

# Experimental diagnosis and kinetic computation of neutral penetration in the Alcator C-Mod edge plasma

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Neutral-plasma interactions are expected to have a significant influence on edge plasma conditions in the edge region of a tokamak plasma, and thus on global plasma confinement. In particular, the particle source from ionization should be considered in the study of plasma transport within the H-mode pedestal. On Alcator C-Mod, a tokamak that often exhibits edge gradient scale lengths on the order of millimeters, we measure profiles of electron density ( $n_e$ ) and temperature ( $T_e$ ) with high spatial resolution edge Thomson scattering and scanning Langmuir probes, giving the background profiles that determine neutral-plasma interaction rates. From these profiles and radial profiles of  $D_\alpha$  emissivity, obtained from measured images of edge emission, we infer atomic density ( $n_0$ ) profiles and the associated radial distribution of the ionization source rate ( $S_{ion}$ ). Using experimental variations in plasma density, we examine the changes in plasma neutral profiles under varied regimes of operation, and look for relationships between atomic mean free path and  $n_e$  pedestal width. Modeling of edge neutral transport is also performed. Because neutral mean free paths can be of the same order as characteristic density gradient scale lengths in the C-Mod edge plasma, we require a fully kinetic calculation of neutral particle transport. We employ KN1D, a kinetic solver for atomic and molecular distribution functions in slab geometry. The computation produces profiles of  $n_0$  and  $S_{ion}$  for given background plasma profiles, while accounting for all relevant interactions, including electron impact ionization and multiple charge exchange events. Benchmarking of the code is performed against the 2D Monte Carlo neutral transport code, DEGAS 2. Benchmark runs and comparisons of computational results with experimental data are presented and discussed.