MEMORANDUM

Date: January 3, 2012
To: Distribution
From: Rolf Ent and Arne Freyberger for the Nuclear Physics Experiment Scheduling Committee
Subject: Accelerator Schedule: Through May 18, 2012

Schedule

Attached is the accelerator operations schedule through May 18, 2012 at 8 AM. It has also been posted at http://www.jlab.org/exp_prog/experiment_schedule/ . The operations schedule is subject to the fiscal year 2012 funding realities and it may require adjustments if budgets are far worse than assumed by this schedule. This schedule covers the last run period of the "6 GeV Era'' before the final shutdown in May 2012 for the completion of the installation of the 12 GeV Upgrade.

The Jefferson Lab Nuclear Physics Experiment Scheduling Committee developed the schedule. Committee members were: Larry Cardman and Arne Freyberger (Co-Chairmen), Hari Areti, Jay Benesch, Volker Burkert, John Domingo, Kees de Jager, Will Oren, Matt Poelker, Joe Prebble, Chris Keith, Dennis Skopik, Mike Spata, Steve Suhring, and Steve Wood. Dave Richards provided advice. As has been the norm, a number of meetings of this committee were necessary to resolve conflicting requirements and to ensure that sufficient resources would be available at the laboratory to properly stage and carry out each of the experiments. The schedule was derived by looking at the requests for major installation work in the experimental halls and the accelerator, evaluating the number and kinds of people needed, and then scheduling to minimize overlap. The schedule request forms were useful in identifying the detailed requirements of each experiment. Information on other laboratory engineering priorities was included to ensure that the required preparatory work could be completed in time. This provided a rough overview of when each hall would be down.

The final schedule was then reached by a series of compromises in running order within each experiment and between halls to work around incompatibilities. It was reviewed and approved by the Director.

The standard section at the end of this memo on "the meaning of priority on the accelerator schedule" is included for reference but all users should read it carefully.

Supplementary Information

Accelerator

The 6-month shutdown started Friday May 13th 2011 and is planned to end Oct. 20th. The scope of work in preparation for the 12 GeV Upgrade on the accelerator is quite extensive. Every attempt has been made to insure that the CEBAF accelerator is 6GeV capable after the 6-month shutdown work is completed. A prolonged CEBAF recovery time starting on Oct. 20th 2011 and terminating with the resumption of the 6 GeV physics program on Nov. 19th is included in the schedule.

We continue to operate with a superlattice photocathode operating at 130kV that produces a maximum beam polarization greater than 80%, typically 85%, with good lifetime. The cathode will require special care during the Qweak experiment. The large Qweak current for the upcoming run, (180 μA), will drive the need to almost weekly spot moves (4h downtime) and monthly heat/activate cycles (16h downtime).

We will continue to reserve 16 hours every week in order to recover RF cavities and perform other limited beam development activities (aka Beam Studies) deemed critical to successful accelerator operations. Beam Study campaigns for the upcoming run include (but will not be limited to) Mott polarimeter upgrade (towards a 1% polarimeter) and model development in support of 12GeV. We continue the effort in operator training, and procedure and tool development to minimize the time needed for accelerator configuration changes and also prepare for commissioning the 12 GeV accelerator.

Hall A

In the Spring of 2011 we ran a series of five "base equipment" experiments in Hall A. We completed the E08-008 experiment (Bertozzi, Gilad, Norum, Wang), an Exclusive Study of Deuteron Electrodisintegration near Threshold, on Feb 22. Next, we performed the experiment E08-010 (Gilad, Higinbotham, Sarty, Sparveris), a Measurement of the Coulomb quadrupole amplitude in the Delta(1232) in the low momentum transfer region, finishing on March 9. This was followed by a first run of E07-006 (Gilad, Higinbotham, Moffit, Piasetzky, Watson), Studying Short-Range Correlations in Nuclei at the Repulsive Core Limit via the Triple Coincidence (e,e'pN) Reaction. On April 14-15 we ran the short experiment E08-009 (Aniol, Benmokhtar, Gilad, Higinbotham, Saha), a Detailed Study of ^{4}He Nuclei through Response Function Separations at High Momentum Transfers. On April 15 we switched over to E08-014 (Arrington, Day, Higinbotham, Solvignon), Three-nucleon short range correlations studies in inclusive scattering for $0.8<Q^2<2.8$ GeV^2, and finally on May 8 we returned to E07-006 to run it for the remaining 5 days until the summer shutdown, which started on May 13.

Thanks to incremental funding from DOE, the engineering and design efforts for the g_2^p/G_E^p pair of experiments, E08-027 (Camsonne, Chen, Crabb, Slifer), a measurement of g_2^p and the Longitudinal-Transverse Spin Polarizability, and E08-007 (Gilman, Higinbotham, Ron, Arrington, Sarty, Day), a measurement of the Proton Elastic Form Factor Ratio at Low Q^2, has been successful and the installation is on track, except for the polarized proton target. Unfortunately, the target failed final tests in late September, becoming non-superconducting on some of its electrical connections. The connections overheated and failed. An attempt to repair the target is underway, by splicing the superconducting wire to regular wire in a fashion that should provide better cooling and avoid the thermal runaway that apparently occurred on this splice in the tests. This repair work will likely delay the start of the experiment until the first week of December. Meanwhile, the beamline elements, including the new low-current beam monitors, chicane, target platform, slow raster, and local beam dump should all be ready. Also, the detectors and data acquisitions systems should be ready.

Hall B

The PRIMEX II run (Gasparian, Dale, Gan, Ito) was completed November 10, and met its goal of measuring the π^0 lifetime with improved precision. Following PRIMEX II, the eg5-TPE experiment was installed requiring a very significant modification of the beam line arrangement (Afanasev, Arrington, Brooks, Joo, Raue, Weinstein). This experiment studied 2-photon exchange contributions by comparing elastic electron-proton scattering and positron-proton scattering cross sections. The experiment was completed February 25 one day later than originally scheduled.

The eg5-TPE run was followed by the re-installation of the Photon Tagger Focal Plane instrumentation that had been removed prior to the eg5-TPE run to protect it from the expected radiation damage during operation of that experiment. A short tagger calibration run was carried out from March 26-28, 2011 to re-establish the proper operation of the energy counters in the focal plane of the tagger magnet.

The G14-HDIce run (Sandorfi, Klein) was originally scheduled to begin with the installation/commissioning of the newly constructed In-Beam-Cryostat (IBC) for polarized HD on March 29. Due to delays in several components of the hardware for the IBC the installation of the IBC was delayed by several weeks until late April, which only allowed for the commissioning of the superconducting magnets and the NMR system. The target sample transfer from the HDIce Lab into the IBC in Hall B was also carried out successfully. However, the cool down of the IBC was limited to 2K (instead of the expected less than 50mK) due to a small copper piping that blocked the liquid He flow to a needle valve that regulates the He flow. A piece of solder was discovered later when the cryostat was opened up. The solder was the cause of the blockage. Due to this problem, the IBC thus did not reach its final operating temperature and the remainder of the commissioning and engineering run could not be completed. The IBC was removed and opened up in the Lab where the blockage was removed and the IBC reached a temperature of <30mK even with relatively low power turbo pumps. After several improvements the IBC was reinstalled in the Hall B beam line and is currently cooling down.

The current plan is for the G14-HD experiment to be fully ready for in beam commissioning by October 31.

Hall C

E08-016 (Carlini, Kowalski, Page), the Q_{Weak} experiment completed run I, taking data through May 2011. During this run, all the Q_{Weak} systems were commissioned, including the new Compton polarimeter. The experiment obtained about 25% of the planned production data and made a number of necessary auxiliary measurements including background measurements on Aluminum.

During the 6 month shutdown, several Q_{Weak} maintenance activities were carried out. Parts of the high power LH_2 target were refurbished, including the replacement of the target cell windows and replacement of bearings in the pump. The power supply for the high power heater was also upgraded which will allow more reliable target operation at high beam currents. In the Q_{Weak} detector hut, a ninth quartz bar, identical to the 8 bars of the main detector was installed. This will map out backgrounds in the detector hut.

During the course of Q_{Weak} run I, the large quadrupole in the Moller polarimeter developed an instability. The quadrupole was replaced, requiring the removal and reinstallation of a part of the beamline and polarimeter.

A number of issues with the downstream beampipe and the dump were also addressed during the down. The bellows at the exit window was replaced with a larger diameter bellows to avoid vacuum problems from radiation damage and the fresh windows were placed on the water cooled exit window of the beamline. Inside the dump, a helium leak was located and repaired, the diffuser (not needed at Q_{Weak} energies) was removed and ion chambers replaced.

New beam current monitors and electronics were installed on the Hall C beamline. These improved BCM systems will reduce contribution of beam current measurements noise to the Q_{Weak} statistics.

During the down, work continued on preparing Hall C for the installation of the Super High Momentum Spectrometer. Cables and fixtures were removed from the spectrometer, the electronics hut was removed and lead contamination was cleaned up. The 300 ton Hypernuclear Kaon Spectrometer was also disassembled and stored in the Experiment Staging building.

After the 6 month down, Hall C will resume production data taking for the Q_{Weak} experiment, running at beam currents from 150 to 180 μA. This run will continue through to the end of 6 GeV beam operations in May 2012.

During time when the accelerator is running at energies incompatible with Q_{Weak} (0.83 GeV in early January), an opportunistic measurement of the parity violating asymmetry in the N→Δ transition will be run.

Footnotes to the Schedule

We summarize here the detailed footnotes to the schedule. They appear in the rightmost column of the schedule listing, and are listed at the earliest date in the schedule when they are applicable; many extend for a considerable time after they first appear. The first five footnotes apply to the entire schedule. All of the footnotes are repeated here for clarity and information.

1. When two or three halls are scheduled, the relative priority listed in the schedule (in the order listed from left to right) is the relative priority of the halls. For example, A/B/C means that Hall A is the highest priority, Hall B has second priority, and Hall C has the lowest priority. If one of the halls has an asterisk, it means that its priority is conditional, and the conditions are given in appropriate footnotes at the beginning of the running of the affected experiment. If the conditions are not met, then the remaining two halls will have priority in the order listed.

2. Energies listed in the schedule for the halls receiving polarized beam are the actual, delivered energies; they include the energy of the injector.

3. When polarized beam is delivered to all three halls, it is not, in general, possible to provide pure longitudinal polarization to all users. We have optimized the beam energies to provide the highest longitudinal polarization (generally over 90%) to all halls during extended periods of scheduled two- and three-hall operation with polarization. For two-hall operation we have occasionally used less than ideal linac energy settings when one or more of the halls has a scheduled pass change in order to optimize polarization delivery over the entire run. This avoids the loss of beamtime associated with a linac energy change, and it avoids energy shifts in the hall that has no interest in changing energy at the time of the transition in the other hall. See the note in the "polarization" subsection of the text on the meaning of priority in the schedule; the note is attached below.

4. Historically we have determined the orientation of the polarization at the injector by setting the Wien angle to a value that minimizes the differences between the hall polarizations (by minimizing the dispersion) so long as this scheme does not result in a reduction of the "sum of squares" figure of merit by more than 2% compared to the optimum figure of merit as determined by summing the squares of the polarization provided to all halls scheduled to receive polarized beam. We have had the additional constraint that if minimizing the dispersion results in a loss of more than 2% relative to the optimum figure of merit, we will revert to our earlier algorithm of setting the Wien filter to maximize the overall figure of merit.

In all cases involving polarized beam delivery the setting of the Wien Filter shall be fixed throughout the running period unless all parties scheduled to receive polarized beam agree to a different setting. ***However, during the running of Q_{Weak}, a decision has been taken to give Q_{Weak} 100% longitudinal polarization and to insist that Halls A and B take the polarization available consistent with the Q_{Weak} requirements.***

5. When polarized beam is provided at a new energy, as much time as necessary during the first shift of polarized beam operation will be used to verify polarization in the halls. This can be done by direct polarimetry in the hall(s) and/or by taking data on a reaction that is adequately sensitive to the beam polarization. By the end of the first shift of production running with polarized beam, the run coordinator(s) for any experiment(s) receiving polarized beam must report to the Program Deputy that they have measured the beam polarization and determined it to be acceptable. Otherwise, a measurement of the beam polarization will be scheduled immediately. When the polarized beam energy is being changed in only one hall (e.g. a "pass change") then that hall should measure beam polarization by the end of the first shift of production running. Further, if the change in settings of the Wien filter are substantial, all three halls should measure and report beam polarization by the end of the first shift of production running with the new setup.

6. Accelerator development time will be allocated 16 hours/week for the duration of this schedule.

7. Collaborative test will be performed to determine the beam quality delivered to the halls after a major down. Halls should be ready and locked at the start of the collaborative checkout. If beam conditions meet the experiment's requirements before the scheduled time, the experiments will be able to use the beam time for production running.

8. Physics production running stops at the end of the owl shift (~ 7 AM).

Additional General Information on Operations and Scheduling Constraints

As noted earlier in this memo, the operation of polarized beams in more than one hall puts severe constraints on our ability to change beam energies.

Technical support from the Accelerator Division for the firm schedule is expected to be adequate. However, experiments that require significant technical support, and are anticipated to run in the next run cycle should be carefully coordinated with the Hall and Accelerator Division engineering staff to avoid possible conflicts with the future demands of the 12 GeV upgrade.

The Meaning of Priority on the Accelerator Schedule

Generally, the assignment of priority to a hall means that the identified hall will have the primary voice in decisions on beam quality and/or changes in operating conditions. We will do our best to deliver the beam conditions identified in the schedule for the priority hall. It will not, however, mean that the priority hall can demand changes in beam energy that would affect planned running in the other halls without the consent of the other halls. Of course, final authority for decisions about unplanned changes in machine operation will rest with the laboratory management.

The operation of more than one hall at Jefferson Lab substantively complicates the interaction between the experimenters and the accelerator operations group. It is in the interests of the entire physics community that the laboratory be as productive as possible. Therefore, we require that the run coordinators for all operating halls do their best to respond flexibly to the needs of experiments running in other halls. The run coordinators for all experiments either receiving beam or scheduled to receive beam that day should meet with the Program Deputy at 7:45 AM in the MCC on weekdays, 8:30 AM on weekends.

To provide some guidance and order to the process of resolving the differing requirements of the running halls, we have assigned a "priority hall" for each day beam delivery has been scheduled. We outline here the meaning of priority and its effect on accelerator operations.

The priority hall has the right to:

- require a re-tune of the accelerator to take place immediately when beam quality is not acceptable
- insist that energy changes occur as scheduled
- obtain hall access as desired
- request beam delivery interruptions for experiment-related operations such as Mott measurements of the beam polarization or pulsed operation for current monitor calibrations, temporarily blocking normal beam delivery to all halls.

These interruptions shall be limited by a sum rule - the total time lost to the non-priority hall(s) due to such requests shall not exceed 2.5 hours in any 24-hour period. It is, of course, highly preferred that these measurements be scheduled at the morning meeting of the run coordinators whenever possible, and coordinated between halls whenever possible.

When the priority hall has requested a re-tune, if the re-tune degrades a previously acceptable beam for one of the other, lower priority running halls, then the re-tune shall continue until the beam is acceptable to both the priority hall and the other running halls that had acceptable beam at the time the re-tune began.

Non-priority halls can:

- require that a retune of the accelerator take place within 2.5 hours of the desired time (it will nominally occur at the earliest convenient break in the priority hall's

schedule)
- require access to the hall within 1 hour of the desired time (again, it will nominally occur at the earliest convenient break in the priority hall's schedule)
- request Mott measurements in the injector within 2.5 hours of the desired time (it is preferred that this be scheduled at the morning meeting of the run coordinators and coordinated between the running halls whenever possible).

The ability of non-priority halls to request retunes and accesses shall be limited by a sum rule - the total time lost to the priority hall due to such requests shall not exceed 2.5 hours in any 24-hour period. (To facilitate more extended tuning associated with complex beam delivery, with the agreement of the run coordinators for all operating halls, the sum rule may be applied over a period as long as three days, so long as the average impact is less than 2.5 hours/day.) In the event that two non-priority halls are running, the 2.5 hours shall be split evenly between them in the absence of mutual agreement on a different split.

All Halls:

Can negotiate with other halls, and with the Accelerator and Physics Division for changes in scheduled energy changes (either direction).

Initial Tune-up of New Beams:

Normally one and one half shifts (12 hours) is set aside for tune-up whenever a new beam setup is being tuned (for unusual beam setups more time may be scheduled explicitly for tuning at the discretion of the scheduling committee). It is understood that beam tune-ups shall *always* be done in the order that the accelerator operations group believes will minimize the *total* time needed to tune *all* scheduled beams (i.e., the "priority hall" beam is not necessarily tuned first). In the event that obtaining the new beam setup requires more than the scheduled time, the Accelerator Program Deputy is authorized to spend up to one additional shift of tuning in an effort to deliver all scheduled beams instead of just the "priority hall" beam.

Polarization:

Note that the setting of the Wien filter, which determines the polarization orientation in all halls, is NOT affected by the hall priority assignment. For two-hall operation we will always optimize the figure of merit for the two running experiments by setting the Wien filter to a value that results in identical longitudinal polarization components for the two halls. For three-hall operation we set the Wien angle to a value that minimizes the differences between the hall polarizations (by minimizing the dispersion) so long as this scheme does not result in a reduction of the "sum of squares" figure-of-merit by more than 2% compared to the optimum figure of merit as determined by summing the squares of the polarization provided to all halls scheduled to receive polarized beam. If minimizing the dispersion results in a loss of more than 2% relative to the optimum figure of merit, we will revert to our earlier algorithm of setting the Wien filter to maximize the overall figure of merit. In all cases involving polarized beam delivery the setting of the Wien Filter shall be fixed throughout the running period unless all parties scheduled to receive polarized beam agree to a different setting.

Finally, any change in the accelerator schedule that has implications for running beyond one week and/or is not agreed to by the run coordinators for all affected experiments and the accelerator program deputy must be discussed and confirmed at meetings to be held (as required) each Tuesday and Friday afternoon at 4:00 in the office of the AD for Physics.

Maintenance/Development The twelve hours per week allotment for both maintenance and beam studies in previous memos proved insufficient for preparation for recent experiments. Beginning in Jan. 2005, the Accelerator Division has asked instead that sixteen hours per week be explicitly assigned for RF recovery, cathode work, operability improvement studies and beam studies in support of PAC approved experiments. Users will be consulted in deciding how these sixteen hours per week are placed on the calendar, i.e. five shorter or three long blocks of time.

Holidays For holidays shown on the schedule as down when we plan to run beam just up to the holiday, the beam will be shut down at ~8 AM on the last day shown as beam delivery.

Energy Constraints on Multiple Hall Operations The standard constraints for the different energies in the three halls during multiple hall operation are reiterated here for your information. The RF separators are able to extract one beam after each pass or, alternatively, to deliver beam to all three halls after five passes. Therefore, it is always the case that: 1. All three beams can have the same energy only on the fifth pass. 2. No two halls can have the same energy, except on the fifth pass. 3. Unusual beam energies in one hall will sometimes preclude multiple beam operation and impose shutdowns on the other halls, unless one or more of the other halls can also use a commensurate, unusual energy.

Polarization Constraints on Multiple-Hall Operations There are two beam energies (2.115, 4.230 GeV) at which purely longitudinal spin can be delivered simultaneously to all three halls when the halls have the same energy. There are, however, many combinations of passes and linac energies at which it is possible to deliver beams with precisely longitudinal polarization to two halls simultaneously, and many combinations at which it is possible to deliver nearly longitudinal polarization to three halls. A technical note covering all combinations of 2-hall polarized beam running is available (TN 97-021). Tables of ideal energies for two-hall operation and optimal energies for three-hall operation are available at the url: http://clasweb jlab.org/spin_rotation/

You can also determine the dependence of the polarization in all three halls on the Wien filter angle for the actual settings of the accelerator. Experimenters scheduled for periods involving multiple-hall polarized beam delivery should consider the possible impact of a transverse polarization component on their measurements, and provide the laboratory with a maximum allowable transverse component if appropriate. Because of the limitations on beam energies associated with the different combinations of linac settings and numbers of passes delivered to the different halls, we have a great deal less flexibility for changing energies in the different halls during polarized beam running.

This is because there are many instances where the nominal linac energy and number of recirculations for the running halls provide reasonable polarization, but where changing the number of recirculations for one of the running halls results in nearly transverse polarization.

In an effort to optimize polarized beam running, we schedule many weeks of operation at energies that are consistent with good polarization in multiple halls. The details vary from run period to run period and hall by hall. In the worst case, the effective polarization delivered to a hall is typically reduced to no less than ~90% of the nominal maximum available from the cathode. This reduction is due to the angle at which the polarization vector will be set relative to the beam direction in the hall in a compromise that will optimize delivery to all halls. For two-hall operation we can optimize the figure of merit for both running experiments by simply setting the Wien filter to a value that results in identical longitudinal polarization components for the two halls. For three-hall operation we have previously used an algorithm that set the Wien filter to a value that maximized the overall figure of merit (the sum of the squares of the polarization provided to all halls scheduled to receive polarized beam). It has been noted that this sometimes results in situations where the delivered polarization is significantly different for the three halls. To "equalize the pain" for three-hall operation, we are adopting a refinement to this algorithm. The Wien angle for three-hall operation will now be set to minimize the differences between the hall polarizations (by minimizing the dispersion) *so long as this scheme does not result in a reduction of the "sum of squares" figure of merit by more than 2% compared to the optimum figure of merit.* In all cases involving polarized beam delivery the setting of the Wien Filter shall be fixed throughout the running period unless all parties scheduled to receive polarized beam agree to a different setting.