ITPA TC-33 joint activity

ITER Ip=15 MA reference cases: sources and profiles in IMAS Data Structure

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Reference ITER 15 MA case to be used for:

- Integrated modeling framework benchmark (HFPS, ASTRA, ETS, PTRANSP etc. But also Portals, Tango, etc).
- Comparing/verifying turbulent transport codes while keeping fixed to this reference case identical pedestal, plasma composition, toroidal velocity and sources.
- Isolating the impact of a particular parameter around a case familiar to all, such as impurity content, rotation, the q profile, the pedestal height etc.

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- **Starting point** : Florian Koechl's JETTO case published in [Mantica PPCF 2020] and used in [Citrin PoP 2023].
- **Time frame** lasting 130 s (from 320 to 450 s)
- **Equilibrium:**
  - I_p=15 MA , B=5.3 T at R=6.2 m,
  - plasma shape from eqdsk file used in starting point
- **Heating/particle/torque sources**:
  - ECRH/ECCD 1 equatorial launcher 17 MW modelled with TORBEAM stand alone, aiming at a deposition profile as close to a Gaussian as possible. Heat and CD sources.
  - NBI 33 MW, 1 on axis, 1 off axis, modelled with ASCOT. Heat, particle and torque sources from the provided IDS.
  - Pellet sources: continuous pellet model using a Gaussian centered at ρ_{tor}=0.85 (ρ_{tor} is the normalized square root of the toroidal magnetic flux with B=5.3T in the normalization, it corresponds to ρ_{pol} =0.93 in normalized square root of poloidal flux units) with a width of 0.1 in ρ_{tor} units. Resulting from feedback on pedestal top electron density of $7.7x10^{19}m^{-3}$.
- **plasma composition**:
  - flat Z_{eff}=1.4, impurity mix based JETTO+EDGE2D ITER Be wall modelling [Eriksson NF2024] : negligible W core content hence no W in the reference case, ratio between Ne and He is n_{Ne}/n_{He}=0.15, hence n_{He}/n_e=2.6%.
  - main ions: 50/50 for D and T.
- **Reference core profiles:**
  - V_{tor} profile fixed as in Florian Koechl's case published in [Mantica PPCF 2020]. Obtained using Prandlt number of 1 and QuaLiKiz.
  - Reference density and temperature profiles resulting from heat and particle turbulent transport from QuaLiKiz prediction up to pedestal top at ρ_{tor}=0.93 (corresponding to ρ_{pol}=0.97).
  - Pedestal top quantities at ρ_{tor}=0.93
    - $T_i=T_e$=4.8 keV (obtained by using the EPED based ITER scaling [Polevoi 2015])

- pedestal density constrained using feedback from pellet fueling on electron density 7.77x10^{19}m^{-3} leading to a pedestal pressure of 118kPa (slightly below the expected ideal MHD limit around 130 kPa).

- Separatrix values T_i=855 eV T_e=620 eV, n_D=n_T=2.6e19 m^{-3} from [Eriksson NF2024]
- 2 q profiles (needed as the magnetic shear in the central high β region impacts the KBM stability and the EP driven MHD)
  - obtained after 95 s of current diffusion (time = 415 s)
  - obtained after 30 s of a triggered sawtooth crash (time=450 s)

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The IMAS data structures have been produced by an HFPS simulation using the above information, keeping the IDS core_sources fixed, the plasma composition fixed and V_{tor}. The evolved quantities have been T_e, T_i, n_D, n_T, the current and the magnetic equilibrium.

They are available in the **IMAS Data Format on the ITER cluster** sdcc-login.iter.org **for 2 time slices.**
At 415 s, relaxed q profile: /work/imas/shared/imasdb/ITER/3/53299/3
At 450 s, flat q profile inside q=1: /work/imas/shared/imasdb/ITER/3/53299/4
You will find for in each directory the following IDS: core_profiles.h5 core_sources.h5 core_transport.h5 equilibrium.h5 master.h5 ntms.h5 summary.h5

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Visualization of the profiles and equilibrium for the 2 time slices:

At 415 s, relaxed q profile: /work/imas/shared/imasdb/ITER/3/53299/3	At 450 s, flat q profile inside q=1: /work/imas/shared/imasdb/ITER/3/53299/4