

C12-12-002

Scientific Rating: A

Recommendation: Approve

Title: A study of decays to strange final states with GlueX in Hall D using components of the BaBar DIRC

Spokesperson: Curtis Meyer

Motivation: This proposal is an extension of the already approved GlueX experiments on meson spectroscopy. For the proposed running, the detector system will be crucially extended by adding a forward Cherenkov particle identification system to enable especially kaon identification at high momenta (3σ K/ π separation up to ~ 4 GeV/c). Without such a system the GlueX program cannot be successfully pursued without severe restrictions. Therefore, PAC 40 strongly encouraged the GlueX collaboration to move forward with the design of such a system and aim at an early installation. The mapping of the spectrum of conventional and exotic hadrons will ultimately require the implementation of a dedicated particle ID system in the forward direction. Kaon identification is essential for resolving the flavor composition of meson states and is needed to allow for a systematic (coupled channel) amplitude analysis of many different hadronic final states to be really able to map out the spectrum of hybrid as well as of conventional mesons (addressing e.g. whole exotic multiplets and not only a single state). The planned investigation of cascade baryons will also profit from the new detector capabilities. The proposal was already given conditional approval in PAC39, conditional on the final design of the particle ID system.

Measurement and Feasibility:

The second stage (named stage IV) of the experiment was approved by PAC40 as E12-13-003 (200 days at an average intensity of 5×10^7 tagged photons/s on target), including the implementation of a level-three trigger based on a new computing farm. This running will provide an increase in statistics by a factor 10 over the initial GlueX running. The collaboration showed that this increase in statistics, coupled with a sophisticated multivariate analysis, allows the production of 10^4 events per 10 MeV/c² mass bin while keeping the background contamination within 10%. The PAC40 proposal was based on the baseline GlueX setup only.

With the present proposal, a design of a Cherenkov PID detector for Hall D is put forward, as requested by PAC39 and again strongly encouraged by PAC40. The design is based on the BaBar DIRC bars, which are available to the collaboration. Including the independent DIRC information into the multivariate analysis provides a high discrimination power and significantly improves the purity of the data samples, and therefore their sensitivity on the contributing amplitudes. Purities of 90% reached in simulations without the DIRC can now be pushed to 99% for several final states and to better than 95% in nearly every case. The latter increase would lead to a sensitivity increase of a factor of 2, the former to a factor of 9, which is a large step forward toward a better understanding of the hadron spectrum.

Issues: The design is viable but R&D is still required. It needs to be decided whether the DIRC can be mounted vertically and whether the new technology of micro-channel plates is usable for light detection or whether the more conservative and more expensive solution of multi-anode PMTs needs to be chosen.

The PAC strongly encourages the GlueX-collaboration to work with the JLab Physics Division for an optimization of the FDIRC-readout and the time schedule.

Recommendation: Approve

GlueX is the flagship experiment in Hall D; the physics motivation for the proposed running is very sound. The motivation for the hardware extension is very obvious to reach the physics goals of the experiment and is strongly supported by the PAC.