Aalto University

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Experimental and computational studies of power and momentum transport in tokamaks

Title of the dissertation	Power and momentum removal in the Scrape-Off Layer of ASDEX Upgrade
Contents of the dissertation	This dissertation studies the power and momentum transport from a contained plasma as hot as the center of the Sun to the solid walls of the tokamak fusion device. Understanding of these processes is important to preserve the first wall of future fusion power plants. In this dissertation, an extensive study of momentum removal in the scrape-off layer of high-confinement plasmas in the ASDEX Upgrade tokamak was carried out. Momentum removal is important to reduce the particle flux onto the divertor targets, preventing damage to these components. The targets are specially designed surfaces which receive the largest heat and particle fluxes. For the same plasma temperature in front of the target plate, momentum removal above the target is stronger in the studied plasmas than in low-confinement plasmas in other devices. Unlike experimental observations in other devices, the momentum removal also depends on the studied radial position across the target. Plasma simulations corresponding to the experimental studies underpredict the momentum removal capability of the experimental plasmas at low plasma temperatures in front of the target plate. On the other hand, it was observed that the plasma simulations correctly predict the peak of the heat loads onto the targets and its dependence on the core plasma density and the plasma current. The inclusion of cross-field drift terms related to the electric field and the pressure gradients are fundamental to achieve this degree of agreement. Human-caused climate change is one of the primary challenges of our generation. The predicted consequences of human-caused climate change are catastrophic: the forced migrations from inhospitable areas, the rise of sea levels, the destruction of habitats, etc. Potential fusion power plants can provide a reliable and safe source of energy, and they would not produce greenhouse gases.
Field of the dissertation	Fusion and plasma physics.
Doctoral candidate	Iván Paradela Pérez, Diploma.
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Opponent	Dr. Holges Reimerdes, EPFL, Switzerland.
Custos	Professor Mathias Groth, Aalto University School of Science, Department of Applied Physics.
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