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Experimental Validation of an Electromagnet Thermal Design Methodology for Magnetized Dusty Plasma Research W. J. BIRMINGHAM, E. M. BATES, C. A. ROMERO-TALAMS, W. F. RIVERA, University of Maryland, Baltimore County — An analytic thermal design method [1] developed to aid in the engineering design of Bitter-type magnets, as well as finite element calculations of heat transfer, are compared against experimental measurements of temperature evolution in a prototype magnet designed to operate continuously at 1 T fields while dissipating 9 kW of heat. The analytic thermal design method is used to explore a variety of configurations of cooling holes in the Bitter plates, including their geometry and radial placement. The prototype has diagnostic ports that can accommodate thermocouples, pressure sensors, and optical access to measure the water flow. We present temperature and pressure sensor data from the prototype compared to the analytic thermal model and finite element calculations. The data is being used to guide the design of a 10 T Bitter magnet capable of sustained fields of up to 10 T for at least 10 seconds, which will be used in dusty plasma experiments at the University of Maryland Baltimore County. Preliminary design plans and progress towards the construction of the 10 T electromagnet are also presented.
[1] W. J. Birmingham, E. M. Bates, and C. A. Romero-Talams, J. Thermal Sci. Engr. Appl. 8, 021008 (2015)

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