Status Update and Plan for Next Steps

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SoLID Collaboration Meeting

June 7-8, 2018

Overview Progress Since Last Meeting (Oct. 2017)

- **Working toward a DOE Science Review for SoLID**

  After the JLab Director's Review Committee report concluded that "the Committee believes that the SoLID Experiment is ready for its DOE Critical Decision Zero (CD0) Review.", SoLID collaboration and JLab management in discussion with DOE working towards a Science Review (late this year).

  Will visit and meet with DOE on June 21.

- **Prepare for the DOE meeting**
- **Science more compelling than ever**
- **Sub-system progresses**
- **Collaboration status**
- **Risks and mitigation**
- **Updated Pre-R&D plan**
- **Timeline**

Moving SoLID Forward in a Timely Way

- Physics more compelling than ever
  - Polarized Intensity Frontier (3-D momentum space imaging, origin of mass, BSM reach)
  - Proton mass and spin highlighted in NAS study
  - Foundation for and path towards EIC Physics
- Timing
  - Be in position to benefit from opportunities, and a prerequisite of EIC
    – SoLID is a must-do program from JLab
  - Need DOE Science Review this Year
  - Timeline (later slides)
- Keep collaboration motivated and engaged
  - Attract Collaborators looking for good projects
  - Compete for International Funding
  - Identified DAQ limit @high rate and Cherenkov @ noisy background as issues for pre-R&D (later slide)

SoLID Physics Program

- **SIDIS**
  - Projections (comparison with CLAS12/SBS/world):
    - Transversity/tensor charge: published
    - Sivers preliminary results on projection, on-going
  - Kaon PID R&D (TOF-MRPC) (Tsinghua/USTC) (Friday morning)
  - SIDIS-Kaon run-group proposal (Zhihong Ye, et al.) (afternoon)

- **PVDIS**
  - Test SM: Impacts with the LHC results (Paul, afternoon)

- **J/ψ**
  - High interest with relation to proton mass (trace anomaly)
  - interference with Bethe-Heitler (Sylvester, afternoon)

- **GPD program**
  - DVMP, TCS approved; DDVCS LOI; Polarized target DVCS, …

- **Others:** 1) Inclusive spin (Ye, afternoon)
  2) e to mu (Yulia, afternoon)

Overview Progress Since Last Meeting (continue)

- **Progress in subsystems**
  - Simulations: Hadron generator (Ye, Friday)
    Optimization for PVDIS (Rich, Friday)
    Tracking (Weizhi/Nilanga Friday)
    ...
  - nMRPC R&D for Kaon detection (Yancheng/Fuyue, Friday)
  - ECal: Continuing Prototyping study (Jixie, Friday)
  - DAQ/GEM R&D on SAMPA joint with TDIS
  - Light Gas Cherenkov: develop test plan (Michael, Friday)
  - Heavy Gas Cherenkov: joint test plan, Gas system, ... (Zhiwen, Friday)
  - Magnet: testing plan (Whit,)

- **Collaboration:**
  - New collaborator: Silviu Covrig (JLab), cryotarget

Status of Committee's Recommendations

- **36 recommendations**
  - All science related recommendations (10) addressed and closed.
  - Items related to viability of approach and experimental technique (detectors, DAQ, software, magnet, beamline):
    - A large portion addressed and closed (10)
    - remain ones (6) are longer term items (end-to-end simulation, …) and ongoing
  - Item related to the resources needed for the SoLID project
    - two addressed and closed
    - others longer term items (8), ongoing

SoLID Project: SIDIS Configuration

ECal: University of Virginia; Shandong University; Tsinghua University

GEM: University of Virginia; University of Science and Technology of China; China Institute of Atomic Energy; Lanzhou University; Tsinghua University

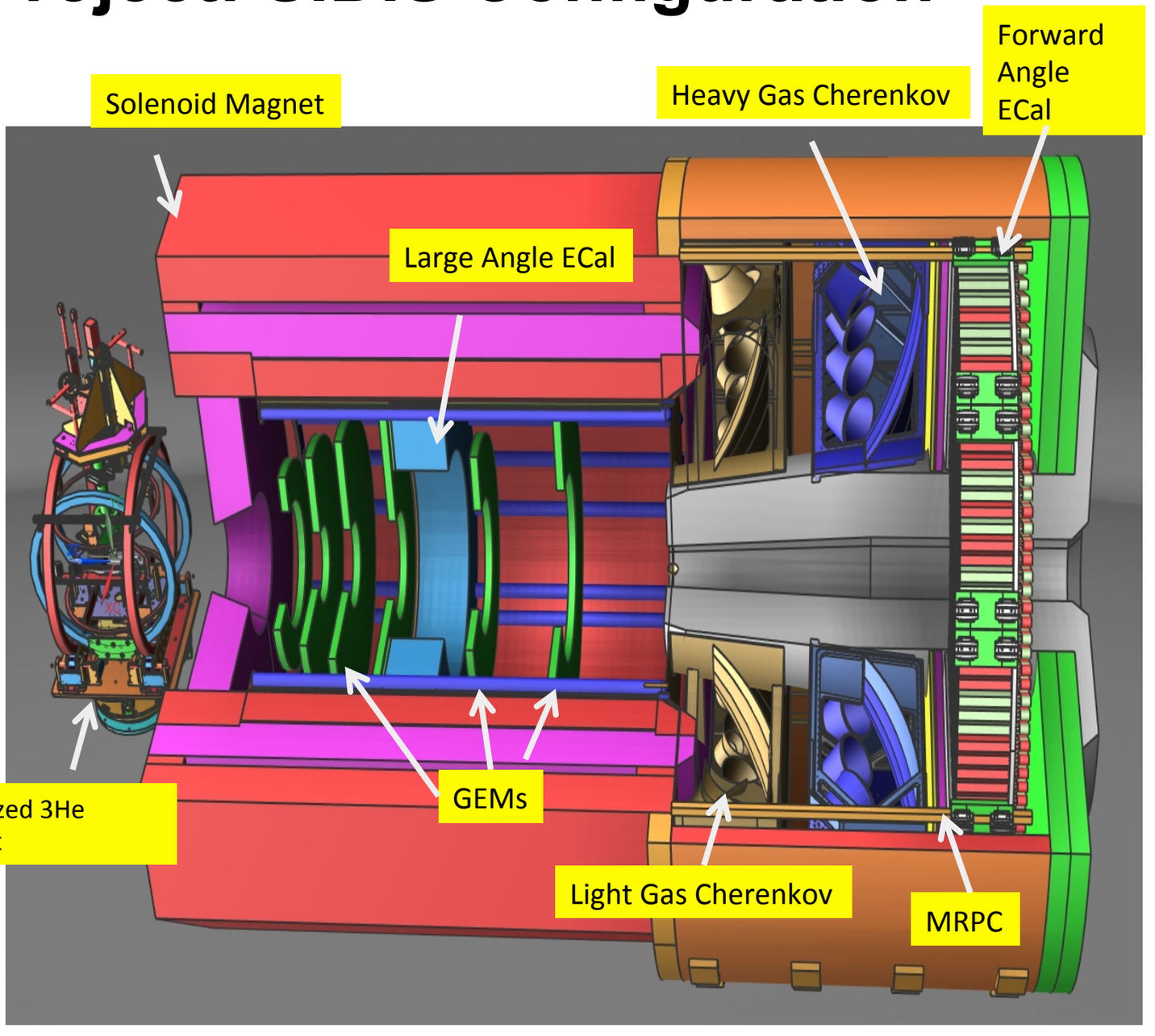
MRPC: Tsinghua University; University of Science and Technology of China

Light Gas Cherenkov: Argonne National Laboratory; Temple University

Heavy Gas Cherenkov: Duke University; University of Regina

Magnet: Jefferson Lab; Argonne National Laboratory

Si[illegible]ns: Duke University; Argonne National Laboratory; Syracuse University; Stony Brook University



Color coding: red, mainly DOE funding;
blue: mainly foreign funding;
green: partially foreign funding

(Pol. 3He Target exists at JLab)

SoLID Collaboration

Full collaboration: 300 members from 72 institutions 13 countries

SoLID core groups and responsibilities

1. **Argonne: Z.-E. Meziani (J/psi, light gas Cherenkov), P. Reimer (Support Structure), S. Riordan (Simulation, baffle), …**
2. **Duke: Haiyan Gao (SIDIS, software, Simulation, heavy gas Cherenkov)**
3. **Jefferson Lab: A. Camsonne (DAQ), J.P. Chen (SIDIS, project manager), O. Hansen (software), C. Keppel (management), B. Sawatzky (slow control), S. Wood (DAQ), Jay Benesch(magnet modeling)…**
4. **Stony Brook: A. Deshpande (Simulation), …**
5. **Syracuse: Paul Souder (PVDIS, Simulation)**
6. **Temple: N. Sparveris (light gas Cherenkov)**
7. **UVa: N. Liyanage (GEM), X. Zheng (ECal), …**
8. **Six Chinese groups: CIAE (GEM), IMP (GEM), Lanzhou (GEM), Shandong (ECal), Tsinghua (MRPC, ECal), USTC (GEM, MRPC), …**
9. **Canadian group: Regina/G. Huber (DEMP, heavy gas Cherenkov)**
10. **UK group: Glasgow/L. Zana (Radiation simulation)**

…

Stony Brook, Syracuse and Riordan@Argonne also play significant roles in MOLLER

Major Technical Risks (I)

- Even with limited resource, the collaboration were still able to make significant progress in addressing major technical risks
  - A number of risks retired:
    - mRPC long-term stability, radiation level, baffle design optimization;
  - A number of risks addressed, and will continue:
    - GEMs, ECal, Kaon PID: significant foreign contributions to continue pre-R&D
    - simulation, DAQ, Cherenkov and magnet: partially addressed, continue pre-R&D

Major Technical Risks (II)

- **Risks retired:**

  Risks, Cost or Schedule or Technical, mitigation

  1. MRPC long-term stability, technical risk, long-term test performed
  2. radiation level, technical risk, full simulation performed
  3. baffle design optimization; cost and technical risks, optimization study performed using simulation with different materials

- **Risks largely addressed, will continue with mainly foreign contributions**

  1. GEMs large size and foils, technical and schedule risks, a) full size tested by both UVa group (Liyanage) and Chinese group (USTC), b) Chinese group (CIAE) developing foil production capability
  2. ECal, technical and cost risks, a) Chinese groups (Shandong and Tsinghua) working with UVa group (Zheng) developing capability to produce Shashilak modules for Ecal to not rely only on one Russian group (IHEP), performed tests on prototypes
  3. Kaon PID, technical risk, Chinese groups (Tsinghua and USTC) obtained funds to perform R&D on upgrade MPRC to significantly improve TOF (sub-30 ps) for Kaon PID

Major Technical Risks (III)

- **Risks partially addressed, require further pre-R&D**

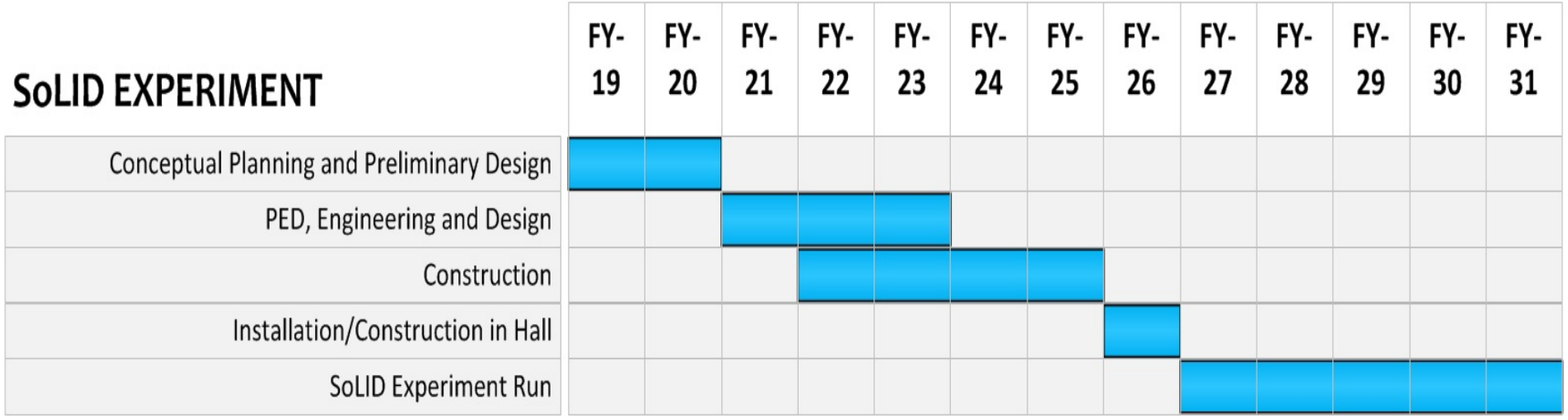
  Risks, Cost or Schedule or Technical, mitigation

  1. End-to-end simulation and reconstruction, technical and cost risks, a) significant amount of simulations performed with staged simulation packages and partial reconstruction and addressed all science related issues and most conceptual design questions; b)will need additional FTEs to continue to develop into full package and perform full simulation and reconstruction
  2. DAQ limitation (front-end readout rates for GEMs and other detectors no contingency for expected trigger rates from simulation), technical risk, a) improved simulation, b)improved the chosen readout system c)study alternative options;
  3. Gas Cherenkov at high rate environment, technical risk, a) performed realistic simulation, b) plan to test a prototype in-beam at JLab;
  4. Magnet, technical and schedule risks, a) CLEOII magnet coils and cryogenical system extracted and transported to JLab, b) developed a plan for test, c) plan to do a cold test in pre-R&D phase.

Pre-R&D Plan

- High SoLID trigger and data rates push limits of current technologies in particular for tracking GEM readout. Pre R&D is required to mitigate these risks.
  - Options for tracking GEM readout will be evaluated to maximize trigger rate and minimize data size.
  - This R&D will be combined with efforts for other upcoming experiments (e.g. TDIS) which face similar DAQ limitations.
- Mitigate risk of poor performance of Cherenkov detectors operating in a high luminosity high background environment in SoLID
  - Design a prototype Cherenkov and test through opportunistic running at JLab under realistic beam conditions with the goal to understand its performance
  - Confirm/improve the simulations used in the SoLID as well as for future high luminosity Cherenkovs design.
- End-to-end simulation to study full system performance and mitigate technical risks
- Magnet cold test to mitigate schedule risk
  - Local cooling system and small power supply in test lab
  - Facilitates calibration of instrumentation and controls in advance

SoLID Experiment Independent Schedule



- Assumes SoLID 5 year project starting FY21
  - will still require significant activity in advance to be ready
- Assumes 1 year total for installation
  - will still require some increased manpower
- Reasonable timeline consistent with JLab and collaboration schedule
  - FY21 project start translates to FY27 run start
  - Best timing for EIC stepping stone

SoLID

- SoLID has exciting, unparalleled scientific potential in both hadronic physics and fundamental symmetries
  - Precursor to EIC science – origin of mass and spin
  - Enhanced science impact
  - Needs to start now!
- SoLID collaboration is international, engaged, and fully committed
  - 300 Collaborators
  - 13 countries
- JLab is fully committed to supporting SoLID
- SoLID collaboration requests
  - DOE science review in 2018
  - DOE support of pre-R&D activities
  - Timely start of SoLID MIE