Light Impurity Transport at an Internal Transport Barrier in Alcator C-Mod*

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Tokamak discharges with internal transport barriers have peaked main-ion profiles that may lead to higher core reactivity. If the impurity profile is also peaked and/or if impurities accumulate, then there will be deleterious effects on the plasma. New measurements of boron profiles with spatial and temporal resolution are reported for Alcator C-Mod. With the addition of these light impurity profiles, the ITB description in C-Mod is more complete and more easily compared to the ITBs generated in other tokamaks.

The Alcator C-Mod ITB is characterized by a peaked pressure profile. Rice[1] has shown that this is accompanied by accumulation of heavy impurities. We have extended these profile measurements to lighter boron ions and employed CXRS techniques for improved spatial resolution. The impurity results are presented in the context of ion and electron thermal transport and main ion particle transport.

It is shown that during the ITB, the profile gradient for fully-stripped boron steepens. Analytical analysis suggests that this follows from an increase in the impurity pinch relative to diffusion. In fact, the impurity transport pinch approaches neoclassical values. These results are confirmed by numerical simulation. The light impurity gradient is at smaller major radius than the ITB-induced profile steepening in either electron temperature or ion temperature.

In previous work on C-Mod,[1] the profile of a heavy impurity (argon) introduced by puffing demonstrated peaking. Experiments in JET[2] show similar results with a marked difference between heavy and light impurities. The ITB on C-Mod shares other profile traits with the JET ITB such as peaking which is consistent with a neoclassical pinch.

* supported by USDOE Grant DE-FG03-96ER54373 and Coop. Agree. No. DE-FC02-99-ER54512

[1] J. W. Rice, et al., Nuclear Fusion 42 ,510 (2002))
[2] R. Dux, et al., Nucl. Fus. 44, 260 (2004)