Role of ExB Shear/Zonal Flow and Rational q in ITB Formation*

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A recent experiment was carried out on DIII-D to further investigate the effects of low-order rational q, ExB shear, and zonal flows on transport. Experiments were conducted in negative central shear (NCS) discharges with different mixes of co/counter neutral beam injection which varied the equilibrium ExB shear in conditions where transient improvements in transport are observed near integer q_{min} values. Although in balanced injected discharges the ExB shear was much lower than the co-injected shots, zonal flow signatures and jumps in T_e, T_i, and v_ϕ were seen at integer q crossings at q_{min}=3 and q_{min}=2. No internal transport barrier formation was seen in the balanced cases while a typical transition to improved core confinement was observed in the co-injected plasmas. The data obtained support the model that sufficient background ExB shear is required for barrier formation and zonal flow effects at integer q_{min} act as trigger in this case. A large set of fluctuation data was obtained. Significant observed turbulence poloidal velocity excursions and reductions in turbulence levels are evidence of large zonal flow structures near rational q surfaces in NCS discharges.

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