Fusion Turbulence without a Toroidal Magnetic Field\textsuperscript{1} M.E. MAUEL, Columbia University, J. KESNER, MIT Plasma Science and Fusion Center — Three decades since Surko and Slusher\textsuperscript{2}, fusion scientists have achieved tremendous progress understanding driven turbulence and turbulent transport in tokamaks. Nonlinear gyrokinetic theory provides a workable formalism for simulating gradient-driven turbulent transport, and recent validation studies in high-power reactor-relevant regimes show important areas of agreement. The new application of nonlinear gyrokinetic theory to toroidal magnetic confinement without a toroidal magnetic field is an important opportunity to extend the reach of turbulence models used for magnetic fusion to different geometries, to higher beta plasmas ($\beta \sim 1$), and to plasma confined in magnetospheres. Magnetic geometry strongly influences turbulent mixing, and low-frequency fluctuations are entirely field-aligned for a toroidal plasma confinement by a purely poloidal field. Fusion turbulence without a toroidal field eliminates coupling between parallel streaming and perpendicular decorrelation, drives either a particle pinch or a thermal pinch\textsuperscript{3}, and exhibits 2D dynamics and the inverse energy cascade\textsuperscript{4}

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\textsuperscript{2}Surko and Slusher, \textit{Science} \textbf{221}, 817 (1983).
\textsuperscript{4}Grierson, \textit{et al.}, \textit{Phys Plasma} 16, 55892 (2009)