PR12-20-011

Scientific Rating: A-

Recommendation: Approved

Title: Measurement of the high-energy contribution to the Gerasimov-Drell-Hearn sum rule

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Motivation: The Gerasimov-Drell-Hearn sum rule relates the integral over the doubly-polarized spin-dependent photo-production cross section off a hadron to the anomalous magnetic moment of the hadron. It may be derived in dispersion theory, where it rests on fundamental concepts such as causality, unitarity, Lorentz and gauge invariance, as well as on a "no-subtraction'' hypothesis. Whilst the integral runs all the way to infinitely large photon energy, experimental studies at LEGS, MAMI, and ELSA have so far been limited to 2.9 GeV. The proposal extends the exploration of the high-energy regime to 12 GeV. The measurement would provide valuable information on Regge phenomenology in the polarization domain in this energy range. This is well motivated and uniquely possible at JLab. An experiment planned for the 6 GeV program did not run.

This experiment will enrich the physics program of Hall D, in particular by using a polarized target. As such, the proposal is strongly endorsed by the GlueX collaboration.

Measurement and Feasibility: The experiment is to run in Hall D with a circularly polarized photon beam generated by polarized electrons impinging on a radiator. It will run in two configurations, which require two different CEBAF beam energies with 21 PAC days at the nominal CEBAF energy and 12 PAC days at an energy 1/3 to 1/2 of the nominal one. It is planned to measure photo-production off protons as well as off deuterons, so that also the neutron GDH integral could be tested. The proponents have decided to use the FROST target design, due to its easier operation and higher neutron polarization. A new version of the target will need to be built. The Hall D detection system is well suited for this measurement, thanks to its large solid angle.

Issues: The TAC report notes that the experiment is quite demanding, but that no real show-stopper has been identified. The PAC agrees with this statement. In addition, the polarized target infrastructure may be re-used in other physics programs at JLab.

Summary: The PAC recognizes the strong science case for this proposal, and recommends running with the full beam time requested in the proposal.