

NPS Collaboration Meeting – 2-3 February 2023

Participants: David Hamilton, Simona Malace, Paulo Medeiros, Steven Lassiter, Dave Gaskell, Carlos Munoz-Camacho, Charles Hyde, Ben Raydo, Yeran Ghandilyan, Julie Roche, Mark Jones, Tanja Horn, Vladimir Berdnikov, Drew Weisenberger, Aaron Brown, Marie Boer, Deb Biswas, Bob Michaels, Bogdan Wojtsekhoski, Alexandre Camsonne, Iuliia Skorodumina, Mitchell Kerver, Casey Morean, Maxime Defurne, Olga Bessidskaia Bylund, Rolf Ent

Online: Hamlet Mkrtchyan, Paul King, Brad Sawatzky, Ed Kinney, Arun Tadeipalli, Bill Henry, Bryan Moffit, Chris Cuevas, Jiwan Poudel, Junhai, Marco Carmignotto, Ole Hansen, Oliver Jevons, Pramita Tiwari, Rafayel Paremuzyan, Stephen Wood, Vardan Tadevosyan, Yaopeng Zhang, Zhenyu Zhe, Zhihong Ye

Mechanical (Paulo)

- Cable run – layout almost complete
 - Must still make the penetration on the roof block – can only be done when hall is closed
 - Cable characteristics - 80ft and 110ft (patch panel to detector – to be also used by other experiments) cables (slide should be updated)
 - Low voltage
 - Cable runs inside hut will be installed in March
 - Details on Cable runs in a talk by Brad – get from Paulo (it's also in Brad's talk from 2021 NPS collaboration meeting)
- Magnet supporting structure reinforcement design – done, must be complete
- Beamline supports on order
- Corrector in purchasing
- Cable lay out and support structure in design (70%) – done in a few weeks
- **Action item from discussion:**
 - Accelerator control of corrector magnet – was in ERR2019, but might be good to meet HallC/ACC (Jay)
 - Need a heavy gauge ground cable from chassis to ground SHMS (Paulo?)
 - Need to check on racks in SHMS hut (Simona/Paulo)
 - Design of cable runs in SHMS hut (contact: Simona)

Controls: temperature, HV, LV, LED, etc. - DSG (Aaron)

- Labview program: screens on cdaq13
 - thermal readback, can be tested in EEL108, Q&A: *how to calibrate the sensors?*
 - **Action item:** Need to assign someone to calibrate sensors
 - High voltage control and monitoring, can set per individual channel – Bob, Simona
 - Low voltage control and monitoring, similar to HV screens
- Alarm system – can it be tested already? *Not yet*
- Hardware fabrication: extension cables for five terminal blocks, also cables for humidity sensors – key sight mainframe in shielded area near Q3; all 60ft cables run in same direction
- All cables from the hut go in the same direction

LED/VTP Trigger (Ben Raydo)

- General concept: Coincidence between HMS and NPS
 - HMS: NIM trigger
 - NPS: VTP trigger (this talk - see more detail below)
- Cluster trigger: 3x3 cluster trigger on clusters when over threshold; 5x5 full waveform readout centered on triggered cluster; fADC->VTP->trigger->TS
 - Will have full waveform, but for trigger still have a threshold
 - 32ns double pulse resolution – could increase threshold to make less sensitive to low background
 - Pedestal – single number
 - Thresholds (3): on each channel, on cluster, and seed threshold (min energy in at least one channel)
 - Pedestal measurement can be done online/offline
- **Action item:** Cable map – need to be shared between FEG and cable layout designers → need to make consistent
- Monitoring VTP (based on HPS) could be made available
- Trigger setup via ascii file
- **Action item:** Checkout without beam: trigger checkout → in EEL108, VTP graphs
 - Trigger firmware ready → needs testing in hardware
- **Action item:** Cluster trigger good – needs to be implemented
- **Action item:** Implement VTP fadc 5x5 mask readout firmware once cluster trigger up and running
- *Suggestion on diagnostics: unbiased running → understand pile up etc.; prescale event where sometimes read out everything; to read out everything can also lower threshold*

DAQ/electronics (Bob)

- CODA setup in EEL108: cosmic from scintillator, 3 crates tied together; soon also have: VTP trigger
- LED driver: board done, VME driver remains to be finished (Bryan), EPICS higher level (DSG) – want to try it out (Simona, Alexandre)
- Base modification with capacitor to suppress 200Mhz oscillations
- **Action items → see Bob's detailed schedule in slides or logbook:**
 - complete calo trigger/DAQ in EEL108
 - upgrade HMS DAQ to CODA3.10,
 - install NPS DAQ in Hall C

Software development and testing (David H)

- Action items (*=high priority):
 - *VTP decoding data (info about reconstructed cluster, but not info on each channel)
 - add fADC waveform fitting code (best to do post-processing since time consuming)
 - *data unblocking in decode software
 - Restart NPS software meetings

Cable assembly (Yeran)

- All cables checked – only two not working
 - Small portion of cables were connected to fADC – those were not re-checked
- **Action item:** obtain cable map (Simona/Yeran) – check cabling at fADC
- To move to hall: disconnect cables, bundle again, and move to hall and reconnect
- Routing of HV and LV (63 ribbon) in EEL108
- Outside cabling 50% done → after can start full scale test

Status of NPS calorimeter (Carlos)

- Cabling inside NPS box complete (signal, HV&LV, optical fibers), temperature sensors, cosmic PMTs in place, cooling water circuit tested, inlet/outlet
- **Action items:**
 - Identify support for: dry air (source, pumps) → detector support group
 - put images on Wiki
 - Need to attach additional sensors (16): cable into multiplexer units, attach front and back sensors to the box → after initial tests complete → could also be done after moving detector into hall
 - Identify where to attach the ground on the calorimeter frame
- **Tests to do:**
 - LED system
 - Cooling system (checked for leaks, but need to certify)
 - Temperature regulation/stabilization – all sensors connected at crystals, tests could be done now
 - Cosmic
 - VTP trigger

Analysis of Cosmic Runs (Julie)

- Block numbering looks fine
- Murad's method based on DVCS HA in good agreement with full waveform analysis
- If assume MIP muon then energy resolution is $2.4\%/\sqrt{E}$
- Blocks not yet well adjusted
- Efficiency for all blocks 98%
- Further noise reduction in analysis via FTT and filter – works for 100ns window that assumes that signal will be in the middle of it
- Bad blocks from cosmic tests: 39, 41, 91 – *Simona plans to check all PMTs*
 - Block 39 missing
 - Block 196 weird data

DVCS Recoil Proton (Olga, Maxime)

- Overall looks doable
- **Action items:**
 - Check available space on HMS side for the polarimeter – get drawing from Steven L.
 - May be possible to use a basic hadron polarimeter, e.g., hodoscope paddles, for 200 MeV energy ranges → investigate that before looking in more detail than reusing SBS

(only detector, not magnet etc.); background should not be an issue at 44deg; revive old hadron polarimeter; are there any precision issues – maybe because py is transverse?

- Discussion about making P. Guichon code available
- Need to check systematics and false asymmetries impact on physics

Strange proton form factor (Bogdan)

- *Why so many points?* – lever arm in Q2 is important
- *How long does it take to disassemble and re-assemble?* – actually, also need to take into account that a new design is needed → **Action item:** write up the procedure
- *Why need PWO?* – precision is important
- *Two photon exchange not expected to be important*

DDVCS with muon detector (Marie, Deb)

- Is there sufficient counting rate? → check if there is enough counts before exploring the details constructing a detectors
 - SOLID and CLAS have assumed certain luminosities 10^{38} with large acceptance. Not much improvement beyond that to be expected
- **Action item:** determine how many counts, then do scaling to determine what acceptance is needed
- Why using GEMS instead of regular muon detector? – typically used or high tracking resolution or if need to reduce material
 - Don't need ultimate resolution of muon pairs (assume that have the protons)
- Start with simple simulation. Take SBS hadron calo and look at differences between pion and muon

TCS (Vardan)

DISCUSSIONS DAY 2

PARTICIPANTS in-person: Paulo Medeiros, Simona Malace, Iuliia Skorodumina, Charles Hyde, Alexandre Camsonne, Carlos Munoz-Camacho, Dave Gaskell, Rolf Ent, Mark Jones, Tanja Horn, Steven Lassiter, Mitchell Kerver, Olga Bessidskaia Bylund, student, Deb Biswas, Marie Boer, Yeran Ghandilyan

PARTICIPANTS online: Aaron Brown, Bill Henry, Bob Michaels, Ed Kinney, Hamlet Mkrtchyan, Jiwan Poudel, Malek Mazouz, Ole Hansen, Pramita Tiwari, Vardan Tadevosyan, Vladimir Berdnikov, Wassim, Yaopeng Zhang, Yeran Ghandilyan, Zhihong Ye

Installation Schedule (Steven L.)

- First week:
 - Spectrometer work: angle min for roofblock, vacuum, much work at front of spectrometer for HB → no access pivot to front of spectrometer

- Beamline work
- Target work and spectrometer work have to be coordinated because of access and space limitations – NPS has to wait until target work complete
- Old PionLT targets will be installed
- **Target cell length needed for experiment: 10cm** – anyway, the only available option
- Detector work
 - Prepare for moving detector and components (disconnect cables etc.)
 - **Action item:** plan to start disconnecting things (disconnect cables) in EEL 108 by mid-April to be ready to transport on 3 May
 - **Action items:**
 - Add transportation of racks and crates from EEL 108 – ADD to Steven L schedule (2 racks)
 - Simona will meet with Paulo in HC to check where they could go in SHMS hut; should not take very long (order 1 day) – further discuss in weekly installation meeting (detector support group, work coordinator)
 - Cable tray and patch panel
 - Transportation – planned for 1 May
 - Install cable carrier
 - Un-spool cables
 - Cable hook-up – planned for mid-May to 1 June
 - Cable checkout can be May 30 to July 21 (new experiment start date); note that the posted date is 17th, so aim for closing the hall on 14th July
 - Most work for collaboration is in June
- Note: take care of He contamination in Hall
- Cable dismounting – what if late? Does it impact schedule
 - It holds up survey and cable connections
 - Mechanical float in schedule
- Discussion items
 - Transportation of detector to the hall – details?
 - Could use target chamber transportation method – suspended on trailer - still will have some tilting
 - Deflate tires to reduce shock (done for Qweak detector)
 - **Specs for transportation:**
 - Reduce any shock
 - If goes at an angle, crystals preferably point up and not down so that they don't slide; shock load
 - **Action item:** Mark on the box the front of the detector and which direction is “crystal point up”
 - Only option is to take the detector from bottom
 - Fall protection for U-tube operation – tie off points needed? – mechanical/design
 - Crane reach for removing SHMS roof block – SHMS at 5.5 deg needed? – mechanical/design
- Critical items
 - Downstream corrector magnet – now sourced to vendor

- HB magnet tests – power up should be fine; cannot map it precisely, but can do spot checks for fringe fields with handheld probe and should do them → possible impact on HMS Optics
- **Action item:** Magnetic field impact from HMS dipole on NPS → see Simona's tests (Steve L. has a profile), then can check what impact would be on NPS PMTs
 - Note: PMTs in NPS have mu metal shielding
- **Action items:**
 - Make 1 slide with when what happens for outside users (when dismount EEL, when move detector etc)
 - Use NPS logbook
- Polarization in Hall measurement: will have MOLLER but no Compton
- Moller does not yet have a target ladder

Checkout with Beam, Run plan, preparations for ERR

Run Plan Discussion (Carlos)

- D. Meekins: what **solid targets** in the ladder → use carbon hole, optics targets, dummy
- No optics between raster and target → can use raster to find center of target, but make sure that raster is working correctly; make sure Yag viewer works
- Add Halo target?
- Need experienced Hall C people at startup of experiment
- Before beam arrives – check calorimeter with cosmics and also do sensitivity of PMTs to magnetic field earlier
- Separate pre-beam items → check list from checkout with beam
- **Optics** → Get list of PionLT optics settings
 - If within a few percent of central momenta then might use the existing matrices
 - Max momentum of HMS is ~ 7.4 GeV/c, but NMR may not work there (have been running NMR at 6.8 GeV/c) – note: highest setting for DVCS is ~ 7 GeV/c
- **Trigger setup** → talk with Simona/Iuliia on details
 - What is the threshold for pions firing? – need to determine the pressure of Cherenkov, if have high threshold then Cherenkov has low number electronics; presently set threshold to 4 GeV/c – anything above calorimeters can handle
- Use of EDTM – plan not to use for dead time calculation
- What rates expected in HMS? – up to 20kHz electrons → need to determine total rate
- Moller measurement: plan to do one per energy setting, need a few shifts for setup, afterwards approximately one shift per measurement
- **Target boiling:** should measure it – in the past on order 3-4%
- **Action item:** Need procedures for angle and distance changes of NPS
- **Magnet tilting:**
 - Look for ERR and previous collaboration meetings, e.g., 2021 slides by Steven L/Paulo
 - Only need 4deg strictly at 6deg NPS angle
 - Minimize magnet tilting
- **Action item:** Post documents on NPS Wiki and also Hall C Wiki
- **Action item:** update kinematics table and post for SIDIS to check

- **Action item:** determine a procedure to decide on final running current
- Need anode current readout
- Analyze data for pile up etc. and use as criterion

Preparations for final readiness (Tanja)

- **Action item:** Shift schedule and Run Coordinators
 - Start asking for RCs
 - Develop shift requirements
 - 2 people required on shift – analysis person (3rd) can be remote
- **Action item:** finalize the documents – most important is the OSP – Alexandre is the liaison
- OSP: calorimeter, magnet, changing angles for calorimeter
 - Procedure for replacing a PMT
 - Monitoring
 - Identify responsibilities – for NPS have to add
- Checklists: spectrometer and NPS or combine – early on verification between tech staff and Users
 - Offset line between HB and NPS sweeper
- Hclist EEL108 – Simona will make one
- **Action item:** submit all the documents by end of April
- Items to test
 - LED tests
 - Cooling and temperature sensors
 - Cosmics
 - Develop diagnostic histograms for NPS for shift takers
 - ET display – development of any supporting tools for that
- **Action item:** make list of things to do once the detector is in the hall
- **Action item:** Need to have weekly installation/preparations for NPS meetings
 - **Thursdays at 8:30am ET – aim for relatively short, e.g., 30min meetings**
 - Global longer NPS meetings every month

Sweeper Magnet Current tuning (Bogdan)

- Bdl in direction of NPS –
- Bdl on beam line from sweeper: two numbers for two different areas
- Field profile: not uniform field, but field integral almost uniform near beam within a few percent
- Large aperture magnet – worry for impact on detectors and specifically PMTs – calculation for mitigation was done and implemented, but should now be checked