# Intrinsic rotation generation in ELM-free H-mode plasmas in the DIII-D tokamak, Part I — experimental observations

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A detailed description is presented of the experiment reported in [S.H. Müller *et al.*, Phys. Rev. Lett. **106**, 115001 (2011)], which reported the first measurements of fluid turbulent stresses in a tokamak H-mode pedestal. Mach probe measurements disclosed a narrow co-current rotation layer at the separatrix, which is also seen in some L-modes [J.A. Boedo *et al.*, Phys. Plasmas **18**, 032510 (2011)]. Independent evidence for the existence of the edge co-rotation layer is presented from main-ion rotation measurements by charge-exchange-recombination spectroscopy in comparable helium plasmas. The probe measurements are validated against density and electron temperature profiles from Thomson scattering and in terms of the measured turbulent particle transport, which is consistent with the global density rise. Non-diffusive non-convective angular momentum transport is required by two independent experimental observations: (1) A persistent dip in the rotation profile separates the edge layer from the evolving core region during intrinsic rotation development. (2) The rotation profiles with co- and counter neutral beam injection appear well described as the simple sum of a constant intrinsic part and the beam-driven part, also demonstrating the profile-independence of the intrinsic torque. Characteristics of the turbulent fluctuations composing the fluid turbulent stresses are discussed, demonstrating that the low amplitude of the Reynolds stress at the separatrix is due to weak correlations between the radial and toroidal velocity fluctuations. A suppression of the fluctuation amplitudes at the peak of the edge co-rotation layer is also observed.

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