Prospects for Energetic Particle Physics in the SMART Tokamak

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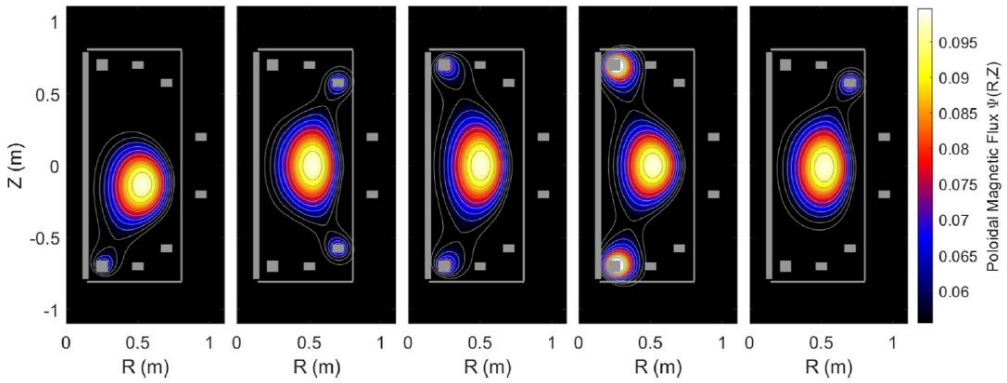
The SMall Aspect Ratio Tokamak (SMART) is a new Spherical Tokamak (ST) aimed at exploring the prospects of Negative Triangularity (NT) in STs and the potential of this combination for a future compact Fusion Power Plant (FPP) [1-3]. SMART has been designed to operate at $B_t \leq 1$ T and $I_p \leq 0.5$ MA with the magnetic axis, R_{mag}~ 0.4-0.6 m, and the plasma minor radius, a ~ 0.2-0.3 m with pulse lengths τ_{pulse} ~ 1 sec [1-4]. A rather large vacuum vessel, with in-vessel control coils and a fast control system allow to scan a wide range of plasma shapes from conventional to spherical tokamaks with triangularities $-0.6 < \delta < 0.6$ and ellipticities, κ, up to 3 (see figure). Two Neutral Beam Injection (NBI) systems with injection energies up to 40 keV and injection powers up to 1.5 MW ensure high heating power densities (≤3 MW/m^3) and large energetic particle contents with supra-Alfvenic velocities. The target plasma scenarios have been developed through an iterative process using the FIESTA code for the magnetic equilibrium, coils positioning, geometries and currents, and the ASTRA code to estimate the plasma performance for a given configuration. ASCOT and TRANSP simulations have been used to predict the machine performance and optimize the design of the NBI system [5, 6] and produce first synthetic diagnostics for the implementation of Fast-Ion Loss Detectors (FILD) and Imaging Neutral Particle Analyzers (INPA). The stability of the SMART plasmas against both core and edge magnetohydrodynamic (MHD) fluctuations has been calculated using the MARS-F code for linear simulations and the MEGA code for hybrid non-linear simulations as function of aspect ratio, triangularity and elongation. In this contribution, an overview of the SMART tokamak, including its physics basis, design, first experimental results and prospects for energetic particle physics will be presented.



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