

From Professor Baessler:

“Peter Winter, one of my collaborators from Argonne National Lab, will have a undergraduate research project, which he describes as follows:

Precision calibration of Nuclear Magnetic Probes for the Muon g-2 experiment

The new Muon g-2 experiment at Fermilab will precisely determine the anomalous magnetic moment, g-2, of the muon, the big cousin of the electron. This quantity is very sensitive to virtual particles and is therefore a very sensitive probe in detecting new physics and particles. The experiment uses muons stored in a 45-m long ring magnet and requires the determination of both the spin precession of the muons and the measurement of the magnetic field. As we are aiming at the very challenging precision of a few tens of one part in a billion (ppb), the key is in understanding tiniest detector effects that could distort the result.

At Argonne National Laboratory, we are responsible for measuring the magnetic field. For that purpose, we have established a former hospital, human MRI magnet that will be used to precisely characterize and calibrate our Nuclear Magnetic Resonance (NMR) probes. We will need to compare the field measurement of different probes and determine the influence of external parameters such as bias voltages or temperature. This project will include the development of the proper hardware setup to precisely align the probes and perform the calibration measurements. The recorded NMR signals need to be analysed and hence suitable analysis algorithms need to be written (e.g. fits of the time spectrum, Fourier transform methods). Variation of the external parameters in a controlled way will further lead to the understanding of tiny effects at the tens of ppb level. The project offers hands on experience with hardware, software and analysis.

The SULI project application involves a generic expression of interest (i.e. “Want to work at Oak Ridge National Lab in Nuclear or High Energy Physics”). Research advisors from this lab select from a list of students that are accepted into the program, one (or more) of whom they want to contact with a specific offer describing a particular research project. That is, if you are the student who is applying, you do not really know for what until you are getting the offer.”