransp plot the core transport

diagnostics/run_plot_eq_ets plot key core profile quantities

diagnostics/run_plot_eq plot the equilibrium

The commands used to produce figure 2 were:

```
diagnostics/run_plot_ne -f ne_5_115.png 5 115
diagnostics/run_plot_te -f te_5_115.png 5 115
diagnostics/run_plot_ti -f ti_5_115.png 5 115
diagnostics/run_plot_psi -f psi_5_115.png 5 115
diagnostics/run_plot_q -f q_5_115.png 5 115
diagnostics/run_plot_zeff -f zeff_5_115.png 5 115
```

The commands used to produce figure 3 were:

```
diagnostics/run_plot_ne -f ne_5_115_s=100.png -s 100 5 115
diagnostics/run_plot_te -f te_5_115_s=100.png -s 100 5 115
diagnostics/run_plot_ti -f ti_5_115_s=100.png -s 100 5 115
diagnostics/run_plot_psi -f psi_5_115_s=100.png -s 100 5 115
diagnostics/run_plot_q -f q_5_115_s=100.png -s 100 5 115
diagnostics/run_plot_zeff -f zeff_5_115_s=100.png -s 100 5 115
```

The commands used to produce figure 4 were:

```
diagnostics/run_plot_coresource -f coresource_5_48.png 5 48
diagnostics/run_plot_coretransp -f coretransp_5_48.png 5 48
diagnostics/run_plot_coresource -f coresource_5_48_s=100.png -s 100 5 48
diagnostics/run_plot_coretransp -f coretransp_5_48_s=100.png -s 100 5 48
```

The commands used to produce figure 5 were:

```
diagnostics/run_plot_eq_ets -f eq_ets_5_40.png 5 40
diagnostics/run_plot_eq -f eq_5_40.png 5 40
```

The following can only be used for comparing the results of `solver_test` since they required the analytic result to be stored in the UAL files.

diagnostics/run_plot_ne_err plot the ne error profile

diagnostics/run_plot_te_err plot the te error profile

diagnostics/run_plot_ti_err plot the ti error profile

diagnostics/run_plot_psi_err plot the psi error profile

The commands used to produce figure 6 were:

```
diagnostics/run_plot_ne_err -f ne_err_2_3.png 2 3
diagnostics/run_plot_te_err -f te_err_2_3.png 2 3
diagnostics/run_plot_ti_err -f ti_err_2_3.png 2 3
```

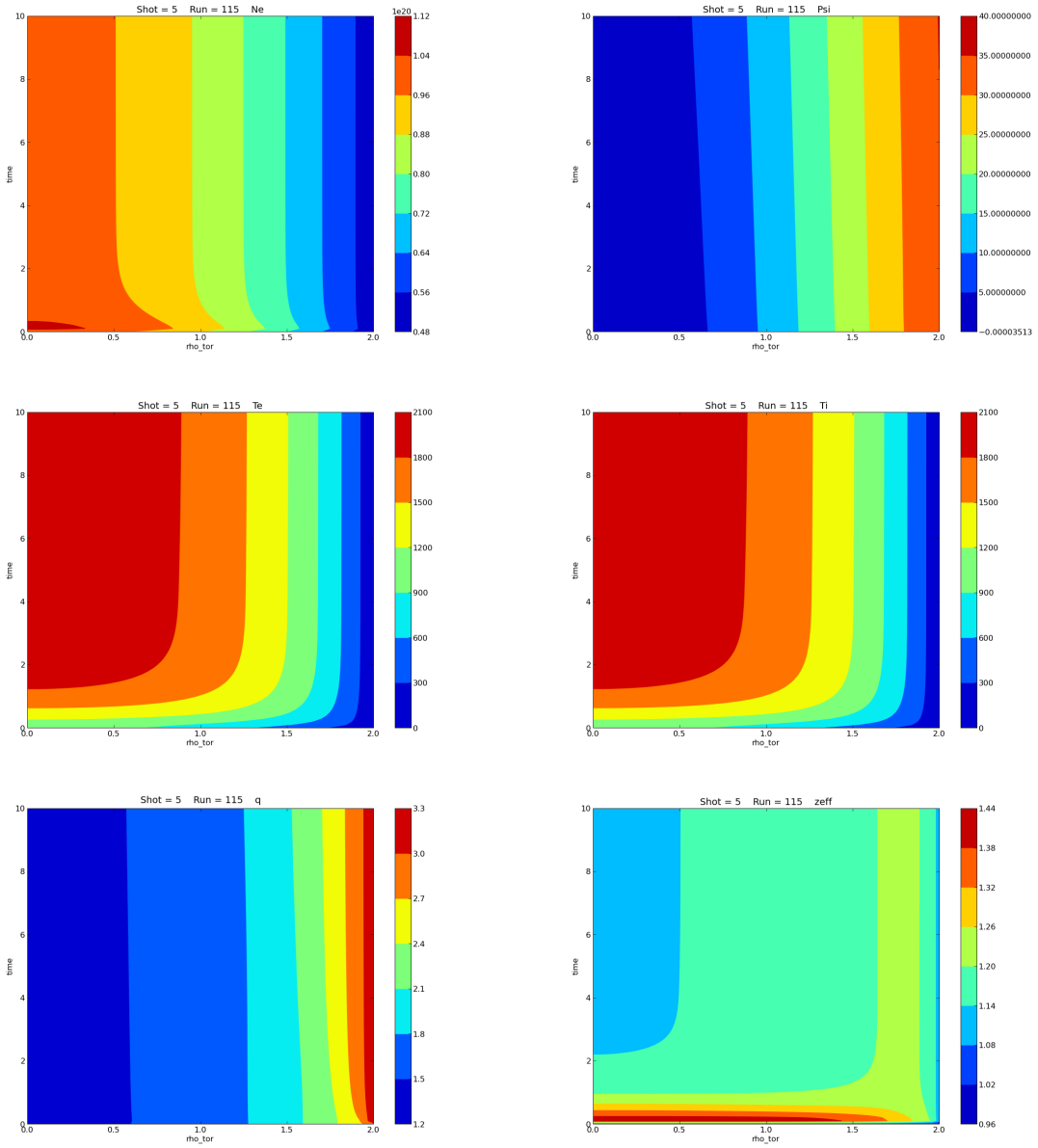

Figure 2: Plot profile of ne, psi, te, ti, q and zeff

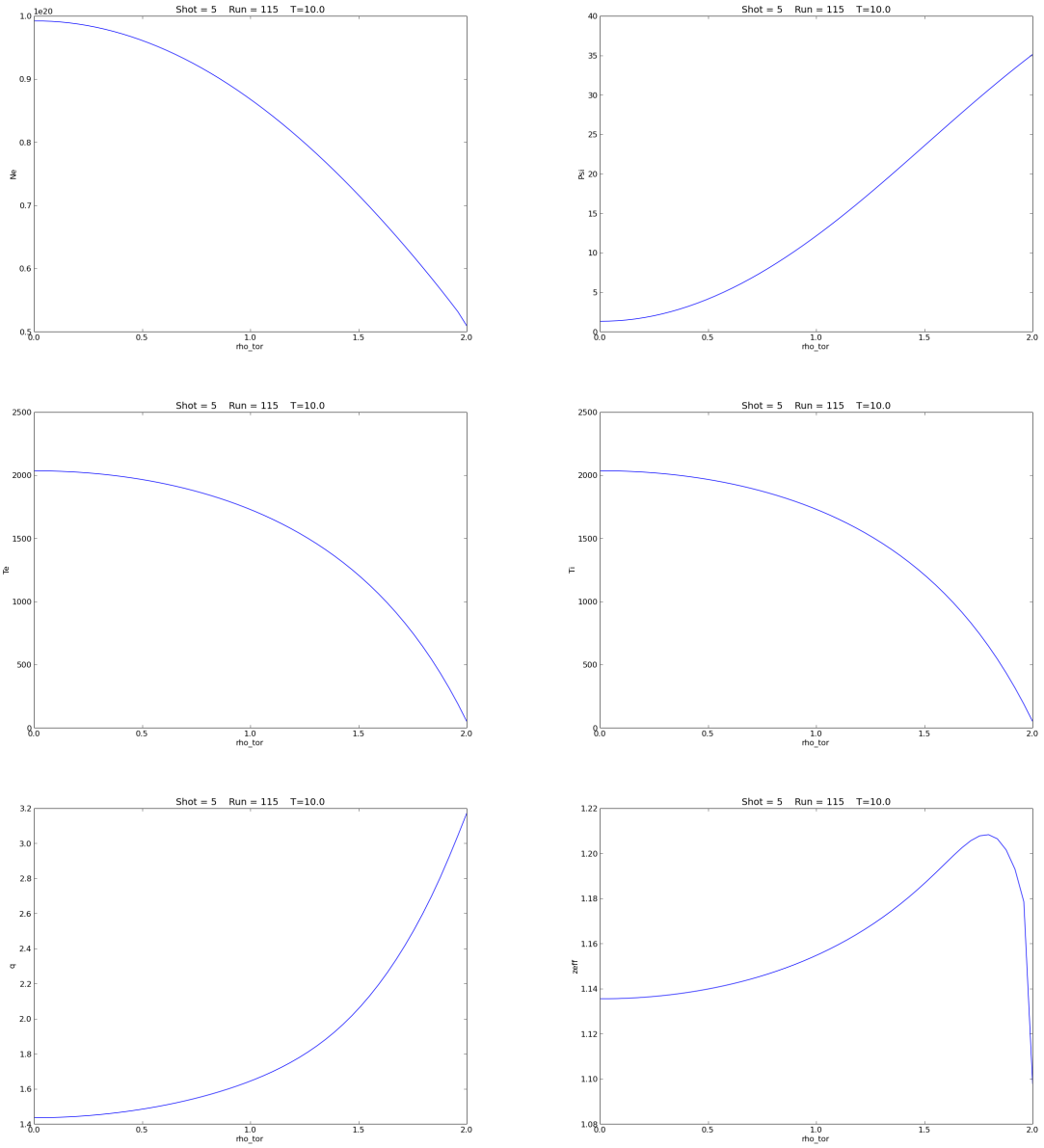

Figure 3: Plot profile of ne, psi, te, ti, q and zeff.

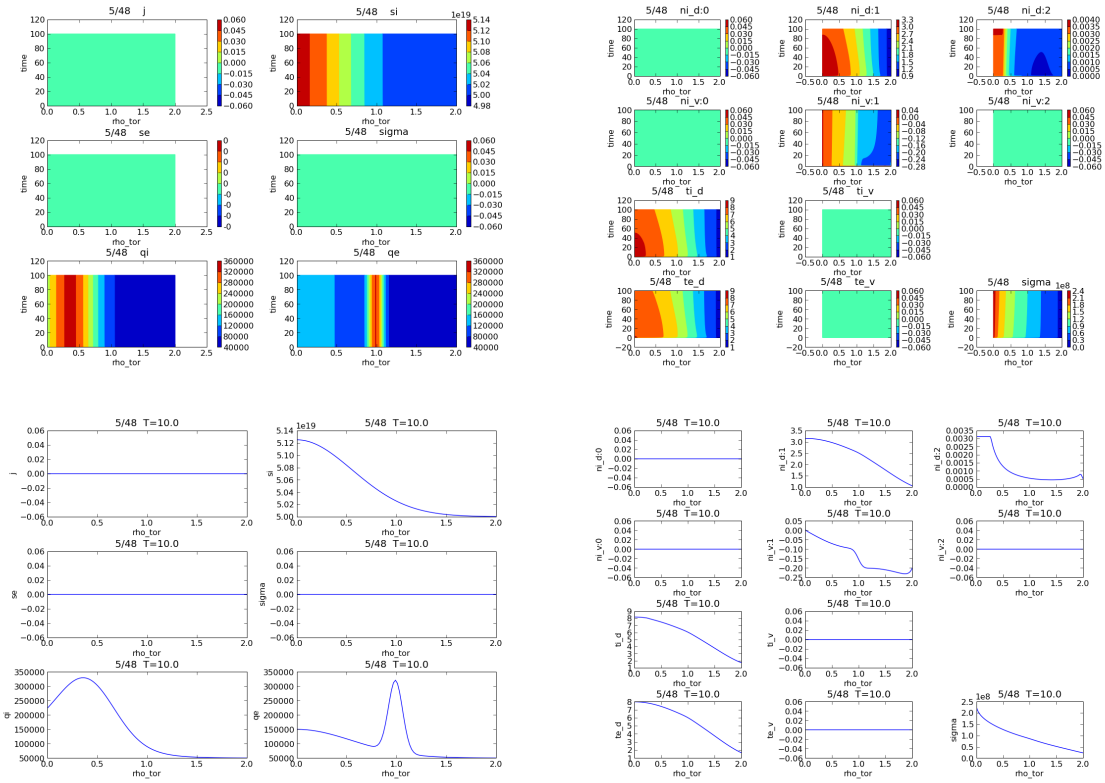

Figure 4: Plot profile of coresource and coretransp.

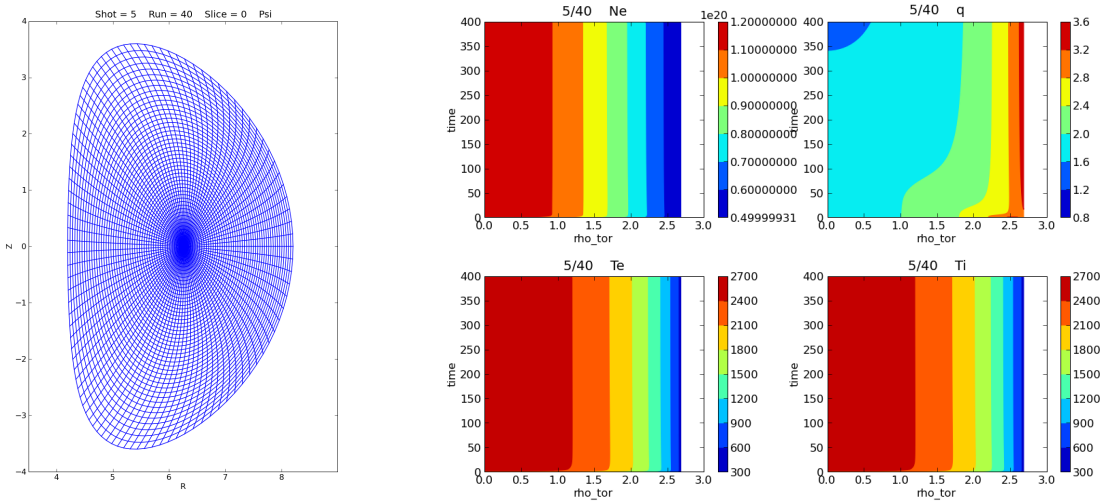

Figure 5: Plot equilibrium and a summary of core profiles.

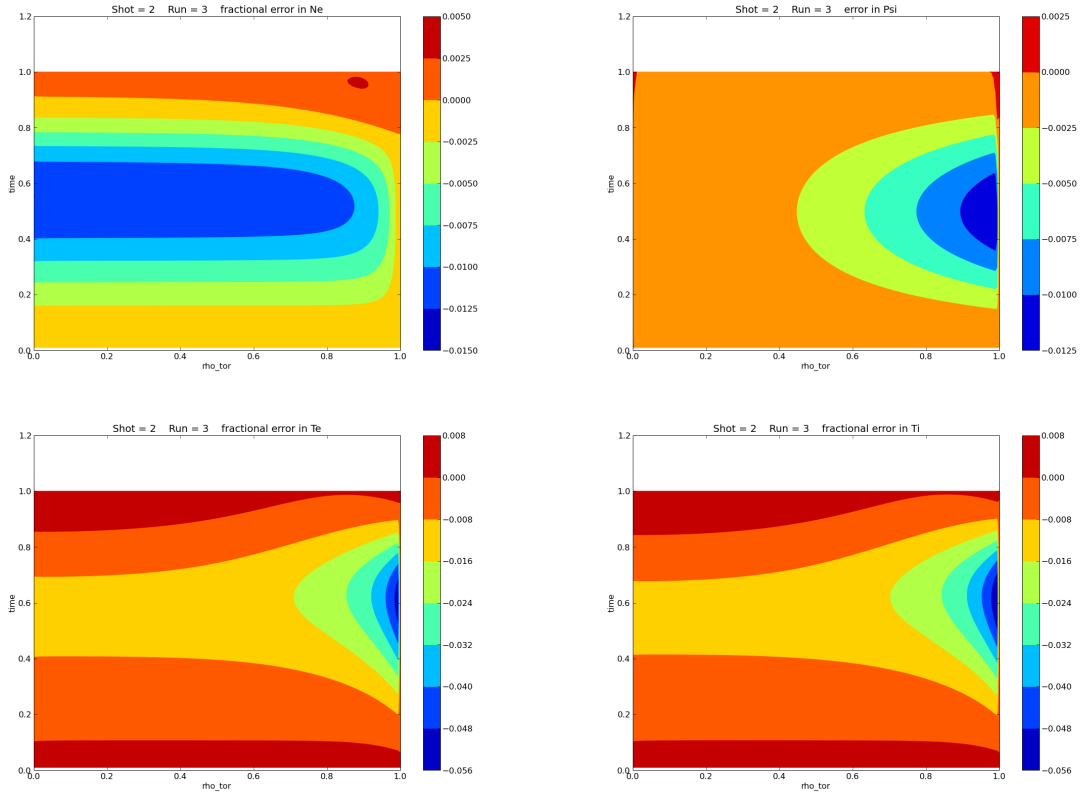

Figure 6: Plot errors between analytic and ETS primary quantities from the anayltic test case.

`diagnostics/run_plot_psi_err -f psi_err_2_3.png 2 3`

For`diagnostics/run_plot_eq` the slice number can be negative in which case all of the slices are written as separate png files suitable for use in making a movie).

For the `equilibrium` CPO, two representations of the equilibrium are possible: $\psi(R, Z)$ and $R(\psi, \theta)$, $Z(\psi, \theta)$. For data in the first format, `run_plot_eq_grid` and for the second `run_plot_eq_coord` should be used.

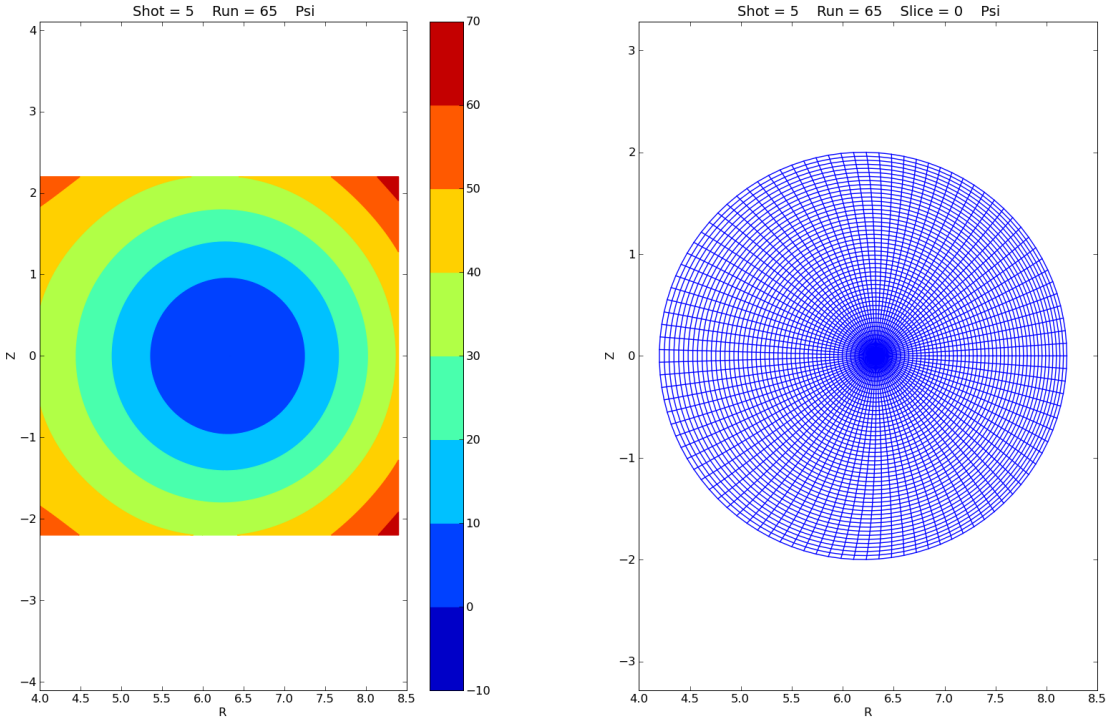

Figure 7: Plot equilibria ($\psi(R, Z)$ and $R(\psi, \theta)$, $Z(\psi, \theta)$)).

The commands used to produce figure 7 were:

```
diagnostics/run_plot_eq_grid -f eq_grid_5_65.png 5 65
diagnostics/run_plot_eq_coord -f eq_coord_5_65.png 5 65
```

For all of the ETS runs, a free boundary equilibrium code is used, producing $R(\psi, \theta)$ and $Z(\psi, \theta)$. Since some other modules might require $\psi(R, Z)$, a module to produce this (and B_R, B_Z and B_ϕ) was written (`equilibrium_augmenter`). The output from this cane seen in figure 8, produced by

```
diagnostics/run_plot_psi_B -f psi_B_5_65.png 5 65
```

Section E (page 52) contains the instructions used at the Code Camp in March 2010 to lead the participants through obtaining, compiling and running the code.

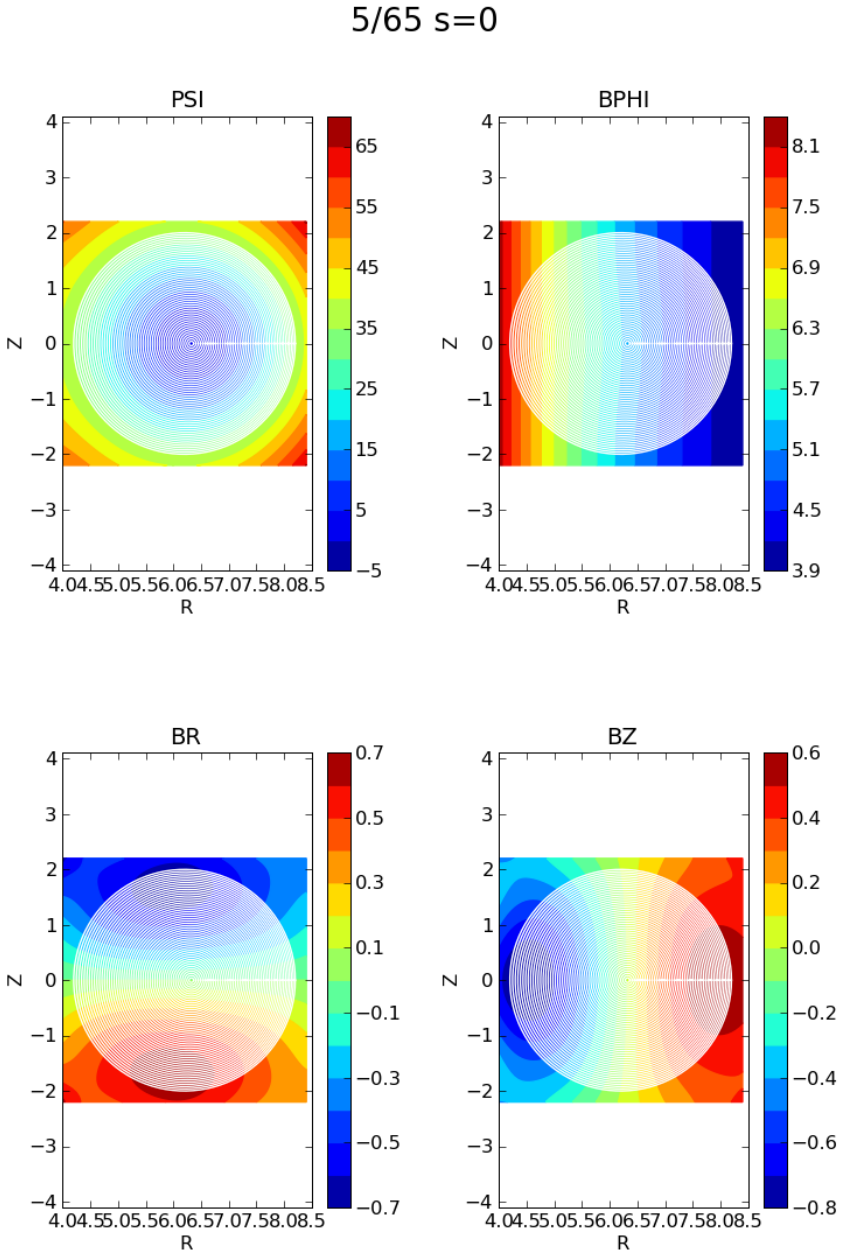

Figure 8: Plot reconstruction of $\psi(R, Z)$ as well as B_R, B_Z and B_ϕ.

6 Some ETS Results

6.1 Workflows with various equilibrium codes

These are based on the cases `case_5_44`, `case_5_45`, `case_5_46`and `case_5_47`. All of these use 4/1 (shot/run) as their starting point, and correspond to a cylindrical case, using BDSEQ, EMEQ and HELENA.

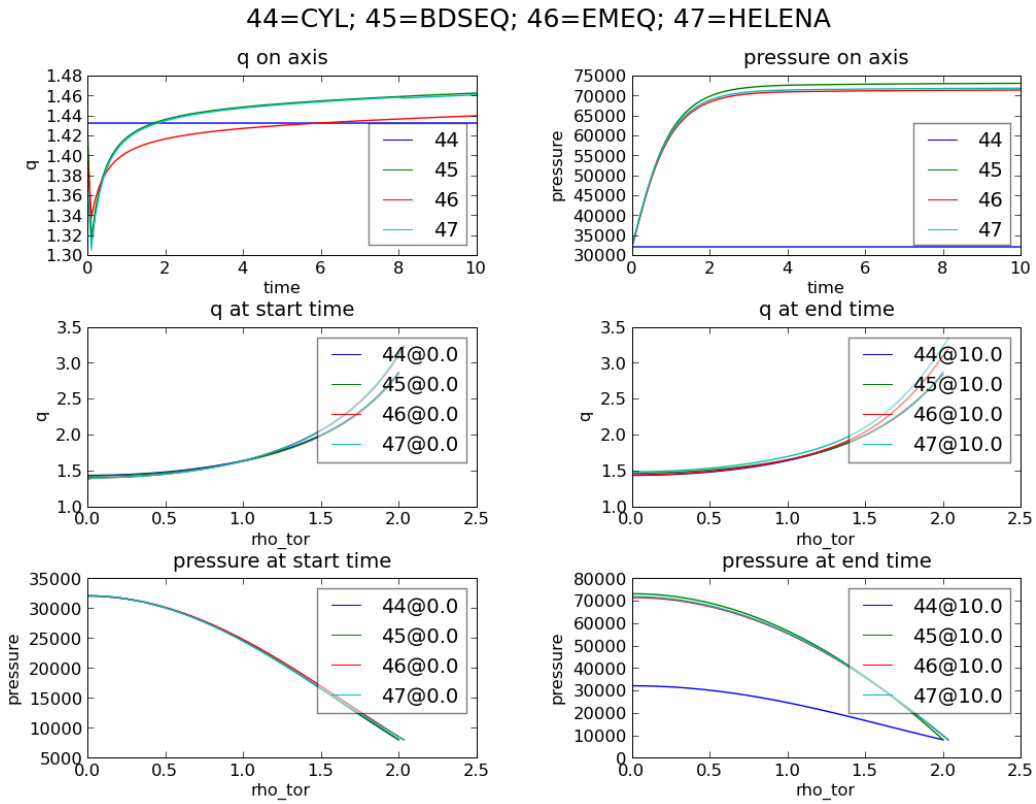

Figure 9: Comparison of results.

A Structure of the "Makefile"

```
#############################################################################
# Initialize some variables used in the Makefile.  Some of these might be      #
# redefined in the file included from config                                   #
#############################################################################
## Default to compiling on the Gateway
  SYS=GW
## Default version is 4.10a
  UAL_VERSION=4.10a
## which preprocessor to use
  CPP=cpp -traditional
## which C compiler to use
  CC=gcc
## which ranlib to use
  RANLIB=ranlib

#############################################################################
# bring in the file obj/SYS if it exists --- this can override the setting of  #
# SYS above                                                                    #
#############################################################################
-include obj/SYS

#############################################################################
# set the OBJECTCODE variable used in much of the rest of the Makefile         #
#############################################################################
OBJECTCODE=obj/${SYS}

#############################################################################
# set some more Makefile variables                                             #
#############################################################################
## where to find doxygen
  DOXYGEN=bin/linux/doxygen
  DOXYGEN=doxygen
## where to find the gnu libmatheval
  LIBDPC = /afs/efda-itm.eu/imp3/user/coster/lib
  LIBMATHEVAL = -Wl,--rpath -Wl,${LIBDPC} -L${LIBDPC} -lmatheval

#############################################################################
# now bring in the configuration for the particular system                     #
#############################################################################
include config/${SYS}

#############################################################################
# and the instructions for compiling C and fortran code                        #
#############################################################################
include obj/compile

#############################################################################
# set up the VPATH for searching for source files                              #
#############################################################################
VPATH = src/solvers src/ets src/convergence src/types src/analytics
VPATH += src/test src/combiner src/neutrals src/sources
VPATH += src/xmllib src/itm_types src/itm_constants src/itm_shared src/itm_tools src/version
VPATH += src/bdseq src/helena2 src/write_cpo

#############################################################################
# bring in helena if we have it                                                #
#############################################################################
ifeq ($(shell [ -d src/helena ] && echo yes || echo no ),yes)
VPATH += src/helena src/helena_lib
DEFINES += -DGOT_HELENA
endif

#############################################################################
# bring in emeq if we have it                                                  #
#############################################################################
ifeq ($(shell [ -d src/equil_emeq ] && echo yes || echo no ),yes)
VPATH += src/equil_emeq
DEFINES += -DGOT_E3EMEQ
```

```
### INCLUDE += -I src/equil_emeq/for
endif

##############################################################################
# bring in chease if we have it                                              #
##############################################################################
ifeq ($(shell [ -e ${OBJECTCODE}/libchease.a  ] && echo yes || echo no ),yes)
DEFINES += -DGOT_CHEASE
CHEASE_LIB = -L${OBJECTCODE} -lchease -linterpos
### -L/afs/efda-itm.eu/user/c/coster/SVN/interpos/trunk/interpos_libs
### -linterpospgi_wolapack -lblas
endif

##############################################################################
# bring in amnsprotolib if we have it                                        #
##############################################################################
ifeq ($(shell [ -d src/amnsprotolib ] && echo yes || echo no ),yes)
VPATH += src/amnsprotolib
DEFINES += -DGOT_AMNSPROTO
LIBAMNSPROTO = ${OBJECTCODE}/libamnsproto.a
endif

##############################################################################
# more VPATHs for different components                                       #
##############################################################################
VPATH += src/neo src/service
VPATH += src/neowes src/etaigb src/gbtransport
VPATH += src/impurity
VPATH += src/cpowork
VPATH += src/perf
VPATH += src/dierckx

##############################################################################
# more VPATHs for SPIDER components                                        #
##############################################################################
VPATH += src/spider
INCLUDE += -I src/spider
INCLUDE += -I src/spider/include

##############################################################################
# bring in neoart if we have it                                              #
##############################################################################
ifeq ($(shell [ -d src/neoart ] && echo yes || echo no ),yes)
VPATH += src/neoart
DEFINES += -DGOT_NEOART
LIBNEOART = ${OBJECTCODE}/libneoart.a
INCLUDE += -I src/neoart
endif

##############################################################################
# bring in neos if we have it                                                #
##############################################################################
ifeq ($(shell [ -d src/neos ] && echo yes || echo no ),yes)
DEFINES += -DGOT_NEOS
LIBNEOS = -LEXTERNAL/NEOS/ITM -lneos_kepler -L/afs/efda-itm.eu/user/s/sauter/public/interpos/interpos_libs/pgf95 -linterpo
endif

##############################################################################
# UAL can have the value                                                     #
#     no: no UAL at all --- use dummy routines                               #
#    yes: use the ISIP provided UAL routines                                 #
#  local: use a locally compiled version of the UAL                          #
##############################################################################
ifeq ($(UAL),yes)
else
ifeq ($(UAL),local)
  VPATH += src/schemas src/UAL
  LIBSCHEMAS = ${OBJECTCODE}/libschemas.a
else
  VPATH += src/schemas src/dummies
```

```
  LIBSCHEMAS = ${OBJECTCODE}/libschemas.a
endif
endif

################################################################################
# the CRONOS solver relies on having MUMPS available                           #
################################################################################
ifneq (X$(MUMPS_BASE)X,XX)
DEFINES += -DWANTCOS
INCLUDE += -I ${MUMPS_BASE}/include -I ${MUMPS_BASE}/libseq
LIBS += -L ${MUMPS_BASE}/lib -l dmumps -L ${MUMPS_BASE}/PORD/lib -l pord \
        -L ${MUMPS_BASE}/libseq -l mpiseq  -l blas
endif

################################################################################
# these are the .o files corresponding to main programs that should be in any  #
# library                                                                      #
################################################################################
EXCLUDELIST = ${OBJECTCODE}/solver_test.o ${OBJECTCODE}/eq_test.o \
  ${OBJECTCODE}/eq_ets_test.o ${OBJECTCODE}/service_test.o \
  ${OBJECTCODE}/prepare_input_cpos.o ${OBJECTCODE}/CreateHDF5Model.o \
  ${OBJECTCODE}/profile_check.o \
  ${OBJECTCODE}/scale_current.o ${OBJECTCODE}/wrapper_helena.o \
  ${OBJECTCODE}/wrapper_ual.o ${OBJECTCODE}/printcpo.o ${OBJECTCODE}/sizecpo.o \
  ${OBJECTCODE}/test_equilibrium_augmenter.o ${OBJECTCODE}/run_helena.o \
  ${OBJECTCODE}/copy_signals.o ${OBJECTCODE}/test_functions.o \
  ${OBJECTCODE}/neo_test.o ${OBJECTCODE}/timescpo.o ${OBJECTCODE}/dump_amns.o \
  ${OBJECTCODE}/run_helena_cpo.o ${OBJECTCODE}/writecpo.o
#${OBJECTCODE}/ual_low_level_hdf5.o

################################################################################
# we build a number of libraries based on the files in various directories     #
# here we set up variables containing the list of .o files in these            #
# directories                                                                  #
################################################################################
ANALYTICS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/analytics/*.[fF] src/analytics/*.[fF]90}}}}}}}
CONVERGENCE_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/convergence/*.[fF] src/convergence/*.[fF]90}}}}}}}
ETS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/ets/*.[fF] src/ets/*.[fF]90}}}}}}}
SOLVER_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/solvers/*.[fF] src/solvers/*.[fF]90}}}}}}}
TEST_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/test/*.[fF] src/test/*.[fF]90}}}}}}}
```

```
TYPES_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/types/*.[fF] src/types/*.[fF]90}}}}}}}
SCHEMAS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/schemas/*.[fF] src/schemas/*.[fF]90}}}}}}}
DUMMIES_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/dummies/*.[fF] src/dummies/*.[fF]90}}}}}}}
XMLLIB_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/xmllib/*.[fF] src/xmllib/*.[fF]90}}}}}}}
ITM_TYPES_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/itm_types/*.[fF] src/itm_types/*.[fF]90}}}}}}}
ITM_CONSTANTS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/itm_constants/*.[fF] src/itm_constants/*.[fF]90}}}}}}}
ITM_SHARED_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/itm_shared/*.[fF] src/itm_shared/*.[fF]90}}}}}}}
ITM_TOOLS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/itm_tools/*.[fF] src/itm_tools/*.[fF]90}}}}}}}
BDSEQ_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/bdseq/*.[fF] src/bdseq/*.[fF]90}}}}}}}
HELENA_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/helena/*.[fF] src/helena/*.[fF]90}}}}}}}
```

```
HELENA_LIB_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/helena_lib/*.[fF] src/helena_lib/*.[fF]90}}}}}}}
HELENA2_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/helena2/*.[fF] src/helena2/*.[fF]90}}}}}}}
NEO_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/neo/*.[fF] src/neo/*.[fF]90}}}}}}}
SERVICE_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/service/*.[fF] src/service/*.[fF]90}}}}}}}
E3EMEQ_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/equil_emeq/*.[fF] src/equil_emeq/*.[fF]90}}}}}}}
UAL_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/UAL/*.c src/UAL/*.cpp}}}}}}}
WRITE_CPO_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/write_cpo/*.[fF] src/write_cpo/*.[fF]90}}}}}}}
COMBINER_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/combiner/*.[fF] src/combiner/*.[fF]90}}}}}}}
NEUTRALS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/neutrals/*.[fF] src/neutrals/*.[fF]90}}}}}}}
SOURCES_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/sources/*.[fF] src/sources/*.[fF]90}}}}}}}
```

```
NEOWES_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/neowes/*.[fF] src/neowes/*.[fF]90}}}}}}}
NEOART_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/neoart/*.[fF] src/neoart/*.[fF]90}}}}}}}
ETAIGB_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/etaigb/*.[fF] src/etaigb/*.[fF]90}}}}}}}
GBTRANSP_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/gbtransport/*.[fF] src/gbtransport/*.[fF]90}}}}}}}
DIERCKX_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/dierckx/*.[fF] src/dierckx/*.[fF]90}}}}}}}
PERF_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/perf/*.[fF] src/perf/*.[fF]90}}}}}}}
COPYSIGNALS_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/cpowork/*.[fF] src/cpowork/*.[fF]90}}}}}}}
IMPURITY_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/impurity/*.[fF] src/impurity/*.[fF]90}}}}}}}
AMNSPROTOLIB_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/amnsprotolib/*.[cfF] src/amnsprotolib/*.[fF]90}}}}}}}
SPIDER_O = ${filter-out ${EXCLUDELIST},\
  ${addsuffix .o,\
    ${addprefix ${OBJECTCODE}/,\
      ${filter-out *,\
        ${basename \
          ${notdir \
            ${shell echo src/spider/*.[fF] src/spider/*.[fF]90}}}}}}}
```

```
ADD_O =

#############################################################################
# now declare the libraries we want, combining some of the directories      #
#############################################################################
LIB_ITM_O = ${ITM_TYPES_O} ${ITM_CONSTANTS_O} ${XMLLIB_O} ${ITM_SHARED_O} ${ITM_TOOLS_O}
LIB_ETS_O = ${TYPES_O} ${SOLVER_O} ${ETS_O} ${TEST_O} ${OBJECTCODE}/ets_version.o
LIB_ANALYTICS_O = ${ANALYTICS_O}
LIB_CONVERGENCE_O = ${CONVERGENCE_O}
LIB_BDSEQ_O = ${BDSEQ_O}
LIB_HELENA_O = ${HELENA_O} ${HELENA_LIB_O}
LIB_HELENA2_O = ${HELENA2_O}
LIB_NEO_O = ${NEO_O}
LIB_SERVICE_O = ${SERVICE_O}
LIB_E3EMEQ_O = ${E3EMEQ_O}
LIB_PERF_O = ${PERF_O}
LIB_ETAIGB_O = ${ETAIGB_O}
LIB_GBTRANSP_O = ${GBTRANSP_O}
LIB_NEOWES_O = ${NEOWES_O}
LIB_NEOART_O = ${NEOART_O}
LIB_COMBINER_O = ${COMBINER_O}
LIB_NEUTRALS_O = ${NEUTRALS_O}
LIB_SOURCES_O = ${SOURCES_O}
LIB_COPYSIGNALS_O = ${COPYSIGNALS_O}
LIB_IMPURITY_O = ${IMPURITY_O}
LIB_DIERCKX_O = ${DIERCKX_O}
LIB_AMNSPROTO_O = ${AMNSPROTOLIB_O}
LIB_SPIDER_O = ${SPIDER_O}

#############################################################################
# the schemas library is only built for the local option from the real sources #
# --- otherwise dummies are used                                          #
#############################################################################
ifeq ($(UAL),local)
  LIB_SCHEMAS_O = ${SCHEMAS_O} ${UAL_O}
else
  LIB_SCHEMAS_O = ${SCHEMAS_O} ${DUMMIES_O}
endif

#############################################################################
# we have a performance library for some systems                            #
#############################################################################
ifeq (${GOT_PERFLIB}, 'yes')
  perflib = -L${OBJECTCODE} -lperf
else
  ADD_O += ${PERF_O}
endif

#############################################################################
#############################################################################
## and now we define the main programs that can be executed, and how to build ##
## them                                                                     ##
#############################################################################
#############################################################################

#############################################################################
# here is the analytic test case which is also the default program to be run   #
#############################################################################
run: ${OBJECTCODE}/solver_test
        @echo
        @echo
        @echo "*** Now running the code ***"
        @echo
        @echo
        @mkdir -p data/OUTPUT
        time ${OBJECTCODE}/solver_test
        @echo
        @echo
        @echo "*** Finished running the code ***"
        @echo
```

```
	@echo
	@echo Comparing the current output with an earlier version in data.GW
	@echo
	@echo
	@diff -rwq -x .svn data.GW/ data/
	@echo
	@echo
	@echo No problems should have been reported
	@echo
	@echo

${OBJECTCODE}/solver_test:: check_version
	@echo

${OBJECTCODE}/solver_test:: ${OBJECTCODE}/solver_test.o ${ADD_O} \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libanalytics.a \
  ${OBJECTCODE}/libconvergence.a ${OBJECTCODE}/libbdseq.a \
  ${OBJECTCODE}/libitm.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}


################################################################################
# the program to compare the output from various equilibrium codes             #
################################################################################
eq_test: ${OBJECTCODE}/eq_test
	time ${OBJECTCODE}/eq_test
	gnuplot GNUPLOT/eq_test.gnuplot
	@echo
	@echo
	@echo "Plots in eq_test.ps"
	@echo
	@echo

${OBJECTCODE}/eq_test:: check_version
	@echo

${OBJECTCODE}/eq_test:: ${OBJECTCODE}/eq_test.o  ${OBJECTCODE}/ets_version.o \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libbdseq.a ${OBJECTCODE}/libhelena.a \
  ${OBJECTCODE}/libhelena2.a ${OBJECTCODE}/libe3emeq.a ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS} ${CHEASE_LIB}

################################################################################
# the program to compare the output from various neoclassical codes            #
################################################################################
neo_test: ${OBJECTCODE}/neo_test
	-rm sigma_par.dat neowes.dat neos.dat neo.dat itmneoart.dat
	time ${OBJECTCODE}/neo_test
	GNUPLOT/neoclassical

${OBJECTCODE}/neo_test:: ${OBJECTCODE}/neo_test.o ${OBJECTCODE}/libneo.a \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libneowes.a \
  ${LIBNEOART} ${OBJECTCODE}/libbdseq.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^  ${LIBNEOS} ${perflib} ${LIBS}

################################################################################
# the main fortran workflow version of the ETS                                 #
################################################################################
eq_ets_test: ${OBJECTCODE}/eq_ets_test
	time ${OBJECTCODE}/eq_ets_test
	@echo
	@echo
	@echo "Finished"
	@echo
	@echo

${OBJECTCODE}/eq_ets_test:: check_version
	@echo

${OBJECTCODE}/eq_ets_test:: ${OBJECTCODE}/eq_ets_test.o ${ADD_O} \
```

```
  ${OBJECTCODE}/libconvergence.a ${OBJECTCODE}/libanalytics.a \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libservice.a \
  ${OBJECTCODE}/libe3emeq.a ${OBJECTCODE}/libcombiner.a \
  ${OBJECTCODE}/libneowes.a ${OBJECTCODE}/libetaigb.a \
  ${OBJECTCODE}/libgbtransp.a \
  ${OBJECTCODE}/libbdseq.a ${OBJECTCODE}/libneutrals.a  \
  ${OBJECTCODE}/libsources.a  ${OBJECTCODE}/libhelena.a  \
  ${OBJECTCODE}/libdierckx.a ${OBJECTCODE}/libimpurity.a \
  ${OBJECTCODE}/libspider.a ${LIBSCHEMAS} ${LIBAMNSPROTO}
        ${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBMATHEVAL} ${LIBS}

################################################################################
# the program for preparing the input CPOs for the ETS                         #
################################################################################
prepare_input_cpos: ${OBJECTCODE}/prepare_input_cpos
        time ${OBJECTCODE}/prepare_input_cpos ${ARGS}
        @echo
        @echo
        @echo "Finished"
        @echo
        @echo

${OBJECTCODE}/prepare_input_cpos:: check_version
        @echo

${OBJECTCODE}/prepare_input_cpos:: ${OBJECTCODE}/prepare_input_cpos.o \
  ${WRITE_CPO_O} ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libets.a \
  ${OBJECTCODE}/libbdseq.a ${LIBSCHEMAS}
        ${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS} ${LIBMATHEVAL}

################################################################################
# copy_signals ??????????????????????????????????????????                     #
################################################################################
copy_signals: ${OBJECTCODE}/copy_signals
        time ${OBJECTCODE}/copy_signals
        @echo
        @echo
        @echo "Finished"
        @echo
        @echo

${OBJECTCODE}/copy_signals:: check_version
        @echo

${OBJECTCODE}/copy_signals:: ${OBJECTCODE}/copy_signals.o ${COPYSIGNALS_O} \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libitm.a  ${LIBSCHEMAS}
        ${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

service_test: ${OBJECTCODE}/service_test
        time ${OBJECTCODE}/service_test

################################################################################
# Framework for testing service routines                                       #
################################################################################
${OBJECTCODE}/service_test:: check_version
        @echo

${OBJECTCODE}/service_test:: ${OBJECTCODE}/service_test.o \
  ${OBJECTCODE}/libservice.a ${OBJECTCODE}/libets.a ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
        ${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

################################################################################
# Print out the size of CPOs                                                   #
################################################################################
sizecpo: ${OBJECTCODE}/sizecpo
        time ${OBJECTCODE}/sizecpo ${ARGS}

${OBJECTCODE}/sizecpo: ${OBJECTCODE}/sizecpo.o ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
```

```
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# Print out the times of CPOs                                                #
##############################################################################
timescpo: ${OBJECTCODE}/timescpo
	time ${OBJECTCODE}/timescpo ${ARGS}

${OBJECTCODE}/timescpo: ${OBJECTCODE}/timescpo.o ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# Print out the CPOs                                                         #
##############################################################################
writecpo: ${OBJECTCODE}/writecpo
	time ${OBJECTCODE}/writecpo ${ARGS}

${OBJECTCODE}/writecpo: ${OBJECTCODE}/writecpo.o ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# Print out CPOs                                                             #
##############################################################################
printcpo: ${OBJECTCODE}/printcpo
	time ${OBJECTCODE}/printcpo ${ARGS}

${OBJECTCODE}/printcpo: ${OBJECTCODE}/printcpo.o ${OBJECTCODE}/libitm.a \
  ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# Test the equilibrium_augmenter routines                                    #
##############################################################################
test_equilibrium_augmenter: ${OBJECTCODE}/test_equilibrium_augmenter
	time ${OBJECTCODE}/test_equilibrium_augmenter

${OBJECTCODE}/test_equilibrium_augmenter:: check_version
	@echo

${OBJECTCODE}/test_equilibrium_augmenter:: \
  ${OBJECTCODE}/test_equilibrium_augmenter.o \
  ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libdierckx.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# run Helena standalone                                                      #
##############################################################################
run_helena: ${OBJECTCODE}/run_helena
	time ${OBJECTCODE}/run_helena ${ARGS}

${OBJECTCODE}/run_helena:: ${OBJECTCODE}/run_helena.o \
  ${OBJECTCODE}/libhelena.a ${OBJECTCODE}/libitm.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# run Helena standalone                                                      #
##############################################################################
run_helena_cpo: ${OBJECTCODE}/run_helena_cpo
	time ${OBJECTCODE}/run_helena_cpo ${ARGS}

${OBJECTCODE}/run_helena_cpo:: ${OBJECTCODE}/run_helena_cpo.o \
  ${OBJECTCODE}/libhelena.a ${OBJECTCODE}/libitm.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

##############################################################################
# run dump_amns                                                              #
##############################################################################
dump_amns: ${OBJECTCODE}/dump_amns
```

```
	time ${OBJECTCODE}/dump_amns ${ARGS}

${OBJECTCODE}/dump_amns:: ${OBJECTCODE}/dump_amns.o \
  ${OBJECTCODE}/libitm.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${perflib} ${LIBS}

################################################################################
# test the libmatheval functions                                               #
################################################################################
test_functions: ${OBJECTCODE}/test_functions
	@${OBJECTCODE}/test_functions ${ARGS}

${OBJECTCODE}/test_functions: ${OBJECTCODE}/test_functions.o \
  ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libets.a ${OBJECTCODE}/libbdseq.a ${LIBSCHEMAS}
	${FC} ${FCOPTS} -o $@ $^ ${LIBMATHEVAL} ${LIBS}

################################################################################
# run the toric test example                                                   #
################################################################################
ifeq ($(TORIC),yes)

VPATH += src/toric
INCLUDE += -I /afs/efda-itm.eu/imp5/user/bilato/Codes/toric6.0/base/Linux/Ser
DEFINES += -DLNTCC
TORIC = /afs/efda-itm.eu/user/b/bilato/usr/x86_64_rhel5/pgf90

run_toric_example: ${OBJECTCODE}/run_toric_example
	@${OBJECTCODE}/run_toric_example ${ARGS}

${OBJECTCODE}/run_toric_example: ${OBJECTCODE}/run_toric_example.o \
  /afs/efda-itm.eu/user/b/bilato/Codes/toric6.0/base/Linux/Ser/libtoric.a \
  ${OBJECTCODE}/libitm.a ${OBJECTCODE}/libets.a ${OBJECTCODE}/libbdseq.a ${LIBSCHEMAS} \
  ${TORIC}/fftw-2.1.5/lib/libfftw.a \
  ${TORIC}/ntcc/i2mex/lib/libi2mex.a \
  ${TORIC}/ntcc/i2mex/lib/libxplasma.a \
  ${TORIC}/ntcc/i2mex/lib/libnscrunch.a \
  ${TORIC}/ntcc/i2mex/lib/libpspline.a \
  ${TORIC}/ntcc/i2mex/lib/libesc.a \
  ${TORIC}/ntcc/i2mex/lib/libmclib.a \
  ${TORIC}/ntcc/i2mex/lib/libfluxav.a \
  ${TORIC}/ntcc/i2mex/lib/libsmlib.a \
  ${TORIC}/ntcc/i2mex/lib/libcomput.a \
  ${TORIC}/ntcc/i2mex/lib/libportlib.a \
  ${TORIC}/ntcc/i2mex/lib/libmdstransp.a \
  ${TORIC}/ntcc/i2mex/lib/libvaxonly.a \
  ${TORIC}/ntcc/i2mex/lib/libmds_dummy.a \
  ${TORIC}/ntcc/i2mex/lib/libgeneric_dummy.a \
  ${TORIC}/lib/libodepack.a \
  ${TORIC}/lib/libfmt.a \
  ${TORIC}/ntcc/i2mex/lib/libezcdf.a \
  ${TORIC}/ntcc/i2mex/lib/liblsode.a \
  ${TORIC}/netcdf-3.5.1/lib/libnetcdf.a
	${FC} ${FCOPTS}  -o $@ $^ ${LIBS}

endif
################################################################################
# help on the Makefile                                                         #
################################################################################
help:
	@echo 'Welcome to the ETS Makefile'
	@echo ''
	@echo 'Common entry points'
	@echo '  run    (default)    compile and run solver_test (ets test framework using an analytical model)'
	@echo '  eq_test             compile and run eq_test (equilibrium test framework)'
	@echo '  eq_ets_test         compile and run eq_ets_test'
	@echo '  prepare_input_cpos  prepare input CPOs for eq_ets_test'
	@echo '  sizecpo             ARGS=(SHOT RUN)  size of cpos'
	@echo '  printcpo            ARGS=(SHOT RUN)  print cpos'
	@echo '  timescpo            ARGS=(SHOT RUN cpos) print times for cpos'
	@echo '  writecpo            ARGS=(SHOT RUN cpos) print cpos'
```

```
	@echo '  service_test        compile and run service_test (service test framework)'
	@echo '  depend              refresh the dependency information'
	@echo '  clean               remove various binaries (.o, .mod, .a and executables)'
	@echo '  DOC                 create the Doxygen documentation (in doc/Doxygen/{html,latex,man,rtf,xml})'
	@echo '  docclean            clean the Doxygen documentation area'
	@echo '  tags                create the TAGS file for emacs'
	@echo '  version             write out the current version based on SVN'
	@echo '  status              writes out date, version, hostname and uname'
	@echo '  SYS                 writes out the SYS variable name'
	@echo '  KEPLER              recreates the 3 actors (analytics, convergence, itmets)'
	@echo '  echo                output the contents of some Makefile variables (used for debugging the Makefile)'
	@echo '  help                writes out this information'
	@echo ''

################################################################################
# building the libraries                                                       #
################################################################################
${OBJECTCODE}/libitm.a: ${LIB_ITM_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libschemas.a: ${LIB_SCHEMAS_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libets.a: ${LIB_ETS_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libanalytics.a: ${LIB_ANALYTICS_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libconvergence.a: ${LIB_CONVERGENCE_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libbdseq.a: ${LIB_BDSEQ_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libhelena.a: ${LIB_HELENA_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libhelena2.a: ${LIB_HELENA2_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libneo.a: ${LIB_NEO_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libservice.a: ${LIB_SERVICE_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libe3emeq.a: ${LIB_E3EMEQ_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libetaigb.a: ${LIB_ETAIGB_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libgbtransp.a: ${LIB_GBTRANSP_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libneowes.a: ${LIB_NEOWES_O}
```

```
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libneutrals.a: ${LIB_NEUTRALS_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libsources.a: ${LIB_SOURCES_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libcombiner.a: ${LIB_COMBINER_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libdierckx.a: ${LIB_DIERCKX_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libperfdummy.a: ${LIB_PERF_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libimpurity.a: ${LIB_IMPURITY_O}
	ar r $@ $?
	ranlib $@

${OBJECTCODE}/libspider.a: ${LIB_SPIDER_O}
	ar r $@ $?
	ranlib $@

${OBJECTCODE}/libamnsproto.a: ${LIB_AMNSPROTO_O}
	ar r $@ $?
	${RANLIB} $@

${OBJECTCODE}/libneoart.a: ${LIB_NEOART_O}
	ar r $@ $?
	${RANLIB} $@

#############################################################################
# used for debugging: print out some of the Makefile variables              #
#############################################################################
echo:
	@echo ${OBJECTCODE}/solver_test.o ${ADD_O} ${LIBSCHEMAS} \
	      ${OBJECTCODE}/libets.a
	@echo ${LIBSCHEMAS} ${LIB_SCHEMAS_O}
	@echo ${ETS_O}
	@echo ${NEUTRALS_O}
	@echo ${SOLVER_O}
	@echo ${BDSEQ_O}
	@echo ${HELENA_O}
	@echo ${HELENA2_O}
	@echo ${NEO_O}
	@echo ${SERVICE_O}
	@echo ${E3EMEQ_O}
	@echo ${E3EMEQ2_O}
	@echo ${LIB_ITM_O}
	@echo ${ETAIGB_O}
	@echo ${GBTRANSP_O}
	@echo ${NEOWES_O}
	@echo ${NEUTRALS_O}
	@echo ${COMBINER_O}
	@echo ${IMPURITY_O}
	@echo ${SPIDER_O}
	@echo X${NUMPS_BASE}X
	@echo ${UAL_O}
	@echo ${LIB_AMNSPROTO_O}
	@echo ${LIB_HELENA_O}

#############################################################################
```

```
# clean up                                                                    #
################################################################################
clean:
        -rm ${OBJECTCODE}/*.o ${OBJECTCODE}/*.${MOD} ${OBJECTCODE}/*.f90 \
  ${OBJECTCODE}/solver_test ${OBJECTCODE}/eq_test ${OBJECTCODE}/service_test \
  ${OBJECTCODE}/eq_ets_test ${OBJECTCODE}/prepare_input_cpos \
  ${OBJECTCODE}/printcpo ${OBJECTCODE}/sizecpo \
  ${OBJECTCODE}/test_equilibrium_augmenter ${OBJECTCODE}/run_helena \
  ${OBJECTCODE}/libanalytics.a ${OBJECTCODE}/libconvergence.a \
  ${OBJECTCODE}/libitm.a ${LIBSCHEMAS} ${OBJECTCODE}/libets.a \
  ${OBJECTCODE}/libneo.a  ${OBJECTCODE}/libservice.a \
  ${OBJECTCODE}/libhelena2.a ${OBJECTCODE}/libbdseq.a \
  ${OBJECTCODE}/libhelena.a ${OBJECTCODE}/libe3emeq.a \
  ${OBJECTCODE}/libcombiner.a ${OBJECTCODE}/libneutrals.a \
  ${OBJECTCODE}/libsources.a ${OBJECTCODE}/libetaigb.a \
  ${OBJECTCODE}/libgbtransp.a \
  ${OBJECTCODE}/libneowes.a  ${OBJECTCODE}/libperfdummy.a \
  ${OBJECTCODE}/libimpurity.a ${OBJECTCODE}/libspider.a ${OBJECTCODE}/timescpo ${OBJECTCODE}/dump_amns ${OBJECTCODE}/writ

################################################################################
# clean up the documentation area                                              #
################################################################################
docclean:
        rm -rf doc/Doxygen/html doc/Doxygen/latex doc/Doxygen/man \
  doc/Doxygen/rtf doc/Doxygen/xml

################################################################################
# create the dependency information                                            #
################################################################################
depend:
        obj/sfmakedepend -p '$${OBJECTCODE}/' ${INCLUDE} \
            -f ${OBJECTCODE}/dependencies src/*/*.[fF] src/*/*.[fF]90
        sed -i~ -e '/\/mpes\./d' ${OBJECTCODE}/dependencies
        sed -i~ -e '/ieee_/d' ${OBJECTCODE}/dependencies
ifeq ($(UAL),yes)
        sed -i~ -e '/euitm_schemas/d' ${OBJECTCODE}/dependencies
        sed -i~ -e '/euitm_routines/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/equil_emeq ] && echo yes || echo no ),yes)
        sed -i~ -e '/equilibrium_emeq/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/etaigb ] && echo yes || echo no ),yes)
        sed -i~ -e '/etaigb/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/gbtransport ] && echo yes || echo no ),yes)
        sed -i~ -e '/gbtransport/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/neowes ] && echo yes || echo no ),yes)
        sed -i~ -e '/neowes/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/neutrals ] && echo yes || echo no ),yes)
        sed -i~ -e '/neutrals/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/impurity ] && echo yes || echo no ),yes)
        sed -i~ -e '/impurity/d' ${OBJECTCODE}/dependencies
endif
ifneq ($(shell [ -d src/spider ] && echo yes || echo no ),yes)
        sed -i~ -e '/spiedr/d' ${OBJECTCODE}/dependencies \
            src/spider/*.[fF] src/spider/*.[fF]90
endif
ifneq ($(shell [ -d src/amnsprotolib ] && echo yes || echo no ),yes)
        sed -i~ -e '/amns/d' ${OBJECTCODE}/dependencies
endif
        sed -i~ /t6_mod_toric.mod/d ${OBJECTCODE}/dependencies
        sed -i~ /iso_c_binding/d ${OBJECTCODE}/dependencies
        sed -i~ /mpi.o/d ${OBJECTCODE}/dependencies

################################################################################
# create the tags used by emacs                                                #
################################################################################
```

```
tags:
	rm TAGS ; etags src/*/*.[fFc] src/*/*.[fF]90

##############################################################################
# create the dependencies if they don't exist                                #
##############################################################################
${OBJECTCODE}/dependencies:
	mkdir -p ${OBJECTCODE}
	touch ${OBJECTCODE}/dependencies
	${MAKE} depend

##############################################################################
# create the Doxygen documentation                                           #
##############################################################################
DOC:
	${DOXYGEN} doc/Doxygen/Doxyfile
	cd doc/Doxygen/latex/ && export pool_size=10000000 max_strings=200000 save_size=50000 hash_extra=100000 extra_mem
	rsync -avP doc/Doxygen/latex/refman.pdf \
		doc/Documentation/ETS_Doxygen.pdf

DOC_Update: DOC
	rsync -avP doc/Doxygen/html/. /afs/efda-itm.eu/project/web2/var.www/html/ITM/doxygen/imp3/ets/

##############################################################################
# write out version information                                              #
##############################################################################
version:
	@echo
	@echo Version of the project = \"`svnversion . repos/ETS/trunk/ETS`\"
	@echo SVN version of the Makefile = \"'$$Id: Makefile 30 2008-08-27 04:32:33Z dpc $$'\"
	@echo

##############################################################################
# write out a short form of the version information                          #
##############################################################################
status:
	@echo `date +%Y-%m-%d` ${SYS} `svnversion . svn/ets/trunk/ETS` `hostname` `uname -r -p`

##############################################################################
# echo the SYS variable                                                      #
##############################################################################
SYS:
	@echo ${SYS}

##############################################################################
# this is supposed to update the Kepler actors created from the ETS sources  #
# --- it probably does not work at the moment                                #
##############################################################################
KEPLER: ${OBJECTCODE}/libanalytics.a ${OBJECTCODE}/libconvergence.a \
  ${OBJECTCODE}/libets.a ${OBJECTCODE}/libservice.a
	rsync -avP ${OBJECTCODE}/libanalytics.a ${KEPLER}/src/cpp/itm/analytics/
	cd ${KEPLER}/src/cpp/itm/analytics/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libconvergence.a ${KEPLER}/src/cpp/itm/convergence/
	cd ${KEPLER}/src/cpp/itm/convergence/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libets.a ${KEPLER}/src/cpp/itm/itmets/
	cd ${KEPLER}/src/cpp/itm/itmets/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libservice.a ${KEPLER}/src/cpp/itm/core2eq/
	cd ${KEPLER}/src/cpp/itm/core2eq/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libservice.a ${KEPLER}/src/cpp/itm/dummyeq/
	cd ${KEPLER}/src/cpp/itm/dummyeq/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libservice.a ${KEPLER}/src/cpp/itm/dummyets/
	cd ${KEPLER}/src/cpp/itm/dummyets/ ; ${MAKE} clean ; ${MAKE}
	rsync -avP ${OBJECTCODE}/libservice.a ${KEPLER}/src/cpp/itm/gentoroidfield/
	cd ${KEPLER}/src/cpp/itm/gentoroidfield/ ; ${MAKE} clean ; ${MAKE}

##############################################################################
# bring in the dependencies                                                  #
##############################################################################
include ${OBJECTCODE}/dependencies
```

```
################################################################################
# entries for creating the version information used in the ETS                 #
################################################################################
current_ets_version = ${shell svnversion src}
labelled_ets_version = \
  ${shell [ -e src/version/ets_version.f90 ] && \
  grep 'version =' src/version/ets_version.f90 | \
  tr "'" " " | \
  awk '{print $$7}'}

.PHONY: check_version

src/version/ets_version.f90 check_version:
        @ echo ${current_ets_version} ${labelled_ets_version}
        @[ "${current_ets_version}" != "${labelled_ets_version}" ] && \
          rm -f src/version/ets_version.f90 && \
          ${MAKE} update_version  && \
          echo Updated src/version/ets_version.f90 || \
          echo src/version/ets_version.f90 was correct

update_version:
        echo "module ets_version"                                              >  src/version/ets_version.f90
        echo "  implicit none"                                                 >> src/version/ets_version.f90
        echo "  character (len=12), parameter :: version = ''svnversion src`'" >> src/version/ets_version.f90
        echo "end module ets_version"                                          >> src/version/ets_version.f90


################################################################################
# a set of patches to bdseq so that it works with the ETS                      #
################################################################################
patch_bdseq:
        patch -p0 < src/patches/bdseq

################################################################################
# amns stuff                                                                   #
################################################################################

run_amns_demo: ${OBJECTCODE}/amns_demo
        @echo
        @echo 'Running' $^
        @echo
        @time $^
        @echo
        @echo 'Comparison with the reference (should show no differences!):'
        @echo
        @-diff -sqx .svn out.REF out
        @echo
        @echo 'Produce the graphics comparison'
        @echo
        ./test_amns.gnuplot
        @echo
        @echo 'Output should be in "test_amns.ps"'

run_amns_test: ${OBJECTCODE}/test_amns
        @echo
        @echo 'Running' $^
        @echo
        @time $^
        @echo
        @echo 'Produce the graphics comparison'
        @echo
        ./test_demo.gnuplot
        @echo
        @echo 'Output should be in "test_demo.ps"'

write_amns: ${OBJECTCODE}/write_amns
        @echo
        @echo 'Running' $^
        @echo
        @time $^
```

```
        @echo

read_amns: ${OBJECTCODE}/read_amns
        @echo
        @echo 'Running' $^
        @echo
        @time $^
        @echo

${OBJECTCODE}/amns_demo : ${OBJECTCODE}/amns_demo.o ${LIBSCHEMAS} # ${OBJECTCODE}/libamnsproto.a
        ${FC} ${FCOPTS} -o $@ $^ ${LIBS}

${OBJECTCODE}/test_amns : ${OBJECTCODE}/test_amns.o ${OBJECTCODE}/libamnsproto.a
        ${FC} ${FCOPTS} -o $@ $^

${OBJECTCODE}/write_amns: src/write_amns.f90
        ${FC} ${FCOPTS} ${UAL_inc} $< -o $@ ${UAL_lib}

${OBJECTCODE}/read_amns: src/read_amns.f90
        ${FC} ${FCOPTS} ${UAL_inc} $< -o $@ ${UAL_lib}
```

B Options in the Makefile "config" files

An example configuration file is the one for the Gateway using the UAL:

```
GOT_PERFLIB = 'yes'
FC=pgf95 -Mnosecond_underscore -fPIC
FCOPTS=-g -O3 # -Ktrap=fp
FCOPTS=-g -O0 # -Ktrap=fp
MOD=mod
LIBS=-llapack -lblas
DEFINES = -DUAL

MUMPS_BASE = /pfs/scratch/imp3/coster/SVN/ETS/branches/COS/SPARSE/MUMPS_4.7.3

UAL=yes
ifeq ($(UAL),yes)
  INCLUDE=-I /afs/efda-itm.eu/project/switm/ual/${UAL_VERSION}/include/amd64_pgi
  LIBSCHEMAS =
  LIBS += -R/afs/efda-itm.eu/project/switm/ual/${UAL_VERSION}/lib \
          -L/afs/efda-itm.eu/project/switm/ual/${UAL_VERSION}/lib \
          -lUALFORTRANInterface_pgi \
          -rpath /afs/efda-itm.eu/project/lsf/7.0/linux2.6-glibc2.3-x86_64/lib
endif
```

C Utility programs

During the development of the ETS a number of tools have been created.

C.1 timescpo

The basic command is of the form:

```
timescpo {-u USER} {-d MACHINE} {-v UAL_VERSION} shot# run# {CPO1} {CPO2} {CPO3}
```

From the Makefile

```
  make timescpo ARGS="-u konz -d aug 20116 2 equilibrium"
```

or, directly

```
obj/GW_UAL/timescpo -u konz -d aug 20116 2 equilibrium
```

The output is

```
 Processing shot/run =         20116  /             2
euitm_path=/afs/efda-itm.eu/user/k/konz/public/itmdb/itm_trees/aug/4.08a/mdsplus/0;/pfs/itmdb/itm_tr
 equilibrium
 Number of time points             1
    2.250000000000000
Closing: idx 0
Closed: status  0
```

C.2 sizecpo

C.3 printcpo

D XML and the .xml and .xsd files

E Instructions used at one of the code camps on how to obtain, compile and run the ETS

```
## This file:  ~wwwimp3/public/2010-03_WS-CC/Training.txt

## Logging in again
bsub -m enea145 -Is tcsh
        OR
bsub -m enea146 -Is tcsh
        OR
bsub -m enea147 -Is tcsh
        OR
bsub -m enea148 -Is tcsh

source /afs/efda-itm.eu/project/switm/scripts/ITMv1 kepler test 4.07b

cd /pfs/scratch/$GROUP/$USER/SVN/ETS_Training



## Move off of the interactive nodes (there are too many of us!)
bsub -Is tcsh

## create the data base if you haven't already done this
/afs/efda-itm.eu/project/switm/scripts/create_user_itm_dir test 4.07b

## set up to use the UAL version 4.07b and machine "test"
source /afs/efda-itm.eu/project/switm/scripts/ITMv1 kepler test 4.07b

## create some space for ourselves on the parallel file system (not backed up!)
cd /pfs/scratch/$GROUP/
mkdir $USER
cd $USER
mkdir SVN
cd SVN

## check out the code
svn co http://gforge.efda-itm.eu/svn/ets/trunk/ETS ETS_Training
cd ETS_Training/

## look at the documentation
acroread doc/Documentation/ETS_TRANSPORT_EQUATIONS.pdf
         OR
kpdf doc/Documentation/ETS_TRANSPORT_EQUATIONS.pdf
         OR
evince doc/Documentation/ETS_TRANSPORT_EQUATIONS.pdf

acroread doc/Documentation/eq_ets_test.pdf
acroread doc/Documentation/ETS_User_Guide.pdf
acroread doc/Documentation/STANDARDISED_EQUATION.pdf

## there are also some presentations in doc/Presentations

## doxygen stuff in doc/Doxygen
setenv pool_size 2500000
setenv save_size 20000
setenv pdf_mem_size 100000
make DOC


## set the default compiler options and set up the dependencies for the ETS
echo "SYS=GW_UAL.local" > obj/SYS
                OR
echo "SYS=g95_UAL" > obj/SYS

make depend
```

```
## produce the initial plasma state, and look at it
make write_input
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
make sizecpo ARGS="4 1"
make printcpo ARGS="4 1"
diagnostics/run_plot_te 4 1
gv te_4_1.ps
diagnostics/run_plot_coresource 4 1
gv coresource_4_1.ps
diagnostics/run_plot_coretransp 4 1
gv coretransp_4_1.ps

## Cylindrical case
cd case_5_44/
make eq_ets_test
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
diagnostics/run_plot_te 5 44
gv te_5_44.ps
diagnostics/run_plot_eq -s 100 5 44
gv psi_5_44.ps
diagnostics/run_plot_ETSslice 5 44 10.0
cd ..

## BDSEQ equilibrium code
cd case_5_45/
make patch_bdseq
make eq_ets_test
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
diagnostics/run_plot_te 5 45
gv te_5_45.ps
diagnostics/run_plot_eq -s 100 5 45
gv psi_5_45.ps
diagnostics/run_plot_ETSslice 5 45 10.0
python diagnostics/compare_run.py
shot:5
run:44
time:10
shot:5
run:45
time:10
cd ..

## EMEQ equilibrium code
cd case_5_46/
make eq_ets_test
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
diagnostics/run_plot_te 5 46
gv te_5_46.ps
diagnostics/run_plot_eq -s 100 5 46
gv psi_5_46.ps
diagnostics/run_plot_ETSslice 5 46 10.0
python diagnostics/compare_run.py
shot:5
run:45
time:10
shot:5
run:46
time:10

## Advanced visualization
( setenv PYTHONPATH diagnostics:$PYTHONPATH ; echo "import eq; \
  eq.plot_psi_coord(5,46,file='psi_5_46.ps',slice=-1)" | ipython )
time /afs/efda-itm.eu/project/switm/mplayer/bin/mencoder \
  'mf://psi_5_46_??????.png' -mf type=png:fps=30 -ovc lavc -lavcopts \
  vcodec=wmv2 -oac copy -o psi_5_46.mpg
/afs/efda-itm.eu/project/switm/mplayer/bin/mplayer psi_5_46.mpg

## Even more advanced visualization
( setenv PYTHONPATH diagnostics:$PYTHONPATH ; echo "import eq_coreprof ; \
  eq_coreprof.plot_psi_coord(5,46)" | ipython )
```

```
echo ne_psi_5_46_??????.png | \
  sed -e 's:ne_psi_5_46_::g' -e 's:\.png::g' | \
  tr ' ' '\n' | \
  xargs -P8 -i@ montage ne_psi_5_46_@.png te_psi_5_46_@.png \
    q_psi_5_46_@.png -mode Concatenate -tile x1 -depth 8 comb_psi_5_46_@.png
time /afs/efda-itm.eu/project/switm/mplayer/bin/mencoder \
  'mf://comb_psi_5_46_??????.png' -mf type=png:fps=30 -ovc lavc -lavcopts \
  vcodec=wmv2 -oac copy -o comb_psi_5_46.mpg
/afs/efda-itm.eu/project/switm/mplayer/bin/mplayer comb_psi_5_46.mpg

## For the truly adventurous
( setenv PYTHONPATH \
  ~coster/public/PYTHON/lib/python2.5/site-packages:diagnostics:$PYTHONPATH ; \
  echo "import eq_coreprof_pp ; eq_coreprof_pp.plot_psi_coord(5,46)" | python )

cd ..

## with transport and source combiner
cd case_5_48/
make eq_ets_test
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
diagnostics/run_plot_te 5 48
gv te_5_48.ps
diagnostics/run_plot_eq -s 100 5 48
gv psi_5_48.ps
diagnostics/run_plot_coretransp 5 48
gv coretransp_5_48.ps
diagnostics/run_plot_coretransp -s 100 5 48
gv coretransp_5_48.ps
diagnostics/run_plot_ETSslice 5 48 10.0
python diagnostics/compare_run.py
shot:5
run:46
time:10
shot:5
run:48
time:10
cd ..

## playing with the XML input
cp -r case_5_44 case_5_144
cd case_5_144
emacs eq_ets.xml
>>>>> >>>>>make consistent with case_5 46
make eq_ets_test
ls -lstra ~/public/itmdb/itm_trees/test/4.07b/mdsplus/0
python diagnostics/compare_run.py
shot:5
run:48
time:10
shot:5
run:144
time:10
cd ..
```

F Other XML inputs that might be needed when running the ETS workflows

F.1 ETS

Flag	Description
parameters	GLOBAL: parameters for ets
dims	BLOCK: specify the dimensions
nrho	NRHO, number of radial points
nion	NION, number of ions
nimp	NIMP, number of impurity types
max_nzimp	MAX_NZIMP, number of impurity ionisation states
solver	BLOCK: specify parameters for the solver
rhon	boundary value of rho
solver_type	choice of numerical solver
sigma_source	option for origin of Plasma electrical conductivity: 0: plasma collisions; 1: transport module; 2: source module
amix	AMIX, mixing factor
amixtr	AMIXTR, mixing factor for profiles
debug_level	debug level
ohmic_heating_multiplier	multiplier for ohmic heating
boundary	BLOCK: specify parameters for the boundary condition
psi_bnd_type	Type of boundary conditions CURRENT
ni_bnd_type	Type of boundary conditions ION DENSITY
ti_bnd_type	Type of boundary conditions ION TEMPERATURE
te_bnd_type	Type of boundary conditions ELECTRON TEMPERATURE
vtor_bnd_type	Type of boundary conditions ROTATION

```
 <?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>
  <dims>
  </dims>

  <solver>
    <ohmic_heating_multiplier> 0.0 </ohmic_heating_multiplier> <!-- switch off ohmic heating -->
  </solver>

  <boundary>
  </boundary>

</parameters>
```

F.2 BDSEQ

Flag	Description

```
 <?xml-stylesheet type="text/xsl" href="./input_etaigb.xsl"
charset="ISO-8859-1"?>

<parameters>

  <nr_eq> 0 </nr_eq>
  <nchi_eq> 0 </nchi_eq>

</parameters>
```

F.3 EMEQ

Flag	Description
parameters	GLOBAL: parameters for emeq
dims	BLOCK: specify the dimensions
neq	NEQ, number of equilibrium points
solver	BLOCK: parameters for the solver
convergence	convergence criterion in EQUILIBRIUM_INTERFACE
aceqlb	convergence criterion in E3ASTR
itermax	maximum iterations in E3ASTR

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./emeq.xsl" charset="ISO-8859-1"?>

<parameters>

  <dims>
    <neq>            100      </neq>           NEQ,   number of equilibrium points -->
  </dims>

  <solver>
    <convergence>    1.0d-4    </convergence>  <!-- convergence criterion in EQUILIBRIUM_INTERFACE -->
    <aceqlb>         1.0d-3    </aceqlb>       <!-- convergence criterion in E3ASTR-->
    <itermax>         1000     </itermax>      <!-- maximum iterations in E3ASTR-->
  </solver>

</parameters>
```

F.4 HELENA

Flag	Description

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./input_helena.xsl"
charset="ISO-8859-1"?>

<parameters>

<!-- profile parameters -->

 <profile_parameters>
   <hbt> .false. </hbt>
<!-- options are: "p' and FF'" | "p' and j_tor" | "p and j_tor" | "p' and q" -->
   <input_type> p' and FF' </input_type>
   <radial_coordinate> rho_vol </radial_coordinate>
```

```
 </profile_parameters>

<!-- shape parameters -->

 <shape_parameters>
   <ishape> 2 </ishape>
   <isol> 0 </isol>
   <ias> 1 </ias>
   <equidistant> 1. </equidistant>
 </shape_parameters>

<!-- global parameters -->

 <global_parameters>
 </global_parameters>

<!-- numerical parameters -->

  <numerical_parameters>
    <nr> 51 </nr>
    <np> 33 </np>
    <nrmap> 51 </nrmap>
    <npmap> 129 </npmap>
    <nchi> 128 </nchi>
    <niter> 500 </niter>
    <nmesh> 5 </nmesh>
    <errcur> 0.1000E-06 </errcur>
  </numerical_parameters>

<!-- diagnostics parameters -->

 <diagnostics_parameters>
   <verbosity> 2 </verbosity>
   <output> none </output>
   <diagnostics_on> .true. </diagnostics_on>
   <standard_output> .false. </standard_output>
   <xmgrace_output> .false. </xmgrace_output>
 </diagnostics_parameters>

</parameters>
```

F.5 NEUTRALS

Flag	Description
parameters	GLOBAL: parameters for neutrals
boundary_conditions	BLOCK: specify boundary conditions
n0_bnd	boundary condition for n0
t0_bnd	boundary condition for t0
neu_bnd_type	neutral boundary condition type
coefficients	BLOCK: coefficients
coef_recycle	recycling coefficient

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./neutrals_settings.xsl" charset="ISO-8859-1"?>

 <parameters>

   <boundary_conditions>

     <n0_bnd>            1.0d15     </n0_bnd>              <!-- density of neutrals at most outer point -->
     <t0_bnd>             0.1d0     </t0_bnd>              <!-- temperature of neutrals at most outer point -->
     <neu_bnd_type>           1     </neu_bnd_type>        <!-- type of boundary conditions for neutral solver -->
```

```
  </boundary_conditions>

  <coefficients>

    <coef_recycle>       0.5d0     </coef_recycle>          <!-- recycling coefficient for charged particles -->

  </coefficients>

</parameters>
```

F.6 SOURCE_COMBINER

Flag	Description
parameters	GLOBAL: parameters for source combiner
multipliers	BLOCK: specify multipliers
C_j_exp	multiplier for j
C_sigma	multiplier for sigma
C_Se_exp	multiplier for explicit electron particle source
C_Se_imp	multiplier for implicit electron particle source
C_Si_exp	multiplier for explicit ion particle source
C_Si_imp	multiplier for implicit ion particle source
C_Sz_exp	multiplier for explicit impurity particle source
C_Sz_imp	multiplier for implicit impurity particle source
C_Qe_exp	multiplier for implicit electron heating source
C_Qe_imp	multiplier for implicit electron heating source
C_Qi_exp	multiplier for implicit ion heating source
C_Qi_imp	multiplier for implicit ion heating source
C_Qz_exp	multiplier for implicit impurity heating source
C_Qz_imp	multiplier for implicit impurity heating source
C_Ui_exp	multiplier for explicit ion toroidal velocity source
C_Ui_imp	multiplier for implicit ion toroidal velocity source

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./source_combiner.xsl" charset="ISO-8859-1"?>

 <parameters>

   <multipliers>

 <!-- multiplier for contributions from (1) ITM data base, (2) NEUTRALS  -->

     <C_j_exp>          1  1     </C_j_exp>      <!-- multiplier for NI current -->

     <C_sigma>          1  1     </C_sigma>      <!-- multiplier for sigma -->

     <C_Se_exp>         1  1     </C_Se_exp>     <!-- multiplier for electron particle explicit source -->
     <C_Se_imp>         1  1     </C_Se_imp>     <!-- multiplier for electron particle implicit source -->

     <C_Si_exp>         1  1     </C_Si_exp>     <!-- multiplier for ion particle explicit source -->
     <C_Si_imp>         1  1     </C_Si_imp>     <!-- multiplier for ion particle implicit source -->

     <C_Sz_exp>         1  1     </C_Sz_exp>     <!-- multiplier for impurity particle explicit source -->
     <C_Sz_imp>         1  1     </C_Sz_imp>     <!-- multiplier for impurity particle implicit source -->
```

```
    <C_Qe_exp>          1  1     </C_Qe_exp>     <!-- multiplier for electron heat explicit source -->
    <C_Qe_imp>          1  1     </C_Qe_imp>     <!-- multiplier for electron heat implicit source -->

    <C_Qi_exp>          1  1     </C_Qi_exp>     <!-- multiplier for ion heat explicit source -->
    <C_Qi_imp>          1  1     </C_Qi_imp>     <!-- multiplier for ion heat implicit source -->

    <C_Qz_exp>          1  1     </C_Qz_exp>     <!-- multiplier for impurity heat explicit source -->
    <C_Qz_imp>          1  1     </C_Qz_imp>     <!-- multiplier for impurity heat implicit source -->

    <C_Ui_exp>          1  1     </C_Ui_exp>     <!-- multiplier for ion rotation explicit source -->
    <C_Ui_imp>          1  1     </C_Ui_imp>     <!-- multiplier for ion rotation implicit source -->

  </multipliers>

</parameters>
```

F.7 TRANSPORT_COMBINER

Flag	Description
parameters	GLOBAL: parameters for transport combiner
multipliers	BLOCK: specify multipliers
C_sigma	multiplier for sigma
C_ne_diff	multiplier for electron particle diffusivity
C_ne_vconv	multiplier for electron particle convective pinch
C_ni_diff	multiplier for ion particle diffusivity
C_ni_vconv	multiplier for ion particle convective pinch
C_te_diff	multiplier for electron thermal diffusivity
C_te_vconv	multiplier for electron thermal convective pinch
C_ti_diff	multiplier for ion thermal diffusivity
C_ti_vconv	multiplier for ion thermal convective pinch
C_vtor_diff	multiplier for ion toroidal velocity diffusivity
C_vtor_vconv	multiplier for ion toroidal velocity convective pinch
checks	BLOCK: checks
negative_diff	check for negative diffusion

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./transport_combiner.xsl" charset="ISO-8859-1"?>

 <parameters>

   <multipliers>

 <!-- multiplier for contributions from (1) ITM data base, (2) neoclassical, (3) anomalous  -->

     <C_sigma>              1  1  1     </C_sigma>          <!-- multiplier for sigma -->

     <C_ne_diff>            1  1  1     </C_ne_diff>        <!-- multiplier for electron particle diffusion -->
     <C_ne_vconv>           1  1  1     </C_ne_vconv>       <!-- multiplier for electron particle pinch -->

     <C_ni_diff>            1  1  1     </C_ni_diff>        <!-- multiplier for ion particle diffusion -->
     <C_ni_vconv>           1  1  1     </C_ni_vconv>       <!-- multiplier for ion particle pinch -->

     <C_te_diff>            1  1  1     </C_te_diff>        <!-- multiplier for electron heat diffusion -->
     <C_te_vconv>           1  1  1     </C_te_vconv>       <!-- multiplier for electron heat pinch -->
```

```
    <C_ti_diff>            1  1  1     </C_ti_diff>        <!-- multiplier for ion heat diffusion -->
    <C_ti_vconv>           1  1  1     </C_ti_vconv>       <!-- multiplier for ion heat pinch -->

    <C_vtor_diff>          1  1  1     </C_vtor_diff>      <!-- multiplier for ion rotation diffusion -->
    <C_vtor_vconv>         1  1  1     </C_vtor_vconv>     <!-- multiplier for ion rotation pinch -->

  </multipliers>


  <checks>


    <negative_diff>        1           </negative_diff>    <!-- check for negative diffusion '0' allow; '1' cut off-->


  </checks>

</parameters>
```

F.8 ETAIGB

Flag	Description

```
<?xml-stylesheet type="text/xsl" href="./input_etaigb.xsl"
charset="ISO-8859-1"?>

<parameters>

  <physical>
    <thresh> 6.0 </thresh>
    <tfloor> 200 </tfloor>
    <beta_reduction> 10.0 </beta_reduction>
    <etae_pinch> 3.0 </etae_pinch>
    <chi_d> 3.0 </chi_d>
  </physical>

  <grid>
    <nrho_transp> 0 </nrho_transp>
    <nion> 0 </nion>
  </grid>

</parameters>
```

F.9 ECRH

Flag	Description
parameters	GLOBAL: parameters for generic source modules (ECRH, ICRH, NBI)
coresource	BLOCK: specify parameters for the coresource CPO
j	expression for j as a function of a normalized radial coordinate [A/m$\hat{2}$]
qe_exp	expression for the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp	expression for the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
qi_exp	NION expressions for the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
	continued

continued	
Flag	**Description**
qi_imp	NION expressions for the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
si_exp	NION expressions for the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp	NION expressions for the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??]
ui_exp	NION expressions for the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp	NION expressions for the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
j_int	desired integral of j as a function of a normalized radial coordinate [A/m$\hat{2}$] (not yet implemented)
qe_exp_int	desired integral of the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp_int	desired integral of the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
qi_exp_int	NION desired integrals of the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp_int	NION desired integrals of the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
si_exp_int	NION desired integrals of the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp_int	NION desired integrals of the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??] (not yet implemented)
ui_exp_int	NION desired integrals of the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp_int	NION desired integrals of the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??] (not yet implemented)

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <coresource>
    <j>
0.0
    </j>
    <qe_exp>
exp(-((x-0.5)/0.05)^2)*5.0e4
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
0.0
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
0.0
```

```
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

</parameters>
```

F.10 ICRH

Flag	Description
parameters	GLOBAL: parameters for generic source modules (ECRH, ICRH, NBI)
coresource	BLOCK: specify parameters for the coresource CPO
j	expression for j as a function of a normalized radial coordinate [A/m$\hat{2}$]
qe_exp	expression for the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp	expression for the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
qi_exp	NION expressions for the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp	NION expressions for the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
si_exp	NION expressions for the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp	NION expressions for the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??]
ui_exp	NION expressions for the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp	NION expressions for the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
j_int	desired integral of j as a function of a normalized radial coordinate [A/m$\hat{2}$] (not yet implemented)
qe_exp_int	desired integral of the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp_int	desired integral of the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
qi_exp_int	NION desired integrals of the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp_int	NION desired integrals of the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
	continued

continued	
Flag	**Description**
si_exp_int	NION desired integrals of the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp_int	NION desired integrals of the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??] (not yet implemented)
ui_exp_int	NION desired integrals of the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp_int	NION desired integrals of the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??] (not yet implemented)

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <coresource>
    <j>
0.0
    </j>
    <qe_exp>
0.0
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
exp(-((x-0.2)/0.20)^2)*2.0e4
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
0.0
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

</parameters>
```

F.11 NBI

Flag	**Description**
parameters	GLOBAL: parameters for generic source modules (ECRH, ICRH, NBI)
coresource	BLOCK: specify parameters for the coresource CPO
j	expression for j as a function of a normalized radial coordinate [A/m$\hat{2}$]
	continued

continued	
Flag	**Description**
qe_exp	expression for the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp	expression for the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
qi_exp	NION expressions for the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp	NION expressions for the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??]
si_exp	NION expressions for the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp	NION expressions for the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??]
ui_exp	NION expressions for the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp	NION expressions for the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
j_int	desired integral of j as a function of a normalized radial coordinate [A/m$\hat{2}$] (not yet implemented)
qe_exp_int	desired integral of the explicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qe_imp_int	desired integral of the implicit part of the electron heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
qi_exp_int	NION desired integrals of the explicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$]
qi_imp_int	NION desired integrals of the implicit part of the ion heating as a function of a normalized radial coordinate [W/m$\hat{3}$/eV ??] (not yet implemented)
si_exp_int	NION desired integrals of the explicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s]
si_imp_int	NION desired integrals of the implicit part of the ion particle source as a function of a normalized radial coordinate [/m$\hat{3}$/s.m$\hat{3}$??] (not yet implemented)
ui_exp_int	NION desired integrals of the explicit part of the toroidal velocity source as a function of a normalized radial coordinate [??]
ui_imp_int	NION desired integrals of the implicit part of the toroidal velocity source as a function of a normalized radial coordinate [??] (not yet implemented)

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <coresource>
    <j>
0.0
    </j>
    <qe_exp>
exp(-((x-0.0)/0.4)^2)*1.0e4
    </qe_exp>
    <qe_imp>
0.0
```

```
    </qe_imp>
    <qi_exp>
exp(-((x-0.0)/0.4)^2)*1.0e4
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
exp(-((x-0.0)/0.4)^2)*2.0e4/(1e6*1.6e-19)
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

</parameters>
```

F.12 SOURCE_DUMMY

Flag	**Description**
parameters	GLOBAL: parameters for eq_ets_test
heating	BLOCK: specify heating
WTOT	Total heating power [W]
RHEAT	Position of the heating profile maximum [m]
FRACT	fraction of power going in different components [-]; from 1 to NION represent ions, last index - electrons
FWHEAT	Full width at the half maximum of heating profile [m]; from 1 to NION represent ions, last index - electrons
particles	BLOCK: specify particles
AMI	Atomic mass number of injected ions
STOT	Injection rate [sˆ1]
RPART	Position of the source profile maximum [m]
FWPART	Full width at the half maximum of source profile [m]
momentum	BLOCK: specify momentum
AMM	Atomic mass number of ions receiving momentum input
UTOT	Total momentum [kg*mˆ2*sˆ1]
RMOM	Position of the momentum profile maximum [m]
FWMOM	Full width at the half maximum of momentum profile [m]
currents	BLOCK: specify currents
JNITOT	Total noninductive current [A]
RCURR	Position of the current profile maximum [m]
FWCURR	Full width at the halth maximum of current profile [m]
	continued

continued	
Flag	**Description**

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./source_dummy.xsl" charset="ISO-8859-1"?>

 <parameters>

   <heating>

     <WTOT>          5.E6          </WTOT>        <!-- Total heating power [W] -->
     <RHEAT>         0.5           </RHEAT>       <!-- Position of the heating profile maximum [m] -->

     <!-- from 1 to NION represent ions, lst index - electrons  -->
     <FRACT>         0.8   2.0     </FRACT>       <!-- fraction of power going in different components [-] -->
     <FWHEAT>        0.2   0.2     </FWHEAT>      <!-- Full width at the halth maximum of heating profile [m] -->
  </heating>


  <particles>

     <AMI>           2.0           </AMI>         <!-- Atomic mass number of injected ions -->
     <STOT>          1.E21         </STOT>        <!-- Injection rate [s^-1] -->
     <RPART>         0.5           </RPART>       <!-- Position of the source profile maximum [m] -->
     <FWPART>        1.0           </FWPART>      <!-- Full width at the halth maximum of source profile [m] -->

  </particles>


  <momentum>

     <AMM>           2.0           </AMM>         <!-- Atomic mass number of ions receiving momentum input-->
     <UTOT>          0.E0          </UTOT>        <!-- Total momentum [kg*m^2*s^-1] -->
     <RMOM>          0.5           </RMOM>        <!-- Position of the momentum profile maximum [m] -->
     <FWMOM>         1.0           </FWMOM>       <!-- Full width at the halth maximum of momentum profile [m] -->

  </momentum>


  <currents>

     <JNITOT>        1.E5          </JNITOT>      <!-- Total noninductive current [A] -->
     <RCURR>         0.5           </RCURR>       <!-- Position of the current profile maximum [m] -->
     <FWCURR>        0.2           </FWCURR>      <!-- Full width at the halth maximum of current profile [m] -->

  </currents>


 </parameters>
```

G Cases stored in coster public database

The data can be found in

/afs/efda-itm.eu/user/c/coster/public/itmdb/itm_trees/test/4.07a/mdsplus/0/

It is all too easy to overwrite a case so beware!

shot	run	comment
0	0	This is mostly a copy of the 4.07a INDEX file — not all of the cases indicated below have yet been created!
		===== TEST =====
1	1	standard test case for analytics
2	1	TEST.1/ analytics, solver 1
2	2	TEST.2/ analytics, solver 2
2	3	TEST.3/ analytics, solver 3
2	4	TEST.4/ analytics, solver 4
2	6	TEST.6/ analytics, solver 6
2	7	TEST.7/ analytics, solver 7
2	8	TEST.8/ analytics, solver 8
2	9	TEST.9/ analytics, solver 9
3	*	CASES/
4	1	write_input (default version)
4	2	write_input with NE0 = NEB = NI0 = NIB = 5e19, SOURCE=0
4	3	write_input with diff_eff(IRHO,1)/diff_eff(IRHO,IION,1) instead of diff_eff(IRHO,2)/diff_eff(IRHO,IION,2)
4	4	write_input with diff_eff(IRHO,3)/diff_eff(IRHO,IION,3) instead of diff_eff(IRHO,2)/diff_eff(IRHO,IION,2)
4	5	same as 4/1 but with more peaked source profiles and 8 MA
4	6	multiple ion species
4	7	same as 4/1 but D shaped plasma
4	8	same as 4/5 but with changed chi profile
4	9	small plasma (Rgeo=4.3m, a0=0.1m, Ip=15kA)
4	10	same as 4/1 but with two impurity species (O,Ne)
4	11	same as 4/10 but with lower impurity density
4	12	same as 4/1 but without sources
4	13	same as 4/1 but with one impurity species (W)
4	14	same as 4/13 but non-equal spacing in RHO
4	15	same as 4/1 but with one impurity species (C)
4	16	same as 4/6 except zero sources
4	17	same as 4/14 but with D,T,3-He,4-He,Be + C,Ne,Ar,Xe,W
4	18	same as 4/1 except H instead of D

continued

continued

shot	run	comment
4	101	same as 4/1 but written by python
4	102	same as 4/5 but with more peaked source profiles
4	103	same as 4/101 except for a loop voltage boundary condition of 0.25
4	104	same as 4/103 except for a loop voltage boundary condition of 0.30
4	201	elongated, triangular equilibrium written by write_input_eq.py
4	202	emeq output based on 4/201
4	309	bdseq based on 4/9
4	409	emeq based on 4/9
4	1000	output from kepler workflow (1 step analytical plasma case)
5	1	older version of 4/1 (switched to using 4/1)
5	2	"standard" case
5	3	sigma_source=0/CYLINDRICAL_ne (uses 4/1)
5	4	sigma_source=0/CYLINDRICAL_T (uses 4/2)
5	5	using 4/3 (0.0 convective contribution) (cylindrical) (sigma_source=0)
5	6	using 4/1 (1.5 convective contribution) (cylindrical) (sigma_source=0)
5	7	using 4/4 (2.5 convective contribution) (cylindrical) (sigma_source=0)
5	8	using 4/3 (0.0 convective contribution) (toroidal) (sigma_source=0)
5	9	using 4/1 (1.5 convective contribution) (toroidal) (sigma_source=0)
5	10	using 4/4 (2.5 convective contribution) (toroidal) (sigma_source=0)
5	11	using 4/3 (0.0 convective contribution) (cylindrical) (sigma_source=1)
5	12	using 4/1 (1.5 convective contribution) (cylindrical) (sigma_source=1)
5	13	using 4/4 (2.5 convective contribution) (cylindrical) (sigma_source=1)
5	14	using 4/3 (0.0 convective contribution) (toroidal) (sigma_source=1)
5	15	using 4/1 (1.5 convective contribution) (toroidal) (sigma_source=1)
5	16	using 4/4 (2.5 convective contribution) (toroidal) (sigma_source=1)
5	17	sigma_source=1/CYLINDRICAL_ne (uses 4/1)
5	18	sigma_source=1/CYLINDRICAL_T (uses 4/2)
5	19	using 4/3 (0.0 convective contribution) (cylindrical) (sigma_source=0)
5	20	using 4/1 (1.5 convective contribution) (cylindrical) (sigma_source=0)
5	21	using 4/4 (2.5 convective contribution) (cylindrical) (sigma_source=0)
5	22	using 4/3 (0.0 convective contribution) (toroidal) (sigma_source=0)
5	23	using 4/1 (1.5 convective contribution) (toroidal) (sigma_source=0)
5	24	using 4/4 (2.5 convective contribution) (toroidal) (sigma_source=0)
5	25	using 4/3 (0.0 convective contribution) (cylindrical) (sigma_source=1)
5	26	using 4/1 (1.5 convective contribution) (cylindrical) (sigma_source=1)
5	27	using 4/4 (2.5 convective contribution) (cylindrical) (sigma_source=1)
5	28	using 4/3 (0.0 convective contribution) (toroidal) (sigma_source=1)
5	29	using 4/1 (1.5 convective contribution) (toroidal) (sigma_source=1)

continued

continued

shot	run	comment
5	30	using 4/4 (2.5 convective contribution) (toroidal) (sigma_source=1)
5	31	sigma_source=0/CYLINDRICAL_ne (uses 4/1)
5	32	sigma_source=0/CYLINDRICAL_T (uses 4/2)
5	33	sigma_source=1/CYLINDRICAL_ne (uses 4/1)
5	34	sigma_source=1/CYLINDRICAL_T (uses 4/2)
5	35	sigma_source=0, emeq, 8 MA, peaked sources, q_axis drops below 1, 1000s (uses 4/5)
5	36	uses ext_transport (based on 4/1)
5	37	9 points, tau_inc/dec...; add_transport=1 (based on 4/1)
5	38	50 points; add_transport=1 (based on 4/1)
5	39	based on 4/6 (multiple ion species)
5	40	D shaped plasma (based on 4/7)
5	41	same as 5/35 but based on 4/8
5	42	experimental case: based on 4/9 and uses evolution.exp [no longer supported]
5	43	experimental case: based on 4/9 and uses evolution from the XML
5	44	cylindrical equilibrium
5	45	bdseq equilibrium
5	46	emeq equilibrium
5	47	helena equilibrium
5	48	workflow with source and transport combiner
5	49	same as 5/17 except NRHO=100 (instead of 50)
5	50	same as 5/17 except NRHO=200 (instead of 50)
5	51	same as 5/17 except dt=0.01 (instead of 0.1)
5	52	same as 5/17 except dt=0.001 (instead of 0.1)
5	53	same as 5/17 except NRHO=500 (instead of 50)
5	54	same as 5/17 except NRHO=1000 (instead of 50)
5	55	same as 5/17 except NRHO=2000 (instead of 50)
5	56	same as 5/17 except NRHO=5000 (instead of 50)
5	57	same as 5/17 except NRHO=10000 (instead of 50) [213GB datafile]
5	58	same as 5/44 but using 4/101 instead of 4/1
5	59	same as 5/45 but using 4/101 instead of 4/1
5	60	same as 5/46 but using 4/101 instead of 4/1
5	61	same as 5/47 but using 4/101 instead of 4/1
5	62	same as for 5/39 except for ntime (100 instead of 10000)
5	63	same as 5/62 except that it uses bdseq
5	64	same as 5/62 except that it uses helena
5	65	same as 5/62 except for equilibrium augmentation
5	66	same as 5/63 except for equilibrium augmentation

continued

continued

shot	run	comment
5	67	same as 5/64 except for equilibrium augmentation
5	68	continuation of 5/65
5	69	continuation of 5/66
5	70	continuation of 5/67
5	71	same as 5/67 except helena, mesh accumulation, nr=40, np=9
5	72	same as 5/67 except helena, mesh accumulation, nr=50, np=9
5	73	same as 5/67 except helena, mesh accumulation, nr=100, np=9
5	74	same as 5/67 except helena, mesh accumulation, nr=200, np=9
5	75	same as 5/67 except helena, mesh accumulation, nr=400, np=9
5	76	same as 5/67 except helena, mesh accumulation, nr=800, np=9
5	77	same as 5/67 except helena, mesh accumulation, nr=40, np=17
5	78	same as 5/67 except helena, mesh accumulation, nr=50, np=17
5	79	same as 5/67 except helena, mesh accumulation, nr=100, np=17
5	80	same as 5/67 except helena, mesh accumulation, nr=200, np=17
5	81	same as 5/67 except helena, mesh accumulation, nr=400, np=17
5	82	same as 5/67 except helena, mesh accumulation, nr=800, np=17
5	83	same as 5/67 except helena, mesh accumulation, nr=40, np=33
5	84	same as 5/67 except helena, mesh accumulation, nr=50, np=33
5	85	same as 5/67 except helena, mesh accumulation, nr=100, np=33
5	86	same as 5/67 except helena, mesh accumulation, nr=200, np=33
5	87	same as 5/67 except helena, mesh accumulation, nr=400, np=33
5	88	same as 5/67 except helena, mesh accumulation, nr=800, np=33
5	89	same as 5/67 except helena, mesh accumulation, nr=30, np=65
5	90	same as 5/67 except helena, mesh accumulation, nr=40, np=65
5	91	same as 5/67 except helena, mesh accumulation, nr=50, np=65
5	92	same as 5/67 except helena, mesh accumulation, nr=100, np=65
5	93	same as 5/67 except helena, mesh accumulation, nr=200, np=65
5	94	same as 5/67 except helena, mesh accumulation, nr=400, np=65
5	95	same as 5/67 except helena, mesh accumulation, nr=800, np=65
5	96	same as 5/67 except helena, mesh accumulation, nr=25, np=129
5	97	same as 5/67 except helena, mesh accumulation, nr=30, np=129
5	98	same as 5/67 except helena, mesh accumulation, nr=40, np=129
5	99	same as 5/67 except helena, mesh accumulation, nr=50, np=129
5	100	same as 5/67 except helena, mesh accumulation, nr=100, np=129
5	101	same as 5/67 except helena, mesh accumulation, nr=200, np=129
5	102	same as 5/67 except helena, mesh accumulation, nr=400, np=129
5	103	same as 5/67 except helena, mesh accumulation, nr=800, np=129
5	104	same as 5/67 except helena, mesh accumulation, nr=20, np=257

continued

continued

shot	run	comment
5	105	same as 5/67 except helena, mesh accumulation, nr=25, np=257
5	106	same as 5/67 except helena, mesh accumulation, nr=30, np=257
5	107	same as 5/67 except helena, mesh accumulation, nr=40, np=257
5	108	same as 5/67 except helena, mesh accumulation, nr=50, np=257
5	109	same as 5/67 except helena, mesh accumulation, nr=100, np=257
5	110	same as 5/67 except helena, mesh accumulation, nr=200, np=257
5	111	same as 5/67 except helena, mesh accumulation, nr=400, np=257 XXX (queue time limit)
5	112	same as 5/67 except helena, mesh accumulation, nr=800, np=257 XXX (queue time limit)
5	113	same as 5/44 (cylindrical equilibrium) except based on 4/10 (2 impurity species)
5	114	same as 5/45 (bdseq equilibrium) except based on 4/10 (2 impurity species)
5	115	same as 5/46 (emeq equilibrium) except based on 4/11 (2 impurity species) (impurity density lower than for 5/113 and 5/114)
5	116	same as 5/47 (helena equilibrium) except based on 4/11 (2 impurity species) (impurity density lower than for 5/113 and 5/114)
5	117	same as 5/37 except use HELENA
5	118	same as 5/48 (workflow with source and transport combiner) except based on 4/12; 30 MW electron heating, 30 MW ion heating
5	119	same as 5/118 except NRHO=200 (instead of 100)
5	120	same as 5/115 except based on 4/13 (W impurity)
5	121	same as 5/120 except based on 4/14 (W impurity) (with higher rho resolution at the edge)
5	122	same as 5/120 except based on 4/14 (W impurity) (with even higher rho resolution at the edge)
5	123	same as 5/120 except based on 4/14 (W impurity) (increase NRHO; higher rho resolution at the edge)
5	124	same as 5/118 except enable the edge neutrals (n0_bnd=1e15)
5	125	same as 5/118 except enable the edge neutrals (n0_bnd=1e16)
5	126	same as 5/118 except enable the edge neutrals (n0_bnd=1e17)
5	127	same as 5/118 except enable the edge neutrals (n0_bnd=1e18)
5	128	same as 5/120 except uses 4/15 (C)
5	129	same as 5/128 except uses ADAS data (direct read)
5	130	same as 5/129 except uses ADAS data via AMNS interface
5	131	based on 4/16 (zero initial sources)
5	132	copy of 5/58 except using a loop voltage boundary condition (4/103)
5	133	copy of 5/59 except using a loop voltage boundary condition (4/103)
5	134	copy of 5/60 except using a loop voltage boundary condition (4/103)
5	135	copy of 5/61 except using a loop voltage boundary condition (4/103)

continued

continued

shot	run	comment
5	136	copy of 5/58 except using a loop voltage boundary condition (4/104)
5	137	copy of 5/59 except using a loop voltage boundary condition (4/104)
5	138	copy of 5/60 except using a loop voltage boundary condition (4/104)
5	139	copy of 5/61 except using a loop voltage boundary condition (4/104)
5	140	same as 5/129 except uses ADAS data via AMNS interface (W)
5	141	same as 5/140 (uses 4/17)
5	142	same as 5/44 (cyl) except that it uses 4/18 insead of 4/1 (H instead of D)
5	143	same as 5/45 (bdseq) except that it uses 4/18 insead of 4/1 (H instead of D)
5	144	same as 5/46 (emeq) except that it uses 4/18 insead of 4/1 (H instead of D)
5	145	same as 5/47 (helena) except that it uses 4/18 insead of 4/1 (H instead of D)
6	*	CASES_eq_ets/
7	1	bdseq P0=5000
7	2	helena2
7	3	helena
7	4	e3astr
7	11	kepler workflow involving bdseq
7	12	kepler workflow involving emeq
7	13	kepler workflow involving helena
7	14	kepler workflow involving imp1/Helena
8	1	bdseq P0=500
8	2	helena2
8	3	helena
8	4	e3astr
9	1	bdseq P0=50
9	2	helena2
9	3	helena
9	4	e3astr
10	1	bdseq P0=5
10	2	helena2
10	3	helena
10	4	e3astr
11	1	ISIP shot/run 4/1
20	1	COS
21	1	
17151	13	ETS-A Workflow started from AUG/17151/2
		===== JET =====
71827	12	prepare_input_cpos_JET_71827_12.xml (no impurities)
71827	13	prepare_input_cpos_JET_71827_13.xml (impurities)

continued

continued

shot	run	comment
71827	21	based on 71827/11
71827	22	based on 71287/12
71827	23	based on 71287/13
71287	36	based on 71287/11 (in case_71827_3 for some reason)
78092	1	from Konz (measurements from JET)
78092	2	from Konz (output from EQUAL)
78092	3	from Konz (output from HELENA)
78092	103	start CPOs based on 78092/3
78092	203	run starting from 78092/103 (NP=17)
78092	303	run starting from 78092/103 (NP=65)
78092	403	run starting from 78092/103 (NP=129)
78092	503	run starting from 78092/103 (NP=257)
78092	603	run starting from 78092/103 (NP=9)
78092	703	run starting from 78092/103 (NP=33)
78092	10003	equilibrium augmentation of 78092/3
===== AUG =====		
17151	0	equilibrium and limiter derived from AUG shotfile using aug_eq.py (cut varies)
17151	1	run helena on 17151/0 (cut=0.99)
17151	2	output from prepare_input_cpos based on 17151/1
17151	3	limiter and multiple equilibrium time-slices from AUG using aug_eq_slices.py
17151	4	run helena on 17151/0 (cut=0.95)
17151	5	output from prepare_input_cpos based on 17151/1 (D+He + C)
17151	6	output from prepare_input_cpos based on 17151/4
17151	7	output from prepare_input_cpos based on 17151/4 (D+He + C)
17151	13	ETS run started from 17151/2 with NP=9
17151	14	ETS run started from 17151/2 with NP=17
17151	15	ETS run started from 17151/2 with NP=33
17151	16	ETS run started from 17151/2 with NP=65
17151	17	ETS run started from 17151/2 with NP=129
17151	18	ETS run started from 17151/2 with NP=257
17151	400	Core-edge coupled case based on 17151/6 (D), initial state
17151	401	Continuation of 17151/10400
17151	402	Continuation of 17151/10401
17151	403	Continuation of 17151/10402
17151	404	Continuation of 17151/10403
17151	405	Continuation of 17151/10404
17151	406	Continuation of 17151/10405
17151	407	Continuation of 17151/10406

continued

continued

shot	run	comment
17151	500	Core-edge coupled case based on 17151/7 (D+He + C)
17151	501	Continuation of 17151/10500
17151	502	Continuation of 17151/10501
17151	503	Continuation of 17151/10502
17151	504	Continuation of 17151/10503
17151	505	Continuation of 17151/10504
17151	700	Continuation of 17151/10505 with more poloidal points for Helena (17 instead of 9)
17151	701	Continuation of 17151/10700
17151	702	Continuation of 17151/10701
17151	800	Continuation of 17151/10702 with more poloidal points for Helena (33 instead of 17)
17151	801	Continuation of 17151/10800
17151	802	Continuation of 17151/10801
17151	10400	Written by coupling.edge_2_core based on 17151/400 and 17151/20400
17151	10401	Written by coupling.edge_2_core based on 17151/401 and 17151/20401
17151	10402	Written by coupling.edge_2_core based on 17151/402 and 17151/20402
17151	10403	Written by coupling.edge_2_core based on 17151/403 and 17151/20403
17151	10404	Written by coupling.edge_2_core based on 17151/404 and 17151/20404
17151	10405	Written by coupling.edge_2_core based on 17151/405 and 17151/20405
17151	10406	Written by coupling.edge_2_core based on 17151/406 and 17151/20406
17151	10407	Written by coupling.edge_2_core based on 17151/407 and 17151/20407
17151	10500	Written by coupling.edge_2_core based on 17151/500 and 17151/20500
17151	10501	Written by coupling.edge_2_core based on 17151/501 and 17151/20501
17151	10502	Written by coupling.edge_2_core based on 17151/502 and 17151/20502
17151	10503	Written by coupling.edge_2_core based on 17151/503 and 17151/20503
17151	10504	Written by coupling.edge_2_core based on 17151/504 and 17151/20504
17151	10505	Written by coupling.edge_2_core based on 17151/505 and 17151/20505
17151	20400	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/400
17151	20401	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/401
17151	20402	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/402
17151	20403	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/403
17151	20404	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/404
17151	20405	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/405

continued

continued

shot	run	comment
17151	20406	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/406
17151	20407	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/407
17151	20500	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/500
17151	20501	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/501
17151	20502	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/502
17151	20503	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/503
17151	20504	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/504
17151	20505	Written by SOLPS/../b2_ual_write.exe based on a SOLPS run with boundary conditions from 17151/505
20116	0	equilibrium and limiter derived from AUG shotfile using aug_eq.py (cut varies)
20116	1	run helena on 20116/0 (cut=0.99)
20116	2	from Konz
20116	102	start CPOs based on 20116/2
20116	202	run starting from 20116/102 (NP=17)
20116	302	run starting from 20116/102 (NP=65)
20116	402	run starting from 20116/102 (NP=129)
20116	502	run starting from 20116/102 (NP=257)
20116	602	run starting from 20116/102 (NP=9)
20116	702	run starting from 20116/102 (NP=33)
===== ITER =====		
1000	0	prepare_input_cpos_ITER_1000_0.xml (eq from boulbe/iter/4.09a/44444/4) [CEDRES++]
1000	1	HELENA run started from 1000/3
1000	2	ETS started from 1000/0 repeatedly using the same CEDRES++ equilibrium
1000	3	vis.py in case_1000_1/ (cut=0.99)
2000	0	prepare_input_cpos_ITER_2000_0.xml (eq from egiovan/test/4.09a/231/12)
2000	2	attempt to start ETS using 2000/0 (CREATE-NL equilibrium)
3000	0	prepare_input_cpos_ITER_3000_0.xml (eq from giovan/test/4.09a/831/12)
3000	2	attempt to start ETS using 3000/0 (FIXFREE equilibrium)

H Some annotated cases

H.1 case_5_37: a case designed to push the limits on speed

The run reads its start CPOs from 4/1 and writes to 5/37 (in test). Data is output on a time base of 1 second. The initial time-step is 0.1 seconds but is allowed to rise to 10 seconds. A corase grid is used (9 points in the radial direction) and the EMEQ equilibrium solver is used. The results are shown in figure 10.

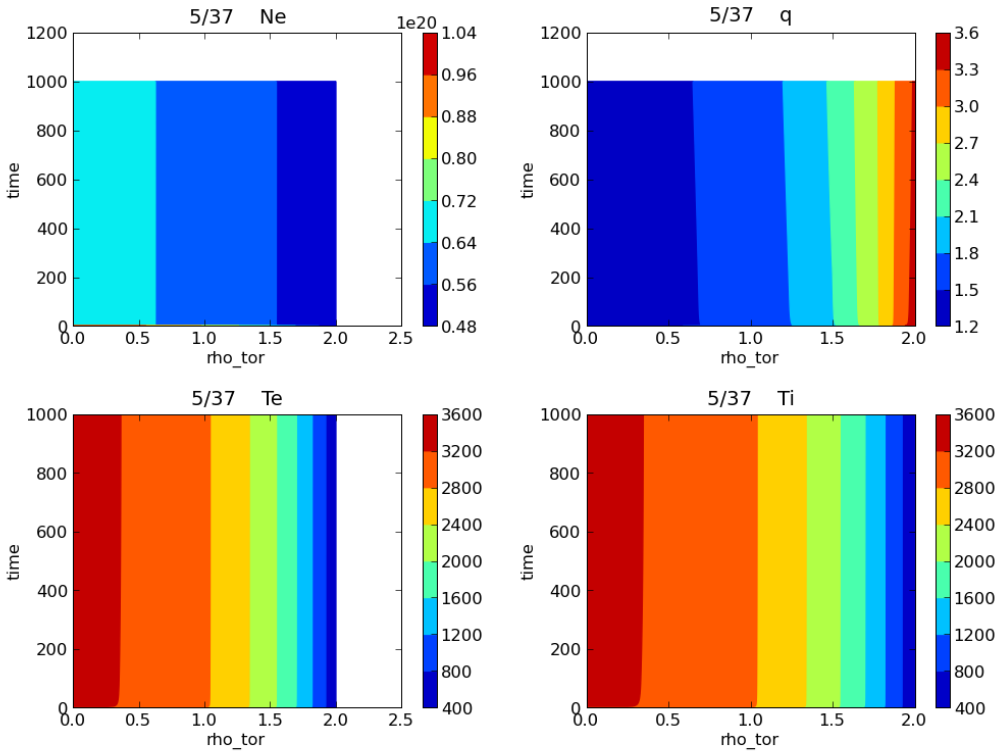

Figure 10: Summary of run 5/37.

1277 iterations were performed in 181 time steps with output performed 129 times.

The run took 61 seconds of which 52.0 seconds was comsumed in doing the writing out of the CPOs. 4 seconds in creating the CPOs at the beginning, and 4 seconds doing calculations (8.45 seconds of user cpu time, 29.67 seconds of system time, 64.25 seconds of elapsed time).

The input files was:

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <input>
    <shot_in>              4     </shot_in>          <!-- shot number -->
    <run_in>               1     </run_in>           <!-- run number -->
    <interpol>             1     </interpol>         <!-- interpolation index -->
    <time_dep_input>       0     </time_dep_input>   <!-- 1 implies time dependence in input data -->
  </input>
```

```
  <output>
    <shot_out>             5     </shot_out>         <!-- shot number -->
    <run_out>             37     </run_out>          <!-- run number -->
    <tau_out>            1.0     </tau_out>          <!-- output frequency -->
  </output>

  <dims>
    <nrho>                 9     </nrho>             <!-- NRHO,  number of radial points -->
    <neq>                  9     </neq>              <!-- NEQ,   number of equilibrium points -->
    <nion>                 1     </nion>             <!-- NION,  number of ions -->
    <nimp>                 0     </nimp>             <!-- NIMP,  number of impurity types -->
    <max_nzimp>            0     </max_nzimp>        <!-- MAX_NZIMP, number of impurity ionisation states -->
  </dims>

  <solver>
   <solver_type>           3     </solver_type>      <!-- choice of numerical solver -->
   <sigma_source>          0     </sigma_source>     <!-- option for origin of Plasma electrical conductivity: 0: plasma
    <tau>              1.0d-1     </tau>              <!-- TAU, time step [s] -->
    <tau_inc>             1.1     </tau_inc>          <!-- time step increment factor if ITERATIONS < ITER_INC -->
    <tau_dec>             0.9     </tau_dec>          <!-- time step decrement factor if ITERATIONS > ITER_DEC -->
    <iter_inc>              5     </iter_inc>         <!-- ITERATION limit to cause increase in time-step -->
    <iter_dec>            100     </iter_dec>         <!-- ITERATION limit to cause decrease in time-step -->
    <tau_min>           0.001     </tau_min>          <!-- minimum TAU, time step [s] -->
    <tau_max>            10.0     </tau_max>          <!-- maximum TAU, time step [s] -->
    <amix>             1.0d-0     </amix>             <!-- AMIX, mixing factor -->
    <convrec>          1.0d-4     </convrec>          <!-- PRECISION -->
    <ntime>             10000     </ntime>            <!-- NTIME, number of time points -->
    <nsol>                  2     </nsol>             <!-- Number of analytical example -->
    <ext_equil>             2     </ext_equil>        <!-- call external equilibrium: 0: none, 1: BDSEQ, 2: EMEQ, 3: HELEN
    <ext_source>            0     </ext_source>       <!-- call external source routines: if 2, call combine_source -->
    <ext_transport>         1     </ext_transport>    <!-- call external transport routines: if 2, call combine_transport
    <add_transport>       1.0     </add_transport>    <!-- additional diffusive transport coefficient -->
  </solver>

  <boundary>
    <psi_bnd_type>          2     </psi_bnd_type>     <!-- Type of boundary conditions CURRENT -->
    <ni_bnd_type>           1     </ni_bnd_type>      <!-- Type of boundary conditions ION DENSITY -->
    <ti_bnd_type>           1     </ti_bnd_type>      <!-- Type of boundary conditions ION TEMPERATURE -->
    <te_bnd_type>           1     </te_bnd_type>      <!-- Type of boundary conditions ELECTRON TEMPERATURE -->
    <vtor_bnd_type>         1     </vtor_bnd_type>    <!-- Type of boundary conditions ROTATION -->
  </boundary>

  <experimental>
  </experimental>

</parameters>
```

(For comparison, using HELENA, the run took 11 minutes, 58 seconds elapsed time, 569.42 user cpu and 82.93 system cpu seconds with the equilibrium code taking 620 seconds.

H.2 case_78092_203: using a JET equilibrium

This case starts from JET/78092/3 (originally from Konz) which was a HELENA run based on JET/78092/2, which in turn was an EQUAL reconstruction based on JET data in JET/78092/1.

The relevant input for preparing the initial CPO is

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <dimensions>
    <nrho>      100      </nrho>
    <nion>        1      </nion>
    <nimp>        0      </nimp>
```

```
    <ntheta>    101      </ntheta>
  </dimensions>

  <output>
    <shot>    78092      </shot>
    <run>       103      </run>
  </output>

  <global>
    <time>      0.0      </time>
    <R0>        2.960000000000000     </R0>
    <B0>        2.245840415197474     </B0>
    <A0>        0.9359649590744112    </A0>
    <Ip>        1673037.784858907     </Ip>
    <Rgeo>      2.919332520294536     </Rgeo>
  </global>

  <equilibrium>
    <equilibrium_ext> coster/jet/4.08a/78092/3 </equilibrium_ext>
    <el>        1.65     </el>
    <tr_u>      0.2      </tr_u>
    <tr_l>      0.2      </tr_l>
  </equilibrium>

  <coreprof>
    <coreprof_ext>                              </coreprof_ext>
    <zn>                    1.0                 </zn>
    <amn>                   2.0                 </amn>
    <zion>                  1.0                 </zion>
    <ni>        (1-x^2)*(1.0E20-5.0E19)+5.0E19  </ni>
    <ti>        (1-x^2)*(1.0E3-5.0E2)+5.0E2     </ti>
    <te>        (1-x^2)*(1.0E3-5.0E2)+5.0E2     </te>
    <vtor>                  0.0                 </vtor>
    <jpar>      (1-x^2)*(1.0E6-0.0E0)+0.0E0     </jpar>
    <qsf>       (1-x^2)*(1.0-3.0)+3.0           </qsf>
  </coreprof>

  <coretransp>
    <coretransp_ext>  </coretransp_ext>
    <sigma>
2.0e7
    </sigma>
    <ne_diff>
0.0 1.0 0.0
    </ne_diff>
    <ne_conv>
0.0 0.0 0.0
    </ne_conv>
    <ni_diff>
0.0 1.0 0.0
    </ni_diff>
    <ni_conv>
0.0 0.0 0.0
    </ni_conv>
    <te_diff>
1.5
    </te_diff>
    <te_conv>
0.0
    </te_conv>
    <ti_diff>
1.5
    </ti_diff>
    <ti_conv>
0.0
    </ti_conv>
    <vtor_diff>
1.0
    </vtor_diff>
    <vtor_conv>
```

```
0.0
    </vtor_conv>
  </coretransp>

  <coresource>
    <coresource_ext>  </coresource_ext>
    <j>
0.0
    </j>
    <sigma_src>
0.0
    </sigma_src>
    <qe_exp>
5.0e4
    </qe_exp>
    <qe_imp>
0.0
    </qe_imp>
    <qi_exp>
5.0e4
    </qi_exp>
    <qi_imp>
0.0
    </qi_imp>
    <si_exp>
5.0e19
    </si_exp>
    <si_imp>
0.0
    </si_imp>
    <ui_exp>
0.0
    </ui_exp>
    <ui_imp>
0.0
    </ui_imp>
  </coresource>

  <coreimpur>
    <coreimpur_ext>      </coreimpur_ext>
    <imp_zn>             </imp_zn>
    <imp_amn>            </imp_amn>
    <nz>
    </nz>
    <diff>
    </diff>
    <conv>
    </conv>
  </coreimpur>

</parameters>
```

The was then performed based on

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./ets.xsl" charset="ISO-8859-1"?>

<parameters>

  <input>
    <shot_in>          78092     </shot_in>          <!-- shot number -->
    <run_in>             103     </run_in>           <!-- run number -->
    <interpol>             1     </interpol>         <!-- interpolation index -->
    <time_dep_input>       0     </time_dep_input>   <!-- 1 implies time dependence in input data -->
  </input>

  <output>
    <shot_out>         78092     </shot_out>         <!-- shot number -->
    <run_out>            203     </run_out>          <!-- run number -->
```

```
    <tau_out>         1.0d-2     </tau_out>          <!-- output frequency -->
  </output>

  <dims>
    <nrho>               100     </nrho>             <!-- NRHO,  number of radial points -->
    <neq>                 50     </neq>              <!-- NEQ,   number of equilibrium points -->
    <nion>                 1     </nion>             <!-- NION,  number of ions -->
    <nimp>                 0     </nimp>             <!-- NIMP,  number of impurity types -->
    <max_nzimp>            0     </max_nzimp>        <!-- MAX_NZIMP, number of impurity ionisation states -->
  </dims>

  <solver>
   <solver_type>           3     </solver_type>      <!-- choice of numerical solver -->
   <sigma_source>          0     </sigma_source>     <!-- option for origin of Plasma electrical conductivity: 0: plasma
    <tau>             1.0d-2     </tau>              <!-- TAU, time step [s] -->
    <amix>            1.0d-0     </amix>             <!-- AMIX, mixing factor -->
    <convrec>         1.0d-4     </convrec>          <!-- PRECISION -->
    <ntime>             1000     </ntime>            <!-- NTIME, number of time points -->
    <time0>              0.0     </time0>            <!-- Start time [s] -->
    <nsol>                 2     </nsol>             <!-- Number of analytical example -->
    <ext_equil>            3     </ext_equil>        <!-- call external equilibrium: 0: none, 1: BDSEQ, 2: EMEQ, 3: HELEN
    <augment_equil>        1     <augment_equil>        1     </augment_equil>    <!-- if 1 add psi(R,Z), B(R,Z) using sp
 </augment_equil>    <!-- if 1 add psi(R,Z), B(R,Z) using splines
    <ext_source>           0     </ext_source>       <!-- call external source routines: if 2, call combine_source -->
    <ext_transport>        0     </ext_transport>    <!-- call external transport routines: if 1, call etaigb and neowes;
  </solver>

  <boundary>
    <psi_bnd_type>         2     </psi_bnd_type>     <!-- Type of boundary conditions CURRENT -->
    <ni_bnd_type>          1     </ni_bnd_type>      <!-- Type of boundary conditions ION DENSITY -->
    <ti_bnd_type>          1     </ti_bnd_type>      <!-- Type of boundary conditions ION TEMPERATURE -->
    <te_bnd_type>          1     </te_bnd_type>      <!-- Type of boundary conditions ELECTRON TEMPERATURE -->
    <vtor_bnd_type>        1     </vtor_bnd_type>    <!-- Type of boundary conditions ROTATION -->
  </boundary>

  <experimental>
    <option>              -1     </option>           <!-- option #: 0: disabled -->
  </experimental>

</parameters>
```

producing output in JET/78092/203. The HELENA parameters used were

```
<?xml version="1.0"?>

<?xml-stylesheet type="text/xsl" href="./input_helena.xsl"
charset="ISO-8859-1"?>

<parameters>

<!-- profile parameters -->

 <profile_parameters>
   <hbt> .false. </hbt>
   <input_type> p and j_tor </input_type>
   <radial_coordinate> rho_vol </radial_coordinate>
 </profile_parameters>

<!-- shape parameters -->

 <shape_parameters>
   <ishape> 2 </ishape>
   <isol> 0 </isol>
   <ias> 1 </ias>
   <imesh> 2 </imesh>
   <equidistant> 0.5 </equidistant>
   <n_acc_points> 2 </n_acc_points>
   <s_acc> 0.0 1.0 </s_acc>
   <sig> 0.1 0.1 </sig>
   <weights> 0.1 0.1 </weights>
```

```
 </shape_parameters>

<!-- global parameters -->

 <global_parameters>
 </global_parameters>

<!-- numerical parameters -->

  <numerical_parameters>
    <nr> 100 </nr>
    <np> 17 </np>
    <nrmap> 100 </nrmap>
    <npmap> 64 </npmap>
    <nchi> 64 </nchi>
    <niter> 32 </niter>
    <nmesh> 20 </nmesh>
    <errcur> 1.000E-03 </errcur>
  </numerical_parameters>

<!-- diagnostics parameters -->

 <diagnostics_parameters>
   <verbosity> 0 </verbosity>
   <output> none </output>
   <diagnostics_on> .false. </diagnostics_on>
   <standard_output> .false. </standard_output>
   <xmgrace_output> .false. </xmgrace_output>
   <profiles_output> .false. </profiles_output>
 </diagnostics_parameters>

</parameters>
```

The results are shown in figure 11, which was produced by

```
diagnostics/run_plot_eq_ets_changing_rho -d jet 78092 203
```

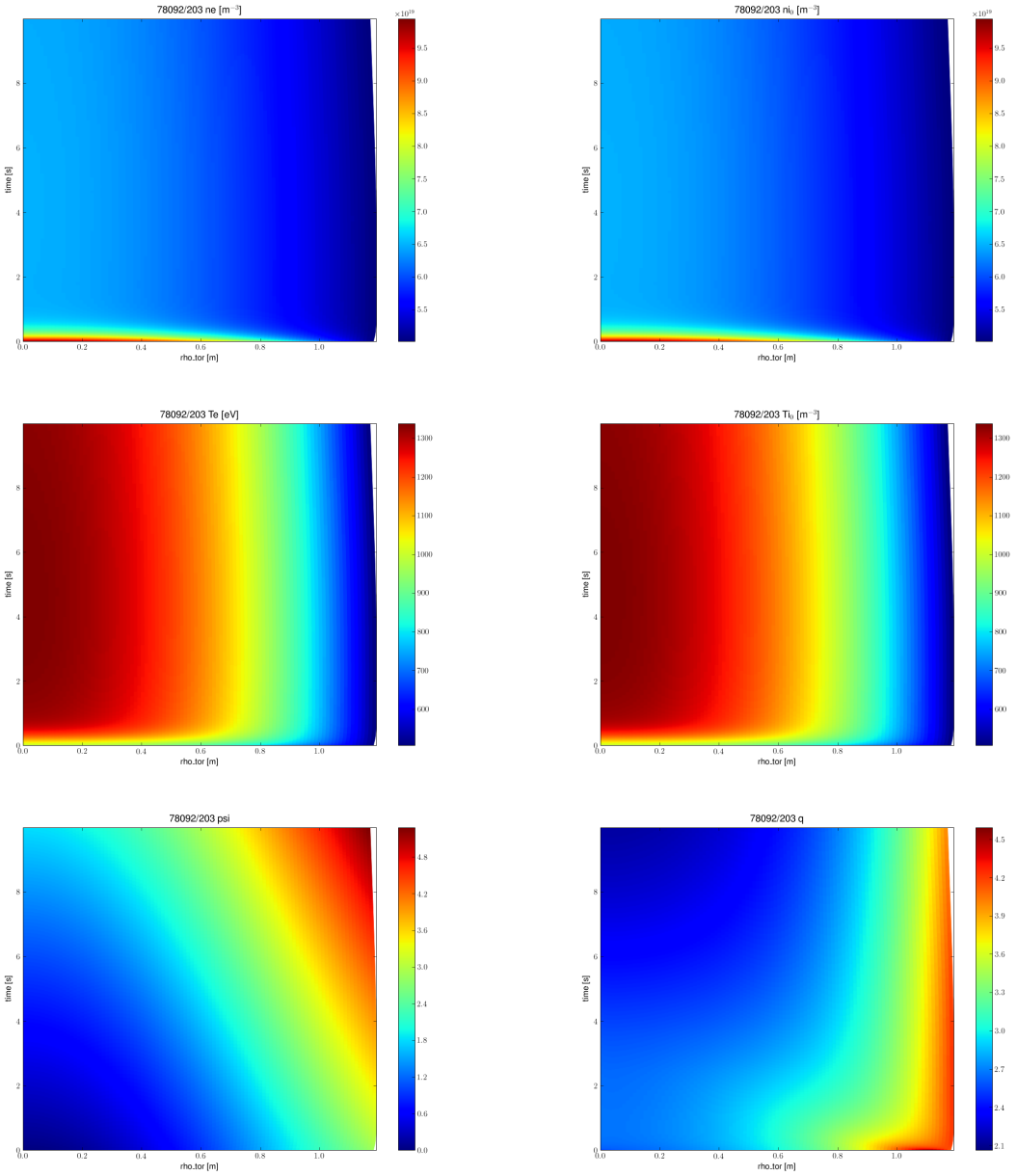

Figure 11: Results of a JET simulation for 78092 (no physics other than the equilibrium!).

I Repository log

Revision	Author	Date	Description
1	dpc	15-04-2008	Create trunk
2	dpc	15-04-2008	Initial check-in from Denis
3	dpc	08-07-2008	Start of a zero-physics Kepler test
4	dpc	30-08-2008	Adding sfmakedepend
5	dpc	30-08-2008	Re-organizing and using sfmakedepend
6	dpc	30-08-2008	Adding libperf.a for Gateway
7	dpc	30-08-2008	Adding libperf for linux.Fujitsu
8	dpc	30-08-2008	Corrected path for svnversion
9	dpc	30-08-2008	Updating version option of the Makefile
10	dpc	04-09-2008	Updated version from e-mail 'ETS copy for repository'
11	dpc	04-09-2008	Updated version from e-mail 'Neutrals for repository'
12	dpc	05-09-2008	Reorganizing ...
13	dpc	05-09-2008	Reorganized
14	dpc	05-09-2008	Output directory for ETS
15	dpc	05-09-2008	More reorganization
16	dpc	05-09-2008	Using the output of the current version on the Gateway as a temporary reference version in data.GW
17	dpc	05-09-2008	Added a README
18	dpc	05-09-2008	Some fixes to remove undefined variables being used, as well as some duplicated '+'s
19	dpc	05-09-2008	Another fix — changed a _DP to d0
20	dpc	14-09-2008	doxygen stuff
21	dpc	15-09-2008	Adding Id keyword
22	dpc	25-09-2008	Change from .f to .f90; update to use (old) coreprof
23	dpc	25-09-2008	Added a comment about copying information from coreprof to eq_in
24	dpc	25-09-2008	Forgot doxygen binary
25	dpc	25-09-2008	removing duplicate call to transport_1
26	dpc	25-09-2008	Found a more recent euitm_schema (4.06d, generated 23/09/2008) at /afs/efda-itm.eu/project/switm/ual/fortraninterface/euitm_schemas.f90
27	dpc	25-09-2008	Use coretransp and coresource
28	dpc	25-09-2008	Collective documentation in src/driver.h
29	dpc	25-09-2008	Added some graphviz stuff
30	dpc	26-09-2008	Trying out callgraphs
31	dpc	26-09-2008	Updated version of doxygen
32	dpc	26-09-2008	Added combine for sources and transport
33	dpc	26-09-2008	rename for sources and transport
34	dpc	26-09-2008	creatimg modules for source, transport and equilibrium
35	dpc	26-09-2008	creatimg modules for source, transport and equilibrium ...
36	dpc	27-09-2008	Updates to Id tags
37	dpc	27-09-2008	Work around for the LaTeX version of the documentation from doxygen

38	dpc	27-09-2008	Updates to Id tags
39	dpc	27-09-2008	Trying out callgraphs
40	dpc	16-11-2008	update doxygen binary
41	dpc	16-11-2008	update doxygen binary
42	dpc	19-01-2009	IMP3 2008 ETS + NEUTRALS
43	dpc	19-01-2009	Resyncing to TAG version MP3_2008/ETS11
44	dpc	19-01-2009	Dummy version of the schemas
45	dpc	19-01-2009	still resyncing
46	dpc	19-01-2009	still resyncing
47	dpc	19-01-2009	Added doxygen info
48	dpc	19-01-2009	Updated doxygen
49	dpc	19-01-2009	plot results
50	dpc	19-01-2009	missed a reference file
51	dpc	19-01-2009	fixing bugs exposed by lahey-fujitsu compiler with debug options
52	dpc	19-01-2009	fixed too long lines
53	dpc	20-01-2009	Changes in the numbering of the output files
54	dpc	20-01-2009	Adding perflib calls + dummy perflib routines
55	dpc	21-01-2009	Testing framework, documentation and some fixes
56	dpc	21-01-2009	Added the ITM schemas to the Doxyfile
57	dpc	21-01-2009	Removing redundant SCHEMAS (content moved to ETS/src/schemas)
58	dpc	21-01-2009	Adding some presentations
59	dpc	22-01-2009	Adding some additional versions of libperf.a
60	dpc	22-01-2009	libperf.a for g95 (64 bit GW version)
61	dpc	22-01-2009	more changes for the perflib stuff (and removing a write statement that was added for debugging)
62	dpc	22-01-2009	Updated README; updates for libperf.a for Intel, Makefile clean option
63	dpc	23-01-2009	Some notes from the 2008 Juelich meeting
64	dpc	23-01-2009	g95 now no longer reports memory left allocated (added deallocation of leaves)
65	dpc	23-01-2009	updating CASES/SUMMARY
66	dpc	24-01-2009	removing extraneoeus neutrals.tmp
67	dpc	24-01-2009	Added some "svn:ignore"s so that svn status produces a more relevant list
68	dpc	24-01-2009	More changes to the embedded doxygen documentation
69	dpc	26-01-2009	changes for doxygen documentation
70	dpc	26-01-2009	Some fixes for the nag compiler
71	dpc	26-01-2009	Some fixes for the nag compiler
72	dpc	27-01-2009	Configuration for JET
73	dpc	27-01-2009	Adding a STATUS file
74	dpc	27-01-2009	Fixing version entry in the Makefile
75	dpc	27-01-2009	STATUS for JET
76	dpc	27-01-2009	More changes for STATUS
77	dpc	27-01-2009	More changes for STATUS

78	dpc	27-01-2009	STATUS for JET
79	dpc	27-01-2009	Updates of STATUS
80	dpc	27-01-2009	STATUS for JET
81	dpc	27-01-2009	More changes for STATUS
82	dpc	27-01-2009	Updates of STATUS
83	dpc	27-01-2009	Updates of STATUS
84	dpc	27-01-2009	Fixes to make the Nag compiler happy (mostly changing 'OUT' to 'IN-OUT' at key places)
85	dpc	27-01-2009	Updates of STATUS
86	dpc	28-01-2009	Added itm_types and itm_constants; standardized real numbers using _R8 (might have missed some); changed the 'right' answer to reflect the changes in constants
87	dpc	28-01-2009	More re-indentation, doxygen authors (sometimes guessed)
88	dpc	29-01-2009	Removed some extraneous interface blocks; replaced some specific functions with their generic equivalent
89	dpc	04-02-2009	Moved doxygen documentation into subdir of doc; added equations to the relevant fortran source files
90	dpc	04-02-2009	LaTeX version of the 'ETS Transport Equations' and a description of the 'Standardised Equation' taken from 'https://solps-mdsplus.aug.ipp.mpg.de/repos/IMP3/ETS/2008-12-31_State_of_the_Equations/tex' rev 40
91	dpc	04-02-2009	Adding Makefile for LaTeX documentation
92	coster	04-02-2009	Changed README to reflect the change of SVN server
93	coster	04-02-2009	Fixed some 'underset's in the docs
94	coster	09-02-2009	Code from Guido Huysmans 2009-02-09
95	coster	10-02-2009	Switching to xml input
96	coster	10-02-2009	missed an 'implicit none'
97	coster	10-02-2009	Switch to gforge for xmllib
98	coster	10-02-2009	Need a fix in the makefile associated with the switch to gforge for the status option
99	coster	10-02-2009	Update of STATUS
100	coster	10-02-2009	32 bit g95 & gfortran
101	coster	11-02-2009	Updating status
102	coster	11-02-2009	Fixing memory leak
103	coster	11-02-2009	Updating STATUS
104	coster	11-02-2009	Updating status
105	coster	13-02-2009	Change pinch velocity to 0 — otherwise we have a possible problem with the core b.c.
106	coster	13-02-2009	Update the reference results to be compatible with the change in the pinch velocity
107	coster	13-02-2009	Plotting for solver "4" (= solver "1" but with splines)
108	coster	14-02-2009	README for compiling Guido's GTS + his plot routines so that his code can be compiled
109	coster	14-02-2009	Implementing solver 4 (= solver 1 but with splines)
110	coster	14-02-2009	Updates of results including solver 4
111	coster	16-02-2009	Latest version from Guido

112	coster	16-02-2009	Change default system to GW
113	coster	16-02-2009	Update README to reflect change in default system
114	coster	17-02-2009	Update from Guido (2009-02-17)
115	coster	17-02-2009	Adding GTS solver (still in test)
116	coster	17-02-2009	blas & lapack
117	coster	17-02-2009	blas & lapack for other configurations
118	coster	20-02-2009	Switched to itmshare repository version of itm_types and itm_constants; still using half cell adjustment of 1st cell
119	coster	20-02-2009	Switched to itmshare repository version of itm_types and itm_constants; still using half cell adjustment of 1st cell
120	coster	20-02-2009	Updating compare.ps
121	coster	20-02-2009	With 2/3 & 5/3 at full precision in main_plasma.f90
122	coster	20-02-2009	Update the reference results (for the 2/3, 5/3 full precision change)
123	coster	23-02-2009	fix some type mismatches
124	coster	26-02-2009	Testing framework for indivudual solvers: run with, e.g. ./TEST.3/run
125	coster	26-02-2009	Rename for windows svn
126	coster	28-02-2009	Origin now at rho=0; updated solvers; updated reference answer; updated analysis in CASES for L2 norm
127	coster	28-02-2009	Update some svn:ignore's

128	coster	28-02-2009	Several problems picked up by the Lahey-Fujitsu compiler running with debugging enabled. Some have been "fixed" — see lines of code with "!DPC 2009-02-28" ——— solver2 ——— The array size of dummy argument 2 is greater than the usable size of the actual array (actual argument h: 1600 bytes, dummy argument h: 1608 bytes). Error occurs at or near line 309 of solut3_ Called from or near line 268 of solver_ritm_integral_ Called from or near line 139 of solution2_ Called from or near line 56 of solution_interface_ Called from or near line 504 of current_ Called from or near line 70 of main_plasma_ Called from or near line 114 of ets.itm_ets_ Called from or near line 190 of MAIN__ ——— The variable (h(200)) has an undefined value. Error occurs at or near line 337 of solut3_ Called from or near line 268 of solver_ritm_integral_ Called from or near line 139 of solution2_ Called from or near line 56 of solution_interface_ Called from or near line 504 of current_ Called from or near line 70 of main_plasma_ Called from or near line 114 of ets.itm_ets_ Called from or near line 190 of MAIN__ ——— ——— In DLOG(dx) or LOG(dx) or DLOG10(dx) or LOG10(dx) or DLOG2(dx) or LOG2(dx), dx.le.0.0 (dx=-0.4903071768573341d+02). Error occurs at or near line 147 of plasma_collisions_ Called from or near line 1352 of temperatures_ Called from or near line 88 of main_plasma_ Called from or near line 114 of ets.itm_ets_ Called from or near line 190 of MAIN__ ——— solver6 ——— The variable (time) has an undefined value. Error occurs at or near line 121 of solution6_ Called from or near line 65 of solution_interface_ Called from or near line 504 of current_ Called from or near line 70 of main_plasma_ Called from or near line 114 of ets.itm_ets_ Called from or near line 190 of MAIN__ ——— In DLOG(dx) or LOG(dx) or DLOG10(dx) or LOG10(dx) or DLOG2(dx) or LOG2(dx), dx.le.0.0 (dx= 0.0000000000000000d+00). Error occurs at or near line 146 of plasma_collisions_ Called from or near line 1352 of temperatures_ Called from or near line 88 of main_plasma_ Called from or near line 114 of ets.itm_ets_ Called from or near line 190 of MAIN__ ——— Both solvers now fail when the log of a non-positive quantity is evaluared.
129	coster	01-03-2009	Reorganization of ETS to create relevant libraries; reorganization of coster branch to make use of ETS libraries in the future
130	coster	01-03-2009	Missed a file ...
131	coster	18-03-2009	Work around for FC2K problems
132	coster	18-03-2009	1d equilibrium from Bruce Scott
133	huynh	19-03-2009	add the ITM cronos solver COS
134	huynh	19-03-2009	correction
135	huynh	19-03-2009	missing files
136	huynh	19-03-2009	correction
137	coster	20-03-2009	Introduced GW_UAL which uses the UAL for writing out the CPOs
138	coster	20-03-2009	Fix for MOD files
139	coster	20-03-2009	Making it clearer when the Makefile is running the code
140	coster	20-03-2009	Update README

141	coster	22-03-2009	Solvers 7 and 8 (in src/solvers/solution7.f90)
142	coster	22-03-2009	expose CONTROL_DOUBLE(5) to the outside (currently retaining control structure internally)
143	coster	22-03-2009	FC2K workaround for main ets routine
144	coster	22-03-2009	made a library of bdseq (compiles, but not yet checked to make sure that it works)
145	coster	22-03-2009	Fixes to solution7 & bdseq to make the gfortran compiler happy
146	coster	22-03-2009	Fixes to bdseq to make the g95 compiler happy
147	coster	23-03-2009	Documented FC2K callable routines
148	coster	23-03-2009	Setting properties on the src
149	coster	23-03-2009	Added target KEPLER in the Makefile to rebuild actors
150	coster	23-03-2009	Coupling to the equilibrium
151	coster	23-03-2009	Test framework for equilibrium
152	coster	23-03-2009	Fix editing error
153	coster	23-03-2009	Fix to src/bdseq/bdseq.f90 from BDS; fix to Makefile
154	coster	23-03-2009	taken on some additions from BDS + some minor fixes/additions
155	huynh	24-03-2009	correction
156	huynh	24-03-2009	add check actor
157	coster	24-03-2009	Moved the allocation of output CPOs from the wrapper into the called routines
158	coster	24-03-2009	codeparam%output_diag not set
159	coster	24-03-2009	fixes so that bdseq can be called more than once
160	coster	25-03-2009	Clean up some comments, include a 'help' option for the Makefile
161	huynh	27-03-2009	add management of the data storage
162	huynh	27-03-2009	some modification due to the data storage
163	coster	28-03-2009	Adding neo and helena2 from branches/COS
164	coster	28-03-2009	A line in the Makefile went AWOL
165	coster	28-03-2009	Disable some output in helena, add some output in eq_test
166	coster	28-03-2009	More changes dealing with helena
167	coster	28-03-2009	fixes for etags, backslash processing
168	coster	28-03-2009	Include .f and .F in the Doxygen documentation
169	coster	28-03-2009	new doxygen binary, reformat solution7 to make doxygen happier
170	coster	28-03-2009	Fix assignment to unallocated variable in helena
171	coster	29-03-2009	for versioning
172	coster	29-03-2009	More wrok on getting the version number handled automatically
173	coster	29-03-2009	More wrok on getting the version number handled automatically
174	coster	29-03-2009	More work on getting the version number handled automatically
175	coster	29-03-2009	Use the UAL routine for deallocating CPOs
176	coster	31-03-2009	Creating some service subroutines/actors
177	coster	31-03-2009	Two service routines to be turned into actors
178	coster	31-03-2009	service test framework
179	coster	31-03-2009	Creating some dummy subroutines/actors
180	coster	31-03-2009	Creating some dummy subroutines/actors

181	coster	31-03-2009	service test framework
182	coster	01-04-2009	service test framework
183	coster	03-04-2009	service updates; bdseq updates
184	coster	03-04-2009	missing area
185	huynh	08-04-2009	correction path
186	coster	09-04-2009	Fix regression
187	huynh	09-04-2009	missing file
188	huynh	09-04-2009	add boundary condition in cpo
189	huynh	09-04-2009	structure memoire pour zneo
190	huynh	09-04-2009	lancement de zneo en interne
191	coster	10-04-2009	more comparisons between helena and bdseq
192	coster	10-04-2009	more comparisons between helena and bdseq
193	coster	13-04-2009	temporary fix for NaN problem '[ets Bugs Item #24]' — should be checked
194	huynh	14-04-2009	add xmllib
195	huynh	14-04-2009	add xmllib
196	huynh	14-04-2009	add xmllib
197	huynh	14-04-2009	add xmllib
198	huynh	14-04-2009	add xmllib
199	huynh	14-04-2009	add boundary conditions
200	coster	15-04-2009	Start using Christian Konz's copy_structures.copy_cpo routine
201	coster	15-04-2009	Trying to get the two versions of helena to co-exist
202	coster	16-04-2009	More work on the equilibrium side
203	coster	16-04-2009	Plotting the right stuff
204	coster	16-04-2009	Removing NaNs from helena output (temporary until helena functions)
205	coster	16-04-2009	Caught a too long line
206	coster	16-04-2009	Conditional Makefile for helena
207	coster	16-04-2009	Default to helena2
208	coster	16-04-2009	helena xml files
209	huynh	17-04-2009	update
210	huynh	17-04-2009	update before new definition gm8 gm9
211	huynh	17-04-2009	update before new definition gm8 gm9
212	huynh	17-04-2009	update before new definition gm8 gm9script.m
213	huynh	17-04-2009	update before new definition gm8 gm9script.m
214	huynh	17-04-2009	update before new definition gm8 gm9lancetest.m
215	huynh	17-04-2009	update before new definition gm8 gm9
216	huynh	17-04-2009	update before new definition gm8 gm9
217	huynh	17-04-2009	update
218	huynh	17-04-2009	update
219	huynh	17-04-2009	update
220	huynh	17-04-2009	add boundary conditions
221	coster	18-04-2009	Some plots for helena
222	coster	18-04-2009	Slight reordering in Makefile; also update clean option

223	coster	30-04-2009	Plotting using the python ual interface
224	coster	01-05-2009	Update because of xmllib relocation
225	coster	01-05-2009	Default to helena2
226	coster	03-05-2009	Analyse performance of UAL
227	coster	03-05-2009	More plots
228	coster	03-05-2009	Latest full analysis
229	coster	05-05-2009	ikind changed to itm_i4
230	coster	07-05-2009	UAL option for eq_test + more diagnostic output for testing Kepler
231	coster	07-05-2009	Plotting tools
232	coster	07-05-2009	Update plotting tools
233	coster	07-05-2009	Update plotting tools
234	coster	07-05-2009	Update plotting tools
235	coster	07-05-2009	Update plotting tools
236	coster	14-05-2009	changes to python interface
237	coster	22-05-2009	Fix [ets Bugs Item #31] reported by Guido Huysmans
238	coster	22-05-2009	Updated results for solver 6 (GTS)
239	coster	22-05-2009	Updates of diagnostics, solvers, equilibrium
240	coster	22-05-2009	svn:ignore updates
241	coster	22-05-2009	euitm_close now only takes 1 argument according to the documentation
242	coster	22-05-2009	condition the include for astra equilibrium
243	coster	23-05-2009	Added some missing output (transport coefficients, ...)
244	coster	23-05-2009	Reorganize 'INCLUDE's
245	coster	23-05-2009	Added a local UAL version (with the necessary UAL routines)
246	coster	23-05-2009	Fixing a change to the ETS input file
247	coster	23-05-2009	Add verbosity flag to euitm_routines.f90
248	coster	24-05-2009	Shorten some too long lines
249	coster	24-05-2009	Configuration with locally compiled UAL for the Gateway
250	coster	25-05-2009	Getting ETS on the GRID
251	coster	25-05-2009	More GRID stuff
252	coster	25-05-2009	More GRID stuff
253	coster	25-05-2009	Cleaning up some GRID stuff
254	coster	26-05-2009	Updating the GRID README
255	coster	26-05-2009	extend bdseq to take un-normalized rho_tor as input
256	huynh	29-05-2009	reverification du code apres passage 4.07a et conditions aux limites
257	coster	29-05-2009	Copy of the ETS before the change to 4.07a
258	coster	29-05-2009	Copy of the ETS before the change to 4.07a
259	coster	29-05-2009	Update for solver 7 (branch 4.06d)
260	coster	29-05-2009	Update for solver 7
261	coster	29-05-2009	Converted to UAL version 4.07a (4.06d version now a branch)
262	coster	29-05-2009	Missed a few pieces ...
263	coster	30-05-2009	Configuration files for AIX
264	coster	30-05-2009	Configuration for Lahey-Fujitsi compiler using UAL
265	coster	30-05-2009	UAL (local) version for g95 on the Gateway

266	coster	01-06-2009	Work around for the old version of TeX on the Gateway
267	coster	01-06-2009	Work around for the old version of TeX on the Gateway
268	coster	01-06-2009	Update to Doxyfile
269	coster	01-06-2009	removing extra printouts in ual_low_level_f77.c; others for switch to 4.07a; update to Doxyfile
270	coster	02-06-2009	Added '-traditional' to CPP definition in the Makefile
271	coster	02-06-2009	Added '-traditional' to CPP definition in the Makefile
272	coster	03-06-2009	Additional diagnostic information
273	coster	04-06-2009	Use 3rd order Lagrangian interpolation instead of linear interpolation in bdseq
274	coster	04-06-2009	Add g95_UAL.local
275	basiuk	25-06-2009	filling safety factor in equilibrium
276	basiuk	25-06-2009	filling safety factor in equilibrium
277	basiuk	25-06-2009	load the input cronos just before zsolver1t with a dt=0.01 s
278	basiuk	25-06-2009	load the input cronos just before zsolver1t with a dt=0.01 s
279	basiuk	25-06-2009	obsolete
280	basiuk	25-06-2009	load the input cronos just before zsolver1t with a dt=0.01 s
281	basiuk	25-06-2009	adding smoothing derivative such as in CRONOS
282	basiuk	25-06-2009	adding smoothing derivative such as in CRONOS
283	basiuk	25-06-2009	q from equilibrium instead of coreprof
284	basiuk	25-06-2009	update
285	huynh	25-06-2009	update boundary conditions
286	huynh	25-06-2009	add pchip interpolation
287	huynh	25-06-2009	add pchip interpolation
288	huynh	25-06-2009	update boundary conditions
289	huynh	25-06-2009	add pchip interpolation
290	huynh	25-06-2009	add pchip interpolation
291	huynh	26-06-2009	update
292	basiuk	26-06-2009	update
293	basiuk	26-06-2009	change central value
294	huynh	26-06-2009	small changes
295	basiuk	29-06-2009	ion density deduced from data.impur
296	basiuk	29-06-2009	modification of ni
297	basiuk	29-06-2009	upgrade
298	basiuk	29-06-2009	correction bug
299	basiuk	29-06-2009	correction bug
300	basiuk	30-06-2009	add jboot
301	basiuk	30-06-2009	add jboot
302	basiuk	30-06-2009	add jboot
303	huynh	30-06-2009	add jboot
304	basiuk	30-06-2009	add jboot
305	basiuk	30-06-2009	add jboot
306	huynh	30-06-2009	add jboot

307	basiuk	30-06-2009	smoothing the central value for sigma
308	basiuk	30-06-2009	smoothing the central value for sigma
309	basiuk	30-06-2009	smoothing the central value for sigma
310	basiuk	30-06-2009	smoothing the central value for sigma
311	basiuk	30-06-2009	smoothing the central value for sigma
312	huynh	01-07-2009	Mahefile modification
313	huynh	01-07-2009	Mahefile modification
314	huynh	01-07-2009	add equi
315	huynh	02-07-2009	change makefile
316	huynh	02-07-2009	change makefile
317	huynh	02-07-2009	change makefile
318	coster	13-07-2009	Preparing for equilibrium coupling case — standard case results still unchanged
319	coster	13-07-2009	forgot the new input files
320	coster	13-07-2009	more updates (standard case still OK)
321	coster	13-07-2009	taking over solver 7 from Kalupin (standard case still OK)
322	coster	13-07-2009	taking over eq_ets routines from Kalupin (standard case still OK)
323	coster	13-07-2009	further updates for eq_ets routines from Kalupin (standard case still OK)
324	coster	14-07-2009	Adding ASTRA equilibrium module
325	coster	14-07-2009	Correct schema
326	coster	14-07-2009	eq_ets_test with output via UAL
327	coster	14-07-2009	Lahey-Fujitsu debug version
328	coster	14-07-2009	Killing a memory leak
329	coster	15-07-2009	Remove zero length file
330	coster	16-07-2009	Some more documentation
331	coster	16-07-2009	Setting things up to use the UAL away from the Gateway
332	coster	16-07-2009	dynamic memory allocation in the equilibrium solver
333	coster	16-07-2009	4.07a
334	basiuk	17-07-2009	add a_minor
335	basiuk	17-07-2009	add a_minor
336	basiuk	17-07-2009	add a_minor
337	coster	17-07-2009	Try to get eq_test running again ...
338	coster	18-07-2009	Cater for the case where the output CPO has not been allocated
339	basiuk	21-07-2009	update helena
340	coster	23-07-2009	Some cleanups and some work-arounds
341	coster	24-07-2009	Switch from mag_axis to toroid_field structures for R0 and B0
342	coster	27-07-2009	updates of the UAL routines
343	huynh	28-07-2009	take Ajj in the computation of Bjj
344	coster	28-07-2009	Update TEST cases; fix problem with uninitialized variable in solver 6
345	huynh	29-07-2009	update
346	coster	30-07-2009	plotting; README
347	coster	30-07-2009	more output in CPO; more plotting
348	coster	01-08-2009	Amendments to plotting

349	coster	06-08-2009	minor updates to python scripts
350	coster	06-08-2009	more output in eq_ets_test; change initial shot/run for eq_ets_test to 4/1; allow for cylindrical case in eq_ets_test by setting neq=0
351	coster	07-08-2009	more plots
352	coster	07-08-2009	some fixes for: vpr¡0; psi_dy(nrho) taken from dy(nrho) rather than the calculation
353	coster	07-08-2009	revert change to eq_ets.xml
354	coster	07-08-2009	Comment out some profiling that overflowed the counters
355	coster	07-08-2009	tidying up TEST.?/
356	coster	08-08-2009	Minor fixes to the equilibrium codes
357	coster	11-08-2009	fix the total current rather than the current density; gm2 was wrong
358	coster	11-08-2009	refine the convergence criteria (preventing a possible problem when vtor=0)
359	coster	11-08-2009	added a TODO; fixed problem with convergence check
360	coster	11-08-2009	Added tau_out
361	coster	11-08-2009	Added tau_out
362	coster	11-08-2009	fixed missing pi in resistivity calculation (D(IRHO) in CURRENT); added an experimental extrapolation of psi to centre of plasma (otherwise 1st two points have the same psi value)
363	coster	13-08-2009	scan for NRHO and DT for eq_ets_test
364	coster	13-08-2009	forgot the schema
365	coster	13-08-2009	Renaming the ASTRA equilibrium solver to EMEQ (historically correct); added a limit to the number of iterations in equilibrium_emeq
366	coster	17-08-2009	output times flag; scan over solvers
367	coster	17-08-2009	update to reflect bug fix in main_plasma (current)[r362]
368	coster	17-08-2009	simple plots if no time dependence
369	coster	17-08-2009	tau_out option
370	coster	17-08-2009	update to bring back into operation
371	coster	17-08-2009	comparisons
372	coster	19-08-2009	change from *_schema.xml to *.xsd; update eq test case; introduce flag for indicating time dependent sources/transport input for eq_ets_test
373	coster	19-08-2009	more output for equilibrium test case
374	coster	19-08-2009	more for the equilibrium test case
375	coster	19-08-2009	ifort on 64 bit systems
376	coster	19-08-2009	more plots
377	coster	20-08-2009	make way for the latest version of bdseq
378	coster	26-08-2009	clean up: changes in the equilibrium interface should be checked
379	coster	19-09-2009	Major update: if you run into problems go back to the previous revision! Updates for shaped plasma (RHON!=2.0), multiple ion species, external transport modules, documentation of switches in eq_ets.xml, and probably some that I have forgotten
380	coster	19-09-2009	Update documentation to include INDEX from the UAL storage area
381	coster	19-09-2009	Fix too long lines
382	coster	19-09-2009	More architectures

383	coster	20-09-2009	Change from RHO to AMID in EMEQ interface — trying to treat non-circular cases properly
384	coster	20-09-2009	Update case list
385	coster	22-09-2009	Start of an User Guide for the ETS
386	coster	22-09-2009	Various modules from Christian Konz (itmshared/branches)
387	coster	22-09-2009	Trying to get a version of eq_ets_test to work without the UAL
388	coster	22-09-2009	Continuing to try to get a version of eq_ets_test to run without the UAL
389	basiuk	25-09-2009	add rho2rho
390	basiuk	25-09-2009	add rho2rho
391	basiuk	25-09-2009	update helena
392	basiuk	25-09-2009	update file generation
393	basiuk	25-09-2009	update file generation
394	basiuk	25-09-2009	add rho2rho
395	basiuk	25-09-2009	add rho2rho
396	coster	25-09-2009	re-enable the convergence loop in the analytic solver test
397	basiuk	25-09-2009	update
398	huynh	25-09-2009	update
399	huynh	25-09-2009	update
400	basiuk	28-09-2009	new shot
401	coster	01-10-2009	version used for ICNSP-2009
402	coster	03-10-2009	Some ETS test cases
403	coster	03-10-2009	ascii version of the starting CPOs
404	coster	03-10-2009	Missing files ...
405	coster	03-10-2009	correct for negative volumes on axis arising from interpolation
406	coster	03-10-2009	fix problem caused by a lack of a SAVE
407	coster	03-10-2009	cleaning up deallocate
408	coster	03-10-2009	fix memory leaks
409	coster	04-10-2009	fix memory leaks
410	coster	04-10-2009	missing use statement
411	coster	04-10-2009	HPCFF configuration
412	coster	04-10-2009	HPCFF configuration
413	basiuk	05-10-2009	compute elongation and correct gm8 and gm9
414	basiuk	05-10-2009	dencut and C_DEN should be equal
415	huynh	05-10-2009	update
416	huynh	06-10-2009	bug sur rho_tor_norm
417	huynh	06-10-2009	new entry file
418	huynh	06-10-2009	new entry file
419	huynh	06-10-2009	update
420	huynh	06-10-2009	suppress time
421	huynh	06-10-2009	suppress time
422	huynh	06-10-2009	suppress time
423	coster	13-10-2009	removing local copy of itm_shared
424	huynh	15-10-2009	update before ETS meeting

425	huynh	15-10-2009	update before ETS meeting
426	huynh	15-10-2009	update before ETS meeting
427	huynh	15-10-2009	update before ETS meeting
428	huynh	15-10-2009	update before ETS meeting
429	huynh	15-10-2009	update before ETS meeting
430	huynh	15-10-2009	update before ETS meeting
431	huynh	15-10-2009	update before ETS meeting
432	huynh	15-10-2009	update before ETS meeting
433	huynh	15-10-2009	update before ETS meeting
434	huynh	15-10-2009	update before ETS meeting
435	huynh	15-10-2009	update before ETS meeting
436	coster	19-10-2009	ICNSP talk
437	coster	20-10-2009	duplicate of the version in itm_shared
438	huynh	20-10-2009	fix problem for equilibrium
439	coster	21-10-2009	updating to 4.07b
440	coster	21-10-2009	switching to 4.07b
441	huynh	21-10-2009	fix interface problem
442	huynh	21-10-2009	deallocate local variable flux_surface
443	huynh	21-10-2009	new actor for initialization of temporary cpo
444	huynh	21-10-2009	add actor which swap time slice between cpo
445	huynh	21-10-2009	update solver:jtot,suppress zconversion,add cos_proftime,modify boundary conditions
446	huynh	21-10-2009	bug in the unit of the pressure
447	huynh	21-10-2009	increase the resolution at the central point
448	huynh	21-10-2009	bug in filling bvac:missing value for time slice bigger than 1
449	coster	22-10-2009	new plotting options
450	huynh	22-10-2009	obsolete
451	huynh	22-10-2009	suppress
452	huynh	22-10-2009	update
453	huynh	22-10-2009	add libutil
454	huynh	22-10-2009	obsolete
455	huynh	22-10-2009	obsolete
456	huynh	22-10-2009	create output for validation
457	huynh	22-10-2009	update
458	coster	22-10-2009	updating to the new treatment of input XML and XSD
459	basiuk	23-10-2009	add cossolver in the ETS structure for testing a solver
460	basiuk	23-10-2009	cossolver for current diffusion only for the moment, same input as ETS
461	basiuk	23-10-2009	needed by cossolver
462	basiuk	23-10-2009	compile COS solver
463	coster	27-10-2009	Change to pick up a different default MUMPS_BASE from the one previously specified that was in a read protected area
464	coster	28-10-2009	new wrappers for code_parameters
465	coster	28-10-2009	update patches

466	coster	29-10-2009	Bringing in additions from Denis
467	coster	29-10-2009	xml and xsd files
468	coster	29-10-2009	updated Makefile
469	coster	29-10-2009	add an option to use helena
470	coster	29-10-2009	add an option to use bdseq
471	coster	29-10-2009	Should now run with bdseq and helena in addition to emeq
472	coster	30-10-2009	Add ifdef's to prevent the lack of MUMPS stopping compilation
473	coster	03-11-2009	some changes for g95
474	coster	03-11-2009	some changes for COS Solver
475	coster	03-11-2009	some changes for g95
476	coster	03-11-2009	more conditionals for: lack of mumps; loack of helena
477	coster	05-11-2009	Cased with differing equilibrium codes
478	coster	07-11-2009	still trying to get all equilibrium cases working
479	coster	07-11-2009	update patch for bdseq
480	coster	07-11-2009	update patch for bdseq
481	coster	11-11-2009	with external sources and transport
482	coster	11-11-2009	fix for non-UAL version of eq_ets_test; remove some memory leaks
483	coster	11-11-2009	forgot etaigb sechema and xml in the case directory
484	coster	11-11-2009	more fixes for the combiners
485	coster	11-11-2009	changing properties
486	coster	11-11-2009	version with external transport and sources should now be working
487	coster	13-11-2009	untested fix for helena coupling (for Konz)
488	coster	19-11-2009	update svn:ignore entries for some of the cases
489	coster	19-11-2009	added a comment to helena.xml
490	coster	19-11-2009	update list of cases
491	coster	19-11-2009	update list of cases
492	coster	24-11-2009	Status document
493	coster	01-02-2010	catching up with the UAL
494	coster	01-02-2010	call assign_code_parameters
495	coster	16-02-2010	to cope with case insensitive filesystems
496	coster	25-02-2010	fix to make sure we write out the same number of equilibrium%codeparam%output_flag's as slices (missed it on the initial state)
497	coster	05-03-2010	Plotting routines from George Breyiannis for visualizing the data in eq_ets_data
498	coster	08-03-2010	Improved plotting routines to deal with slices; improved documentation
499	coster	08-03-2010	Plotting routines from Denis Kalupin
500	huynh	08-03-2010	obsolete
501	huynh	08-03-2010	result of cronos
502	coster	08-03-2010	Cleaning up the input files for case_5_44
503	coster	08-03-2010	Cleaning up the input files for case_5_45
504	coster	08-03-2010	Cleaning up the input files for case_5_46
505	coster	09-03-2010	plot script from Denis
506	coster	09-03-2010	Update of nrho to get the case to work

507	coster	09-03-2010	work around problems with plotting the equilibrium for eq_ets_runs
508	coster	09-03-2010	removing unnecessary files
509	coster	09-03-2010	updates of size of boundary specification
510	coster	09-03-2010	Added sizecpo and printcpo
511	coster	09-03-2010	close the surface
512	coster	09-03-2010	patch for the release version of bdseq
513	coster	09-03-2010	entry for patching bdseq (patch_bdseq)
514	coster	09-03-2010	fix the scan labels
515	coster	09-03-2010	Documentation update
516	coster	10-03-2010	correct patch to patches
517	coster	10-03-2010	reintroduce ugly hack to bdseq wrapper because bdseq produces too much information compared to the other equilibrium codes
518	coster	10-03-2010	program for CPO sizes
519	coster	11-03-2010	clean up eq_ets.xml
520	coster	12-03-2010	replace the horrible hack in src/test/ets_wrapper_bdseq.f90 with a more elegant one in src/test/eq_ets_test.F90 (so that the intial equilibrium slice has the same structure as the later ones)
521	coster	12-03-2010	update from DK
522	coster	12-03-2010	fix in etsslice.py for zion; print output filename
523	coster	12-03-2010	Close the equilibrium plots
524	coster	15-03-2010	updating doxygen version
525	coster	24-03-2010	change in the logic of the combiner routines so that a '0' flag indicates that the data is not added — this fixes a problem with the output from neutrals which was returning NaN which remained a NaN even after multiplying it by 0.0
526	coster	24-03-2010	switch off the contribution from neutrals in source_combiner.xml — there seems to be a problem with it returning NaN
527	coster	24-03-2010	test case for IMP5 (D,T,He-3,He-4)
528	coster	31-03-2010	add chease to testing framework; update XML for helena; optimize for config/GW_UAL
529	coster	31-03-2010	relax constraints for helena
530	coster	31-03-2010	adding 4.07a branch
531	coster	31-03-2010	4.07b branch created before transitioning to 4.07c
532	coster	06-04-2010	python programs (in development) for writing CPOs
533	coster	27-04-2010	4.07c branch created before transitioning to 4.08a
534	coster	27-04-2010	cleanup and add zn & zeff for imp5
535	coster	27-04-2010	cleanup and add zn & zeff for imp5
536	coster	27-04-2010	setting up for 4.08a
537	coster	30-04-2010	module to add psi_RZ to the equilibrium CPO
538	coster	30-04-2010	added option to augment the equilibrium output with psi, br, bz, bphi (R,Z)
539	coster	03-05-2010	adding examples
540	coster	04-05-2010	setting up a separate area for example cases
541	coster	04-05-2010	setting up a separate area for example cases; also moving gnuplot scripts to GNUPLOT/

542	coster	04-05-2010	setting up a separate area for example cases
543	coster	04-05-2010	setting up a separate area for example cases
544	coster	04-05-2010	Setting up ETS_Examples in branches
545	coster	04-05-2010	Setting up ETS_Examples in branches
546	coster	04-05-2010	Adding READMEs for the ETS Examples
547	coster	12-05-2010	add a missing link ...
548	coster	12-05-2010	fix BCs
549	figueire	12-05-2010	
550	figueire	12-05-2010	
551	figueire	12-05-2010	
552	figueire	12-05-2010	
553	figueire	12-05-2010	
554	figueire	15-05-2010	
555	figueire	15-05-2010	
556	huynh	18-05-2010	add libutil
557	huynh	18-05-2010	update
558	huynh	18-05-2010	more cpo signal output
559	huynh	18-05-2010	add libutil
560	huynh	18-05-2010	update
561	huynh	18-05-2010	add libutil
562	huynh	18-05-2010	obsolete
563	huynh	18-05-2010	add libutil
564	huynh	18-05-2010	obsolete
565	huynh	18-05-2010	update
566	huynh	18-05-2010	update
567	huynh	18-05-2010	update
568	huynh	18-05-2010	move to LIBUTIL
569	huynh	18-05-2010	remove write
570	huynh	18-05-2010	add cpo signals
571	huynh	18-05-2010	obsolete
572	figueire	22-05-2010	
573	figueire	23-05-2010	
574	figueire	24-05-2010	
575	figueire	24-05-2010	
576	figueire	24-05-2010	
577	coster	24-05-2010	4.08a version of the model tree
578	figueire	25-05-2010	
579	figueire	02-06-2010	
580	coster	03-06-2010	Fixes as per e-mail from Antnio Figueiredo
581	huynh	03-06-2010	solve the ual problem
582	huynh	03-06-2010	solve the ual problem
583	basiuk	03-06-2010	suppress fort file and reduce tend
584	basiuk	03-06-2010	bug time solved

585	basiuk	03-06-2010	fix the time bug of equi
586	basiuk	03-06-2010	change saving rule of equi
587	basiuk	03-06-2010	change saving rule of equi
588	basiuk	04-06-2010	MatLab access to CPO
589	huynh	04-06-2010	few changes
590	basiuk	14-06-2010	add more equilibrium cpo signals
591	huynh	14-06-2010	fix a bug: bad dimension of phi
592	huynh	14-06-2010	fix a bug: missing equilibrium signals
593	figueire	28-06-2010	
594	figueire	29-06-2010	
595	figueire	29-06-2010	
596	figueire	29-06-2010	
597	figueire	29-06-2010	
598	coster	29-06-2010	additions from Denis for JET case (if you run into problems revert to previous version and report to DPC)
599	figueire	30-06-2010	
600	figueire	30-06-2010	
601	figueire	30-06-2010	
602	figueire	01-07-2010	
603	coster	07-07-2010	fix transpose problem
604	figueire	09-07-2010	
605	coster	10-07-2010	adding output in emeq
606	figueire	10-07-2010	
607	figueire	10-07-2010	
608	coster	11-07-2010	plotting updates; allow for restarts from previous runs
609	kalupin	12-07-2010	initial
610	figueire	12-07-2010	
611	stankiew	12-07-2010	initial
612	ivanova	12-07-2010	initial
613	ferreira	12-07-2010	ETS_jet : testing exp2itm for JET data, and ETS soft start
614	ferreira	12-07-2010	ETS_jet
615	huynh	12-07-2010	add time for neo cpo
616	ferreira	12-07-2010	ok, adding stuff to ETS_jet this time
617	ferreira	12-07-2010	+ NEUTRALS
618	galk	12-07-2010	a test
619	figueire	12-07-2010	
620	huynh	12-07-2010	wrapper for kepler
621	huynh	12-07-2010	wrapper for kepler
622	coster	12-07-2010	fix equilibrum –¿ equilibrium
623	coster	12-07-2010	Add talk based on the EPS 2010 poster by Basiuk, Huynh et al
624	figueire	13-07-2010	
625	kalupin	13-07-2010	remove yesterday's version
626	kalupin	13-07-2010	ETS V&V version

627	kalupin	13-07-2010	ETS V&V version
628	huynh	13-07-2010	comment
629	huynh	13-07-2010	document
630	figueire	14-07-2010	
631	coster	14-07-2010	missed an equilibrum
632	kalupin	15-07-2010	Merged soft start and impurity
633	kalupin	15-07-2010	Merged soft start and impurity
634	kalupin	15-07-2010	Somehow got lost ...
635	kalupin	15-07-2010	Somehow got lost ...
636	kalupin	15-07-2010	Somehow got lost ...
637	kalupin	15-07-2010	Somehow got lost ...
638	kalupin	16-07-2010	version 16.07.2010
639	coster	20-07-2010	Some more cases
640	coster	20-07-2010	updates for kepler, sign of jphi
641	coster	20-07-2010	fix problem with local copies of CPO_*
642	coster	20-07-2010	fix problem with local copies of CPO_*
643	coster	20-07-2010	switch back to the official order of arguments in helena
644	coster	20-07-2010	more compilation options
645	coster	20-07-2010	missed a place where the order of parameters in the helena call needed to be corrected
646	coster	21-07-2010	add missing eq_ets.xml's
647	coster	21-07-2010	changing copies of CPO_* to links
648	coster	21-07-2010	changing copies of CPO_* to links
649	coster	21-07-2010	fix suspected bug in main_plasma
650	coster	21-07-2010	splitting a too long line
651	coster	21-07-2010	write exactly what is returned by helena
652	coster	22-07-2010	switch off more output in HELENA
653	coster	22-07-2010	helena case with mesh accumulation
654	coster	22-07-2010	preparing for the Mac
655	coster	22-07-2010	preparing for the Mac
656	coster	22-07-2010	sign change functionality moved to the wrapper
657	coster	23-07-2010	eliminate some memory leaks
658	coster	23-07-2010	eliminate some memory leaks
659	coster	23-07-2010	more debug options for config/GW_UAL.local
660	coster	11-08-2010	reworked 'write_input' to derive its input from an xml file; changed its name to 'prepare_input_cpos'; added a utility, 'test_functions', for testing on-the-fly function evaluation (used in the new 'prepare_input_cpos'
661	coster	11-08-2010	bringing in changes for impurities
662	coster	11-08-2010	catering for helena which does not return quantities on the same rho_tor grid as it received on input
663	coster	11-08-2010	quash a bug
664	coster	11-08-2010	pesky bug
665	coster	11-08-2010	update ascii CPO versions of the input files
666	coster	11-08-2010	missed this ...

667	coster	11-08-2010	missed this ...
668	coster	11-08-2010	Some HELENA cases
669	coster	11-08-2010	added generic ECRH, ICRH and NBI modules
670	coster	12-08-2010	missed this new dependency
671	coster	13-08-2010	fix a compiler complaint about a missing save in generic sources; fix a logic problem when using the ascii CPO version
672	coster	13-08-2010	switch off some debugging information
673	coster	15-08-2010	drop the restriction to 32 bit
674	coster	15-08-2010	inputs for prepare_input
675	coster	15-08-2010	moved to PREPARE_INPUT_CPOS_XML
676	coster	15-08-2010	JET with impurities
677	coster	15-08-2010	JET cases
678	coster	15-08-2010	trying to get all the cases up-to-date
679	kalupin	16-08-2010	version with dummy source
680	coster	16-08-2010	modified the ETS User Guide (incorporated contents of eq_ets_test.tex)
681	coster	16-08-2010	added comments to the Makefile
682	coster	16-08-2010	extended the ETS User Guide
683	coster	16-08-2010	extended the ETS User Guide
684	kalupin	16-08-2010	version with dummy source 16.08.2010
685	coster	17-08-2010	added figures to the ETS User Guide
686	kalupin	17-08-2010	some bags corrected
687	coster	17-08-2010	added more figures to the ETS User Guide
688	coster	17-08-2010	reformat Makefile
689	coster	17-08-2010	picky compiler ...
690	coster	18-08-2010	added more figures to the ETS User Guide
691	coster	18-08-2010	added more figures to the ETS User Guide
692	kalupin	18-08-2010	dummy source 18.08.2010, included current and momentum sources
693	coster	18-08-2010	descriptions of the code inputs (from XSD)
694	coster	18-08-2010	descriptions of the code inputs (from XSD)
695	coster	18-08-2010	more updates
696	coster	18-08-2010	Added descriptions to the schemas
697	coster	18-08-2010	switch to using ipython which doesn't have a problem with png files
698	coster	18-08-2010	fix bug in the Makefile
699	coster	18-08-2010	update CPO_* files
700	coster	18-08-2010	updates to the config's
701	coster	18-08-2010	catch up with ISIP changes
702	coster	18-08-2010	fix bounding box
703	coster	18-08-2010	moved to PYTHON/
704	coster	18-08-2010	shorten too long lines
705	coster	18-08-2010	allocate if not associated
706	coster	18-08-2010	shorten too long lines
707	coster	18-08-2010	shorten eq_ets_test standard test case
708	coster	18-08-2010	fix bounding box

709	coster	18-08-2010	some housekeeping
710	coster	18-08-2010	some more housekeeping
711	coster	18-08-2010	some more housekeeping
712	coster	18-08-2010	some more housekeeping
713	kalupin	19-08-2010	test
714	kalupin	19-08-2010	update local changes
715	kalupin	19-08-2010	update local changes
716	kalupin	19-08-2010	update local changes
717	kalupin	19-08-2010	update local changes
718	kalupin	19-08-2010	libperf.a
719	coster	19-08-2010	making it easier to run
720	coster	20-08-2010	another jet case
721	coster	20-08-2010	more figures; describe JET case
722	coster	20-08-2010	neoclassics
723	coster	20-08-2010	continuing neo work
724	coster	20-08-2010	neoclassics
725	coster	21-08-2010	update format of INDEX table
726	coster	21-08-2010	allow for specifying integrals of sources
727	coster	21-08-2010	allow for specifying integrals of sources
728	coster	21-08-2010	update cases ...
729	coster	21-08-2010	add a program for writing out the times contained in stored CPOs
730	coster	21-08-2010	Comparing neowes and neo(=nclass)
731	coster	21-08-2010	used for the neoclassical comparisons
732	coster	21-08-2010	generalize
733	coster	22-08-2010	updated CPOs
734	coster	22-08-2010	switch to 10s and add the 'in-house' collisions based sigma_par
735	coster	22-08-2010	switch to 10s and add the 'in-house' collisions based sigma_par
736	coster	22-08-2010	check augmentation for JET shot
737	coster	22-08-2010	update on schema; update for plotting with a varying rho
738	coster	22-08-2010	add the option to stop on floating point problems — stops when a nan results
739	coster	22-08-2010	see what a slightly higher radial resolution does to energy conservation
740	coster	23-08-2010	consolidating documentation
741	coster	23-08-2010	consolidating documentation
742	coster	23-08-2010	extending the documentation
743	coster	23-08-2010	extending the documentation
744	coster	23-08-2010	add ETS timeline (MS Project)
745	coster	24-08-2010	added internal sigma_par for D only case
746	coster	24-08-2010	use environment variables DATAVERSION and TOKAMAKNAME; calculate neoclassics for a pure D case
747	coster	24-08-2010	use environment variables DATAVERSION and TOKAMAKNAME
748	coster	24-08-2010	use environment variables DATAVERSION and TOKAMAKNAME
749	coster	24-08-2010	added some more cases to ETS_Status: JET, AUG, NBI, ECRH, ICRH

750	coster	24-08-2010	documentation updates
751	coster	24-08-2010	more on equilibrium augmentation
752	coster	24-08-2010	documentation updates
753	huynh	25-08-2010	update
754	huynh	25-08-2010	less verbose version
755	huynh	25-08-2010	add on persitent memory option
756	basiuk	25-08-2010	add output file
757	basiuk	25-08-2010	suppress warning
758	basiuk	25-08-2010	suppress warning
759	basiuk	25-08-2010	suppress warning
760	basiuk	25-08-2010	suppress warning
761	basiuk	25-08-2010	suppress warning
762	basiuk	25-08-2010	suppress warning
763	kalupin	25-08-2010	In collisions: LOG replaced by LOG10
764	huynh	25-08-2010	save COS august 2010
765	basiuk	25-08-2010	suppress initdata from the workflow and add coresource, antennas
766	coster	25-08-2010	documentation
767	coster	25-08-2010	important fix to plasma_collisions where the natural logarithm had been used in the calculation of the coulomb logarithm instead of base 10 logarithm — this resulted in a too high plasma conductivity
768	coster	25-08-2010	consolidated documentation
769	coster	25-08-2010	plotting impurities
770	coster	25-08-2010	add sigma_par.dat, if available, to neoclassical.ps
771	coster	25-08-2010	bringing in Denis' summy source routine
772	coster	25-08-2010	bringing in Denis' summy source routine
773	coster	25-08-2010	documentation
774	coster	26-08-2010	add ETS Doxygen PDF
775	basiuk	26-08-2010	add source
776	huynh	26-08-2010	mistake
777	basiuk	26-08-2010	add source
778	huynh	26-08-2010	change allocation
779	huynh	26-08-2010	change allocation
780	huynh	26-08-2010	change allocation
781	coster	26-08-2010	documentation: some renames; added '-t' option description for the python plotting scripts
782	huynh	26-08-2010	add code parameters
783	basiuk	26-08-2010	bugs correction
784	basiuk	26-08-2010	index correction
785	huynh	26-08-2010	add code parameters
786	huynh	26-08-2010	update code parameters
787	huynh	26-08-2010	add code parameter to source
788	coster	26-08-2010	description of timescpo
789	coster	27-08-2010	memory leak

790	huynh	27-08-2010	update codeparam for source
791	huynh	27-08-2010	update codeparam for source
792	huynh	27-08-2010	update codeparam for source
793	huynh	27-08-2010	update codeparam for source
794	basiuk	27-08-2010	add npar in abserror of LH power
795	basiuk	27-08-2010	add LH parallel index and zeff
796	coster	27-08-2010	g95_UAL.local
797	basiuk	27-08-2010	mis a jour de l occurence 2 de coresource
798	basiuk	27-08-2010	transmission de b0 et r0
799	basiuk	27-08-2010	shot 32299, TS Vl = 0
800	basiuk	27-08-2010	bug corretcions
801	coster	27-08-2010	resolution scan for AUG 20116
802	coster	28-08-2010	update ETS log
803	coster	28-08-2010	Added doxygen comments
804	coster	28-08-2010	integerate dummy_source
805	coster	28-08-2010	integerate dummy_source
806	coster	28-08-2010	doxygen generated documentation
807	coster	30-08-2010	catch up on the shift from input_etaigb.xml to etaigb.xml
808	coster	30-08-2010	more figures
809	coster	30-08-2010	catch up on the shift from input_etaigb.xml to etaigb.xml
810	coster	30-08-2010	W starting case
811	coster	30-08-2010	cannot assume that coreprof and equilibrium have the same grid in rho_tor
812	coster	30-08-2010	add '-t' option to many of the python scripts
813	coster	30-08-2010	python version of write_input
814	coster	30-08-2010	neo_test now requires l3interp from libbdseq.a
815	coster	30-08-2010	W case
816	coster	30-08-2010	update figures, documents
817	kalupin	31-08-2010	bug in main_neutrals is fixed
818	coster	31-08-2010	71827/24 JET Case
819	coster	31-08-2010	update figures, documents
820	coster	31-08-2010	update figures, documents
821	coster	31-08-2010	update figures, documents
822	coster	01-09-2010	some cases with neutrals
823	coster	01-09-2010	remove out-of-date ETS_Solver.tex; update solver convergence figures
824	coster	01-09-2010	remove out-of-date ETS_Solver.tex; update solver convergence figures
825	coster	01-09-2010	update solver convergence figures
826	coster	01-09-2010	update solver convergence data
827	coster	01-09-2010	update solver convergence data
828	coster	01-09-2010	W data; remove unused decalarations of pi
829	coster	01-09-2010	want to be able to use cpp directives
830	coster	01-09-2010	remove unused decalarations of pi
831	coster	01-09-2010	want to be able to use cpp directives
832	figueire	01-09-2010	

833	figueire	01-09-2010	
834	figueire	01-09-2010	
835	figueire	01-09-2010	
836	coster	02-09-2010	update figures
837	coster	02-09-2010	add the comparison between RZ and AMNSPROTO atomic physics
838	kalupin	02-09-2010	Neutrals output to CPO added
839	ferreira	02-09-2010	branch for VV
840	ferreira	02-09-2010	a folder to keep utilities and supporting code for ETS
841	ferreira	02-09-2010	supporting libraries for ETS
842	ferreira	02-09-2010	initial commit with the changes needed to compile ETS @ GAP/Viggs (oSUSE) * my config for the oSUSE box added, minor detail changed in Makefile to be able to compile (lib mumps_common added) TODO: fix the missing l3interp @ prepare_input_cpos.F90
843	coster	03-09-2010	add info about using prepare_input_cpos
844	coster	04-09-2010	more HELENA resolution study plots
845	coster	05-09-2010	Kepler ETS
846	coster	05-09-2010	Kepler ETS
847	figueire	06-09-2010	
848	coster	06-09-2010	Kepler ETS
849	coster	06-09-2010	more figures
850	coster	07-09-2010	more on the use of the AMNS interface
851	coster	07-09-2010	amns
852	coster	09-09-2010	doc update
853	coster	13-09-2010	AMNS use by ETS
854	coster	13-09-2010	AMNS use by ETS
855	huynh	14-09-2010	update
856	ferreira	14-09-2010	a) minor bugs fixed in solution7.f90 b) tweaks to eq_ets_test, main_plasma, etc for the V&V (a new fortran workflow will be created for the V&V in the future) note: to compile this version on the gateway, remove underscores from the matheval functions (to be fixed later).
857	ferreira	14-09-2010	revert Makefile to the trunk version
858	huynh	15-09-2010	for 4.08b
859	huynh	15-09-2010	for 4.08b
860	huynh	15-09-2010	for 4.08b
861	huynh	15-09-2010	for 4.08b
862	huynh	15-09-2010	for 4.08b
863	huynh	15-09-2010	for 4.08b
864	huynh	15-09-2010	for 4.08b
865	huynh	15-09-2010	for 4.08b
866	huynh	15-09-2010	for 4.08b

867	huynh	15-09-2010	obsolete
868	coster	16-09-2010	update bug in ohmic heating found by Antonio
869	coster	16-09-2010	update bug in ohmic heating found by Antonio
870	ferreira	27-09-2010	matheval function underscores removed
871	huynh	04-10-2010	update
872	huynh	04-10-2010	update
873	kalupin	05-10-2010	GB transport for benchmarking with ISM
874	kalupin	05-10-2010	BgB transp
875	huynh	06-10-2010	obsolete
876	huynh	06-10-2010	obsolete
877	huynh	06-10-2010	update
878	huynh	06-10-2010	new version of HELENA
879	huynh	06-10-2010	add interpos
880	huynh	06-10-2010	bohm/gyrobohm
881	huynh	06-10-2010	reduce time
882	huynh	06-10-2010	add PID controller
883	huynh	06-10-2010	add security
884	huynh	06-10-2010	add 2D dimension
885	kalupin	07-10-2010	merged with ASTRA
886	huynh	08-10-2010	update
887	huynh	08-10-2010	memory allocation
888	huynh	08-10-2010	memory allocation
889	huynh	08-10-2010	memory allocation
890	huynh	08-10-2010	update
891	huynh	08-10-2010	update
892	huynh	08-10-2010	memory allocation
893	huynh	08-10-2010	suppress message
894	huynh	08-10-2010	update
895	huynh	08-10-2010	update
896	huynh	11-10-2010	add new cpo:coresoure,antennas
897	kalupin	11-10-2010	new signals added to the output COREPROF, total source needed by Coppi-Tang model
898	kalupin	11-10-2010	new signals added to the output COREPROF, total source needed by Coppi-Tang model
899	kalupin	11-10-2010	move up
900	kalupin	12-10-2010	some new signals filled with zeros
901	huynh	18-10-2010	update
902	huynh	18-10-2010	update
903	huynh	18-10-2010	update
904	huynh	18-10-2010	update
905	huynh	18-10-2010	update
906	huynh	18-10-2010	update
907	huynh	19-10-2010	update

908	huynh	20-10-2010	add coretransp
909	huynh	20-10-2010	add coretransp
910	huynh	21-10-2010	blindage des allocation
911	huynh	21-10-2010	add fc2k input
912	huynh	21-10-2010	add fc2k input
913	coster	21-10-2010	Add svn:keywords property 'Id'
914	coster	23-11-2010	prepare for 4.08b by archiving 4.08a version
915	coster	23-11-2010	prepare for 4.08b by archiving 4.08a version
916	coster	23-11-2010	prepare for 4.08b by archiving 4.08a version
917	coster	23-11-2010	prepare for 4.08b by archiving 4.08a version
918	coster	25-11-2010	switching to 4.08b
919	huynh	01-12-2010	correction bug
920	coster	07-12-2010	Known bugs
921	huynh	08-12-2010	avant innsbruck
922	huynh	08-12-2010	without heat transport
923	huynh	08-12-2010	without heat transport
924	huynh	08-12-2010	without heat transport
925	huynh	08-12-2010	without heat transport
926	huynh	08-12-2010	without heat transport
927	huynh	08-12-2010	without heat transport
928	huynh	08-12-2010	without heat transport
929	huynh	08-12-2010	without heat transport
930	huynh	08-12-2010	without heat transport
931	coster	08-12-2010	force a version for itm_shared
932	coster	08-12-2010	Global README for the ETS
933	coster	08-12-2010	fix typo affecting non-UAL version
934	coster	08-12-2010	fix typo affecting non-UAL version
935	coster	08-12-2010	adding ets.xsd and ets.xml
936	coster	08-12-2010	adding ets.xsd and ets.xml
937	coster	09-12-2010	update 'correct' answer
938	coster	09-12-2010	lift 'doc' directory to just under the trunk
939	coster	09-12-2010	link for the 'lifted' doc
940	figueire	10-12-2010	
941	figueire	10-12-2010	
942	figueire	10-12-2010	