

A magnetic coil levitation simulator for physics exploration

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Abstract. A first-principle, axisymmetric, eddy current model of a coil levitated above a conducting surface has been developed and is available for free download in MS Excel spreadsheet form for use in physics classrooms and experimental lab settings. The model can predict the performance and scaling laws for various coil and conducting surface configurations. The typical coil configuration consists of a multi-turn, circular coil and several solutions are presented. This model was developed for the General Atomics Fusion Educational Outreach Program* for use in a “Build-it Day” program in which teachers analyze and construct equipment, including a levitating coil, for use in physics classes. Typical user inputs include wire gauge, material conductivity, coil diameter, applied voltage, and number of turns. Some variables can be optimized to satisfy the levitation force balance equation. A thermal sub-model provides an estimate of the coil temperature rise and ultimately dictates the capability of an inertially cooled coil system. The eddy current formulation is general in its architecture and can be used for other complex eddy current simulations.

* DOE Grant Number DE-FG02-97ER54402