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Turbulence and selective decay in the SSX plasma wind tunnel[1]
TIM GRAY, MICHAEL BROWN, DAN DANDURAND, MIKE FISHER, KEN FLANAGAN, DARREN WEINHOLD, Swarthmore College, V LUKIN, NRL — A helical, relaxed plasma state has been observed in a long cylindrical volume. The cylinder has dimensions $L = 1$ m and $R = 0.08$ m. The cylinder is long enough so that the predicted minimum energy state is a close approximation to the infinite cylinder solution. The plasma is injected at $v \geq 50$ km/s by a coaxial magnetized plasma gun located at one end of the cylindrical volume. Typical plasma parameters are $T_i = 25$ eV, $n_e \geq 10^{15}$ cm^{-3}, and $B = 0.25$ T. The relaxed state is rapidly attained in 1–2 axial Alfvén times after initiation of the plasma. Magnetic data is favorably compared with an analytical model. Magnetic data exhibits broadband fluctuations of the measured axial modes during the formation period. The broadband activity rapidly decays as the energy condenses into the lowest energy mode, which is in agreement to the minimum energy eigenstate of $\nabla \times \vec{B} = \lambda \vec{B}$. While the global structure roughly corresponds to the minimum energy eigenstate for the wind tunnel geometry, the plasma is high beta ($\beta = 0.5$) and does not have a flat λ profile. Merging with plasma plumes injected from both ends of the cylinder will be compared to the non-merging plasmas.

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