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Towards a Measurement of Vacuum Magnetic Birefringence with ALPS II

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The vacuum magnetic birefringence (VMB) effect is a long-standing prediction of quantum electrodynamics (QED) that has yet to be observed in a laboratory setting. The ALPS group at DESY intends to measure this elusive phenomenon for the first time by leveraging the unique infrastructure of the ALPS II experiment. The setup will measure the differential optical path length between two orthogonally polarized laser beams as they traverse a modulated magnetic field generated by 24 superconducting dipole magnets. To amplify the expected signal, a 250-meter-long high-finesse optical cavity will be employed. With over 200 meters of 5.3 T magnetic field, this configuration can achieve an expected VMB signal strength orders of magnitude larger than previous experimental effort. Reaching the sensitivity required to observe the QED-predicted birefringence would represent either a landmark confirmation of QED or an indication of physics beyond the Standard Model. Here, I will present our ongoing characterization of birefringence noise in our control and readout scheme using a 19-meter test cavity and outline the forthcoming steps towards a full VMB measurement with the ALPS II magnet string.

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