Ph 78/79 @ Caltech

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Project Title (can be changed later): The Neutron EDM project: B_0 magnet construction and characterization

Is this an Experimental (Ph 78) or Theoretical (Ph 79) project?: Experimental Ph 78
If Experimental, will you be using Ph 78 as a substitute for Ph 77ab?: Yes, I will be using it as a substitute.

Is this project a continuation of a SURF or other research project (yes/no)?: No.

Brief Project Description: (Please fit entire document on one page; okay to reduce font size as needed. *Return .pdf files only*):

I will be working on a component of the neutron electric dipole moment (nEDM) project, which has been in progress for many years now. The central element of the experimental apparatus is a large cryogenically cooled vessel containing multiple magnets and layers of shielding to control the fields applied to the neutrons and liquid helium inside. I will be working on constructing and characterizing the main "B_0 magnet," which is a cylindrical structure approximately eight feet high and five feet wide that will generate a uniform field throughout the inside of the apparatus. Our goal is to be able to demonstrate uniformities in the field up to ~5ppm/cm.

The construction phase will involve mechanical assembly, electrical connections, a vacuum demonstration, and cryogenic cooling to <7 K. The magnet will have three layers of electromagnetic shielding: copper, superconducting lead, and metglas. The shielding will create boundary conditions that improve the uniformity of the field and protect against external AC magnetic fields. Once assembly is finished in December, we will test the effectiveness of the shields and then perform the first cooldown and take field measurements. Then, we will open up the vessel, make necessary changes to the magnet, and perform a second cooldown and measurement campaign in February.

Data collection and analysis will consist of measuring B-field vs. position throughout the interior of the apparatus at different temperatures, and then performing Maxwell guided fits on the data to recreate the shape of the magnetic field. We will also need to characterize and correct for background fields in the fitting. By March or April, the entire cryogenic vessel and the B_0 magnet will be shipped to Oakridge National Labs, where the nEDM project will be taking place.