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MHD stability and Disruption studies in DTT

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The Divertor Tokamak Test (DTT) is a new tokamak device whose main mission is to explore innovative divertor concepts for DEMO and test them in heat loads conditions on plasma facing components relevant to a fusion reactor. The device has recently gone through an interim design process [1], and the machine assembly is going through its detailed design phase.
The DTT is a high toroidal field high plasma current superconductive tokamak, with 5.5MA maximum plasma current, 6T maximum field, a major radius of 2.14m and a minor radius of 0.64m. The DTT magnets system will be able to explore various magnetic divertor configurations, among which lower single null and double null, snow flake and X-divertor, at a significant fraction of its maximum plasma current and heating power. The foreseen maximum auxiliary power is about 46MW, with a main component of ECRH, complemented by negative ion NBI and ICRH.
In particular, ECRH is expected to generate a significant off-axis current drive, which can affect MHD stability through q-profile. The ideal stability of the full current single null configuration has been studied using the MARS MHD code, through a parametric scan of stability as a function of plasma current and pressure profile.
Although DTT main mission is focused on plasma exhaust studies, it is conceived as being flexible in order to address several ITER and DEMO relevant problems. Among these, disruption diagnosis and mitigation are of high importance for DTT, given the high plasma current and injected power in a compact design. Moreover, the high toroidal field and large range in plasma elongation make it an ideal machine to study runaway electrons physics. For these reasons, a disruption mitigation system (DMS), based on both Massive Gas Injection and Shatter Pellet Injection, is necessary.
In this talk, the initial MHD stability studies on DTT reference scenario will be shown, together with the design of MHD and disruption diagnostics and DMS. The design effectiveness will be tested by using MHD modelling of a full current disruption using CarMa0NL code [2], which also includes the electro-magnetic currents and forces induced in the Vacuum Vessel.

References

[1] https://www.dtt-project.enea.it/downloads/DTT_IDR_2019_WEB.pdf
[2] F. Villone et al., Plasma Phys. Control. Fusion 55 (2013) 095008

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