Effect of ion ∇B drift direction on density fluctuation poloidal flow and flow shear

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Abstract. The divertor magnetic geometry has a significant effect on the poloidal velocity and resulting velocity shear of turbulent density fluctuations in the outer region of L-mode tokamak plasmas, as determined via two-dimensional measurements of density fluctuations with Beam Emission Spectroscopy on DIII-D [J.L. Luxon, Nuclear Fusion **42**, 614 (2002)]. Plasmas with similar parameters, except that in one case the ion ∇B drift points towards the divertor X-point (lower single-null, LSN), and in the other case, the ion ∇B drift points away from the divertor X-point (upper single-null, USN), are compared. Inside of r/a=0.9, the turbulence characteristics (density fluctuation amplitude, flow direction, correlation lengths) are similar in both cases, while near r/a=0.92, a dramatic reversal of the poloidal velocity of turbulent eddies relative to the core flow direction is observed in plasmas with the ion ∇B drift pointing towards the divertor X-point. No such velocity reversal is observed in plasmas with the ion ∇B drift pointing away from the divertor X-point. This poloidal velocity reversal results in a significantly larger local shear in the poloidal velocity of density fluctuations in plasmas with the ion ∇B drift pointing towards the divertor X-point. Additionally, these plasmas locally exhibit significant dispersion, with two distinct and counter-propagating turbulence modes. Likewise, the radial correlation length of the density fluctuations is reduced in these plasmas, consistent with biorthogonal decomposition measurements of

dominant turbulence structures. The naturally occurring density fluctuation poloidal velocity shear in these LSN plasmas may facilitate the LH transition that occurs at an input power of roughly one-half to one-third that of corresponding plasmas with the ion ∇B drift pointing away from the X-point.