

Preparations for the CLAS12 commissioning run

S. Stepanyan (JLAB)

CLAS/CLAS12 Collaboration meeting

November 1-4, 2016

From proposal to run

Jefferson Lab > Physics > Program Advisory Committee Privacy and Security Notice

Search the JLab Site

Program Advisory Committee

User Liaison Home | Users Group | **Program Advisory Committee** | User/Researcher Information print version

PAC Resources

- PAC 40
- Proposal Submission
- Guidelines for Proposals
- Reports
- Archives
- Directory of Proposals
- Membership
- Summary Workshops
- Experiment Summaries
 - 6 GeV: pdf
 - 12 GeV: pdf

Program Advisory Committee (PAC)

([See Flow Chart](#))

Basic Steps:

- I. [Proposal Phase](#)
- II. [Approved Proposal: Preliminary Planning Phase](#)
- III. [Design Phase \(Users and Experimental Hall responsibility\)](#)
- IV. [Construction Phase \(Users and Experimental Hall responsibility\)](#)
- V. [Scheduling of Experiment by Jefferson Lab](#)
- VI. [Equipment Installation \(Users and Experimental Hall responsibility\)](#)
- VII. [Preparation for Running the Experiment](#)
- VIII. [Commission equipment \(following written procedures documented in COO\)](#)
- IX. [Run the experiment \(following written procedures documented in COO\)](#)
- X. [Decommission the equipment \(if appropriate\) and store or dispose of target and/or contaminated apparatus properly](#)
- XI. [For apparatus that will/may be used again \(e.g. the Base Equipment in the Halls\), review experience to date and, as appropriate:](#)



VII. Preparation for Running the Experiment

A. Submit to the Jefferson Lab DSO documentation on personnel and procedures at least one month before the start of the experiment:

1. Submit final ESAD.
2. Submit final [RSAD](#).
3. Submit COO (Conduct of Operations Document). In the COO describe Experiment Responsibilities, Collaboration Organization, Operations Personnel, Training Required, etc.
4. Submit Safety Check lists.
5. Submit ERG (Emergency Response Guidelines).
6. Submit experimental procedures, both for shift leaders and shift takers (in the form of how-to's or on wiki pages) and for experts (in the form of an operations manual and/or OSPs).

(Note: The bulk of the experiment procedures will be in the form of an operations manual for the major experimental equipment that will be referenced by the COO.)

B. Pre-operation checkout of equipment installation and procedures by experiment collaboration can be done with work control documents. This serves to verify operability after installation and to review integration to the extent possible without the use of beam.

C. Jefferson Lab review of the safety of the installed equipment prior to its use with beam.

(This review will be carried out by Division Safety Officer in collaboration with subject matter experts, further EH&S Personnel, and the assigned Liaison Physicist, verifying conformance to the ESAD and checking functionality of safety aspects of the apparatus and items and issues specifically identified on the Experiment Installation Checklist by the RC review.)

D. Experiment Readiness Clearance (ERC) issued by AD for Physics.

(Note: This will include a verification that all reviews are in place, as denoted in the Experiment Readiness Checklist. It also verifies that the experiment installation check has been completed, as documented on the Experiment Installation Checklist, and that all issues and concerns have been satisfactorily resolved, as detailed in the Issue/Concern Checklist.)



Review process for the CLAS12 Commissioning

- A. Experimental Readiness Review (ERR) organized by physics division
- for ancillary equipment, took place in June (2016), need to address recommendations
 - toroid magnet, took place in multiple steps, all recommendations have been addressed
 - CLAS12 base equipment and the 12 GEV beamline, will take place on **December 6-7**
 - solenoid magnet, still to come

Review in December includes both, KPP run in the spring and commissioning (engineering) run in the fall of 2017.

- B. Accelerator Readiness Review (ARR) organized the Lab (planned for January 9&10)
- must have successful ERR, with most recommendations addressed!
 - commissioning plan with clear requirements for beam
 - manuals and OSPs for every equipment that will participate in the run

Will authorize beam delivery to the hall.



ERR

Hall B Experiment Readiness Review Jefferson Lab December 6-7, 2016

This review has two goals:

- Goal 1):* To demonstrate the readiness to achieve the 12 GeV project KPP in an expedient manner during the pre-ops phase;
- Goal 2):* To demonstrate the readiness to achieve the goals of the CLAS12 commissioning experiments including the ancillary equipment.

This includes:

- All the 12 GeV baseline forward and central detectors (DC, LTCC, FTOF, PCAL, EC, HTCC, SVT, CTOF);
- The beam lines, scattering chamber, magnets, and targets to be used for KPP and commissioning experiments;
- The electronics and DAQ;
- For goal 2), the progress on the recommendations of the CLAS12 ancillary ERR.

Charge

1. Has the entire beamline, targets, detectors configuration been defined (including ownership, maintenance and control during beam operations)?
2. Have the specific equipment to reach goals 1) and 2) been demonstrated for operational readiness? Is all the necessary equipment installed and operable? If not, what are the completion/commissioning schedule and procedures?
3. Are the formal documentation requirements and reporting (run coordinator → shift leaders) procedures for achieving goals 1) and 2) adequate, appropriate and complete (COO, ESAD, RSAD, ERG, OSP's, general equipment operation manuals, etc.)?
4. Are the beam commissioning procedures and machine protection systems in place? Is there a commissioning plan for each detector subsystem (that includes detector checkout, data taking and performance studies) in place?
5. Are the radiation levels expected to be generated in the hall acceptable? Is any local shielding required to minimize the effects of radiation in the hall equipment?
6. Have all the jobs that need to be done to mount, run and analyze the commissioning experiments been identified and defined adequately?
7. Are the responsibilities for carrying out each job identified, and are the manpower and other resources necessary to complete them on time in place?
8. Have all the recommendations of the ancillary ERR been addressed?



CLAS12 Experiment Readiness Review
Jefferson Laboratory, December 6 - 7, 2016

Committee

Eric Christy
 Eugene Chudakov
 Ed Douberly
 Hovanes Egiyan
 Ed Folts (observer)
 Dave Gaskell
 Javier Gomez (observer)
 Laura Gonella
 David Lawrence
 Todd Satogata
 Brad Sawatzky
 Elton Smith (chair)
 Vashek Vylet
 Jennifer Williams

Tuesday, December 6, 2016 — CEBAF Center, Conference Room L102

8:00 a.m. - 8:30 a.m. Executive Session

8:30 a.m. – 8:35 a.m. Welcome – Charge Discussion (5) P. Rossi
 8:35 a.m. – 9:15 a.m. Project Scope and Overview [1,2] (20+20) G. Young

9:15 a.m. - 12:00 p.m. CLAS12 Subsystems I

9:15 a.m. – 9:45 a.m. Electromagnetic Calorimeters [3,4] (15+15) L.C. Smith
 9:45 a.m. – 10:15 a.m. Time-of-Flight Systems [3,4] (15+15) D.S. Carman

10:15 a.m. – 10:30 a.m. Coffee Break

10:30 a.m. – 11:00 a.m. Cherenkov Counters [3,4] (15+15) Y. Sharabian
 11:00 a.m. – 11:30 a.m. Drift Chambers [3,4] (15+15) M. Mestayer
 11:30 a.m. – 12:00 p.m. Silicon Vertex Tracker [3,4] (15+15) Y. Gotra

12:00 p.m. - 1:00 p.m. Executive Lunch

1:00 p.m. - 2:30 p.m. CLAS12 Subsystems II

1:00 p.m. – 1:30 p.m. Report on Previous ERRs [8] (20+10) E. Pasyuk
 1:30 p.m. – 2:00 p.m. Data Acquisition and Trigger [6,7] (15+15) S. Boyarinov
 2:00 p.m. – 2:30 p.m. Slow Controls [6,7] (15+15) N. Baltzell
 2:30 p.m. – 3:00 p.m. Event Reconstruction [6,7] (15+15) V. Ziegler

3:00 p.m. – 3:15 p.m. Coffee Break

3:15 p.m. – 4:15 p.m. Hall B Commissioning Configuration [1,2,7] (30+30) S. Stepanyan
 4:15 p.m. – 4:45 p.m. Discussion and Homework (30) All

4:45 p.m. - 6:00 p.m. Executive Session

Wednesday, December 7, 2016 — CEBAF Center, Conference Room L102

8:00 a.m. - 8:30 a.m. Executive Session

8:30 a.m. - 9:30 a.m. Hall B Tour

9:30 a.m. – 10:00 a.m. Beam Delivery to Hall B [4] (15+15) M. Tiefenback
 10:00 a.m. – 10:30 a.m. Radiation Budget [5] (15+15) G. Kharashvili

10:30 a.m. – 10:45 a.m. Coffee Break

10:45 a.m. – 11:15 a.m. Installation [2,6,7] (15+15) B. Miller
 11:15 a.m. – 12:00 p.m. Commissioning Plans and Documentation [3,4] (25+20) ..D.S. Carman
 12:00 p.m. – 12:15 p.m. Summary (15) V. Burkert
 12:15 p.m. – 1:00 p.m. Homework Discussion (45) All

1:00 p.m. - 3:00 p.m. Executive Session and Executive Lunch

3:00 p.m. - 3:30 p.m. Closeout



Where we are with ERR preparations

- ❑ A task-force for preparing the CLAS12 operations documentation and getting ready for ERR is formed (S. Stepanyan/D. Carman/E. Pasyuk)

- ❑ Wiki with links to documentation exists

<https://clasweb.jlab.org/wiki/index.php/CLAS12 OPS Doc>

- ❑ Documentation for each detector includes Operations manual (will be stored and revision controlled using git) and OSP (90% complete)
- ❑ A new Emergency Response Guidelines (ERG) has been available for online training (through training page, SAF111), for more than a month. This training is required (along with Radworker I, Oxygen Deficiency, and basic JLab training) for unescorted access to the Hall.
- ❑ All the documentation and web pages for it, and for run control will be ready by mid November



Documentation status

ESAD (Experimental Safety Assessment Document): Identifies potential hazards and measures to mitigate them

- 90% ready

RSAD (Radiation Safety Assessment Document): Identifies radiation budget for experiment & controls for staying within budget

- RadCon has it

COO (Conduct of Operations): Outline how to conduct experiments in safe and effective manner, Describes shift worker training requirements, defines key roles

- Done

OSP (Operational Safety Procedure): Procedures and hazard analysis for systems exceeding a given risk

- Available for : PCAL/EC, DC, FTOF, CTOF, SVT. Development started for the remaining components. Everything will be ready by mid November, 2016.

Operation Manual

- Available for: PCAL/EC, DC, FTOF, CTOF, SVT, Beamline, DAQ. Development started for the remaining components. Everything will be ready by mid November, 2016.



Run management

- The Hall-B run page will contain everything needed for managing the run process: safety documentation, detector operation manuals, procedures and day-by-day instructions for shift takers
- Preparation of the hardware for run will use JLAB HCO data-base
- eLOG will be used for bookkeeping
- Shifts will be generated from the collaboration membership DB using the existing shift scheduler (used in the past by CLAS and HPS)

Jefferson Lab > Physics > Hall B

Experimental Hall B

Hall B Main | CLAS | CLAS12 | Other Expts | Run Info | Publications | Public Interest

Current Run Information: Beamline Commissioning and Demonstration of KPP

- Run page
- Conduct of Operations (COO)
- Experiment Safety Assessment Document (ESAD)
- Radiation Safety Assessment Document (RSAD)
- [Hall-B Emergency Response Guidelines \(ERG\)](#)
- [Electronic Logbook Entries](#)
- [Accelerator and Experimental Shift Schedules](#)
- [CLAS12 wiki page](#)

12000 Jefferson Avenue, Newport News, VA 23606
Phone: (757) 269-7621 Fax: (757) 269-7848

Hot Checkout

Readiness Signoff Exceptions Checklists Links Reports Setup Help

Choose... **Readiness**

All Components {9,385} (125 Masked)

- ✗ JLAB
- ✗ CEBAF
- ✗ LERF
- ✓ Cryo
- ✗ Facilities
- ✗ Hall A
- ✗ Hall B
- ✗ Hall B Beamline
- ✗ Hall B Detectors
- ✗ Hall B CLAS12 Detector
 - ✗ Hall B CLAS12 Calormeter
 - ✗ CLAS12 EC
 - ✗ CLAS12 PCAL
 - ✗ Hall B CLAS12 TOF
 - ✗ CLAS12 CTOF
 - ✗ CLAS12 FTOF 1a
 - ✗ CLAS12 FTOF 1b
 - ✗ CLAS12 FTOF 2a
 - ✗ HallB CLAS12 DC
 - ✗ CLAS12 DC Region1
 - ✗ HV
 - ✗ LV
 - ✗ Readout
 - ✗ CLAS12 DC Region2
 - ✗ CLAS12 DC Region3
 - ✗ CLAS12 CND
 - ✗ CLAS12 FT
 - ✗ CLAS12 HTCC
 - ✗ CLAS12 LTCC
 - ✗ CLAS12 MVT
 - ✗ CLAS12 SVT
 - ✓ Hall B HPS Detector
 - ✓ Hall B PRad Detector
- ✗ Hall B Acceptance
- ✓ Hall B Beam Transport Monitors
- ✓ Hall B DAQ
- ✗ Hall B Slow Controls
- ✓ Hall B Sweep
- ✗ Hall C
- ✗ Hall D

Status Key

- ✓ Ready
- ✓ Checked
- ✗ Not Ready
- ✗ Masked
- NR Not Applicable

Node Key

- Category/System
- Subsystem
- Component
- Group



Hall B Key Performance Parameters

Commissioning Run: 15 days: April 24 – May 7, 2017

Detector operational: events recorded with a > 2 nA electron beam at > 6 GeV beam energy (3 passes)

KPP Demonstration:

1. Detector running for 8 hours recording data from all subsystems.
2. Screenshots of beam status and/or accelerator e-log.
3. Plots showing relative timing of calorimetry, time-of-flight, and Cherenkov detectors.
4. Event displays showing correlated particle hits in the Forward Detectors.
5. Plots of reconstructed particle trajectories showing target position.
6. Particle identification plots using signals from calorimetry and Cherenkov detector.



Options for beam running without solenoid

- I. If solenoid is not in place or if solenoid is in place but still needs work before mounting CTOF :
 - a) configure beamline without the cryo target with vacuum all way to the FC beam dump
 - b) mounting 2H01 harp at the location of the CLAS12 target (in principle HTCC also can be installed, no interference)
 - c) run up 10 nA beam and tune it on the target (in this case on the harp)
 - d) turn torus ON and set the current $I=2000$ A
 - e) using ~~25 μ m W~~ ^{500 μ m ^{12}C} wire-in close proximity to the beam, generate low luminosity, $\sim 10^{32}$ $\text{cm}^{-2}\text{sec}^{-1}$ (e-W) interactions
 - f) collect data with (HTCC/DC/LTCC/FTOF/PCAL/EC
 - g) test tracking (momentum and vertex determination), time-of-flight measurements for PID, calorimeter cluster reconstruction for electron and photon identification

- II. If CTOF is installed, but work on the solenoid continues, move solenoid ~ 1 meter upstream and proceed with a) to c) of I.

GEMC simulations without solenoid field present showed that occupancies and rates in the CLAS12 forward detectors are acceptable at luminosity of $\sim 10^{32}$ $\text{cm}^{-2}\text{sec}^{-1}$



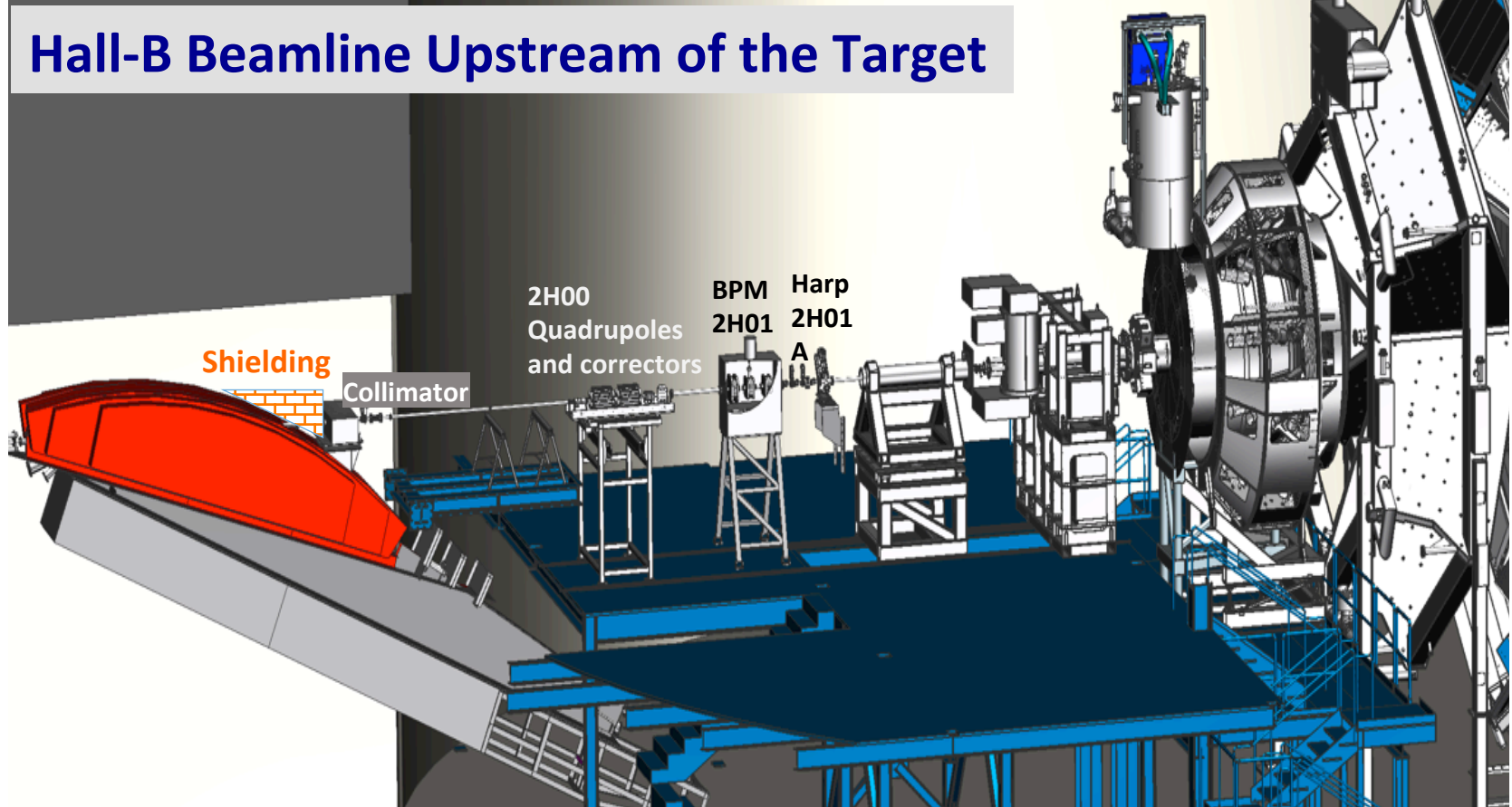
KPP Run in Spring

- During DOE OPA review three options for demonstrating KPP of CLAS12 and closing CD-4b have been presented and discussed:
 - Option A, fully assembled CLAS12, with solenoid and torus operational
 - Option B, CLAS12 Forward Detector is fully assembled and operational, solenoid is in place but is not ready, just serves as a support for CND and CTOF. Run at low luminosity, use Forward Detector to demonstrate KPP
Solenoid is late, expected to arrive end of March. Beam run must be done before “meter read”, May 6. To little time to receive solenoid, install, check and mount CND and CTOF. Running the KPP takes time from solenoid work
 - Option C, do not wait for the solenoid arrival, fully assemble forward detector, fabricate a temporary support for CTOF, put together the beam line and run KPP as soon beam will be available in February.
- DOE review committee unanimously praised Option C and recommended to work details, including various possible delivery dates for solenoid. This option decouples KPP running and solenoid delivery, leaves more time and resources for the solenoid work.

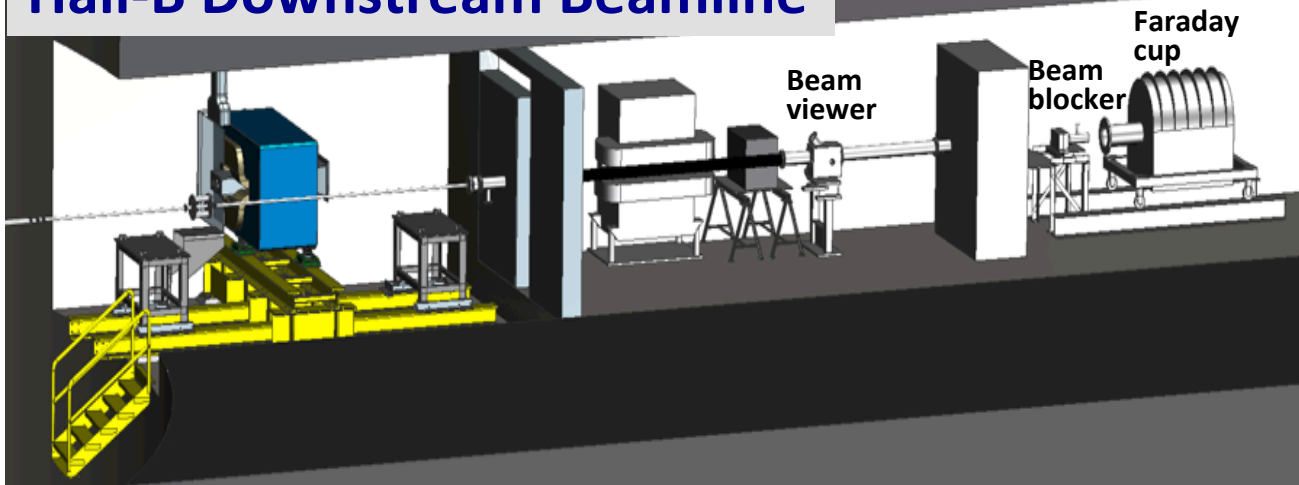
Solenoid has to be complete by September 2017 to close CD-4b.



Hall-B Beamline Upstream of the Target

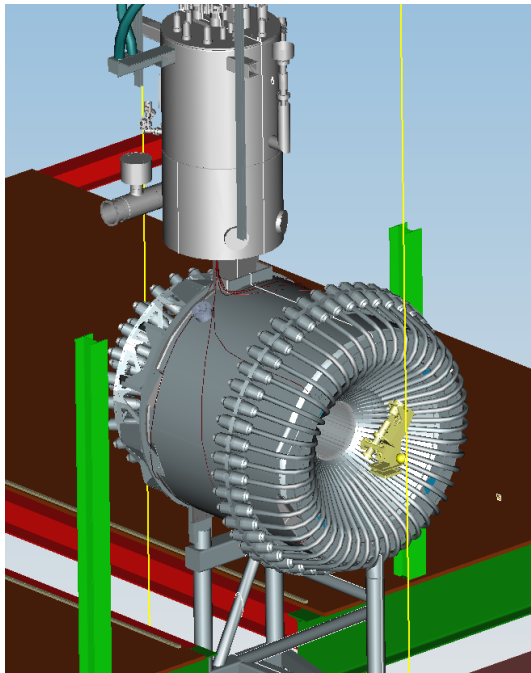


Hall-B Downstream Beamline

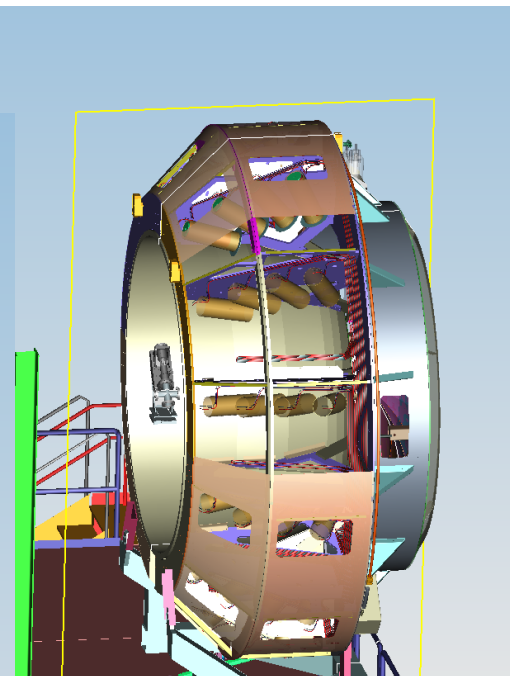
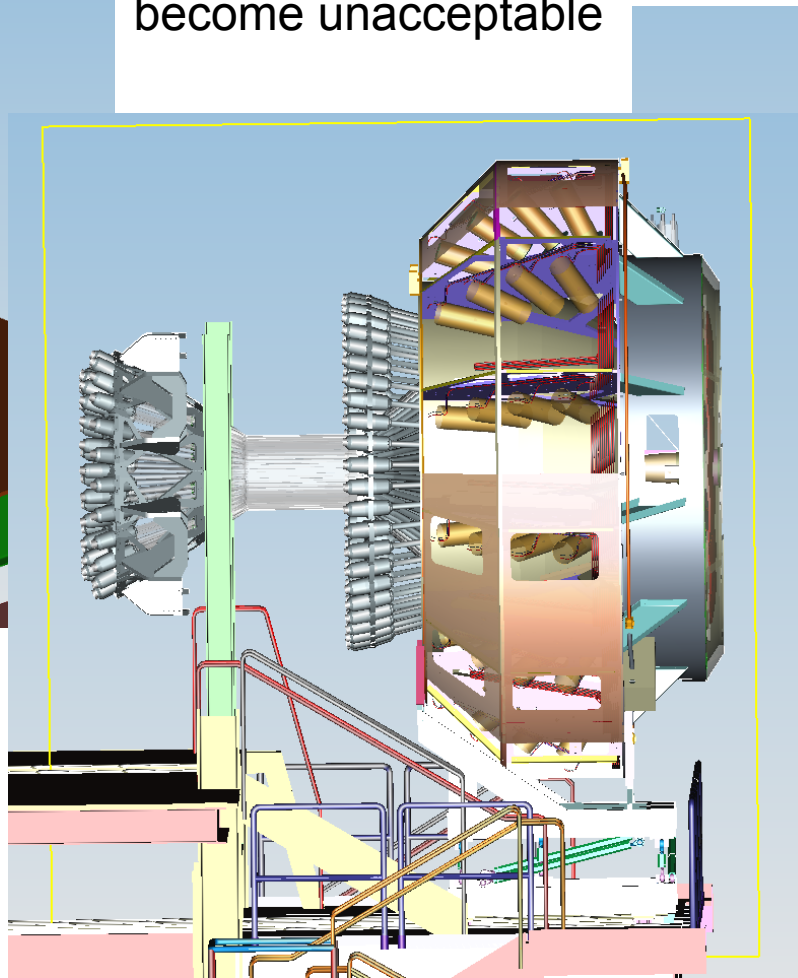


Option C

Run ~ 5 nA beam, $E > 6$ GeV, move ^{12}C wire towards the beam, stop when rates in FD will become unacceptable



Install 2H01 wire harp at the location of the CLAS12 target.
Mount 0.5 mm ^{12}C wire on the harp stick and use it as a target.



Simulations show we should be able to run at 10^{32} - 10^{33} $\text{cm}^{-2} \text{s}^{-1}$ luminosity, enough to fulfill KPP requirements



Summary

- Preparations of the Hall-B/CLAS12 detector systems for the beam running are in progress
- There is a detailed commissioning plan for each detector subsystem that includes detector checkout, data taking and performance studies
- Hall-B beam line has already been used for experiments with 1 and 2 pass beams and showed excellent performance. Critical components for safe delivery of beams to Hall-B for KPP run are almost ready, with many improvements to the previous system
- There is a preliminary plan for beamline commissioning with dedicated beam time in February-March 2017
- After beamline commissioning 2-3 days of beam (at least 50% machine availability) will be needed to complete the KPP run
- **Collaboration must deploy necessary manpower to help detector leads in preparation for spring run, and to build up pool of detector experts for the run (experts on call, calibration, monitoring of detector performance)**

