**Magnetothermodynamics: Measuring the equations of state in a relaxed MHD plasma for magneto-inertial fusion**[1] MANJIT KAUR, L. J. BARBANO, E. M. SUEN-LEWIS, J. E. SCHROCK, A. D. LIGHT, Swarthmore College, D. A. SCHAFFNER, Bryn Mawr College, M. R. BROWN, Swarthmore College — The estimation of the equations of state (isothermal or adiabatic) for any set-up is necessary to envisage its behavior as the theoretical models and numerical simulations rely on them. In this talk, we will present compression experiments in which we generate parcels of magnetized, relaxed plasma (called Taylor states[1]) and compress them in a closed volume. We call these experiments magnetothermodynamics. The compressed plasma parameters are measured in a compression volume and a PV diagram is produced which shows ion heating during plasma compression. The magnetohydrodynamic and the double adiabatic (i.e., Chew, Goldberger and Low) equations of state are tested under several experimental conditions. The results from these experiments show that the parallel component of double adiabatic equation of state fit our data best. The compression of this magnetized, relaxed plasma is being investigated as an eventual target for magneto-inertial fusion reactors. [1]Gray *et. al.*, Phys. Rev. Lett. 110, 085002 (2013)

Manjit Kaur
Swarthmore College

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