APR12-2012-000496

Abstract for an Invited Paper
for the APR12 Meeting of
the American Physical Society

The Future of Boundary Plasma and Material Science[1]

DENNIS WHYTE, MIT

The boundary of magnetic confinement devices, from the pedestal through to the surrounding surfaces, encompasses an enormous range of plasma and material physics, and their integrated coupling. It is becoming clear that due to fundamental limits of plasma stability and material response the boundary will largely define the viability of an MFE reactor. However we face an enormous knowledge deficit in stepping from present devices and ITER towards a demonstration power plant. We outline the future of boundary research required to address this deficit. The boundary should be considered a multi-scale system of coupled plasma and material science regulated through the non-linear interface of the sheath. Measurement, theory and modeling across these scales are assessed. Dimensionless parameters, often used to organized core plasma transport on similarity arguments, can be extended to the boundary plasma, plasma-surface interactions and material response. This methodology suggests an intriguing way forward to prescribe and understand the boundary issues of an eventual reactor in intermediate devices. A particularly critical issue is that the physical chemistry of the material, which is mostly determined by the material temperature, has been too neglected; pointing to the requirement for boundary plasma experiments at appropriate material temperatures. Finally the boundary plasma requirements for quiescent heat exhaust and control of transient events, such as ELMs, will be examined.

[1]Work supported by US DoE award DE-SC00-02060