# Z-DEPENDENCE OF LOW-Z IMPURITY TRANSPORT IN DIII–D*

M.R.Wade,† D.G. Whyte,Δ D.R. Baker, R.D. Wood,◊ and W.P. West
*General Atomics, P.O. Box 85608, San Diego, CA 92138-9784*

Experiments have been conducted on DIII–D to address the charge dependence of impurity transport of low-Z impurities and the variation of this dependence on confinement regime. These studies are motivated by the observation that the steady-state profiles of various low-Z impurities (helium, carbon, and neon) appear to be dependent on both the impurity mass/charge and confinement mode. For example, in L–mode and in ELMing H–mode plasmas, the concentration (relative to the electron density ) profiles of helium, neon, and carbon are all nearly constant over the entire plasma radius (i.e., the profiles are similar in shape to the electron density profile). In both of these cases, the electron density profile is peaked on-axis (albeit in ELMing H–mode the peaking is only moderate). However, in VH–mode plasmas, whereas the helium density profile continues to mimic the electron density profile shape, the carbon and neon profiles are distinctly hollow. In this case, the electron density profile is slightly hollow. The time evolution of the carbon and neon density profiles in a single discharge that has a L–mode, VH–mode, and ELMing H–mode phase clearly indicate that these profile changes are not consistent with a change in the impurity source at the edge and most likely are due to changes in the internal transport of the discharge. These observations suggests that a transition from anomalously dominated transport (with no Z dependence) to transport with neoclassical-like behavior is occurring as the confinement properties are improved.

To address these obvious differences in transport behavior of low-Z impurities, experiments to determine the transport coefficients (namely, particle diffusivity and convective velocity) have been carried out by introducing perturbative gas puffs of helium, nitrogen, and neon in L–mode, ELMing H–mode, and VH–mode plasmas. These experiments were carefully conducted so that direct comparisons between the various confinement modes should be possible. From these experiments, it is apparent from measurements of the decay time of the injected nitrogen that the impurity confinement time roughly doubles between L–mode and H–mode and then doubles again between H–mode and VH–mode, which is consistent with the increase in energy confinement. Results of the full transport analysis to determine the transport coefficients will be presented along with an attempt to compare the measured impurity fluxes with those predicted from neoclassical theory.

---

*Work supported by the U.S. Department of Energy under Contract Nos. DE-AC03-89ER51114, DE-AC05-84OR21400, and W-7405-ENG-48.

†Oak Ridge National Laboratory, Oak Ridge, Tennessee.
ΔINRS — Energie et Materiaux, Varennes, Quebec, Canada.
◊Larwrence Livermore National Laboratory.