Density modelling for hybrid scenario at JET & ITER, preliminary results

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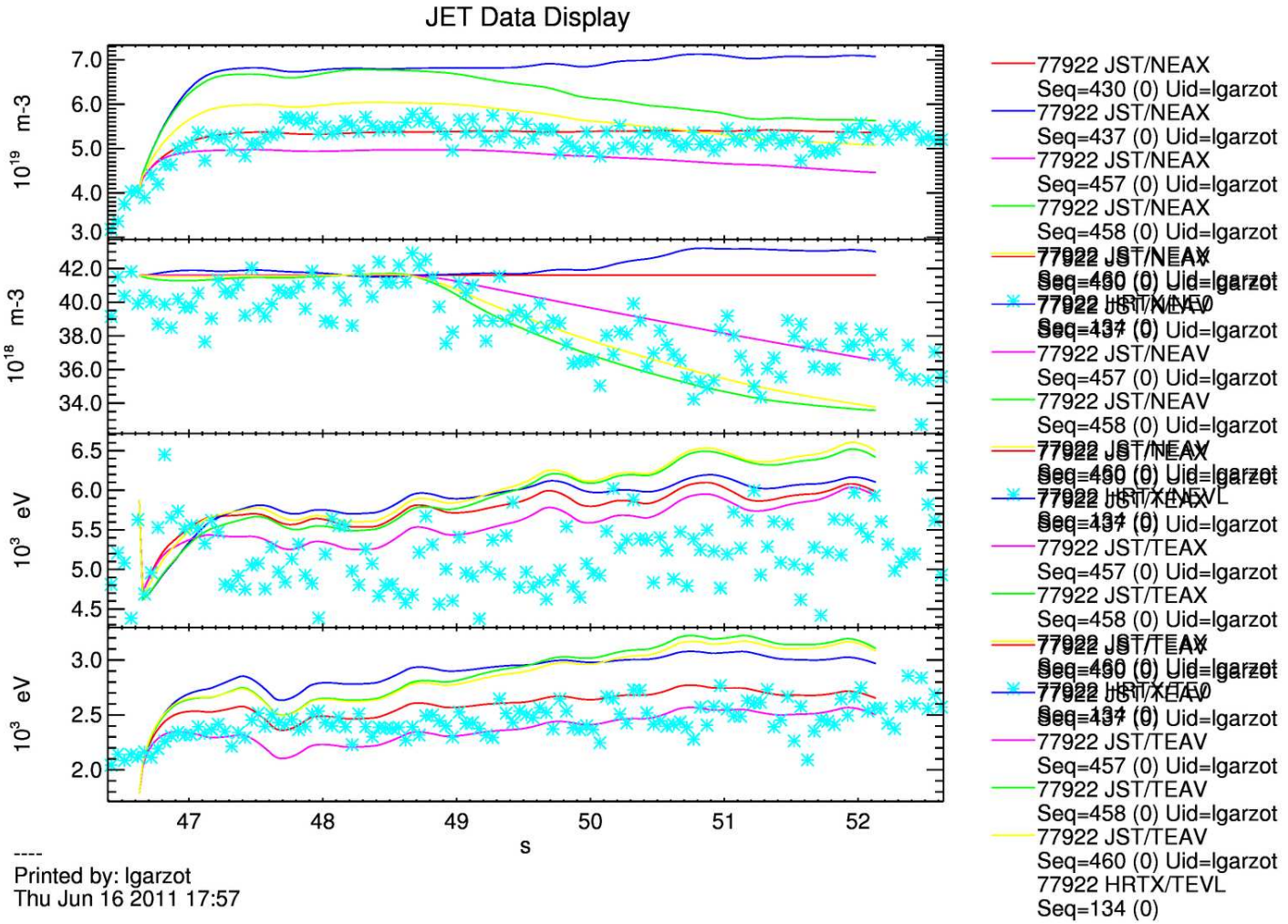
Plan

- Fully predictive simulation (including density and fuelling) of JET and ITER hybrid scenarios.
- JET shot 77922. (Problems with density profile peaking/NBI source and recycling).
- ITER start from CRONOS simulations (shot 100, sequence 174). Increased density scan.

Situation for JET

- JET fully predictive simulation from 46.63 s to 53.13 s with Bohm/gyro-Bohm completed
  - seq 430: recycling R=1 no NBI source (flat-ish density profile, rest seems ok).
  - seq 437: NBI source switched on, reduced recycling.
  - seq 457: adapted R to track <n>, no NBI source.
  - seq 458: adapted R, full NBI source.
  - seq 460: adapted R, half NBI source.

Examples


JET Data Display
7.0
6.0
5.0
4.0
3.0
10^19 m-3
42.0
40.0
38.0
36.0
34.0
10^18 m-3
6.5
6.0
5.5
5.0
4.5
10^3 eV
3.0
2.5
2.0
10^3 eV
47
48
49
50
51
52
s

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77922 JST/NEAX
Seq=430 (0) Uid=lgarzot
77922 JST/NEAX
Seq=437 (0) Uid=lgarzot
77922 JST/NEAX
Seq=457 (0) Uid=lgarzot
77922 JST/NEAX
Seq=458 (0) Uid=lgarzot
77922 JST/NEAV
77922 HRTX/NEV0
77922 JST/NEAV
Seq=457 (0) Uid=lgarzot
77922 JST/NEAV
Seq=458 (0) Uid=lgarzot
77922 JST/TEAX
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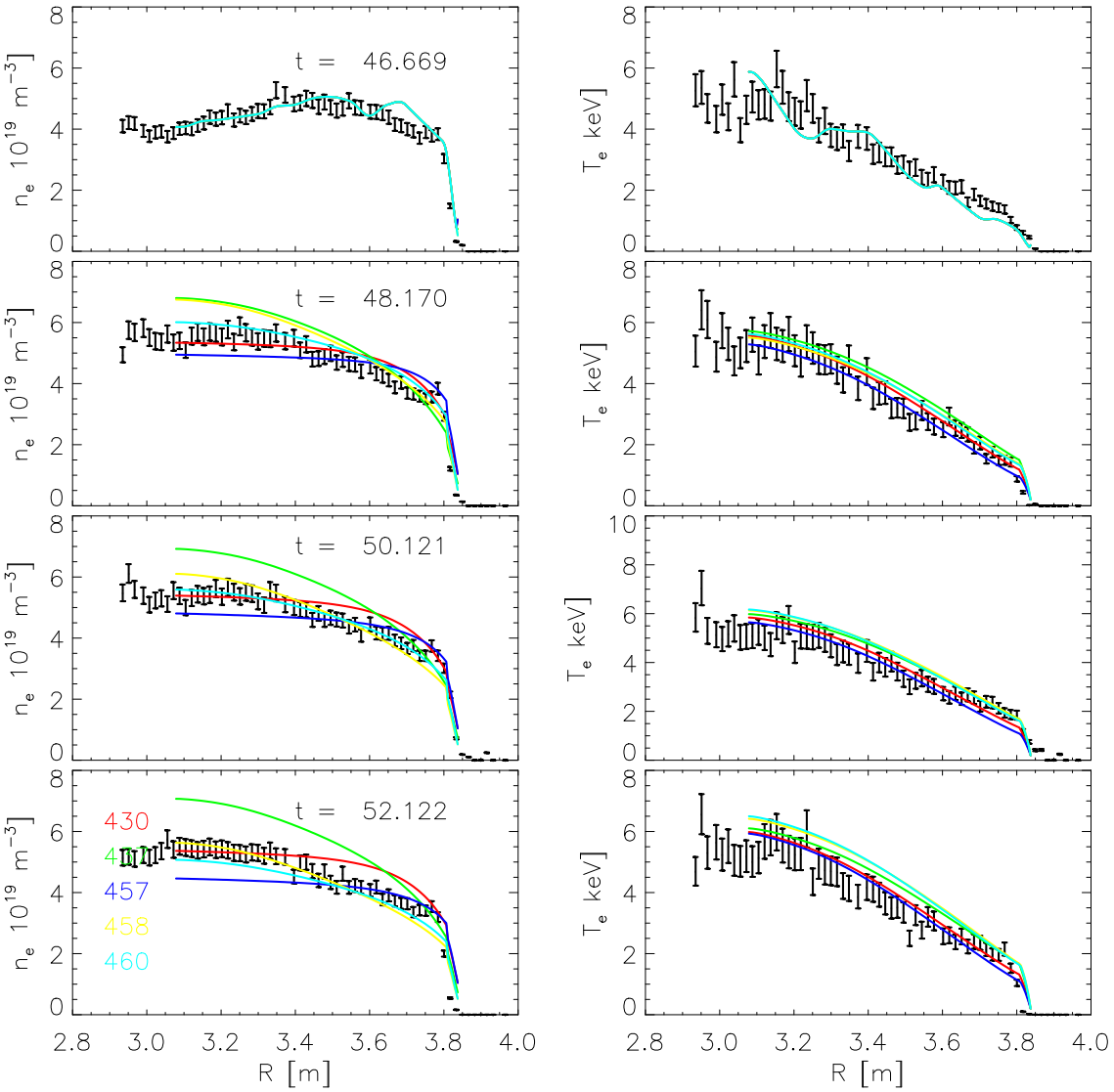
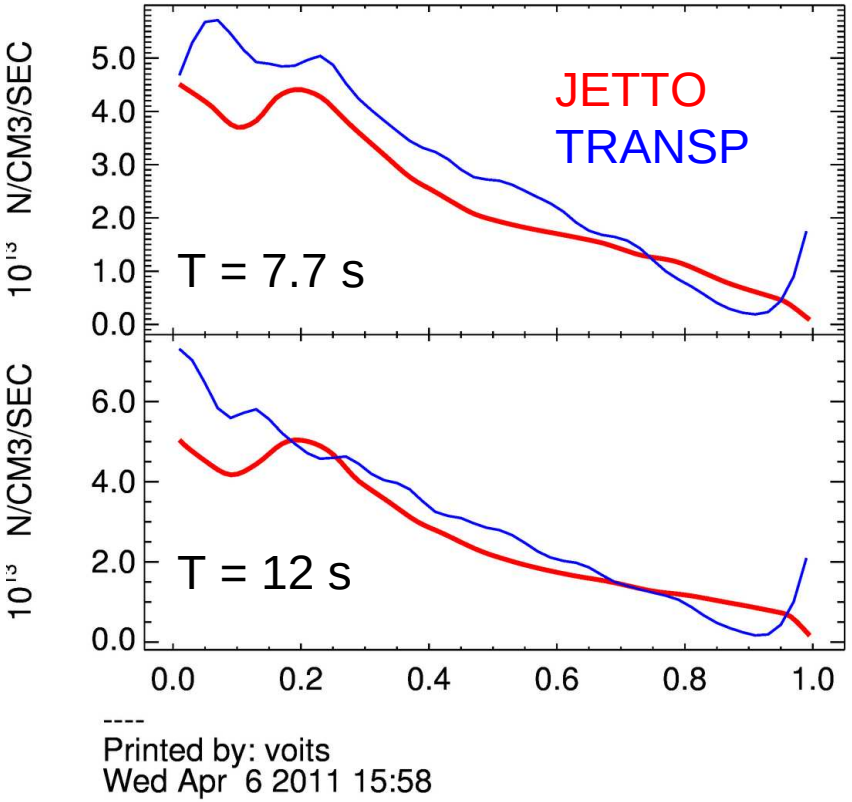
77922 JST/TEAV
77922 HRTX/TEV0
77922 JST/TEAV
Seq=457 (0) Uid=lgarzot
77922 JST/TEAV
Seq=458 (0) Uid=lgarzot
77922 JST/TEAV
Seq=460 (0) Uid=lgarzot
77922 HRTX/TEVL
Seq=134 (0)

Examples

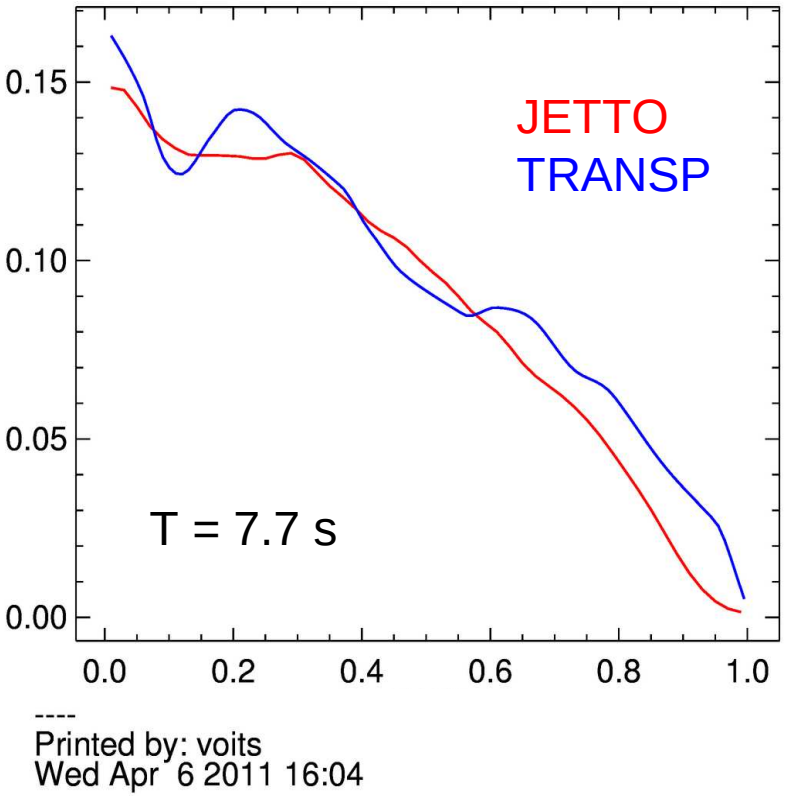

t = 46.669
t = 48.170
t = 50.121
t = 52.122
430
457
458
460
n_e 10^{19} m^{-3}
T_e keV
R [m]

NU-BEAM vs JETTO NBI source

NBI particle source



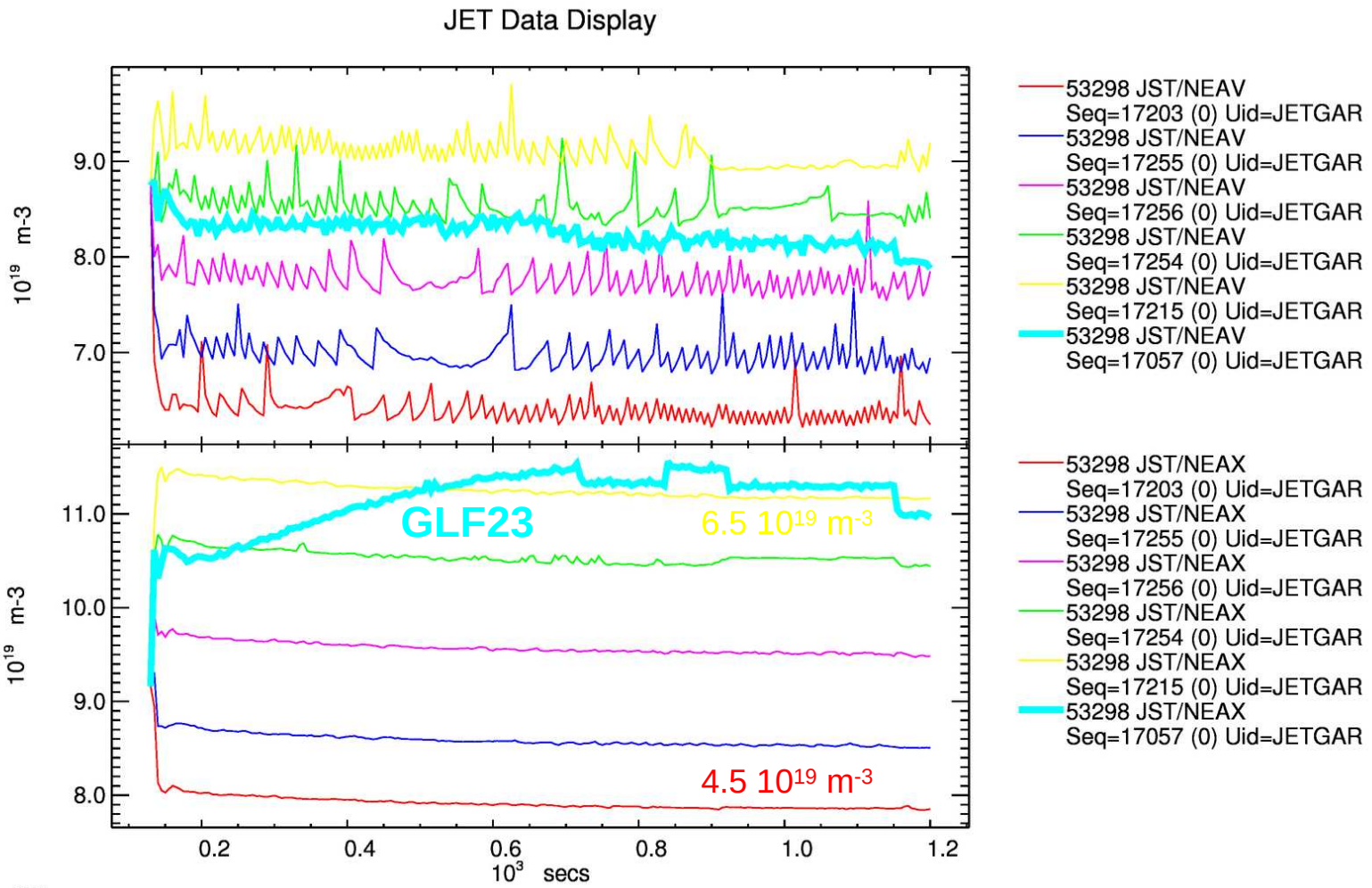
NBI power deposition (electrons)



Situation for ITER

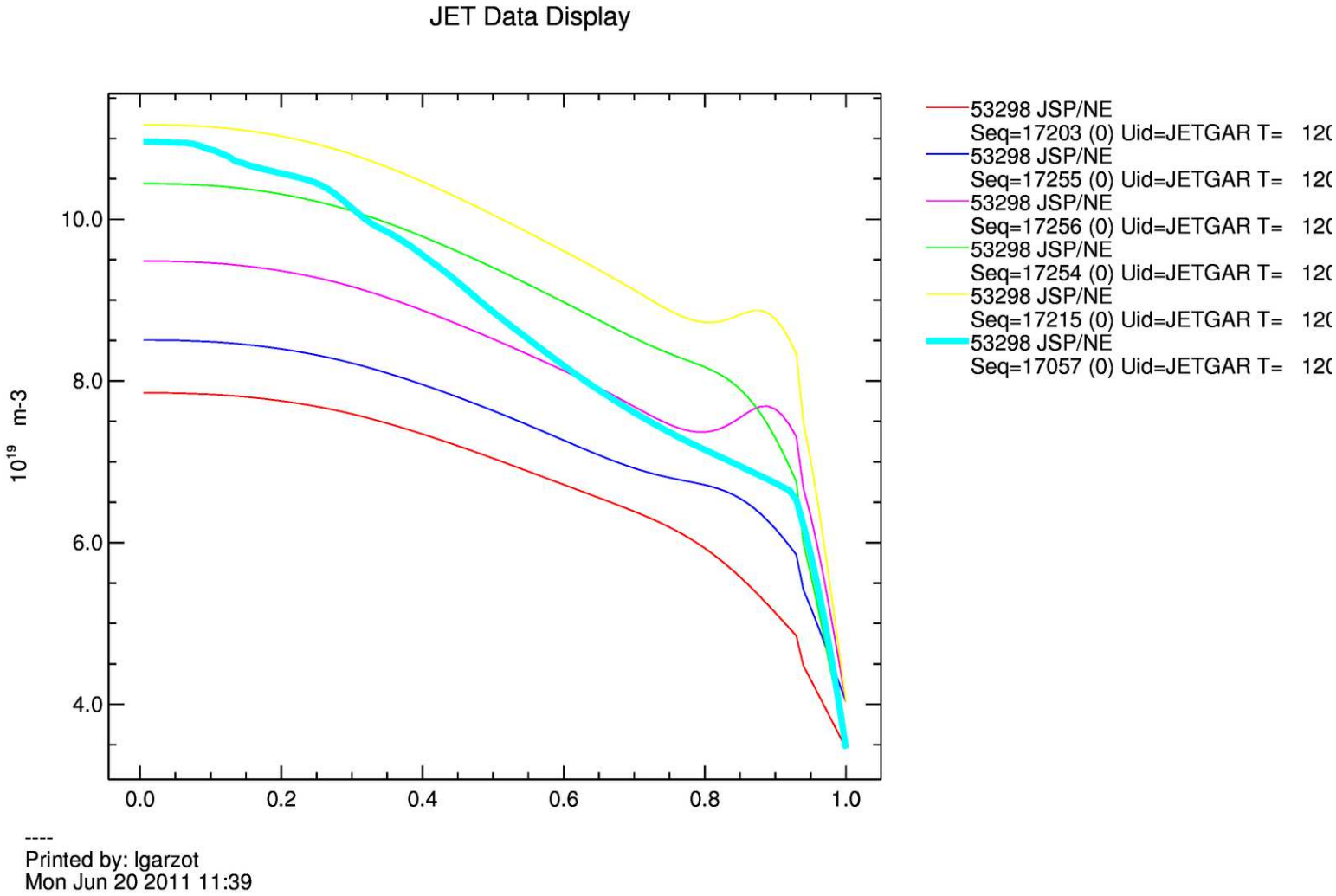
- Fully predictive simulation from 130 s (start of H-mode) to 1200 s with Bohm/gyro-Bohm.
  - R=0, pellet fuelling with feedback on the density at the top of the barrier.
  - Density scan performed (more later).
- Equivalent case with GLF23 performed.
  - R=0 continuous pellets, continuous ELMs.
  - Attempted same density scan, but run into problems with GLF23 (under investigation).

Examples



Density scan by changing density at top of ETB

Profiles


JET Data Display
10.0
8.0
6.0
4.0
10^{19} m-3
0.0
0.2
0.4
0.6
0.8
1.0
53298 JSP/NE
Seq=17203 (0) Uid=JETGAR T= 12(
53298 JSP/NE
Seq=17255 (0) Uid=JETGAR T= 12(
53298 JSP/NE
Seq=17256 (0) Uid=JETGAR T= 12(
53298 JSP/NE
Seq=17254 (0) Uid=JETGAR T= 12(
53298 JSP/NE
Seq=17215 (0) Uid=JETGAR T= 12(
53298 JSP/NE
Seq=17057 (0) Uid=JETGAR T= 12(

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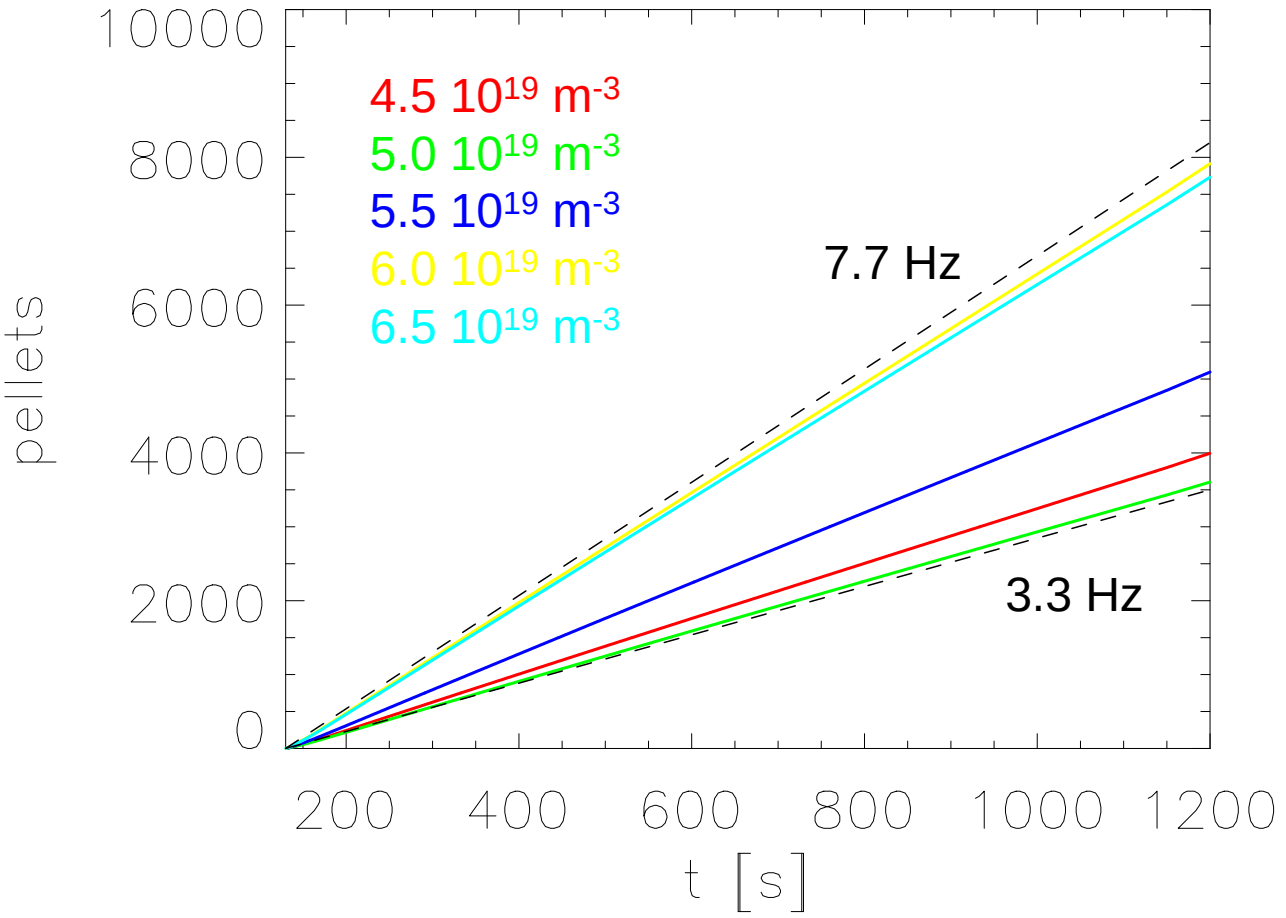
Pellet frequency

Not linear neither strictly monotonic



Provisional conclusions

- Shot 77922:
  - good simulation with B/gB, adjusting recycling improves the results,
  - NBI particle source seems reasonable (checked with NU-BEAM),
  - however: full NBI source still overestimate density peaking, especially at the beginning of the simulation,
  - support the existence of an additional transport mechanism? Current density cannot be simulated with neoclassical resistivity either,
  - still trying to deploy GLF23.
- ITER hybrid scenario:
  - achieved a set of simulations with B/gB with different densities and established fuelling requirements,
  - attempt to run the same density scan with GLF23 in progress but numerical problems make difficult to perform a fully predictive parametric scan with GLF23, continuous ELMs and continuous pellets. Issues are under investigation.