Proposal # **PR12-20-011** for **PAC48** **Hall: D**

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

Contact person: Alexandre Deur (JLab)

Beam time:

Beam days requested: 33
Detector commissioning time included in request: not specified

Base Equipment

Beam parameters:

Energy:	~12 GeV	yes
	<6 GeV	no
Current:	0.25 μA	yes
Polarization:	e- longitudinal	no
Emittance:	similar to GlueX	yes
Bunch spacing	2 or 4 ns	yes
Radiator:	0.002%	yes
Collimator:	5 mm	yes

Targets:

H, D:	Polarized butanol (FROST-type)	no

Spectrometers:

Hall D	standard	yes

New elements : polarized FROST-type target; beam helicity distribution hardware.
Comment about the text: In the text one can see several formulas as N+ - N- = $\Delta\sigma$, where **N+** and N- are the count numbers measured with particular helicities and $\Delta\sigma$ is the difference of cross sections. The beam polarization factor is not shown explicitly, but is implied.

New systems and conditions:

1. **Electron beam:** The experiments requires a longitudinally polarized electron beam. Without an electron polarimeter located somewhere in front of the radiator one has to rely on Mott measurements in the injector and calculations of the spin precession in the machine. The latter strongly depends on the beam energy, in particular if the experiment is not scheduled to run with the full beam polarization. Polarization measurements in other halls may help. The polarization stability over extended time periods may become a problem. New hardware needs to be installed in order to provide Hall D with the helicity signal from the accelerator.
2. **Low energy running:** The experiment will strongly benefit from running at an energy <6 GeV, which will allow to match the results with the existing data. It can be done by running the accelerator at low energy. Such running has taken place for other halls, at a small number of passes. A potential problem at low energies is the calibration of the

magnets in the Hall D beam extraction line. Such special conditions may require a considerable setting time and a one-hall operation for the duration requested (about 11 days)

3. **Polarized target:** The target group in ENP has built and operated similar targets. Building a new one would require considerable resources and may be justified if a wider physics program for such a target exists.The polarized target cell 10 cm long will be located in the Hall D solenoid, where the field is about 1.6T and the field gradient along Z is about 0.005T/cm. According to the target group such a gradient should not impact the target polarization measurements and other procedures.
4. **Detectors:** No significant change with respect to the GlueX configuration or operation is proposed.

Summary:

The experiment requires a new FROST-type polarized target. Jlab has built and used such targets successfully. Building, installing and operating such a target would require a considerable effort. The experiment will need to use the longitudinal electron beam polarization, which has not been used so far. The results will depend on polarization measurements at the injector. The experiment requires to run at the full beam energy, but also at a low beam energy. Such running of Hall D has not been tested yet. Although the experiment is quite demanding, no real showstopper has been identified. The investments may be reused in case a broader program for polarized targets in Hall D has been developed. The proposal has been endorsed by the GlueX collaboration after passing an internal review.