Topic D	Requested: ☒ Oral ☐ Poster	Panel suggestion: ☐ Oral ☐ Poster

Spectroscopic Measurements of Ion Temperatures and Parallel Flows in the DIII–D Divertor*

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Ion temperatures and parallel flow velocities in the DIII–D divertor have been measured from the shapes and shifts of visible impurity and deuterium spectral lines. This study is motivated by a desire to verify experimentally the convective energy transport, with plasma flow velocities approaching Mach 1, predicted by energy balance considerations for the case of detached divertor operation in DIII–D.[1] These data will also contribute directly to studies of divertor impurity transport in a variety of operating conditions. Emissions from seven poloidal and five quasi-tangential views are recorded simultaneously using a 1.3 m Czerny-Turner spectrometer equipped with a CCD detector. Multiplet patterns from C II, C III, and B II are analyzed by comparing with theoretical profiles obtained from exact calculations for the Zeeman/Paschen-Back effect and the viewing geometry with respect to the magnetic field.[2] The poloidal views, which are essentially perpendicualr to the magentic field, are used to establish fiducial wavelengths for the signals from the quasi-tangential views from which the parallel flow velocities are obtained. Ion temperatures range from 5–20 eV. Flow velocities observed in the outer divertor leg are typically $0.5–1.0 \times 10^6$ cm/s whereas they are $1.0–3.0 \times 10^6$ cm/s in the inner leg; in all cases they are directed toward the target plate.

Bulk speeds less than 0.5×10^6 cm/s have been observed for deuterium atoms in detached plasmas, and analysis is underway to determine the extent to which they reflect deuteron flow. The D_α lineshapes from which such flows are inferred indicate the distribution function is isotropic in velocity space with respect to the flow velocity and that the temperatures are of the order of 1 eV, necessary conditions if the neutral particle radiation is representative of a recombining plasma. In contrast, the lineshapes from regions which are too hot for recombination to take place generally exhibit nonisotropic disributions as expected for atoms (or molecules) excited directly following release or reflection from the target plate. The existence of recombining regions during detachment is established from deuterium line ratios.[3]

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1A.W. Leonard, M.A. Mahdavi, *et al*., Phys. Rev. Lett. **78**, 4769 (1997).

2R.C. Isler,R.W. Wood, C.C. Klepper, N. Brooks, M.E. Fenstermacher, and A. Leonard, Physics of Plasmas **4**, 355 (1997).

3R.C. Isler, G.R. McKee, N.H. Brooks, W.P. West, M.E. Fenstermacher, and R.D. Wood, Physics of Plasmas **4**, 2989 (1997).