Impurity ion flow and temperature measured in a detached divertor with externally applied non-axisymmetric fields on DIII-D*

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The multichord divertor spectrometer (MDS) is used to study the relationship between impurity ion flows and detachment in the DIII-D divertor. Specifically, results will be presented which explore changes in the flows resulting from the use of non-axisymmetric fields in both attached and detached divertor conditions. These experiments were performed in edge localized mode (ELM)ing H-mode plasmas with the grad-B drift toward the target plates, with and without \(n=3\) resonant magnetic perturbations (RMPs). This work builds upon previous studies, which showed changes in the impurity ion flow velocity within the divertor during detachment in axisymmetric lower-single-null (LSN) discharges [1]. The spectrometer also provides measurements of the changes in impurity ion temperature and density, which occur under these conditions.

Understanding the role impurities, especially carbon, play in transporting and radiatively dissipating energy in these experiments is important for translating the detachment scenarios observed in DIII-D to devices with different impurity populations. Modifications to the ion flow structure are among the changes that are predicted to occur as a result of the presence of non-axisymmetric fields [3]. Comparisons of the flows and ion temperatures measured with and without applied RMPs are presented to facilitate comparisons between measurements and modeling of the divertor plasmas.

Measurements made with the MDS are also compared to those made using coherence imaging spectroscopy (CIS) [2], providing an important benchmark between the two techniques. The CIS technique provides two-dimensional flow patterns while the MDS data yield line-of-sight measurements. However, the emitting regions for a given ion tend to be localized enough that their coordinates can be determined by the Zeeman splitting of the spectral lines and correlated with the CIS analysis.


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