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Transport with Reversed Shear in the National Spherical Torus Experiment[1]

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In NSTX plasmas with strongly reversed magnetic shear ($dq/dr < 0$) in the plasma core we can observe a marked improvement in electron confinement compared to otherwise similar plasmas with positive or only weakly reversed shear. The shear profile is determined by the early evolution of the plasma current, the plasma cross-section, and the neutral-beam heating power. Although the q-profile is sensitive to the development of MHD instabilities during the current ramp, once established, the strongly reversed shear can be maintained for periods greater than 0.2 s. In the region of shear reversal, the inferred electron thermal diffusivity can be significantly reduced. Detailed experimental investigation of this phenomenon has been made possible by the successful development of a motional Stark effect (MSE) polarimetry diagnostic suitable for the low magnetic field in NSTX, typically 0.3 – 0.5 T. This innovative system currently measures the magnetic field line pitch at 12 locations over a region extending from the plasma center to near the outboard edge of the plasma. Several of the unique features of this system will be highlighted. Measurements of the electron and ion temperature, density, and plasma toroidal rotation profiles are also available with high spatial and temporal resolution. Integrated analysis of these data with equilibrium, transport, and stability codes has been performed to assess the results in terms of theoretical models for the turbulence postulated to be responsible for anomalous transport.

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