Conduct of Operations for Hall C
E12-06-110, E12-06-121
February 27, 2018

Contents

1 Preface

As part of its mission, JLab provides the resources necessary for international collaborations of scientists to carry out basic research in nuclear physics and related disciplines. This research must be conducted in a manner that ensures that environmental, health and safety (EH&S) concerns receive the highest consideration. At the same time the programmatic goals of the laboratory require that it produce the highest quality physics results efficiently.

Guidance on how to balance thoughtful, measured EH&S concerns with efficient operation has been taken from the Director's Safety Council, the JLab EH&S Manual, and the JLab Director's Office. A graded approach is followed in which the measures taken are matched to the scale, cost, complexity, and hazards of the operation.

This document outlines how approved experiment collaborations will conduct operations in a safe and effective manner during the time period that E12-06-110, E12-06-121 are on the floor. Installation periods are not covered by this document. Furthermore, this document is directed to physics users and physics staff rather than the Hall C technical staff. It must be read, understood, and followed by all members of the collaboration.

2 Documentation

This experiment uses the standard Hall C equipment, the Moller polarimeter, and a polarized ^{3}He target. All of the procedures to be used during the course of the experiment are contained in the following documents[1]:

- The Conduct of Operations for Hall C E12-06-110, E12-06-121 (COO), the document you are now reading.
- Experiment Safety Assessment Document (ESAD) for E12-06-110, E12-06-121 (referring to the base equipment as well as any experiment-specific changes)
- Radiation Safety Assessment Document (RSAD)
- JLab Emergency Response Guidelines (ERG)
- Hall C Standard Equipment Manual

Reference copies of these documents will be available in the Counting House for the duration of the experiment. The present document shall hereafter be referred to as the COO. The Experiment Safety Assessment Document shall hereafter be referred to as the ESAD, and the Radiation Safety Assessment Document shall be referred to as the RSAD. The ESAD and COO may also be

[1]The process is documented at `http://www.jlab.org/user_resources/PFX`

available on the WWW at an experiment-specific web site[2]. **The COO, the ESAD and the RSAD are required reading for shift personnel.**

A full description of the physics motivation for the experiments, collaboration lists, and general plans for carrying out an experiment can be found in the proposal(s) to the JLab Program Advisory Committee (PAC).

3 Shift Personnel Training

All personnel on shift are required to have successfully completed and be current in the following JLab safety training:

- EH&S Orientation (SAF 100)
- Radiation Worker Training (SAF 801)
- Oxygen Deficiency Hazard Training (SAF 103)
- Hall C Safety Awareness Walk-Through (SAF112)
- Conduct of Operations (SAF 120)

All experiment personnel are required to have radiation badges in their possession during their shifts. The Safety Awareness Walk-Through will emphasize hazards that are typical of normal Hall operations. Hazards peculiar to the current experimental setup are addressed in the appendices of this document. In addition, all shift personnel will be trained in the safety procedures to be followed for access to the Hall during restricted or contolled access periods (see Appendix B for special requirements during the "laser lockdown" period). The Hall access training will include a brief discussion of the purpose and operation of the Personnel Safety System (PSS) for the Hall. Individuals within the collaboration may be required to have other equipment or procedure-specific training. The need for such training shall be determined by the experiment spokesperson in consultation with the Hall Leader and Physics Division Safety Officer.

In addition, experiment personnel must familiarize themselves with the sections of the JLab EH&S Manual relevant for their work in the Hall. A reference copy of this document is available in the main hallway of the Counting House. It is also available via `http://www.jlab.org/ehs/ehsmanual/index.html`.

Finally, JLab Lock and Tag[3] training is required for all staff/users who will be performing maintenance on electrical and mechanical equipment which cannot be physically and verifiably isolated from an energy source. This training, SAF104, can be found at:
`http://www.jlab.org/div_dept/train/webbasedtraining.html`.

[2] https://hallcweb.jlab.org/experiments/A1n

[3] The EH&S Manual provides Lockout/Tagout information in Chapter 6110 at `http://www.jlab.org/ehs/ehsmanual/manual6110.html`.

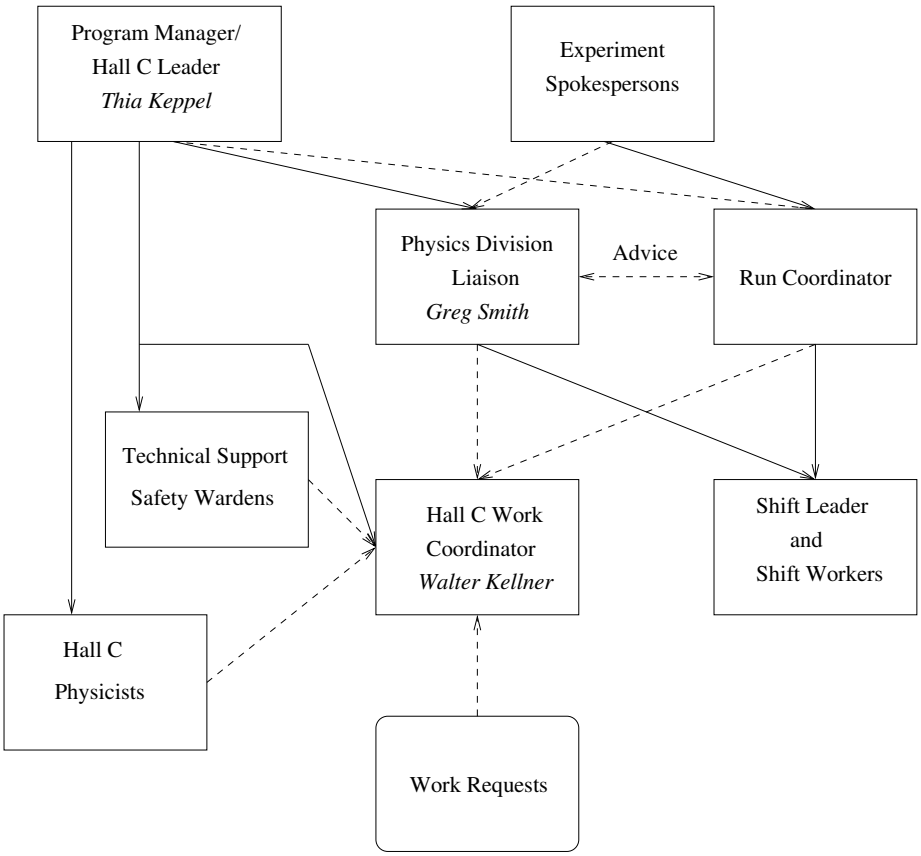

Figure 1: Functional Organization of the Hall C Team. Dashed lines indicate information flow, solid lines indicate responsibility.

4 Organization and Administration

The operation of the experiment is directed by the Spokespersons and the Hall Leader, Thia Keppel. An organization chart for the experiment is found in Figure 1.

4.1 Run Coordinator

The Run Coordinator is the immediate on-site manager of the experiment and is responsible for ensuring that the physics goals of the experiment are met. This individual is designated by the experiment spokespersons and approved by the Hall Leader. The Run Coordinator shall ensure that the Hall Group Leader, Physics Division Liaison, and at least one Spokesperson are aware of all pertinent issues. The Run Coordinator shall promote an environment in which the highest safety standards are maintained. **All Run Coordinators must**

ensure that all of the JLab training necessary to perform their duties is up to date before their shift as Run Coordinator commences. The functions of the Run Coordinator are:

I. To manage daily operation of the experiment:

- to ensure that the run plan is clear to the shift workers.
- to define the data quality appropriate for the goals of each shift.
- to track the progress of the experiment.
- to coordinate and schedule activities (e.g., Hall accesses) in order to optimize productivity.
- to ensure that an experiment checklist is completed every 24 hrs during standby shifts.
- together with the Physics Division Liaison, to ensure that the counting house is manned appropriately: i.e., sufficient personnel are present to safely carry out the experimental program or monitor the apparatus as needed.

II. To coordinate interactions between JLab and the experiment. This entails:

- to ensure that the Hall C Group Leader and Experiment Spokespeople are aware of all necessary issues.
- informing the Program Deputy of the experiment's status and plans at a 7:45 AM program deputy/halls meeting in the MCC during the working week, and at an agreed upon time on weekends or holidays.
- representing the collaboration at the 8:00 AM daily summary meeting in the MCC during the work week.
- attending the 1:30 PM Wednesday scheduling meeting in the MCC conference room to represent the collaboration and to present a report on the preceding week.
- remaining in the local area and being available by cell-phone/pager at all times. (If temporarily unavailable the Run Coordinator must designate another qualified collaborator as a replacement.)
- in conjunction with the Hall Work Coordinator, scheduling work by groups outside the collaboration.
- interact with the Accelerator Program Deputy to plan and conduct unscheduled activities.

- in conjunction with the Hall Work Coordinator, scheduling work by groups outside the collaboration. This work will normally coincide with the scheduled machine maintenance days. This coordination requires a weekly meeting of these two individuals. The product of this meeting will include any necessary updates to the "Access Authorization List".

- to be responsible for safe transition of the Hall to Restricted Access in coordination with the Hall work coordinator.

- to provide an oral report at the weekly Hall C meeting[4] updating the experimental progress to the collaboration.

III. To submit a written report to the Hall Leader which includes run time statistics and a description of any significant problems with the Hall instrumentation.

4.2 Physics Division Liaison

Broadly speaking, the Physics Division Liaison to the experiment is a Hall C staff member selected by Thia Keppel to oversee the hall's interests with respect to personnel and equipment protection.[5] This is true for all four halls. However, the role of the Physics Division Liaison may include other responsibilities depending upon the experiment and other factors. His/her responsibilities include:

- Oversee that proper rules of safety are carefully followed in the conduct of the experiment.

- Approve a Hall status change to Restricted Access in coordination with the Hall Work Coordinator.

- Training verification of shift workers via JList software.

- Together with the Run Coordinator, ensure that the counting house is manned appropriately: i.e., sufficient personnel are present to safely carry out the experimental program or monitor the apparatus as needed.

4.3 Hall Work Coordinator

The Hall Work Coordinator's responsibilities are:

- to act as the **single point of contact for all work in the hall.**

[4] typically held at 3:00pm on Monday.

[5] The responsibilities described here correspond to those of the Physics Division Liaison during the operating phase of the experiment as outlined in the EH&S Manual Chapter 3120/Glossary.

- to determine if the scheduled activities in the hall can be done safely. These activities shall be coordinated with the Physics Division Liaison and the Run Coordinator. Tasks should also be inputted into the work task lists `http://www.jlab.org/listsites/`.

- to ensure that workers are properly trained, are familiar with all significant hazards, and are aware of all applicable work control documents associated with the project.

- in coordination with the Physics Division Liaison, ensure that the hall apparatus is made safe before giving permission to make a transition to Restricted Access (e.g., turn off unused magnets, install protective shields as needed, fulfill specific requirements in the ESAD, etc.).

4.4 Shift Leader

Each shift is led by a Shift Leader. The selection of shift leaders is the responsibility of the Run Coordinator and Physics Division Liaison. The Shift Leader has the following responsibilities:

- to carry out the scientific program planned for the shift in a safe and efficient manner.

- to ensure that the logbook contains a complete and accurate description of the events and actions which occurred during the shift.

- to serve as primary contact between the machine control center (MCC) and experiment personnel.

- to oversee that hall equipment is operated properly.

- to ensure the shift checklist is performed every eight hours on operating shifts.

- to ensure that equipment malfunctions are properly labeled and locked-out if necessary and to communicate this to shift personnel and subsystem experts.

- to note in the logbook when workers from outside groups (such as survey and alignment) stop by the counting house before entering the hall when in Controlled Access. Furthermore, to confirm that these workers have communicated with the Run Coordinator and the Hall Work Coordinator.

- to coordinate the response of the shift crew to any emergency situation, including the notification of appropriate individuals as outlined in the Hall C Emergency Response Guidelines (ERG).

- to ensure that in any emergency situation the experiment Physics Division Liaison, Run Coordinator, and Hall Leader are notified immediately.

- to notify the Run Coordinator and the Hall Leader, if the hall is down due to equipment failure for more than four hours.

The Shift Leader has the following authority:

- to assign tasks to the shift members as needed.
- to request that the state of the hall be changed (Request for a change to Restricted Access must be approved by the Physics Division Liaison.)
- to limit the number of people in the Counting House or hall if required to effectively and safely carry out the experiment.
- to limit access to hall on-line computers if required to effectively and safely carry out the experiment.
- to authorize qualified personnel to make modifications in the experiment configuration within the allowed parameters, as specified in the standard equipment manual.
- to authorize time accounting for the shift.

4.5 Shift Member

The responsibilities of each shift member are to:

- carry out the scientific goals of the shift in a safe and efficient manner under direction of the shift leader.
- read the logbook to be aware of changes in goals, operating parameters, and new documentation.
- monitor the equipment for problems.
- maintain adequate records of the progress of the shift.
- be present before the start of each shift and coordinate current operating conditions with the previous shift.
- keep all training up-to-date.

4.6 Accelerator Operations Hall Liaison

Each physics hall has an Accelerator Operator or Crew Chief assigned as a Hall Liaison. The Hall Liaison helps to facilitate information exchange between the experimenters and the MCC Operations Group, both in advance of and during actual experiments. The Hall Liaison, among other things, is responsible for making sure that experiment-specific information, procedures and requirements are available to all other operators and Crew Chiefs so that beam delivery can proceed efficiently. The Hall C liaison is Daniel Moser.

4.7 Accelerator Physicist Liaison

The Accelerator Physicists Experiment Liaison serves as the primary contact on hall beam physics issues for the Physics, Accelerator and Engineering Divisions. This liaison owns the process of establishing physics quality beam to the experiment including developing beam optics configurations capable of meeting the experiments requirements, identifying tools needed to diagnose, monitor and verify beam performance during the experiment as well as developing beam startup, setup and commissioning plans. The Hall C liaison is Jay Benesch.

4.8 Engineering Liaison

Each experiment conducted at JLab will be evaluated to determine if its complexity requires facilitation with the Engineering Division to help ensure a successful outcome. Experiments that require facilitation will be assigned an individual from the Engineering Division to act as liaison between the Division and the associated Experimental and Physics Division staff. The liaison acts as a single point contact in order to facilitate information exchange between the experimenters and those in the Engineering Division responsible for, but not limited to, the systems requirements, design, scheduling, fabrication, installation, testing, documentation, and budgeting. Ideally, the liaison is aware of all work conducted by Engineering for the experiment and ensures the appropriate resources are defined and allocated. Any issues and/or concerns are identified, documented, and tracked.

For the current run period, the review found that no such liaison was required.

5 Operating Procedures

5.1 Shift Routines

There are two types of shifts for active hall experiments: Operating and Standby. Operating shifts are the normal status when beam is available for the experiment. Standby shifts are periods designated by the Run Coordinator when beam is not available or not in use in the hall and none of the equipment, except for the target, requires continuous monitoring. Standby status may result from normal operational planning or from abnormal conditions such as a major down time due to equipment failure.

5.1.1 Operating Shifts

During operating shifts, 24 hour occupation of the counting house area will be maintained by crews of at least two persons [6] in 8 hour shifts. One person per shift is designated as the Shift Leader.

[6] The readiness review committee may require more personnel depending on the complexity of the experiment. Two people are the minimum required for safe operations.

The number of persons assigned to a shift will depend on the tasks assigned during the shift. A shift schedule will be posted in the Counting House listing the times and names of personnel on shift and identifying the Shift Leader and Run Coordinator, cell 757-270-8916. The shift schedule may be available at an experiment-specific website. The Run Coordinator may also designate and supervise other teams for duties such as offline analysis.

5.1.2 Standby Shifts

During Standby shifts, shift personnel are not required to be on site at JLab but must be available through telephone contact to come in if they are needed. Monitoring the target system can require the presence of a Target Operator during a standby shift. The Target Operator then also acts as Shift Leader. The Run Coordinator will ensure that the shift checklist is executed at least once every 24 hours.

5.1.3 Operations Turnover

The electronic log book, accessible from the web, is a very effective means of remotely obtaining information about experimental operations. This allows experimenters to log in remotely and view all log book entries prior to commencing their shift. Information which can only be recorded in the paper log book, should be noted accordingly, point to in the electronic logbook, and communicated between incoming and outgoing shift personnel directly.

Efficient and effective shift changeovers during experiment operation are enhanced by overlapping shifts. Therefore, whenever possible, shift leaders and workers are scheduled in shifts that are staggered by four hours, leading to an overlap of half a shift. If this is not the case, shift members must show up ten minutes prior to shift start (and plan to stay ten minutes after) for the purpose of information exchange to those taking over the same tasks. In all cases incoming shift leaders must discuss the experiment and Hall status with the outgoing shift leaders.

5.1.4 Timely Orders to Operators

The initial run plan is the responsibility of the Run Coordinator and shall be clearly recorded in the log book. This plan specifies the tasks to be performed in the next 48–72 hours, including any special conditions or data runs, updated documentation and its location and/or alternate plans. Any changes to the run plan shall be recorded in the log book and the white board in the counting house.

5.1.5 Operator Aid Postings

The day-to-day schedule, contact instructions for key personnel, and any other information relevant to current activities are located on the white board in the Counting House. Shift personnel should consult the white board, especially

at the beginning of their shift, to be aware of any updates to current running conditions.

Information pertaining to daily activities in Hall C must be posted on the bulletin board or written on the white board at the entrance to the hall.

5.2 Hall Access

Work in designated radiation areas will be carried out in accordance with the JLab RadCon Manual. In particular, no material may be removed from the hall after beam delivery without proper approval from the RadCon Group. During operations, no one is allowed in the hall without either being accompanied, or informing shift personnel and checking in on a regular basis.

During a running experiment the hall will normally be in Beam Permit. When temporary access to the hall is needed the Shift Leader can ask the MCC to bring the hall to Controlled Access. If long term access to the hall is required, the Shift Leader may request the hall be brought to Restricted Access. Such a request requires prior approval from the Physics Division Liaison, while the actual transition will be supervised by the Hall Work Coordinator.

Restricted Access is a state where delivery of beam and/or RF power is not permitted, and entry to and exit from the hall is not controlled by the Personnel Safety System. This is the normal state of the hall when the accelerator is off and no experiments are running. Access is "restricted" only in the sense that the hall is not open to the general public. Well-defined check-list procedures are to be followed whenever the hall is brought to and from Restricted Access.

Restricted Access is the period when all major work must be completed in the hall. Consequently, all activities require advanced planning and must be scheduled for resources and safe operation. In order to streamline the activities in the hall and ensure everyone has ready access to the current status and requirements for work, there are two important resources:

- Single point of contact, which is the "Hall Work Coordinator"
- Information board at the entrance to the hall

All work must be scheduled through the Hall Work Coordinator. The content on the information board is the responsibility of the hall safety wardens and the Hall Work Coordinator. The information board will contain all critical information required for safe entry into the hall. This information will include a succinct, one page safety summary covering the hall's current safety hazards and mitigating measures (to be read by all persons working in the hall), active Operational Safety Procedures (OSPs) and Temporary Operational Safety Procedures, required temporary work permits (e.g., Radiation Work Permits), current activities in the hall, points of contact, and required training and safety equipment.

5.3 Collaboration Request for Laboratory Resources

The collaboration may request additional services from Accelerator Division through the Accelerator Division Liaison, Geoffrey Krafft. Alternatively, the collaboration may also request additional services from hall personnel through the Physics Division Liaison, Greg Smith. These requests should be noted in the logbook. Some requests may require that an OSP, or TOSP be developed.

Major, abnormal, or unanticipated configuration modifications such as stacking or movement of significant shielding, unanticipated vacuum work, unanticipated beam line modifications, the replacement of a wire chamber, etc., require approval of the Hall C Leader, Thia Keppel [7], and the use of appropriate personnel. The Hall Leader may require that a OSP, or TOSP be prepared.

5.4 Scheduling of Work by Outside Groups

Work in the hall that is to be performed by groups outside the collaboration such as survey and alignment, plant services, air conditioning, etc., must be scheduled so that it does not endanger personnel or equipment or interfere with the experiment. Non-emergency activities by these groups should be scheduled to coincide with the planned accelerator maintenance periods. To maximize efficiency, the Run Coordinator (representing the collaboration) and the Hall Work Coordinator (representing Hall C) will concur on work scheduling. The Hall Work Coordinator's job is to coordinate activities in the hall so that work can take place smoothly and safely and to insure that multiple activities do not interfere.

The Work Coordinator and the Run Coordinator will meet as needed to plan the work scheduled for the upcoming maintenance period. The product of this meeting will be a list of work in the hall, the required access state of the hall (Controlled or Restricted), appropriate work control documents, and educational or other safety measures (such as escorts) that are needed.

The ATLis should be used for coordinating the cross divisional work activities `http://www.jlab.org/listsites/`.

5.5 Control of Equipment and System Status

The operation of the standard experimental equipment is documented in the Hall C Standard Equipment Manual. This document includes information on the normal response to alarms and equipment malfunctions.

The ESAD and Hall C Standard Equipment Manual lists the authorized subsystem experts. This list may be amended as necessary to reflect personnel and training changes with the authorization of the subsystem expert. A copy of these amendments will be attached to the main document and kept in the Counting House.

[7] Configuration changes as outlined above can affect site boundary dose and the production of airborne radioactivity. They require consulting with RadCon or EH&S personnel, as appropriate.

All general equipment installation, maintenance, and testing activities are to be carried out in accordance with the JLab EH&S Manual.

5.6 Equipment Labeling

The experiment and hall equipment shall be properly labeled so it can be quickly identified by both shift and maintenance personnel. Proper labeling helps prevent incorrect operation or modification of equipment by non-experts and facilitates proper and efficient operation by qualified personnel. Labeling also increases the likelihood that proper procedures will be followed in case of emergency.

Improper labels should be corrected immediately if possible. Otherwise, the Shift Leader should be notified so that correct labeling can be requested from the qualified expert.

5.7 Independent Verification

The Run Coordinator will provide the shift crew with a set of measures for checking the quality of the experimental data. The up-to-date Hall C shift checklist (and instructions) shall be made available to shift personnel at hall-specific sites on the data acquisition computers. The checklist will be completed at least once per shift during operating shifts and once per day during standby shifts. Additional items may be added to the list by the Run Coordinator or subsystem experts.

The Hall C work coordinator provides more general check lists for closing the experimental Hall and conditions when the Hall is used as an accelerator dump.

5.8 Logkeeping

Shift personnel will update the electronic logbook, which serves as the record of the experiment. The quality of the information recorded in the logbook determines the utility of the data. All data recorded electronically will be referenced in the computer logbook with the appropriate run number and run information. All relevant activities are to be recorded, including all changes of experiment conditions and equipment failures.

Checklists performed using Hall C-specific forms should also be scanned into the computer logbook when completed. The completed paper forms should be stored in a binder in the counting house. All deviations from normal operating parameters shall be recorded in the logbook.

The computer logbook will also serve as the primary reference for the determination of the operational efficiency of the experimental apparatus in the Hall. As such it is essential that it provide an accurate record of the capability of the equipment to carry out the intended research program. Finally, the computer logbook is the place of record for all safety issues and introductions of new or updated documentation and procedures.

A Special Procedures for Hall C

There are no special operating procedures for Hall C.

B Special Procedures for E12-06-110, E12-06-121

Each shift requires a shift leader and a polarized ^{3}He target operator. A third person on shift is extremely useful, but not required. The shift leader has the standard duties of shift leader to ensure proper data taking, log all activity, and to fill out the Beam Accounting form. The target operator should focus on the operation of the polarized ^{3}He target. Target operator training is arranged by Jian-ping Chen. The shift leader or third shift worker will run the DAQ and online analysis codes.

This run period uses the "standard" Hall C equipment and a polarized ^{3}He target, and the Moller polarimeter. The use and safety procedures of the standard equipment are documented in the Hall C Standard Equipment Manual available from the Hall C web page. The polarized ^{3}He target will be used in Hall C for the first time. The Moller polarimeter will be used by "Moller experts" to measure the beam polarization. The Moller polarimeter, while used to be part of the Hall C standard equipment during the 6 GeV era, will be used for the first time after the 12 GeV upgrade. The use and safety procedures of the polarized ^{3}He target and the Moller polarimeter are documented in the TOSP (Target Operation Safety Procedures) and the Moller OSP, respectively, available from the experimental webpage of E12-06-110, E12-06-121.

One special requirement of the polarized ^{3}He target is the "laser lockdown" period. During this period, only personnel with polarized ^{3}He target training or laser safety training will be allowed to access the hall. Details of the "laser lockdown" period and its safety and training requirement are documented in the TOSP.

To summarize, the following OSPs are associated with E12-06-110, E12-06-121:

- Jefferson Lab Hall C Standard Equipment Manual;
- Polarized ^{3}He Target OSP;
- Moller Polarimeter OSP.

C Signature Sheets

After reading this document, as well as TOSP, OSP of the Moller polarimetry, ESAD, RSAD, and ERG, workers need to sign the signature sheet located in the "yellow binder" of the experiment specific documents. This binder can be found in the Hall C counting house and in the MCC.