Dear Marco,

First I apologize for the delay to get the report. Miguel's part is missing and the review will continue without his comments.

Stepan's comments/suggestions :

- page 8, the CLAS12 performance parameters, the line before the last, are overstated

- page 9, exclusive events: did anyone study the DVCS event extraction from RGC? RGC is closer to RGH than RGA

- page 9, the last paragraph, discussion about RICH. The statement is that two modules in a left and right symmetric configuration will reduce the systematics. This is not true for RGH, as the second module will be placed in sector 3 since sector 4 will be off.

- page 10, they want to use the correctors on 2H00 girder. In Fig. 6, the raster pairs are in the place of 2H00, and I do not see how they can fit the girder there (see comment on Fig.6).

- page 12, last paragraph starts with "1Based", "1" should be removed.
On the raster size, the same comment as Sebastian's, 7cm/7mm. They do discuss the raster system, stating that they will use what RGC used, a radius of 6.5 mm at 1 Hz. The first pair of the raster magnets is in the same place, upstream of the tagger magnet. What is shown in Fig.6 is the second pair. This arrangement will require higher currents for the same radius.

- Fig.6, 2H01 BPM cannot be where it is now. It should be upstream of the chicane. There is no room for that between the raster pair and the first chicane magnet. This means the raster pair should be moved farther upstream, farther from the target, and will need a higher current for the same radius as RGC.
- On page 13, the last paragraph, in the middle, it states that the central chicane magnets are an 11 cm off-axis to align with the bent beam. In Fig.9, the electron beam at chicane 2 and chicane 3 is off by about 13 cm.

Two lines down, it talks about the beam angle at the target, and that beam is aligned with the CLAS12 axis at the target. What is the beam angle at the target? The beam cannot be aligned with the CLAS12 axis at the target, and why is beam x=0 at the target? Beam x should be at 0, and the beam should be aligned with the axis after passing the target field.

- Recoil detector: It will be interesting to see electron \phi vs. recoil proton \phi. I think they are correlated, and with photons being detected in forward calorimeters, protons will mostly be opposite to electrons (\ phi_prot~\phi+180degrees). They have two recoil detectors, beam left and right on the horizontal plane with +/-25 degrees vertical aperture. One of these detectors will not be of much use as one of the horizontal CLAS12 sectors (sec.4) will not be available for electron detection.

- Fig.21, I do not understand the z vs. x plots. I think x and z are swapped.

- page 26, physics background, all studied backgrounds are from target, how about the upstream window, for example? The window can be thin, but it will see recoil detectors in much smaller angles, and rates can be high and will be distributed over the whole surface.

- Figs. 23, 24, and 25, upper left plots x and z are swapped.

- page 33, the last paragraph. They are considering to have “the sheet-of-flame” in Sector 4. I told them before that it was not a good idea. On beam right, we have the pie tower where the beamline and DAQ electronics are located. We had issues with radiation on electronics in the past. So, it is better to go to Sector 1.

Sebastian’s comments :

1) PAC52 had 4 bullets that should be addressed. They are IMPLICITLY addressed to some extent in the proposal, but often without detailed explanations and quite superficially. Also, I would prefer to tackle the beast head-on and quote these 4 bullets directly in the “Executive Summary" and explain how the new proposal addresses them (can be all a bulleted list, but that way the PAC knows they were taken seriously and don’t have to wade through a lot of detail to find the relevant info).

2) The Physics Motivation cites some fairly old papers - in light of the PACs concern that new data have superseded the need of the proposed measurements (which is of course not true), more up-to-date papers would be better.

3) One aspect that is incongruent: Kaons and the RICH are discussed early on, but then it turns out that Sector 4 tracking has to be turned off entirely (correct?), so only one sector with RICH remains. Probably can’t be helped, but unfortunate… as a consequence, there is nothing about Kaons in the later sections of the proposal.

4) All figures are tiny and impossible to read on paper - even at maximum magnification on my computer screen, some are illegible (top left Fig. 8, all of Fig. 11)

5) There are lots of technical details and discussion for the recoil detector, but in the end I have the feeling that the design is not final, and hence it would be hard to reliably estimate the performance. E.g., looking at the occupancies Fig. 18 and Figs. 23-25, how sure are we that particles that end up in the hot zones will be properly reconstructed (especially back to the proper vertex which is required for momentum determination)? Have there been full simulations of the reconstruction of tracks with all of the hits in the 3 tracking planes? Have obstructions (pillars, NMR coils, temperature probes) in the target been fully implemented? (They are not shown in Fig. 3). Do all of the backgrounds (sheet of flame etc.) include the additional effect of rastering? Ideally, the proposers would pick ONE design, ONE type of GMPD, one set of electronics that they KNOW will be available, and then simulate the entire chain from signal + background to reconstructed proton tracks with realistic reconstruction software. Maybe this WAS actually done - but the text appears vague (e.g., first line last para p. 24: “,..is now BEEN implemented” -> HAS BEEN implemented or IS NOW BEING implemented/

6) Just an aside: I keep getting told that you cannot do DVCS without a FT - now the proposal seems to say you can. How does that affect the statistics, and in which kinematics? Similarly, p.40 talks about pi0 but they may also be affected by the lack of the FT.

7) Fig. 44-45 is the money plot that shows what this experiment can do. However, little is said about how we go from Fig. 44 (asymmetry) to Fig. 45, including integrating over the unmeasured region. While the reduction in uncertainty over the range 0.1-1.4 is impressive, the effect on delta-d and delta-u is more modest. Also, how do you get the information on both u and d-quarks - does that require n data?

8) Why are the TTSAs (Fig. 46) not centered on zero? I thought that they are sinusoidal? Is Fig. 47 just ONE panel from the ones in Fig. 46? Which one? It doesn't look too impressive - the error bars are large and the asymmetries are tiny (I assume the y-axis is in %?). What are the raw (measured) asymmetries - even smaller? I'm worried about systematics - the only way to form the asymmetry is by comparing data taken many hours apart (after target spin flips) - check with RG-C experience that this is not trivial. This should be discussed in systematics (6.3).

Here are some more specific details:
1) The beam raster is variously quoted as having a 7 cm (!) **diameter** or 7 mm **radius** (both on p. 12). Practically nothing is said about the rastering system (where the magnets will go), and Fig. 6 seems to show only one of the 2 raster magnet pairs. (BTW, it also has NO labels for ANYTHING shown in that figure). Has there been a full beam transport calculation including the combined effect of the chicane and raster magnets? Are all the backgrounds and occupancies shown for a beam on center or also for one at the maximum raster radius? Fig. 7 is rather confusing in comparison to Fig. 6 and doesn't really show where the magnet apertures will be.

2) Fig. 9 doesn't tell us how many beam particles were thrown, and what the intensity of the background will be. Also, the caption is unclear especially as far as the 3rd row is concerned - I cannot make sense of it.

3) Fig. 35: Caption has been mistakenly copied from Fig. 33. All following figure captions have typos, e.g. "is" instead of "in"

4) Fig 43: Give full information about the width of the bin shown.

5) Fig. 29 has wrong units on the x-axes, and the z vs. x labels on Figs 23-24 are confusing (wrong?)

6) Beam time request - table: Why is the material thickness only 1 gm/cm^2 for a 2 cm long target? Does that include the He? Also, a bit more detail about "Operations" would be helpful - how often will the target polarization be flipped, etc.