REVIEW OF THE CLAS-ANALYSIS 2007-117

COMMITTEE: ANGELA BISELLI (CHAIR), VALERY KUBAROVSKY, AND CARLOS SALGADO

1. General comments

(1) The note needs much more explanations on the basic physics behind the analysis. e.g. Feymann diagrams, exchanges expected in the basic reactions, theoretical predictions for cross section, masses, branching ratios. Is the analysis checking any model in particular? In summary the introduction is too short and imcomplete. How good is the mass value for the Φ^{--}? Should the search be done in a larger range?
(2) The descriptions of the data reduction, PID, energy loss and momentum corrections are extremely short and incomplete. There are only 8 pictures with absolutely no details about the quality of the data analysis. I believe that the experimental group made a great job and made analysis very carefully. However it was not reflected in the written analysis note.
(3) The committee thinks that to better believe upper limit for the Φ^{--} cross section, the authors must cross-check their analysis with a standard resonance. e.g. measure a cross section of a resonance among their data (using their analysis, acceptance corrections...)and compare it with previous measurements.
(4) The committee would like to see more explanations about the basic event structure of the initial sample and biases (or not) introduced by basic cuts and triggers. e.g. what are the event multiplicities, kinematic distributions, and how these compare to the simulations distributions
(5) Is there any significant enhacement about 1.92 GeV in figure 13b?

2. Specific comments

(1) abstract: "do not show any statistically significant enhancement" Was there any statistical test done to test the hypothesis of an enhacement? I guess it could be one below your 200 pb limit? Re-phrase.
(2) Page 4, paragraph 1, line 13 Trigger bit 6 had very complicated structure as described in the note. I checked with Sergey the eg3 trigger file and found that in fact the trigger demanded just 3 sectors in coincidence. This may lead to the significance problem in the analysis due to the incorrectly calculated acceptance. It means that all cross section upper limits are wrong. This issue has to be carefully tested.
(3) Page 4: The triggers seems to be highly selective. Have they been simulated? Do we understand their biases?

(4) Page 5: Why the cut on the Λ is done on both M_c and M_u (energy loss corrected and uncorrected invariant masses) and not just the corrected value?
(5) Page 6, paragraph 1, line 6 The cut +/- 1 ns for the proton and pion vertex time is very stringent. It is true that in average the TOF time resolution is about 200 ps (for protons closer to 300 ps). However it degrades significantly (up to 1 ns) with the increasing paddle number especially for protons. More over the average difference between TOF and RF moves from the zero value as well. It will be nice to produce the proton-pion time difference for individual proton paddles. It has to be investigated.
(6) Page 6, paragraph 1 DOCA cut is used very extensively in this analysis. I think that it is necessary to investigate the DOCA distribution in different regions of the phase space, for example as a function of the θ angle. Usually this distribution has long tails that may be difficult to reproduce in the MC program. it would be nice to make an analysis with MC events as well to make sure that the systematics is under control.
(7) Is it possible to have more details on how DOCA is calculated and defined?
(8) Page 6, Equation (2): It is not clear how the parameters in the denominator of equation (2) were chosen (0.0017, 0.45 and 1.5). Are these distributions really have constant resolution in the total CLAS phase space? I don't think so. If you want to use equation (2) with constant resolution for all events you have to prove it. Usually it is not the case for CLAS. Are the terms of the χ^2 uncorrelated?
(9) Page 7, paragraph 2, Equation (3): T_0^{SEB} and T_{π^-} are calculated in the different vertex points. In principle it is necessary to translate T_0^{SEB} to the π^- vertex and only after that to make a correction. It is too wide from my point of view.
(10) Page 7-8 Figure 3: it seems that all the work done in adjusting the start time does not affect the pi selection cut at all? The cut seems really loose, what is the criterium for determine that cut value of $\pm$ 0.5?
(11) Page 8, paragraph 2: Two methods for the *eloss* corrections are used in CLAS data analyses: MC and eloss procedure [20]. Did you check that these two methods give close results?
(12) Page 9, paragraph 2 I understand that the momentum correction procedure is described in the master thesis [21]. However it will be useful to include the short description and main results in the note as well.
(13) Page 10, Equation (4). Same question as for Equation (2): how are the parameters at the denominator are chosen? Selection criteria includes DOCA and it's error 2.25 cm. Where is this number 2.25 coming from? Is it independent on the kinematics (for example the Λ or π^- momenta/angles)?
(14) Page 10, paragraph 3 I don't think that $\Sigma(1385)$ creates significant bgrd under the $\Xi(1321)$ peak. The mass difference is 66 MeV and the FULL width is only 40 MeV.
(15) Page 12, paragraph 2 How many Ξ events do you have in the Fig.7? What is the main source for the event's loss? How did you choose the 1.5 cm cut? Where is it coming from?

(16) Page 12, paragraph 2: I am not sure I understand what it means to include all the possible pairs in the invariant mass. Doesn't that mean that you are double counting?
(17) Page 16, paragraph 2,line 4: The timing window 0.8 ns can be too narrow for the event's selection. This cut has to be investigated in details to make sure that there is no hidden loss. I remember from the g11 analysis that you need to apply about 20% correction factor if you want to use such s strong cut.
(18) Page 17: $N_{sim} = N_{gen}$
(19) Page 19: is the value of the acceptance for $\Phi^{--}(1.860)$ at 0.4%? Can we make any measurements with such a small acceptance!!! If I understand correctly the acceptance some of the other possible kinematics of the Φ^{--} are even lower?
(20) Page 19, Fig. 10 It would be useful to present not only invariant mass distributions but also other kinematical variables (momenta, angles...) and compare data and MC.
(21) Page 21, table 1: What is the average acceptance? It is not clear why the acceptance for row #1 and for row # 4 are so different? As I understand this is the same reaction. The three-body phase space and four-body phase-space with a fixed-mass 1.862 are identical. Isn't it? It looks like a bug that goes to the estimation of the systematics.
(22) Page 22: Could you provide the total integrated luminosity (e.g. in pb^{-1})?
(23) Page 22, equation (11) I believe that you have to combine Equations (11) and (12) from the very beginning. The equation (11) looks very strange with the definition of "S" as the effective target surface. It is not clear what is effective target surface.
(24) Page 23, paragraph 4 It is not clear what is the reason for the reduction by 20% the four-track events when you put the start counter in coincidence with tagger.

    I don't agree that uncertainty in CLAS are typically under 10%. You have to prove this statement. For example (from g11 experience):
    - Rate dependence for the 3 prongs events - 19%
    - Multiple hits in the tagger - 18%
    - Trigger inefficiency - 15%
    - 2 (!) ns tagger cut - 6%

    This is 70% correction factor in total. There are no such a study in this analysis note.

    The only way to check the systematics in such an extreme experiment (high current, 4-prongs events) is to find the reference reaction with known cross section and estimate this cross section from your own data. I don't think that we can release the cross section (or upper limit of the cross section) without such a test.
(25) I would like to see more details and plots of all the systematics studies that were done (details about how the cuts were modified, comparison of spectra etc). I would like to see some plots that show the studies done regarding the acceptance and I would like to know if the authors have any insight on why the acceptance is so different for different events configurations.

(26) Page 24: the Figures showing the final spectra (e.g. Fig 13) should have a line or an arrow, indicating where the enhancement should be
(27) Page 24: Fig. 13 and 14. Is it $\Lambda\pi^-\pi^-$ or $\Xi^-\pi^-$ invariant mass spectra? How does $\Lambda\pi^-\pi^-$ spectrum look like?
(28) Page 25, paragraph 1 What is the the tight cut applied to select the Ξ?
(29) Page 25, paragraph 2,line 4 What is the definition of the sidebands?
(30) Page 25: Did you fit the cascade mass spectrum? What are the values you got? Can you show the sideband selection in the cascade mass spectrum? Could you calculate a cascade cross section with the sideband subtraction and compare with previous measurements?
(31) Page 25, paragraph 2 Where are the results with the different cuts on $c\tau$?
(32) Page 26, paragraph 3 The described procedure looks very complicated with absolute no supporting pictures. Can we look for example to the reconstructed Ξ live time? Does it come out right? I am not sure that the background was chosen correctly. Maximum likelihood method doesn't demand "reasonable" population in each mass bin. It works with any population. So it is not clear what is the reason for the different mass bin in two methods.

    In fact there is more simple and direct check for the sideband subtraction method. You have to perform a one-dimensional fit of the $\Lambda\pi$ mass distribution for every $\Lambda\pi\pi$ mass bin with linear background. This is exactly corresponds to the sideband subtraction method. You can fix Ξ mass and width to make the fit more stable.
(33) Page 26, paragraph 3: Can we have more details about the fit? How many free parameters do you have? Are the fits stable? What is the quality of the fits?
(34) Page 27, fig 15 It is hard to compare the red and black errors in this picture. Can you produce this picture with the same mass bin?
(35) Page 28. Is it possible to have in the note a description of the Rolke Method in general and how the calculation was done in the analysis?
(36) Page 28: 15.1 Did you use Fig 13- b)? Can you show your upper limit with the extra K? I cannot find what reference values did you use to calculate the upper limit of the Φ^{--} cross section. Which width and mass of expected signal in 15.1.2 (gaussian above background) did you use? I do not understand why "for comparison here we ignore the acceptance and background uncertainties and assume 100% acceptance/efficiency"? I guess Feldman-Cousins can not handle this but you are using the Rolke et al. method at the end?
(37) Page 31: Fig 17 It is interesting that the upper limit gets better (more restricted) as the mass increases, and the data statistics decreses. I guess it is because of Fig 11 (acceptance). How this curve differ for the different kinematics of table 1?
(38) Page 32, conclusion There is only one comparison with the previously estimated upper limit (HERMES). Can we compare CLAS limit with other experiments? How does it look in the variety of the previously published data? Do we have any theoretical estimation of this cross section? Can we make any conclusion about the existence of this particle or its total width?

3. Grammar/typos comments

(1) Page 3, paragraph 2,line 2: willdenote → will denote
(2) Page 4, paragraph 1,line 5: were → where
(3) Page 4, paragraph 1,line 7: wide → in diameter
(4) Page 9, paragraph 2,line 2: remainsin → remains in
(5) Page 18, 5th line from the bottom: f → of
(6) Page 21, paragraph 1,line 1 give → given
(7) Page 23, last line assign → assigned
(8) Page 25, paragraph 1 evaluate → evaluated