The physics of W transport illuminated by recent progress in W density
diagnostics at ASDEX Upgrade

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Recent studies dedicated to the experimental characterization and the theoretical modeling of
the W density behavior have indicated that the size and the direction of the radial transport of
W are strongly affected by the poloidal density distribution, that is, by the parallel transport, as
well as by the competition between the neoclassical and the turbulent transport contributions.
Thereby, the W density behavior is the result of complex interactions among all of these compo-
nents, which have to be realistically described by theoretical models in order to reach a reliable
predictive capability. At ASDEX Upgrade, the realization of such complexity has motivated the
development of improved diagnostic tools, enabling more accurate reconstructions of the 2D
W density distribution over the poloidal cross section as well as the determination of the W
transport coefficients. By this, a more comprehensive and systematic study became possible, in
which single effects are more precisely identified and investigated. The large mass and charge of
W ions imply that the centrifugal force and any small poloidal electric field strongly affect their
dynamics. The resulting poloidal distribution of W is measured and compared with the predic-
tions of the model which combines a centrifugal asymmetry with the impact of ICRF and NBI
ions. Such a measurement provides a validation of the modeled fast particle distribution as a
function of various plasma parameters and heating sources. Additionally, transport coefficients
are locally measured by exploiting the sawtooth perturbations. For the first time, this provides
a direct experimental validation of the theoretically predicted enhancement of the neoclassical
transport in the presence of heavy impurities localized on the low-field side. Finally, consist-
tently with recent theoretical results, we observe that heating profiles, and in particular the ratio
between electron and ion heating, have an impact on the competition between neoclassical and
turbulent transport components in the radial direction. The experimentally observed flattening
of the W density profile in the core is strongly correlated with the electron heating fraction, as
obtained in experiments which compare ECRH with ICRH in NBI heated H-mode plasmas.

References


\textsuperscript{*} See http://www.euro-fusionscipur.org/mst1