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Simulation of Heating and Current Drive Sources for Scenarios of the ITER Research Plan

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The H&CD systems in the ITER Research Plan

- Three external H&CD systems:
  - Electron Cyclotron wave: 170 GHz, 20 MW (+20)
  - Ion Cyclotron wave: 40-55 MHz, 20 MW (+20)
  - Neutral Beam Injection: 870 keV H⁺, 1 MeV D⁻, 33 MW (+16.5)
- One intrinsic H&CD process:
  - Fusion reaction:
    - 3.5 MeV ~80-100 MW for DT 15 MA/5.3 T baseline scenario

The ITER Integrated Modelling & Analysis Suite IMAS

- IMAS provides a standard and managed access to experimental and simulated data
  via Interface Data Structures (IDS)
- Aims at integrating free-boundary evolution, core-edge-SOL transport, divertor physics and PFC models to allow high fidelity physics simulations
- Is suitable for any fusion tokamak device
- Will be used for ITER data processing and analysis
- To know more: https://imas.iter.org

The IMAS Data Dictionary

- Core
- Edge
- Physics phenomena
- Fueling
- H&CD
- Other plant systems
- Diagnostics
- Data management

Towards a High Fidelity Plasma Simulator

The H&CD workflow and its Graphical Interface

- Choice of H&CD codes for each source
- Configuration of code parameters for each code

References

Note: higher NBI+ICRH synergy in FPPO-2: [A. Polevoi et al, submitted to NF (2020)]

- ICRH modelling: 10 MW:
  - 40 MHz, for N=1 D(e)
  - 53 MHz for n=2 T heating

- Weak RF- and RF-NBI synergy (+5% ICRH)
- Dominant electron heating (alphas)
  - Significant core ion heating (+40%) due to combined ICRH, NBI and a heating

Conclusion

- IMAS provides a standard for integrated modeling delivering a high level of modularity and flexibility
- A key deliverable is a high-fidelity plasma simulator including self-consistent calculation of free-boundary equilibrium + core-edge transport
- The H&CD workflow has been developed as an essential element of any high-fidelity plasma simulator, enabling the modeling of the synergy between H&CD sources
- The H&CD workflow has been integrated within the core-edge JNTRAC transport solver
- The DNA-free boundary equilibrium code is being coupled to the JNTRAC transport solver
- A first version of a high-fidelity plasma simulator is expected soon!