Roma, October 29th 2018

To: CLAS Coordinating Committee

Object: RGK experimental program with 2018 data taking – expected impact of additional 7 calendar days of data taking in 2019.

Main facts.

Recently a message of the JLab Director officially announced a run schedule change for 2018, due to the five weeks of delay in the recovery of CEBAF operations.
In the original schedule, 21 + 7 calendar days were planned at 7.5 GeV and 6.5 GeV, respectively and Run Group K (RGK) opportunistically accepted to use them, anticipating some of the approved PAC time.
The new schedule foresees a total of 11 + 7 calendar days of running at lower energies, corresponding to a non-negligible reduction of 10 calendar days at 7.5 GeV.
In the view of a possible data taking extension in spring 2019, RGK could aim to access additional 7-10 calendar days, to compensate for the 2018 schedule change.

Expected physics outcome of 2018 RGK run.

The aim of the first RGK data taking is multifold; the first days would be dedicated to:

1. The optimization of data acquisition parameters (thresholds and calorimeters energy windows) to obtain sustainable rates in both low and medium-high W kinematical regions;
2. The commissioning of a new dedicated trigger including one electron in the FT, one forward and one central charged particle;
3. The validation of exclusive events reconstruction efficiencies, projected by Monte Carlo studies.

The production runs are focused on:

4. exclusive reaction channels for baryon spectroscopy studies;
5. first DVCS events at energies lower than 10.8 GeV.

Expected statistics

Golden Channel: according to Monte Carlo studies, detection efficiencies of 5 - 10% are expected for $K^+\Lambda$ events in the low Q^2 and the high Q^2 regions (corresponding to scattered electrons detected in the Forward Tagger and in the CLAS Forward Carriage, respectively).
Assuming a luminosity of 7 10^{34} cm^{-2} s^{-1}, and considering a total cross section of 9.7 nbarn, integrated in the kinematical range [0.08 GeV^2 <Q^2 <2 GeV^2 - 1.6 GeV<W<2.5 GeV – 2.5< θ_e<22], the rate of reconstructed $K^+\Lambda$ events we expect obtain is about 10 events per second, corresponding to 10^5 events/day, which correspond to about 200 events/day in a (W-Q^2-θ_k) 8x8x8 binning.
Other exclusive channels as $\pi^-\pi^+$p are expected to count between 10 and 50 times more.

While the preliminary statistics foreseen in 3.5 PAC days it is not expected to be sufficient for a publication on the $K^+\Lambda$ golden channel, other exclusive channels, such as $\pi^-\pi^+p$, ωp, etc. may still provide enough statistics for a publication, even if their analysis is not expected to be completed in the shortest time.

Combination of data at different energies.
Combining results obtained at different energies requires a non-trivial simulation effort to control absolute efficiencies and background suppression, especially in the case of DVCS analysis.

RGK is expected to access to additional 47 PAC days at both 6.4 GeV and 8.5 GeV in the upcoming years and it would benefit from continuous periods of run at the same experiment setting, to minimize the systematic errors due to combining data from data acquisitions, distant in time, where the CLAS12 detector response may sensibly differ.

Energy change problems.
The option of using 7-10 calendar days in March to compensate for the 10 calendar days poses the additional question of the overall data taking efficiency when the number of passes is changed during the run. Considering 1 calendar day loss for the energy pass change, and 1-2 days of beam and DAQ optimization runs, the effective production run days would likely reduce from 3.5 PAC days to 2 PAC days, for which the new acquired statistics with a different experimental set-up is likely to be insufficient for any physics impact.

Possible trade-off with RGA for overall data taking optimization
A possible beam-time trade-off with RGA would be to start implementing and commissioning the RGK additional trigger [1 electron in the FT + central hadron (CTOF-CND coincidence) + 1 forward hadron] as soon as possible during the November RGA runs and leave the additional March week shifts to RGA.

For run group A this trade would require 1-2 calendar days dedicated to trigger studies during RGA time in November, fully compensated by additional 7 calendar days in March.
For run group K this solution would minimize the time dedicated to DAQ optimization in the November /December runs, approximately gaining the expected 2 PAC days of data taking.

Best Regards,

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For the RGK