ITM-09-IMP5-T3: FAST ICRH CODE FOR ROUTINE ANALYSIS

VR: T. Hellsten, A. Hannan, T. Johnson, J. Höök

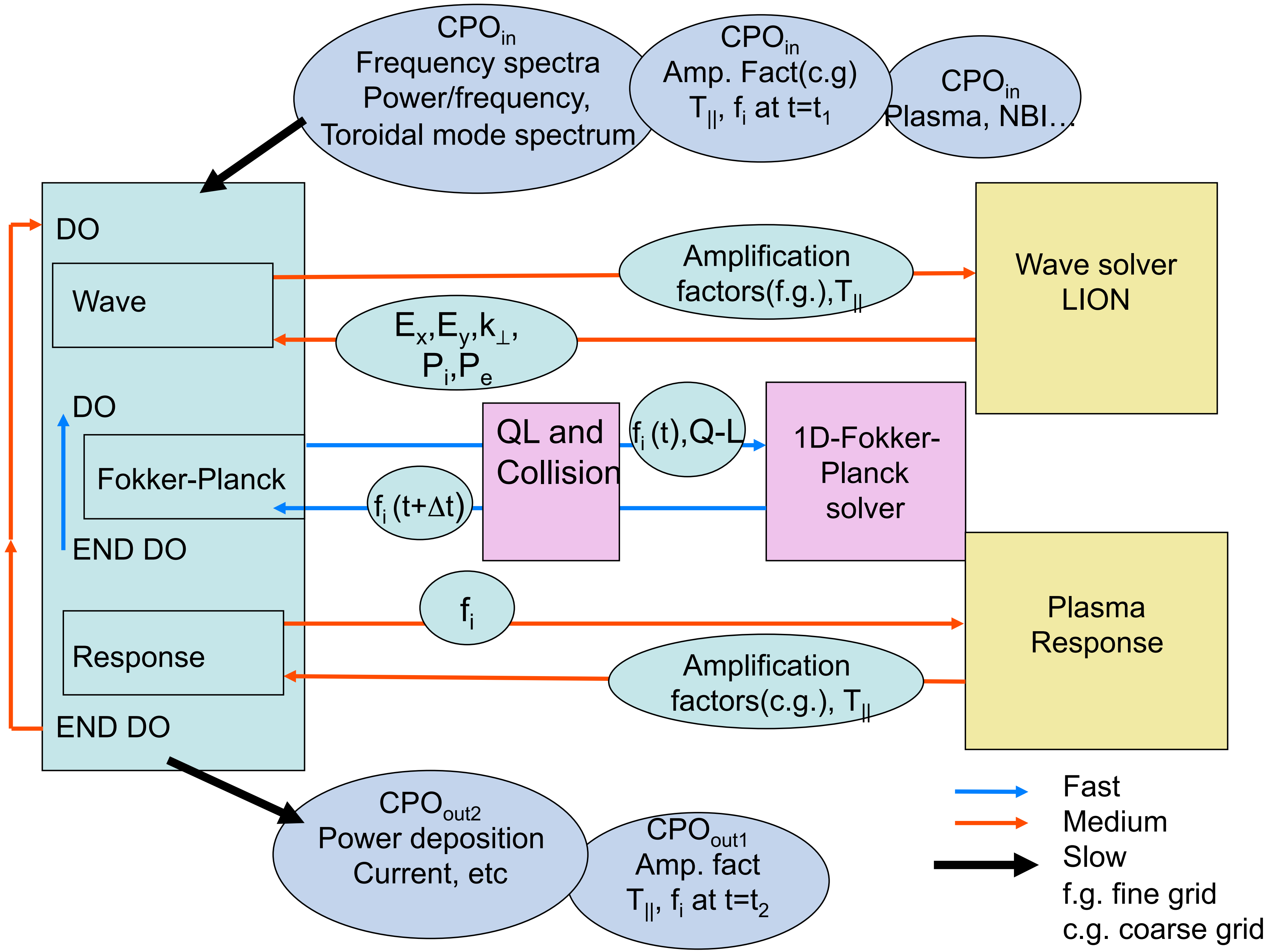
CRPP: L. Villard

ITM-09-IMP5-T5: DEVELOPMENT OF AN ADVANCED 3D FOKKER –PLANCK SOLVER FOR IONS FOR ORBIT AVERAGED MONTE CARLO CODE.

VR: T. Hellsten, Q. Mukhtar, T. Johnson, J. Höök.

ITM-09-IMP5-T5: ADOPTIVE δf-METHOD FOR ICRH

VR: J. Höök, T. Hellsten



CPO$_{in}$
Frequency spectra
Power/frequency,
Toroidal mode spectrum
CPO$_{in}$
Amp. Fact(c.g)
$T_{||}$, f_i at $t=t_1$
CPO$_{in}$
Plasma, NBI…
DO
Wave
Amplification factors(f.g.),$T_{||}$
Wave solver LION
E_x,E_y,$k_\perp$,
P_i,P_e
DO
Fokker-Planck
END DO
QL and Collision
f_i (t),Q-L
1D-Fokker-Planck solver
f_i (t+Δt)
f_i
Response
Plasma Response
Amplification factors(c.g.), $T_{||}$
END DO
CPO$_{out2}$
Power deposition
Current, etc
CPO$_{out1}$
Amp. fact
$T_{||}$, f_i at $t=t_2$
Fast
Medium
Slow
f.g. fine grid
c.g. coarse grid

ITM-09-IMP5-T3: Fast ICRH code for routine simulation IMP-3

- Wave code: LION, FEM-code, the suceptibilty tensors and $T_{||}$ are modfied for the resonant
- Fokker-Planck code time dependent 1D cubic FEM.

The code is running.

Remains to be done:

Further tests

Some diagnostics should be added (fusion yield)

Documentation

Some restructuring before adopting CPOs

NBI and Fast ions to be added to the Fokker-Planck

ITM-09-IMP5-T5: DEVELOPMENT OF AN ADVANCED 3D FOKKER –PLANCK SOLVER FOR IONS based on Monte Carlo.

- **VR:** T. Hellsten, Q. Mukhtar, T. Johnson, J. Höök,

Description: Development of algorithms for reduce fluctuations and improve convergence.

A new δf-method for ICRH have been developed (1D) presented at Lissabon conf 2009. It reduce the source term by making sucssesive better approximation of the zeroth order approximation.
Resampling is used to reduce the representation of the bulk plasma.

A new method is being developed for 3D.

Optimisation of the numerical scheme for Monte Carlo calculations with singular boundaries.
An adoptive method for 1D has been worked out Q.

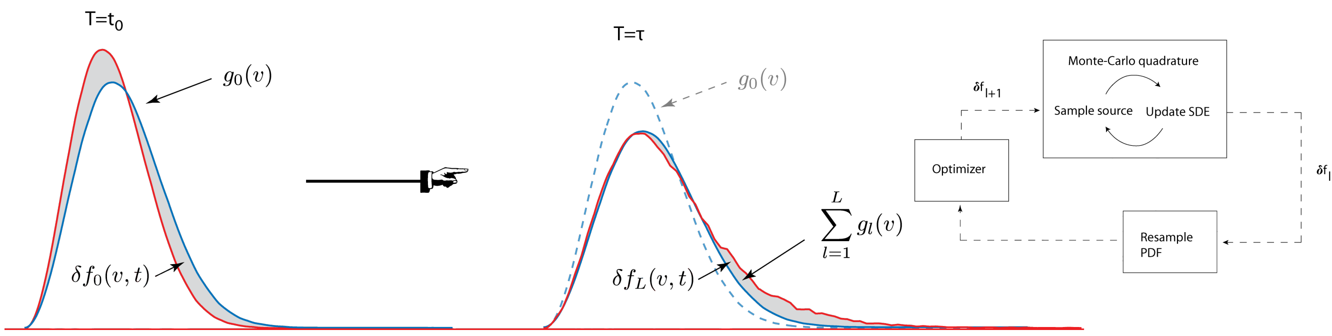
Extending the scheme to 3D. (looks very promising)

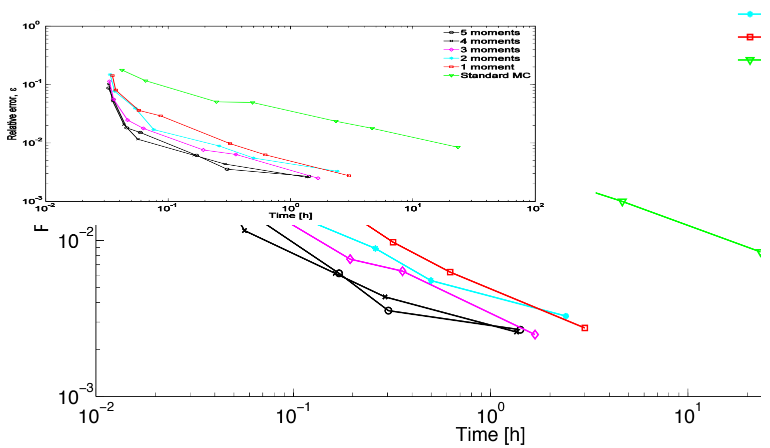
ITM-09-IMP5-T5: Adoptive δf-method for ICRH

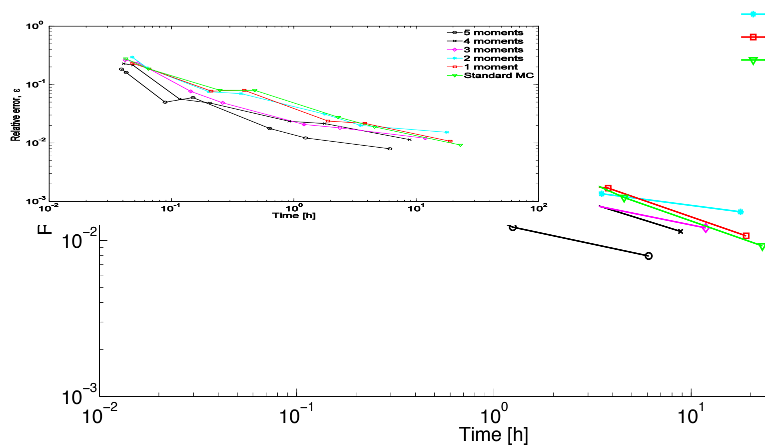
VR: J. Höök, T. Hellsten,

This δf-method requires new source particles with +/- weights.

Resampling is done periodicly and improvement of the zeroth order approximation to reduce the source term.







For low power density (left) a large gain is obtained. Colours corresponds to different moments.

http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5535198&isnumber=5568511

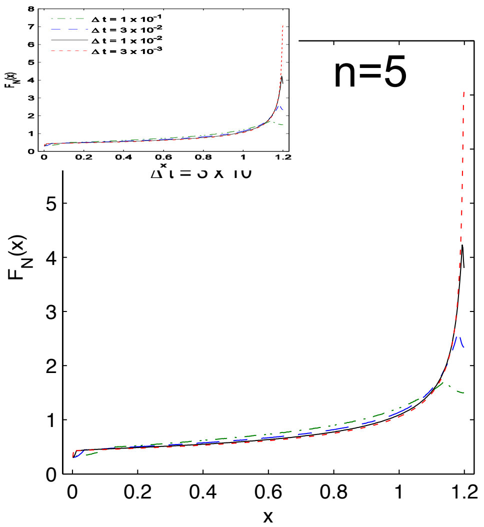
VR: Q. Mukhtar, T. Hellsten, T. Johnson

ITM-09-IMP5-T5

Diffusion ekvation singular at $\Lambda = 0$ and $\Lambda = R/R_0$

$$\frac{\partial f}{\partial t} = \frac{\partial^2}{\partial \Lambda^2}\left(2\Lambda\left(\frac{R}{R_0} - \Lambda\right)\gamma f\right) - \frac{\partial}{\partial \Lambda}\left(\left(2\frac{R}{R_0} - (n-2)\Lambda\right)\gamma f\right)$$

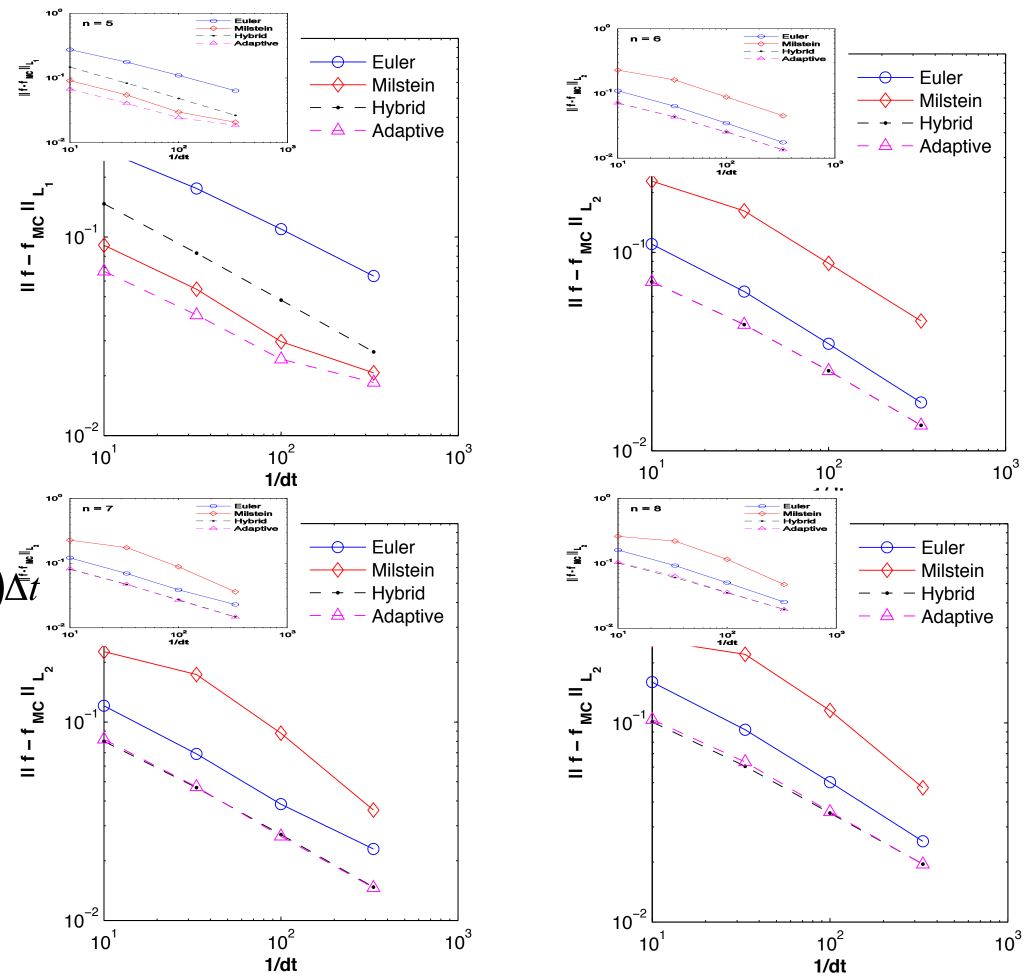
Steady state solution $f = \left(\frac{R}{R_0} - \Lambda\right)^{-\frac{(6-n)}{2}}$



$$X_{n+1} = X_{n+1} + \mu\Delta t + \varsigma b\sqrt{\Delta t} + \tfrac{C}{2} b b'\left(\varsigma^2 - 1\right)\Delta t$$

$$b = \sqrt{4\Lambda\frac{R}{R_0}\left(1 - \Lambda\frac{R_0}{R}\right)}$$

$$\dot{\mu} = \left(2\frac{R}{R_0} - (n-2)\Lambda\right)$$



Euler C=0; Milstein C=1
Hybrid C=0.5
http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5530410&tag=1