Recent SOLPS modelling of long-legged divertor configurations

INTRODUCTION

- Long-legged divertor configurations can re-activate a reactor’s operational space, where core and exhaust requirements overlap.
- Increased parallel connection length, and/or decreased B field at the target (total flux expansion), and/or increased neutral compression in the divertor.
- We present an overview of recent modelling of long-legged divertors, performed by UKAEA and the University of York.

DEEP DETACHMENT

- In [7], deeply-detached simulations obtained via deuterium fuelling (puff scan) and nitrogen seeding (seedling scan) were compared, using the same seeding and fuelling scans in MAST-U as in the DLS sensitivity study.
- For similar detachment front locations (5 eV points), significant recombination is only observed in the fuelling-driven detached simulation and is negligible in the seeding-driven detached simulation.

REACTOR RELEVANCE

- In [8], the utility of an engineerly-plausible long-legged divertor was assessed for DEMO within the Eurofusion work package WP-DTT1/ADC.
  - The outer divertor connection length was increased by 75% and the total flux expansion by 30%.
  - For the same $n_{e,sep,OMP}$ ($\bar{e}_{Ar}$), the $\sim$0.5 lower $\bar{e}_{Ar}$, (~0.8 lower SX (black circles)) required a factor $n_{e,sep,OMP}$ to achieve operationally-tolerable exhaust conditions, compared to the SN (pink squares).
  - The SX with 300 MW input power required only slightly higher $n_{e,sep,OMP}$ and $\bar{e}_{Ar}$, compared to the SN with 150 MW input power.
  - This improvement was attributed primarily to the increased connection length of the SX, rather than the marginally increased total flux expansion.
  - In SX, a significantly larger fraction of the radiated power was located in the divertor, while the SN radiated more from the core.

REFERENCES

[6] O Myatra et al. (2021) to be submitted
[7] O Myatra et al. (2021) to be submitted
[8] L Xiang et al. (2021) submitted to NF