JEF Plan for PAC44

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PAC42 Comments

Issues: The proposal was considered by PAC 39 (as PR12-12-003) and PAC 40 (as PR12-13-004) and deferred in both cases. The PAC understands the very strong scientific interest of performing new measurements of rare η decays with improved sensitivity to test the SM. In particular, the PAC sees the determination (iv) of Q from the $\eta \rightarrow 3\pi$ decay ratio and the Dalitz distribution as the most compelling physics result and recommends to perform this measurement as a run group with GlueX and experiment PR12-10-011 (which is approved to measure the $\eta \rightarrow 2\gamma$ decay width via the Primakoff effect). This part of the proposal can be performed with the existing calorimeter (FCAL) used by GlueX.

The other three physics goals (i)-(iii) will need the FCAL-II, which will mean a major investment in various kinds of resources. The PAC recognizes that (as was requested) compatibilities and synergies with GlueX were addressed in the resubmitted proposal and that the physics case was further refined. However, the physics of FCAL-II was considered too speculative to displace the GlueX program. Of course, the impact of a discovery in the proposed channels would be enormous; so as not to prevent these studies from running in the near future, we therefore ask that FCAL-II and the associated JEF physics program be fully incorporated to run in parallel with GlueX. We have thus given the experiment a C2 rating: approval of the physics case with the condition that JEF return to a later PAC with a convincing demonstration of their capabilities for running concurrently with GlueX. We ask that the experimenters include all approved phases of GlueX in their simulations, including JEF compatibility with the newly approved DIRC detector. In this way, the opportunities presented by the much higher-resolution FCAL-II for the wider GlueX program including the Primakoff-η experiment can be quantified and run times optimized.

It was also pointed out in the proposal that there is ongoing theory work on both the SM test parts (i) and (ii) and the physics regarding chiral perturbation theory (iii). We approve these parts of the proposal under the conditions that (i) it is demonstrated that they can run simultaneously with the approved GlueX program (this should in particular include an estimate of the background due to the higher coincidence rate) even when the expected DIRC bars will be installed, and (ii) that the theory motivation is sharpened further. The PAC would also like to see more details on the envisioned program on η' decays.

PAC42 Recommendation

Recommendation: **C2 conditional approval**
The proposed experiment exploits the unique capabilities provided by Hall D to improve on the measurements of dominant and rare η decay modes. However, in order to optimize the impact of the FCAL-II, an evolved proposal should be formulated that demonstrates the physics reach of the new device when operated in parallel with the approved GlueX program.

Activity	Responsible persons	Targeted due date
Setup Monte Carlo simulation programs including FCAL-II	Sasha and Ilya; Simon	Nov 15
4γ background simulation With (and without) DIRC detector	Sasha, Zhenyu and her students	Feb 1 (collaboration meeting: Feb 16-18)
Optimize background suppression with GlueX data and comparison with PYTHIA	Simon	Feb 1
Motivation for FCAL-II	Dave	Dec 1
Extension to eta’	Dave	Jan 15
Theory update	Liping	Jan 15
Draft proposal	Liping and Dave	Mar. 31
Final proposal	Liping and Dave	May 1