Minutes of A1n/d2n collaboration meeting on July 24th, 2019

black = Notes and discussions;

red = (more urgent or immediate) to do’s; – note the whole minutes are a giant to do list.

**bold blue 3 = new findings and/or significant updates**

pink = manpower discussions/needs.

green 4 = items from Dec ‘18 meeting that have eluded everyone’s radar and need followup

**Steve W. (scheduling):**

In the published schedule, we have

(7/18/2019-10/31/2019 installation)

11/1-12/19/2018 A1n (49 days)

1/22-2/13/2019 A1n (23 days)

2/14-4/10/2020 d2n (57 days)

4/11-5/5 contingency

- With the 18-day delay in the Hall C summer program (PREX2 will run longer but not relevant for us) we will likely push A1n start to 11/19.

- the request of two times 3-day 1-pass run for calibration has been acknowledged.

Discussions:

(Jay)

- the late finish of PREX2 will affect the planned accelerator work. This work is needed for the high energy run in C in the fall. So it is not irrelevant to us but timing wise it should be okay (to start in Nov).

- there is a possibility to start beam earlier in January depending on how the X’mas shut down is done (warm tunnel, 2K vs. 4K etc). It’s possible to shut down for 12/23-1/2/2020, then it will take one week to restore and beam starts on 1/9/2020.

(Thia):

- A1n start in the Hall is determined by the target installation, not by the accelerator. We are not pushing for start on 11/1 because of the target;

(JP, Bert, Walter);

- One week is needed for target rotation (to be finalized)

(Xiaochao):

- with the 18 day delay and the 3 days needed for 1-pass commissioning, if we keep the target rotation at X’mas then there is only 28 days of high x running, compare to 50 days of approved calendar time (25 PAC days). Start the beam early in January will be very helpful. In this case we will continue with high x run until near end of January, then rotate the target, then resume A1n (low x) and d2n.

- Overall there are too many uncertainties in scheduling at the moment. A lot of these will be more clear within two weeks (scheduling discussion will be within this time frame).

(Thia):

- what are the angles needed for A1n+d2n? Need to make sure we keep this range clear on the floor during summer decommissioning. - done, list sent to Thia by Xiaochao on the same day.

- any spectrometer rotation needs to be checked with Steve Lassiter.

– Note: for positron runs should plan to do this only on SHMS (not HMS), since setting the HMS to positive polarity is more difficult (require access).

**Walter (installation):**

- Nothing really changed since last meeting, though schedule is being pushed ~18 days. Now showing target installation ends on 11/30 but that is a conservative estimate.

(Thia/JP to Xiaochao): PI/spokespersons need not worry about details of scheduling, start dates etc. Just ask for beam time.

- JP reminded that laser alignment, target field mapping etc should all be included in the installation schedule.

- (Thia): collaboration should come up with a list of survey need.

**Dave G. (beamline and Moller)**

- the quad configuration needed for 1- and 5-pass is different: 1 quad for 1-pass and 2-quads for 5-pass. Because of the way the quads are powered now, need to swap power cables between the two configurations. Should take only 2 hours, and no more than 1 shift in the worst case.

- but the swapping may cause confusion to the Ops. Need to work out two versions for the optics

(Xiaochao) – cable swapping can be done during the one-shift pass change (right?). If more time is needed, it can be done opportunistically (later), not necessarily delay beam start at 5-pass.

Note: later we talked about commission the hall and the experiment with 2-pass beam (beam line and target checkout, some optics). But this cannot save Moller commissioning because Moller needs to be commissioned at each energy/pass. Thus we will not require polarization nor Moller work for 2-pass.

Prepare for run:

- Moller measurement should only be done by a small group of experts. Need two measurements per week by two people. The two will be Dave Gaskell plus one person from the collaboration.

- Someone from the collaboration needs to track the time dependence of the polarization, and help to determine if extra measurements are needed. Examples are QE change, spot move, heating??, Wien angle change, etc.

- Need someone from the collaboration to do Moller analysis, comparison with Monte Carlo etc (student).

- not urgent, but Moller analyzer is written in Fortran, with some upgraded to C++/ROOT. Need a modern version, someone interested in coding and with plenty of time might want to work on this.

*From Dec ‘18 meeting:*

*– pipe on beamline needed for beam alignment – (D.G.) as of July 2019 this has not been installed yet but design is completed and parts fabricated.*

*– There were discussions about how to protect the Be window from air during target rotation – need followup;*

**Mark J. (raster)**

Q (audience): Does the accelerator have the raster controller modified?

MJ: Chris C. has talked to them.. (is it done then??)

- Revisted the hot spot problem: Currently showing ~50% higher central hot spot. As discussed in December 2018 meeting: We need 10%, g2p reached 10% after a student’s hard work. etc.

MJ: Hall C is slow raster alone, Hall A has both slow and fast raster (???).

JP: Doesn’t matter. g2p reached 10% uniformity with slow raster alone.

Would be good to have a student help with raster work.

(XZ): do we have a scope showing real-time raster pattern in the counting house?

**Caryn P. (Beam asymmetry “Aq” control):**

- Reminder: Requirement from A1n/d2n is <200ppm(A1n) or 100ppm(d2n) per hour-long run. “Both can be done” (CP).

- Aq is mostly determined by the IA cell of Hall C;

- when PREX/CREX runs, the parity DAQ/HAPPEX feedback monitor does feedback on Hall C Aq and control it.

- some data taken this summer, without feedback Aq was 200ppm every minute. With feedback adjustment every minute, shows ~+/-30ppm Aq per minute, accumulated Aq drops to <1ppm after 30 minutes.

- for fall/spring, may ease up on feedback interval (currently every minute).

Prepare for run:

- To control Hall C Aq we need Hall A parity DAQ/feedback control to run all the time.

- (Brad) need tracking all information (QIA etc) in Hall C EPICS. QIA (and other important settings) should also be in the alarm handler.

- (Xiaochao) should have those parity settings in the shift checklist too.

- There will be a ~2 weeks period where Hall C runs after Hall A finished CREX. We need to involve some PREX/CREX expertise in our collaboration for the whole run, and keep the parity DAQ running when A is not taking data. (Possible names: Paul King, Amali...)

- Our shifters need to know how to monitor/run parity DAQ.

*From Dec ‘18 meeting:*

*– Q: what is the actual change in energy during Hall A beam modulation? – Chip will find out; – this can be important for elastic calibrations at 1-pass. General consensus is this should not be larger than “normal” noise.*

*– followup Q: If Hall A is off during our 1pass calibration run, will modulation be off for sure, or do we need to remind Hall A to turn it off?*

*– Need Hall C’s BCM102 – Brad will follow up.*

**Jixie Z. (A1n optics calibration)**

(JP): Hall C HMS must had past data for ytar beyond +/-5.5cm?

(MJ): no, longest target was 10cm LH2 and only ran up to 60 deg.

(Thia): reminded HMS ytarg acceptance is only +/-8cm.

– can we use 1-mm dia carbon hole to calibrate raster size?

(JP, Brad): we use this only to align the beam. Using hole size to judge raster size quickly online is okay, but not for “raster calibration” (of course)!

slide 4: (Thia, JP, Brad) why using 2 foil carbon target? Should use 7 foil.

(JZ): events that hits the tungsten plate may only lose energy and still enter spectrometer.

(others): no, they are completely stopped.

slide 5: correlation. (MJ) what is shown is for all orders. So this is indeed a good evidence there is no correlation between dP and angle at all.

- for carbon elastic calibration, we need to turn off all but 2 scintillator bars. Need to check simulation with real data to confirm scintillator bar position.

(MJ): simulation vs. data match really well on the focal plane. HMS is better understood/known, but SHMS is also quite good.

- need to be able to quickly determine online whether the scintillators kept on are the correct ones.

p8: angle calibration using sieve slits. Require 25 events for center (small) hole, for each foil. Tried 30 deg and different passes.

p12: 30-deg using 5-pass requires 900 minutes! (too long). But 2-pass requires only 160 min.

**We can commission the experiment (beam line and target checkout, aligning beam, angle optics) at 2-pass, do as much as we can, then switch to 1-pass for elastic and Delta calibration and dP calibration.**

p14: need to redo table with 7-foil.

discussion on using DIS events at 30 deg to calibrate angle:

(JP): Can’t do this, holes are spread out.

(MJ): Yes we can!

- might need to confirm this using existing data – can we see holes using inelastic events?

- current limit on current with raster off is 20uA in Hall C. Our solid target can take 30uA (raster on and off, heating on foil holder is similar). Need to update the raster-off limit to 30.

(JP) can’t optics be done with raster on?

**Mingyu C. (A1n 1pass runplan)**

- p5 (Brad) need to also keep in mind real rate effect on VDCs and trigger efficiency;

- on elastic PbPt (JP): 3% measurement on one arm is good enough → 3 hours on HMS is good enough.

- p6 (TA) reference cell doesn’t go up to 10atm. (It can but it could blow);

(JP) N2 pressure curve needs focus on low pressure.

→ need a detailed list of (1) suggested N2 pressure for pressure curve (elastic, 1pass, ideally per cell); (2) suggested He pressure for pressure curve (elastic, 1pass, ideally per cell); (3) suggested H2 pressure for elastic (elastic, 1pass, one time); (4) suggested N2 pressure for dilution (DIS, 5 pass, per kinematics); (5) suggested He pressure for dilution (DIS, 5 pass, per kinematics); and (6) suggested H2 pressure for cross section (DIS, 5 pass, per kinematics).

- time needed to change reference cell pressure (TA): about 5 min for 0→ 8 atm; then 1min each to reduce 8 atm → 6 atm, etc.; <10min to change from H2 to N2;

- (JP) When working on the detailed run plan, need to preserve 3He gas. Leave this as last in reference cell for 1-pass run, then first for 5-pass run (or next kinematic setting), etc.

– (JP reminded) ideally we need N2 and He pressure curve for every cell. But since it can only be done at elastic/1-pass, we can only do this once in spring and once in fall.

**Brad S. (d2n overall runplan)**

(XZ): A1n resonance data can only be done on SHMS (8 cal days, one arm). Can d2n balance this by running on HMS only for 8 days? Or should A1n time be re-calculated between HMS/SHMS? – need followup

(JP reminded): for each kinematic setting need 1 run each for H2, N2, 3He ref cell, not pressure curve

(JP): time needed for polarimetry: pNMR can be minutes, NMR or EPR can be one per shift or even less frequent.

*from Dec ‘18 meeting:*

*There were discussions about how to protect the Be window from air during target rotation – need followup;*

**Scott B. (new 3He elastic proposal)**

discussions: should change Q2 settings to pin-down the zero-crossing!

- need to make sure windows/QE rates have been properly considered.

**JP (target overall status):**

– safety incident caused the lab to close for two weeks, caused delay;

– target experts will need extensive training (Radcon II, lock/tag, etc) to work on the target pivot;

– next going on in target lab: water calibration over the weekend, plus testing Fulla (need Fulla from UVa on Thursday/tomorrow). Target will be disassembled on Aug. 6th.

– will send Savior back to UVa for testing.

(Gordon): should check if Savior has leak. A leak can easily explain the reduced performance observed at JLab. Also 2.5 years is a long time for a glass cell being repeatedly tested.

**Mingyu and Junhao Chen (target details);**

no note here, everything is fine!

**Todd A. (reference cell system);**

Showed some simulation by Silviu (note from XZ: some of these were shown at biweekly meeting last year, see mintues);

(Thia): For deuterium we had some data that confirmed well Silviu’s simulation.

Discussions on beam trip rate/ramping:

- As already determined from Silviu’s simulation, our minimum ramp rate is 1uA/sec or 30sec total to reach 30uA. Data during this time cannot be used due to density settling and possible large Aq.

(Brad) but cutting out beam ramps will affect the cross section measurement! (JP) but cross section measurements are not statistically limited so should be fine!

Biggest effect is systematic effect on the target density, which is about 6% from Silviu’s simulation along the beam path. This can’t be determined from reference cell runs as reference cells will have the same effect. But can be studied using absolute H2 cross section.

– discuss again about trip rate. We have known (from Jay) for a long time trip rate will be 10/hr with 2 RF recoveries per week. This has not changed. In a followup email (7/25) from Jay: “Trip rate will also be bad. RF at least ten/hour with two RF recovery periods per week. Another five/hour likely either from BLMs or Hall B halo detectors. There's hope for significant improvement in 2021 but no earlier; I'll know more about that after an 0900 meeting Friday.”

So, 15/hr \* 0.5min = 7.5min/hr. If the efficiency is already low, let’s say 35min of good beam per hour, the loss due to beam ramping is 7.5/35min or ¼ of beam!

Note: beam ramping is more a target cell safety requirement than a data requirement. So even though A1n is less sensitive to density settling, we can’t use a faster ramp rate.

– (Thia, Brad) It’s important we don’t push for a higher gradient (energy) because trip rate can be significantly poorer at 10.6 than 10.5 GeV. (But we are already running 10.5 GeV so nothing to do here, I think?)

*from Dec ‘18 meeting:*

*– how much gas do we need? (N2, H2, 3He) → need run plan – followup July 2019: Todd said he thinks he has enough gas.*

**Munchuna R. (target field directions):**

– need to send a list of supply/space need to JP for testing the field magnet in the hall.

**Gordon (Field gradient):**

– reported on effect of HMS Q1 at 13.5 deg and 600A (note: this appears to be one of d2n setting). Effect is small compare to gradients from other fields/magnets (such as Hb).

– can scale linearly for A1n’s 12.5 deg, 6.8 GeV/c (Q1 current is 893A so 50% higher). So effect is still small.

– to do: would like to run this for the high x run to make sure we are okay. (Good idea! since we will be there for 50 days!). Settings for HMS is 30 deg, 2.9 and 3.5 GeV/c. Iset for HMS Q1 are 378A and 456A, respectively. If need to run this with “everything on”, Sylvester J. has all settings worked out in a spreadsheet sent by email (7/24), which are copied and attached as Appendix A to this document (see last page).

**Gordon (Cell production):**

– Recap: We need 6 cells for A1n/d2n running

– Overall, best cell is Fulla (17hr, 53%). Tests show much better performance than last December due to discovering a large AFP loss in the system (which has since been corrected);

– Two more cells are not quite usable (but not absolutely unusable): Florence (11hr, 45%) and Brianna (23hr, 53% pre-damage; 14hr, ??% post high laser power damage).

– Savior shows significantly lower performance when tested at JLab (42hr, >55% at UVa; 28hr, ~38% at JLab). Reason may be due to leak and/or normal aging (it’s 2.5 years old!). – now ranked below Brianna and Florence.

– Will produce one cell per week between two sites (UVa and W&M). Stay tuned. Next cell to be made is “Yeti”.

– p.17 has a nice cell comparison by Todd.

**(Thia): Ed Folts is now tracking on cell production/testing status. By 9/1, need 3 more cells produced, and 2 minimum at the performance level of Fulla.**

**Brad S. (Detectors and PID):**

Did not compile a good summary of PID performance (electron efficiency and pion rejection, etc).

(XZ): Will you work out a list of working pressure/gas mix conditions to use for both A1n and d2n?

(Brad): Yes!

From Dec ‘19 meeting:

NGC and HGC each has separate problems: HGC Npe is too low; NGC mirror was fixed and re-aligned which improved Npe, but the hole at the center of focal plane gets bigger.

We should be prepared to use both NGC and HGC (JP)

What’s the threshold momentum we need? – may not need GC for high momentum settings (XZ) – this will simplify the gas mix.

(Brad) We urgently need people to become familiar with hcana. Suggest someone leading weekly meetings with all graduate students. Need one senior local person as the expert and “go to” person too.

– possibly to start right away: initial lead by Syvelster J., with Jixie Z. as the 2nd lead and local expert. Melanie will start working on online checking scripts and online analysis; All other students get started too.

– XZ will start to brainstorm a list of online monitoring needed and discuss this with Melanie this weekend (on shift in Hall C). Some very random thoughts are as follows:

---- basic detector checkouts, must include scintillator hit position, cherenkov and lead glass;

---- online electron PID plots and cuts determined on the fly;

---- Helicity dependent (N+ and N-) W spectrum (cut if needed), Q2 spectrum, xbj spectrum (cut when needed);

---- online analyzer spits out total N+ and N- for good electrons, asymmetries, (binned when appropriate);

---- online analyzer spits out accumulated statistics (see above) for a given kinematics.

---- what else?

---- need better checklist instructions and need include all variables on parity control.

**General discussions:**

– We will need to meet bi-weekly from now on. Tuesday afternoon seems to work for everyone.

– Thia updated: sent collaboration’s reply (July 2019 version) to Patrizia R., who forwarded to the ERR committee. Next will wait for their reply. Meanwhile, **management has started formal tracking on collaboration’s readiness with particular focus on cell production (crucial item).**

– First item to discuss will be an update on manpower. So far we have:

 Students:

 Mingyu Chen (UVa, A1n)

 Melanie Ruhfuss (Temple, A1n)

 Junhao Chen (W&M, d2n)

 Murchhana Roy (Kentucky, d2n)

 Postdoc/senior researcher:

 Arun Tadepalli (Hall A/C, local)

 Jixie Zhang (UVa, local)

 Bill Henry (Hall C, local) ← need confirm

 Syvelster Joosten (Temple, not local)

 partial W&M postdoc (Todd A., can only be RC).

 possible Temple postdoc???

Summary of manpower need that popped up during today’s meeting:

– Analysis need – significant and urgent

– Moller expert and Moller student – significant and urgent

– Parity need (expert level) – need involve some parity experts

– Raster need – partial student may be okay, does not need to be a thesis student (?).

– On shift signup page/schedule: Too early to set this up.

(XZ, based on discussion with Doug H. and Brad S:

possible requirement is 18 shift “points” for two experiments or 12 for single experiment.

1 weekday day shift = 1 shift point;

1 weekday swing shift= 1.5 shift point;

1 weekend day or swing shift = 1.5 point;

1 owl shift any day = 2 points.

1 shift on X’mas even or X’mas Day = infinite points … … )

– estimate total number of shifts needed: 4 months \* 30 days \* 3 shifts = 600 shifts.

– estimate total number of RCs needed: 4 months \* 30 days/ 10 days = 12 RCs.

**Appendix A:**

Magnet Iset for all kinematics, by Sylvester J.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **A1n HMS** |  |  |  |  |  |  |  |  |
| **Kin** | **Eb (GeV)** | **Ep (GeV)** | **theta** | **Q1 I (A)** | **Q2 I (A)** | **Q3 I (A)** | **D I (A)** |  |
| 1 | 10.5 | 5.7 | 12.5 | 743.33 | 596.05 | 286.91 | 1,829.95 |  |
| 2 | 10.5 | 6.8 | 12.5 | 893.16 | 737.26 | 342.20 | 2,416.52 |  |
| 3 | 10.5 | 2.9 | 30 | 377.78 | 300.35 | 146.18 | 888.71 |  |
| 4 | 10.5 | 3.5 | 30 | 455.97 | 362.55 | 176.34 | 1,072.52 |  |
| **A1n SHMS** |  |  |  |  |  |  |  |  |
| **Kin** | **Eb (GeV)** | **Ep (GeV)** | **theta** | **HB I (A)** | **Q1 I (A)** | **Q2 I (A)** | **Q3 I (A)** | **D I (A)** |
| A | 10.5 | 5.8 | 12.5 | 1,946.82 | 1,217.82 | 2,045.55 | 1,345.96 | 1,850.55 |
| B | 10.5 | 3.4 | 30 | 1,127.68 | 713.90 | 1,199.12 | 789.01 | 1,084.81 |
| C | 10.5 | 2.4 | 30 | 793.91 | 503.93 | 846.44 | 556.95 | 765.75 |
| D | 10.5 | 7.5 | 12.5 | 2,552.33 | 1,582.75 | 2,645.11 | 1,740.46 | 2,392.95 |
|  |  |  |  |  |  |  |  |  |
| **d2n HMS** |  |  |  |  |  |  |  |  |
| **Kin** | **Eb (GeV)** | **Ep (GeV)** | **theta** | **Q1 I (A)** | **Q2 I (A)** | **Q3 I (A)** | **D I (A)** |  |
| A' | 10.5 | 4.3 | 13.5 | 560.23 | 445.48 | 216.55 | 1,321.61 |  |
| B' | 10.5 | 5.1 | 16.4 | 664.51 | 529.34 | 256.76 | 1,592.70 |  |
| C' | 10.5 | 4 | 20 | 521.13 | 414.38 | 201.47 | 1,226.75 |  |
| D' | 10.5 | 2.5 | 25 | 325.66 | 258.89 | 126.08 | 765.81 |  |
| **d2n SHMS** |  |  |  |  |  |  |  |  |
| **Kin** | **Eb (GeV)** | **Ep (GeV)** | **theta** | **HB I (A)** | **Q1 I (A)** | **Q2 I (A)** | **Q3 I (A)** | **D I (A)** |
| A | 10.5 | 7.5 | 11 | 2,552.33 | 1,582.75 | 2,645.11 | 1,740.46 | 2,392.95 |
| B | 10.5 | 7 | 13.3 | 2,371.64 | 1,475.73 | 2,468.77 | 1,624.43 | 2,233.42 |
| C | 10.5 | 6.3 | 15.5 | 2,122.42 | 1,325.42 | 2,221.89 | 1,461.99 | 2,010.08 |
| D | 10.5 | 5.6 | 18 | 1,877.10 | 1,175.83 | 1,975.02 | 1,299.54 | 1,786.74 |