

**Abstract Submitted for the Forty-Ninth Annual Meeting  
Division of Plasma Physics  
November 12–16, 2007, Orlando, Florida**

Category Number and Subject: 7.6.3 Plasma Control Systems

[ ] Theory [X] Experiment

**Tokamak Plasma Equilibrium Controllability Limitations Due to Delays,\*** D. Sondak, E. Schuster, *Lehigh U.*, M.L. Walker, *GA* – When designing the control loops for tokamaks, it is important to acknowledge the effects of time delays. An assumption which is sometimes made is that if the system open loop response is intrinsically slow, due for example to substantial vessel shielding or to the imposition of limits on rate of change of control currents, then extra time delays which are individually shorter than these will not have significant undesirable effects on control. However, because delays and phase lags are in general cumulative in effect, this assumption is typically incorrect. This study examines and quantifies these effects in the axisymmetric control loop in superconducting tokamaks, for the case of plasma current control, radial and vertical position control, and plasma boundary control. Delays in the power supplies, data acquisition, and vessel structure are taken into account. Methods for remediating the negative effects due to time delays are also presented.

\*Supported by the Pennsylvania Infrastructure Technology Alliance (PITA), the NSF CAREER award program (ECCS-0645086), and the US DOE under DE-FG02-92ER54141, and DE-FC02-04ER54698.