

SOLPS-ITER modeling of JT-60SA with metallic wall

Giulio Rubino, G. Calabrò, M. Wischmeier









This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

Work overview



First scoping study of SOL plasma and outer divertor conditions Assesment of the feasibility of the Scenario 3 with W wall





Transport coefficients definition



 Transport coefficients for JT-60SA were defined by fitting JET n_e and T_e midplane profiles although discrepancies are observed at outer target



✓ Rescaled by 2 to approach $λ_{q,Eich}$





General trends







Detachment achievement

✓ Detachment defined by the J_{sat} decrease by 80%



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Energy balance analysis

Intenal energy balance between outer divertor entrance and target to identify the driver for power load mitigation

$$[A_x q_x]_{down} - [A_x q_x]_{up} = \int_{up}^{down} S_{en,tot} h_x A_x dx$$

✓ Diffusion in PFR and geometry causes reduction close to the separatrix ✓ Impurity radiation ($P_{rad,D} \approx 15\% P_{rad,tot}$) is the main mechanism





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Pressure balance analysis

✓ Pressure balance between equatorial plane and outer target to identify the driver for detachment

$$\left[\frac{B_{\theta}}{B}A_{x}\left(p+m_{i}n_{e}v_{\parallel}^{2}\right)\right]_{down} - \left[\frac{B_{\theta}}{B}A_{x}\left(p+m_{i}n_{e}v_{\parallel}^{2}\right)\right]_{up} = \int_{up}^{down} S_{mom,tot}h_{x}A_{x}dx$$

✓ D^+ - D_2 collisions triggered by the low T_e is the main mechanism
Attached
Detachment onset
Detachment





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Operational window



- ✓ Scan in the Γ_{D} and Γ_{N} to define possible operational window
- A wide operational window can be defined in the neighborhood of n_{e,sep} = 3 x 10¹⁹ m⁻³

✓ Limits imposed by
$$T_e$$
 and f_{rad} > 50%





Conclusions



✓ The assessment shows the possibility to operate JT-60SA in the high density scenario

✓ A wide operational windows can be defined

 \checkmark Manageable power load are obtained with a relatively low f_{rad} and $Z_{eff,sep}$

✓ Most stringent constrain is T_e

 Energy balance identify the impurity radiation as main power load mitigation mechanism

 Pressure balance shows the key role played by D⁺ - D₂ collisions to achieve detachment



Ongoing and future work

- ✓ A more sophisticated analysis is ongoing with drift terms taken into account
- Same procedure with a definition of the transport coefficients with a more recent JET experiment (close in terms of P_{aux})
- ✓ Benchmark with SONIC code (in collaboration with QST) ongoing









Thank you for your attention