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Towards divertor–relevant conditions in BiGyM: insights from SOLPS–ITER modelling

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Plasma–material interactions are a key challenge for magnetic confinement fusion and are widely investigated in linear plasma devices. The GyM [1] linear device currently operates at plasma densities of 10^{15}–10^{17} m^{-3}, electron temperatures below 15 eV, and ion fluxes up to 10^{21} m^{-2} s^{-1}, representative of tokamak main chamber conditions.
To reach divertor–relevant plasma regimes (densities of about 10^{19} m^{-3} and ion fluxes approaching 10^{23} m^{-2} s^{-1}), GyM is being upgraded to the high–density BiGyM device, featuring helicon–wave plasma generation via two 10 kW birdcage antennas at 13.56 MHz, a revised magnetic configuration, a redesigned vacuum vessel, and new in–situ surface diagnostics.

This contribution presents the plasma modelling activities conducted with SOLPS–ITER[2] to support the upgrade. Parametric simulations assessed the influence of injected power, neutral pressure, magnetic field configuration, and boundary conditions on plasma density and temperature. Different working gases, including helium and argon, were considered to evaluate the plasma performances.

For a representative discharge in helium (B = 20 mT, p = 0.8 Pa, P = 3 kW), predicted electron densities of (1.5–2.0)×10^{19} m^{-3} and electron temperatures of 4–5 eV are obtained along the device axis.

Plasma density and temperature vary by less than 15% across the different magnetic configurations, at a fixed absorbed power density. For refining the spatial distribution of electron heating according to the magnetic configuration, initial work has been carried out to couple SOLPS–ITER simulations with power deposition modelling from helicon sources performed in COMSOL.

The predicted plasma conditions meet the performance targets set for the BiGyM upgrade, confirming that the adopted design choices are well suited to access divertor–relevant regimes and supporting the finalisation of the device construction.

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