Toward the analytical description of particles and heat transport Inside large magnetic islands

Chiara Marchetto*†[1], Magali Muraglia[2], Nicolas Dubuit[2], Olivier Agullo[2]
[1]ISC-CNR, Dipartimento Energia, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy
[2]Aix-Marseille Université, CNRS, PIIM UMR7345, Marseille, France

Abstract

An NTM (Neoclassical Tearing Mode) island in a tokamak can be as large as a considerable fraction of the small radius.
Large magnetic islands, leading to the flattening of kinetic profiles, are observed to impact heavy impurity transport in fusion plasmas [1].
This issue becomes important and urgent with the "2024 new ITER baseline", which include a Tungsten (atomic mass 183.85) first wall [2]. Tungsten core accumulation could lead to significant performance degradation or even to the termination of the discharge by radiative collapse.

To address this problem, we must understand how the island magnetic topology changes the transport of heat and of the different particles with respect to what would happen without the island.
The first step is an expression for the proton diffusion coefficient inside the island. This is interesting as it allows for a sort of validation, not so common in basic physics. Its validation could consist in inserting it into a transport code (such as ASTRA or JETTO) and reproduce the observed kinetic profiles.
Preliminary results on the diffusion coefficient will be given.

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[1] Nucl. Fusion 56 (2016) 066002
[2] ITER Organization 2024, Initial evaluations in support of the new ITER baseline and Research Plan, ITER Technical Report ITR-24-004 (www.iter.org/technical-reports)

*Speaker
†Corresponding author: chiara.marchetto@isc.cnr.it