A review on the current status of power and particle exhaust physics: 
modeling, experiment and open issues

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Studying the power and particle exhaust physics remains a key issue when aiming at 
extrapolating the findings from existing tokamaks to future burning plasma devices 
such as ITER and DEMO. Physics models implemented into complex numerical 
codes as well as simple scaling laws are being used for such extrapolations. The 
scaling laws available are based on experimental data or on numerical simulations. 
They have only limited range of validity and insufficient sets of such laws currently 
exist that could be used by system codes for a conceptual design of a future device. 
On the other hand complex numerical codes have made remarkable progress in recent 
years in describing the physics processes at work in low recycling as well as for the 
completely detached divertor. Nevertheless, they fail in numerically reproducing 
quantitatively as well as qualitatively many experimental observations in the very 
important transitional regime ranging from high recycling to partial detachment.

This contribution will review the progress made in recent years in validating the 
numerical code packages against experimental data as well as the developed scaling 
laws. The shortcoming of the numerical validation will be presented and discussed. 
The comparison of numerical simulations to experimental data from extensive 
diagnostics observing the divertor volume allowed the identification of open issues in 
our understanding of power and particle exhaust physics. Unresolved items that have 
arisen during these investigations will be presented for discussion. Key issues are 
perpendicular transport in the divertor, the role of drift terms, the role of CX process 
for pressure loss and perpendicular redistribution of pressure, the quantification of the 
volumetric recombination as well as the interaction of power loss with momentum 
loss processes. 
An outlook on activities for the near term future will be given.

This work has been carried out within the framework of the EUROfusion Consortium and has received 
funding from the Euratom research and training programme 2014-2018 under grant agreement No 
633053. The views and opinions expressed herein do not necessarily reflect those of the European 
Commission.