Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Thermal Design of a Bitter-Type Electromagnet for Dusty Plasma Experiments: Prototype Design and Construction W.J. BIRMINGHAM, E.M. BATES, CARLOS ROMERO-TALAMÁS, W.F. RIVERA, Univ of Maryland-Balt County — For the purpose of analyzing magnetized dusty plasma at the University of Maryland Baltimore County (UMBC) Dusty Plasma Laboratory, we are designing a resistive water cooled Bitter-Type electromagnet. When completed, the magnet will be programmable to generate fields of up to 10 T for at least 10 seconds and up to several minutes. An analytic thermal design method was developed for establishing the location of elongated axial cooling passages. Comparisons with finite element analysis (FEA) data reveals that the thermal design method was capable of generating cooling channel patterns which establish manageable temperature profiles within the magnet. With our analytic method, cooling hole patterns can be generated in seconds instead of hours with FEA software. To further validate our thermal analysis as well as manufacturing techniques of our magnet design, we are now constructing a prototype electromagnet. The prototype is designed to operate continuously at 1 T with a current of 750 A, and has four diagnostic ports that can accommodate thermocouples and optical access to the water flow. A 1.25 inch diameter bore allows for axial field measurements and provides space for small scale experiments. Thermal analysis and specifics of the electromagnet design are presented.

William Birmingham
Univ of Maryland-Balt County

Date submitted: 24 Jul 2015 Electronic form version 1.4