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Cooling System Design for a Split High Field Bitter-type Electromagnet WILLIAM BIRMINGHAM, EVAN BATES, CARLOS ROMERO-TALAMAS, WILLIAM RIVERA, University of Maryland, Baltimore County — For the purpose of analyzing magnetized dusty plasma at the University of Maryland Baltimore County (UMBC), we are designing a split resistive electromagnet. When completed, the magnet will be capable of generating fields of 10 T for 10 seconds. The type of design proposed here was originally developed by Francis Bitter, and achieves high magnetic fields by helically stacked disk-shaped solenoids with axially oriented cooling channels. In order to ensure the safety and functionality of the apparatus, the geometry and placement of the cooling passages must be designed to establish a manageable temperature profile throughout the coil. The estimated power consumption from resistive losses is nearly 7 MW, thus it is imperative to optimize the cooling capacity of the system. The cooling capacity is limited by the mass of chilled water available at one time and the maximum achievable mass flow through the coils. The system is also designed to withstand the resultant mechanical stresses from the Lorentz force. Slot-shaped cooling channels are used. The number and placement of these channels is optimized through an iterative and integrated design process which combines analytic calculations with finite element analyses. The methodology and results of the design process is presented.

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