The SoLID Director's Review

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The SoLID Director's Review

Jefferson Lab

February 22 & 23, 2015

Committee Members

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Committee Charge

1. For each proposed configuration of SoLID, review the relevance of the physics program and potential risks to the physics case.

2. Review the viability of the viability of the approach used in the project with respect to the general experimental technique proposed for the approved physics program.

3. Review the understanding, completeness, and credibility of the resources estimated in both manpower and cost.

Committee Charge

1. For each proposed configuration of SoLID, review the relevance of the physics program and potential risks to the physics case. This should include:

    a. The completeness and credibility of the discussion of the experimental reach, including statistical, systematic and theoretical uncertainties.
    b. Ability to handle the desired luminosities and backgrounds including impacts on both the apparatus and beam line down stream of the target.
    c. The implications for the relevance of the physics results in the context of possibly competing experiments at both JLab and internationally.

Committee Charge

2. Review the viability of the viability of the approach used in the project with respect to the general experimental technique proposed for the approved physics program. This should include the evaluation of the credible plans for

   a. Any R&D required to meet the technical challenges of the experiment.
   b. Proposed magnet concept and choice, including magnet configuration modifications (if any), magnet cool down and infrastructure requirements.
   c. Proposed detector concept and associated electronics and data acquisition.
   d. Beam line design including collimation and shielding.
   e. Cryogenic and polarized target system concepts.
   f. Beam polarimetry requirements.

Committee Charge

3. Review the understanding, completeness, and credibility of the resources estimated in both manpower and cost. In addition to the apparatus, this should include:

   a. Experience, expertise and quantity of the scientific and technical manpower for the project.
   b. Utilities (power, cabling, LCW, cryogenics) requirements for the project.
   c. Requirements from Jefferson Lab on for instance engineering needs, electron beam, polarized source, and cryogenic target requirements.
   d. General experiment installation and alignment issues, including potential interaction with other Hall A programs and operations.

Agenda

Monday February 23

Charge – B. McKeown
Physics Overview – H. Gao
Hall A & SoLID – C. Keppel
SoLID Overview – J. Chen
Experimental Requirements – P. Souder
Radiation – L. Zana

(parallel sessions)

EM Calorimeter – X. Zheng
Light-gas Cherenkov – M. Paolone
Heavy-gas Cherenkov – M. Meziane

Magnet … Engineering + Costs – R. Wines
Magnet … Infrastructure – W. Seay
Project Management – J. Chen

Tuesday February 24

(parallel sessions)

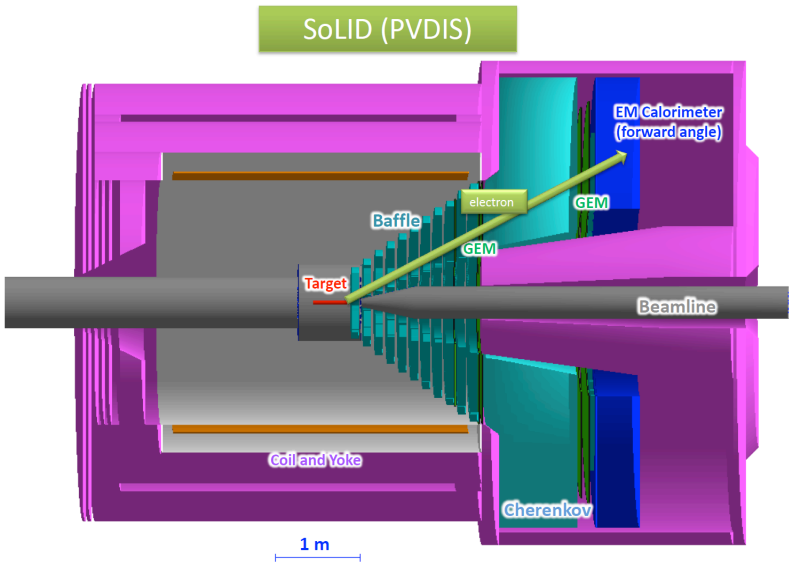
MRPC – Y. Wang
GEM US – N. Liyanage
GEM China – J. Liu

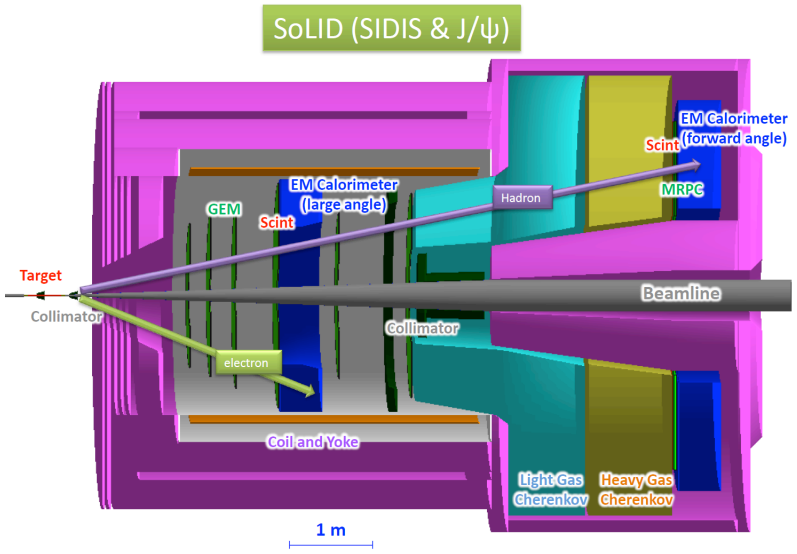
Baffle & Trigger Rates – Z. Zhao
Software/Simulation – S. Riordan
Software/Tracking – O. Hansen
DAQ & Trigger – A. Camsonne

Questions and Answers

Closeout

Major SoLID Configurations





The committee reviewed two configurations of the SoLID detector. One for **Parity-violating Deep Inelastic Scattering** (**PVDIS**), and one for **Semi-inclusive Deep Inelastic Scattering** (**SIDIS**). Both configurations use the same detector hardware, but the hardware is located differently between the two.

Executive Summary

The Preliminary CDR (July 2014) is well developed for this phase of experimental planning. Of particular note is Appendix B, which contains details on each major system such as duration, needed JLab support, and anything unique to the system that drives the project. **The SoLID detector, as proposed, together with its suite of highly-rated experiments make this program at least as large as both the GlueX program in Hall D and the CLAS-12 program in Hall B.**

Overall the Committee members were very impressed with the quality of the material presented and the state of SoLID as presented. They were **also very impressed with the high level of international contributions to SoLID.** The collaboration should be commended on the international nature of their effort. **The Committee felt that SoLID was in a good state to move forward**, but also identified a number of areas where additional work will be needed, as well as a number of items that are either not included, or underestimated in current planning. The recommendations from this report, together with the excellent comments in the Dry-run review report form 2012, can provide guidance on moving SoLID towards its ultimate realization.

Report Format

Standard DOE Report Format

- Observations—Statement of facts.
  - 9 under charge 1, 38 under charge 2 and 17 under charge 3.
- Findings—What the committee members believe to be true based on their review.
  - 13 under charge 1, 23 under charge 2 and 16 under charge 3.
- Recommendations—Actions that the committee members felt will need to be addressed.
  - 17 under charge 1, 16 under charge 2 and 10 under charge 3.

Physics Relevance and Risks

Recommendations:

- Better comparisons with the expected results on programs such as SBS and particularly CLAS12 are needed to clarify the need for the SoLID SIDIS program. Crisp demonstrations of the improvements possible with SoLID should be developed.

- End-to-end simulation with realistic subsystem responses and material budgets, and complete track finding and reconstruction should be developed. Should be pursued with high priority.

- Acceptance, efficiencies, and systematic uncertainties should be simulated for each of the core measurements.

- The dead-time(s) in the DAQ chain should be modeled.

Viability of Approach and Experimental Technique

Recommendations:

- Develop an overall R&D plan for the project with a timeline.
- Look at the possibility of adding kaon identification.
- Contact groups with similar calorimeters to underrstand design choices and resources needed.
- Investigate schedule risk in GEM foil production.
- Use full simulation and reconstruction to optimize cost and physics reach and derive clear performance requirements.
- Test the CLEO magnet at Jefferson Lab before installation.
- Include a new power supply for the magnet in the costs.

Viability of Approach and Experimental Technique

Recommendations:

- Consult with other halls to more-accurately estimate software needs.
- Explore tools at Jefferson lab that can handle the expected data volumes.
- Complete radiation calculations to determine activation and absorbed dose on components and mitigate as appropriate.
- Confirm the baffle design, including the support structure, is optimized for background rejection and signal acceptance. Furthermore the baffle design should minimize the generation of secondary backgrounds.

Utilities (power, cabling, LCW, cryogenics)

Recommendations:

- Compare assumed resource levels in some key areas (software, DAQ & project management) to make sure they align with other similar projects (Halls B & D).
- Create a high level resource loaded schedule to develop a more realistic funding a resource profile.
- Carry out a cost benefit analysis for any system being reused.
- Start integration planning.
- An effort should be made to clearly specify resources required from JLab that are not explicitly included (effort, non-effort, equipment, space, etc.).
- Develop a preliminary resource loaded schedule for installation and the corresponding space management of the hall floor.
- Start planning how to change between the two configurations.

Response of the SoLID Collaboration

SoLID Collaboration Meeting, May 14 & 15 at Jefferson Lab

- Nearly every presentation presented actions and plans to address the recommendations..
- Included magnet, software, detectors, physics, ….

Strengthening the Physics Case

- Unique, A+ measurements are essential for such a large funding request.
- An expensive device for a "multi-purpose" program should be a strong argument, but need to both
  – elucidate this, and
  – underscore it with some unique science
- Create plot to make quantitatively very clear that the polarized 3He SIDIS program will be the best worldwide program for neutron SIDIS measurements
- PVDIS unique and high priority
  – Put together a bullet-proof defense of the PVDIS program (technical and interpretational)
  – d/u case will diminish with collider data, MARATHON, BONUS12,… all coming in the next ~5ish year pipeline. CSV?
  – Be ready to quantitatively answer how much better SoLID does than something like a three year run with HMS-SHMS?
- GPD case suggested by committee
  - e+p -->e+p+(e+e-) was mentioned as reaction which is effectively inaccessible in CLAS12
  – Be ready to compare to CLAS12 with an upgrade to a luminosity of 10^36 (apparently not impossible on the timeframe of SoLID)
  – Exclusive measurements with the mediocre resolution of a solenoid may make GPD's a challenge

Strengthening the Physics Case

Thia Keppel

Physics Relevance and Risks

3) For the PVDIS measurements, the viability of the elastic scattering calibration procedure, to determine absolute Q2 should be demonstrated by simulations for similar scattering angles to those probed in DIS, and with realistic misalignments.

Bob? short term (few months?)?

4) Bin migration effects should be simulated for the measurements of the sharply rising J/ψ production cross section near threshold.

5) The signal and background trigger rates should be simulated for the J/ψ measurements.

Zhiwen? short term?

8) Better comparisons with the expected results on programs such as SBS and particularly CLAS12 are needed to clarify the need for the SoLID SIDIS program. Crisp demonstrations of the improvements possible with SoLID should be developed.

Mehdi/Zhihong/Kalyan/Alexei? short term?

J.P. Chen

Physics Relevance and Risks (continue)

9) The SoLID Collaboration should investigate the possibility of kaon identification, especially given their high luminosity.
17) The collaboration is encouraged to explore the power of extended kaon identification (through Cherenkov or TOF).
Yuxiang/Jin? long term (~ > 1 year?)

10) The SoLID collaboration should investigate the feasibility of carrying out a competitive GPD program. Such a program would seem particularly well suited to their open geometry and high luminosity. If SoLID's luminosity is sufficiently high to permit a program of precise Double Deeply Virtual Compton Scattering (DDVCS) measurements, it would make a groundbreaking contribution to GPD studies. Alex/ Zhihong/Zhiwen? short-long term

2) Acceptances, efficiencies, and systematic uncertainties should be simulated for each of the core measurements
Zhihong/Rakitha/Zhiwen? short term

J.P. Chen

Simulations/Software

1) End-to-end simulations with realistic subsystem responses and material budgets, and complete track finding and reconstruction should be developed.

7) The development of a simulation framework with realistic reconstruction and analysis should be pursued with high priority and increased resources.

16) The collaboration is strongly encouraged to develop an end-–to-–end realistic simulation and reconstruction to further optimize cost and physics reach and derive clear performance requirements for the individual subdetectors.

23) Having a functional simulation and reconstruction routines as soon as possible should be a high priority in the software effort. Such software will pay off many times over in experimental design and avoiding pitfalls

Ole/Zhiwen/Seamus? long term

6) The dead-time(s) in the DAQ chain should be modeled.

Yuxiang/Bob? mid-term (~ 6 months?)

J.P. Chen

Detectors

11) Develop an overall R&D plan for the project with a timeline
Subsystem coordinators/JP? short term?

12) Close interaction between the US and Chinese groups in the development of GEM foils to assure good quality control Is highly recommended.
13) Investigate the schedule risk when GEM foils are not produced in a timely way and continue to pursue Tech-–-Etch as a potential supplier for the foils.
Burnd/Xiaomei? short-long term?

14) The calorimeter group is encouraged to contact other groups (ALICE, LHCb and possibly CMS) to understand the detector design choices these groups have made and resources needed for construction.
Xiaochao? short term

15) The stability tests of the conductivity of the glass for the MRPCs should be extended for a much longer period and the risk associated with the R&D needs to be identified.
Yi Wang? short term?

J.P. Chen

Magnets

18) The Committee strongly recommends testing the CLEO magnet coils (cold test), power supply and controls, before installation in Hall A.
Robin? long term?

19) A new magnet power supply should be included in the total cost Of SoLID
Robin? short term?

20) Evaluate the schedule impact of mapping the magnetic field in situ in Hall A.
Robin/User? Short term?

32) We strongly recommend tests at JLab of the CLEOII magnet coils (cold test), ideally with the new power supply and controls, before Installation into the hall.
Robin? long term?

30) A cost benefit analysis for any systems being reused should be carried out, including the magnet power supply.
Robin? short term?

J.P. Chen

DAQ/Slow Control

21) The plans for the High Level Trigger and the needs for slow control need to be worked out in detail and the implications for resources need to be evaluated.
Alex/Brad? short term?

22) Closer communication with the other JLab experiments and the JLab computing center is strongly encouraged.
Alex/Ole/Brad? short term?

26) Compare the resource levels you have assumed in some key areas (particularly in software, data acquisition and project management) to make sure the estimates align with other similar projects or there is a good reason they do not.
Ole/Alex/JP? short term?

Radiation/Baffle/Switch-over

24) Complete radiation calculations to determine activation and absorbed dose on components of concern and mitigate as appropriate.
Lorenzo? short term?

25) It should be confirmed that the baffle design, including the support
structure, is optimized for background rejection and signal acceptance. Furthermore the baffle design should minimize generation
of secondary backgrounds.
Richard/Zhiwen/Robin? short term?

35) The project should start planning the process of how to change from one SoLID configuration to another in order to better understand the time and effort involved and if there are any potential issues such as radiation levels.
Paul/Robin/Lorenzo/JP? short term?

Cost/Resource/Project Management

27) Redo the cost estimate using an average cost per type of resource..
JP? short term?

28) Create a high level resource loaded schedule to get a more realistic
schedule, funding and resource profile. This will also allow JLab to better determine their ability to support the FTE needs.
34) The project should develop a preliminary resource loaded schedule for the installation and the corresponding space-–-management plan for the hall floor.
Subsystem/Robin/Ed/JP ? short term?

33) An effort should be made to clearly specify resources required from JLab that are not explicitly in the project (effort, non-–-effort, equipment, building space, etc.).
Robin/JP? short term?

General/Integration/Dependencies

29) Revisit the comments of the 2012 Internal Review Report in conjunction with the recommendations from this report.
JP? short term?

31) Appoint a small team to facilitate the integration planning for SoLID.
Paul/Bob/JP? short term?

Findings: The plans and R&D necessary to deal with the small polarization of the D2 target need to be fully developed.
Chris/Dave? long term?

Summary/Conclusions

- The Preliminary CDR (July 21, 2014) is well developed for this phase of experimental planning. Overall the Committee members were very impressed with the quality of the material presented and the state of SoLID as presented.

- The SoLID detector, as proposed, together with its suite of highly-rated experiments make this program at least as large as both the GlueX program in Hall D and the CLAS-12 program in Hall B.

- The SoLID collaboration is actively addressing the recommendations from the Director's Review, and moving forward on developing this significant 2'nd generation 12-GeV experiment.

Addressing the Recommendations (Software/DAQ)

- Software group will address the 4 Recommendations regarding developing an "end-to-end simulation and reconstruction framework". A design document will be available by the end of the summer.
- Software group will address the Finding about demonstrating track measurement capability, if necessary. ETA 1 year.
- Simulation group should address the Recommendation regarding simulating acceptances etc. for each of the core measurements. ETA?
- Software group will address the Recommendation to estimate software needs in consultation with other halls. ETA 2-3 months. Note: Already without such consultations, the available SoLID software manpower does appear insufficient at this time.

Both the software and the DAQ groups should follow the Recommendation to communicate closely with other JLab experiments and the JLab computing center regarding data handling. ETA 2-3 months. This should yield:

- Estimate of required computing resources
- Plans for calibration and production analyses
- Specifications for the level-3 trigger farm
- Performance expectations for simulation and reconstruction software (time per event etc.)

Ole Hansen