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FTP/P1-07: "Snow Flakes" Divertor and 10 MA Scenarios in FAST

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The overarching FAST goals lead to a more flexible design and to a research plan based on three DEMO and ITER priorities: A) exploring plasma wall interaction in reactor relevant conditions, B) testing tools and scenarios for safe and reliable tokamak operation up to the border of stability, C) addressing fusion plasmas with a significant population of fast particles, plus being complementary to the JT60-SA missions. Unique of the FAST approach is the capability of addressing all of them simultaneously in a single, fully integrated scenario with dimensionless physics parameters very close to DEMO and ITER. FAST has the possibility to tackle the power exhaust problem in regimes relevant to DEMO with an actively cooled W-divertor capable to sustain loads up to 20 MW/mq with P/R˜22 MW/m. A "Snow Flakes" divertor can be implemented in FAST with the present poloidal coils up to the reference scenario with Ip=6.5 MA. According to the 2-D plasma edge code TECXY the peak power flow along the SOL field lines can be reduced by a factor ≈3.0. A new FAST scenario has then been designed at Ip=10 MA, BT=8.5T, q(95)≈2.3. Transport simulations by using the code JETTO and the first principle transport model GLF23 indicate that, under these conditions, FAST could achieve an equivalent Q≈3.5. FAST will be equipped with a set of feedback controlled active coils located between the first wall and the vacuum vessel (≈25 cm far from the plasma edge) and accessible for maintenance with the remote handling system. Preliminary studies indicate that these coils can carry currents up to 20 kA (≈4 MA/mq) with AC frequency up to few kHz. The coil set will produce magnetic perturbation with toroidal number n=1 or n=2. MHD analysis performed with the linear code MARS (both assuming the presence of a perfect conductive wall at r/a=1.3 and using the exact 3D resistive wall structure) shows the possibility of the FAST conductive structures to stabilize n=1 and n=2 ideal modes. This leaves therefore room for active mitigation of the resistive mode (down to a characteristic time of 1 ms) for safety purposes. The main target of this experiment is the preparation of a complete and reliable low q(95) scenario, ready to be transferred to a possible ITER scenario very close to its operational limits.

Country or International Organization of Primary Author

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Collaboration (if applicable, e.g., International Tokamak Physics Activities)

International Tokamak Physics Activities

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