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Measurements of Energy and Helicity Cascades, Relaxation Rate, and Ion Temperature in HIT-SI A.C. HOSSACK, J.S. WROBEL, T.R. JARBOE, D.A. ENNIS, C.J. HANSEN, G.J. MARKLIN, B.A. NELSON, R.J. SMITH, University of Washington — Inverse cascades of magnetic helicity to lower toroidal modes and cascades of free energy to higher modes are observed in the HIT-SI device. Measurements from surface magnetic probes show that the helicity injectors initially couple to an n= 1 eigenmode of the confinement volume and the helicity in this mode subsequently decays to the $n = 0$ minimum energy spheromak state. Thus helicity follows an inverse-cascade to lower λ but magnetic energy released in the relaxation process follows a normal cascade to higher toroidal modes. The time delay between the predicted peaks in toroidal current assuming instantaneous relaxation and the actual toroidal current peaks as measured by the surface probes is a measure of the relaxation time. The relaxation time is measured to be 4.2 +/- 2.8 microseconds, much faster than the Sweet-Parker relaxation time of 60 to 100 microseconds. A Doppler spectrometer measures impurity ion temperatures in excess of 50 eV during recent deuterium operations, a significant increase from 20 eV with helium discharges. Work supported by USDoE.

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