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Theory of the Poloidal Spin-up Precursor to Transport Barrier Formation[1] G.M. STAEBLER, General Atomics — The phenomenon of a sudden change in the poloidal flow prior to the reduction in transport and the steepening of temperature and density profiles has been observed both at the edge (high-modes) and in the core (enhanced reversed shear (ERS-modes) of tokamaks. The poloidal spin-up precursor is narrowly localized in the (radial) direction across magnetic flux surfaces. Although the reduction of turbulent transport is consistent with the theory of $E \times B$ flow shear suppression, the localized poloidal spin-up precursor has not been explained by the theory until now. It will be shown that the observed flow pattern is well described by a new class of bifurcation to the momentum balance equations. The new physics follows from extending the standard neoclassical theory of poloidal flow damping to include the turbulent viscous stress. The new bifurcation results from balancing the non-linear turbulent viscous tress with the linear poloidal flow damping due to the neoclassical parallel viscous stress. The new bifurcation results in a mono-polar $E \times B$ flow structure (with a large poloidal component) which is narrowly localized in the radial direction. The peak in the flow is shown to reduce and finally disappear as the diamagnetic velocity shear increases.

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