NPS Collaboration Meeting

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Jefferson Lab

17 – 18 July 2024

History of NPS Meetings

- *10 November 2012*: Opportunities for DVCS and other physics with NPS (IPN-Orsay)
- *14 November 2013*: NPS Collaboration Meeting (JLab)
- *19 November 2014*: NPS Collaboration Meeting (JLab)
  - *15-16 June 2015*: NPS and $PbWO_4$ Meeting (JLab)
- *21 January 2016*: NPS Collaboration Meeting (JLab)
- *19 January 2017*: NPS Collaboration Meeting (JLab)
  - *6-7 February 2017*: High-Intensity Photon Sources Workshop (CUA)
- *23 January 2018*: NPS Collaboration Meeting (JLab)
  - *13-15 November 2018*: NPS Frame Meeting (JLab)
- *1 February 2019*: NPS Collaboration Meeting (JLab)
  - *25-26 June 2019*: NPS Frame Meeting (JLab)
- *3 February 2020*: NPS Collaboration Meeting (JLab)
- *1-2 February 2021*: NPS Collaboration Meeting (Remote due to Covid-19)
- *16 February 2022*: NPS Collaboration Meeting (Remote due to Covid-19)
- *2-3 February 2023*: NPS Collaboration Meeting (JLab)
- *August 2023 – May 2024: NPS Run Group 1a experiments*
- ***17 – 18 July 2024*: NPS Collaboration Meeting (JLab)**

[Link to NPS Meetings in the Wiki]

NPS passed the ERR in 2019

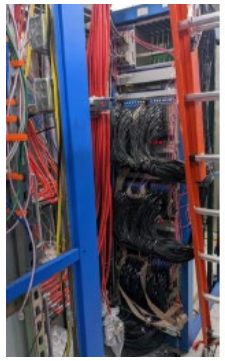
2021 Assembly postponed due to Covid

Installation for Run Group 1a

NPS storage, lessons learned, and Start RG1a Analysis

(Brief) Overview NPS RG1a 2023/2024

- Installation, cabling, and testing started in April 2023 and was completed in September 2023
  - fADC250 with streaming triggers
- Encountered radiation damage to PMT preamp
  - Required uninstall/modify/reinstall the components (15 December 2023 – 13 January 2024); shielding was also installed at beam side of the calorimeter
- Encountered an issue with LH2 target – contamination?
- RG1a experiments completed in May 2024
- NPS de-installation, de-cabling, etc. in May/June 2024
  - Disassembled NPS component stored in different location according to master spreadsheet
- RG1a analysis started




[Link to RG1a Analysis in the NPS Wiki]

NPS RG1a Analysis

Meeting minutes, agenda, and schedule

ELOG: We use this software for offline analysis results.

Redmine (online analysis only): We no longer use this software, but it is linked here for a keepsake.

NPS Science Program

NPS Wiki

Run Group 1a (NPS at small angles and HMS - SHMS used as carriage for NPS):

- **E12-13-010** (Run status: complete): Exclusive Deeply Virtual Compton and Neutral Pion Cross-Section Measurements in Hall C Link
- **E12-13-007** (Run Status: complete): Measurement of Semi-Inclusive pi0 Production as Validation of Factorization Link
- **E12-22-006** (Run status: complete): Deeply Virtual Compton Scattering off the neutron with the Neutral Particle Spectrometer in Hall C Link
- **E12-23-014** (Run status: complete): Measurements of the Ratio R = sigmaL/sigmaT p/d ratios, Pt dependence, and azimuthal asymmetries in Semi-Inclusive DIS pi0 production form proton and deuteron targets using the NPS in Hall C Link

Run Group 1b (NPS at small angles and HMS - SHMS used as carriage for NPS):

- **E12-06-114** (35 days moved to Hall C): Measurements of the electron-helicity dependent cross-sections of deeply virtual Compton scattering

Run Group 2 (NPS at large angles and HMS - SHMS used as carriage for NPS):

- **E12-14-003**: Wide-angle Compton Scattering at 8 and 10 GeV Photon Energies Link
- **E12-14-005**: Wide Angle Exclusive Photoproduction of pi-zero Mesons Link

Run Group 3 (NPS+CPS - SHMS used as carriage for NPS)

- **E12-17-008**: Polarization Observables in Wide-Angle Compton Scattering at large s, t, and u Link

Run Group 4 (NPS reconfigured as part of an ECAL+HCAL system downstream from target)

- **E12-17-008**: A Search for a Nonzero Strange Form Factor of the Proton at 2.5 (GeV/c)^2 Link

Run Group 5 (NPS+Positrons)

- **C12-20-012** (status C2): Deeply Virtual Compton Scattering using a positron beam in Hall C Link

LOIs and proposal being developed

- LOI12-23-003: GluToNY: Gluon tomography in nucleons by gamma-polarimetry
- LOI12-23-014: Recoil Nucleon Polarization in Deeply Virtual Compton Scattering and Neutral Pion Electroproduction in Hall C
- C12-18-005: Timelike Compton Scattering Off a Transversely Polarized Proton Link (requires NPS + CPS)

NPS RG1a complete – analysis starting (see Thur. agenda)

Many additional ideas: see discussion session today

Today: discuss lessons learned from run, preparations for the next NPS experiment

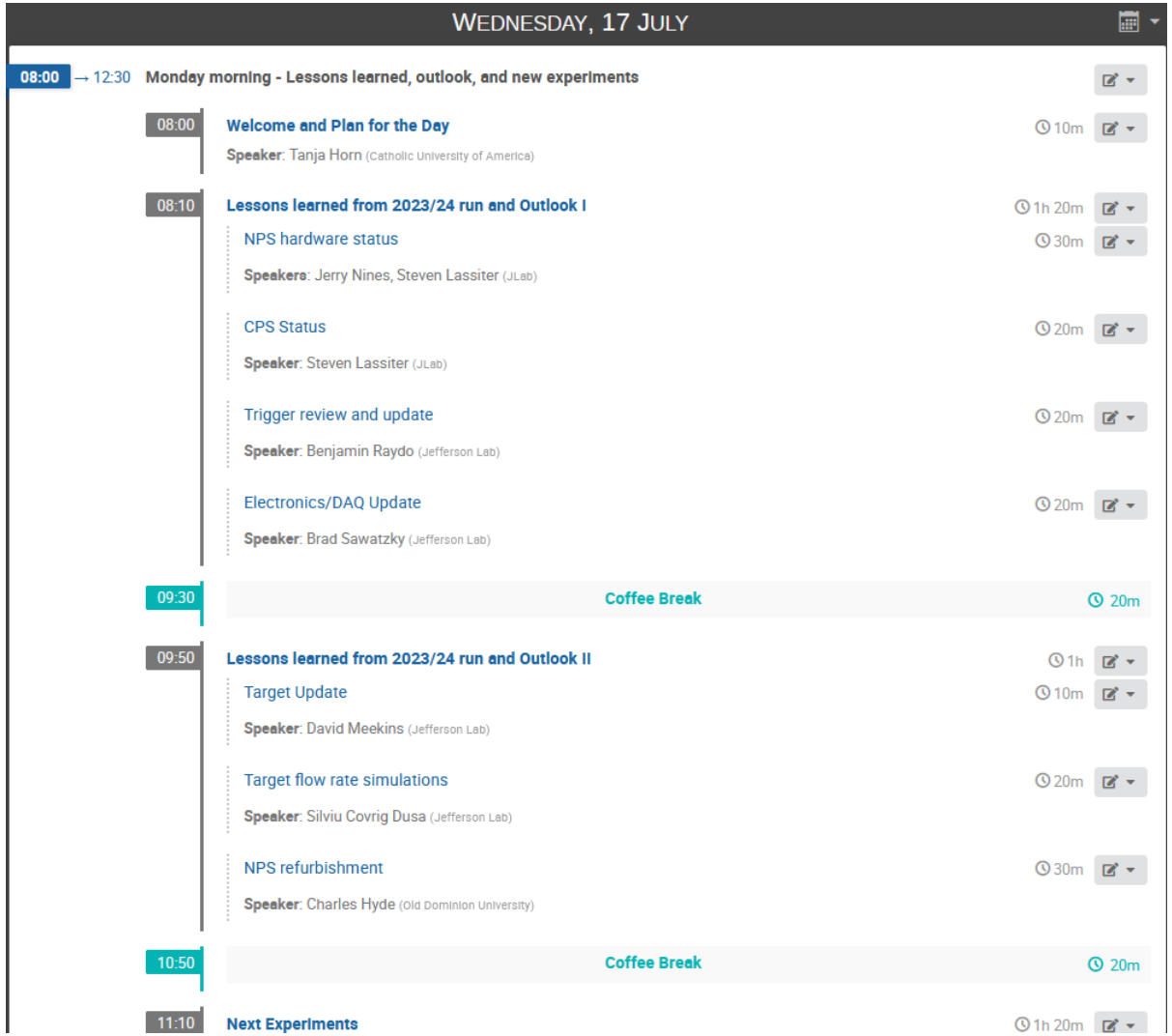
Goals of this meeting

- Lessons learned from 2023/24 run and outlook
  - Plans for updates/optimization etc.
- Preparing for the next experiments (Run Group 1b, 2, …)
  - Readiness
  - Configuration of NPS
  - Additional equipment
  - Scheduling requests
- New physics ideas with NPS
- RG1a Analysis Goals and Planning
  - Readiness
- Additional discussion
  - NPS NIM paper, paper on thermal PWO analysis
  - Talks

➢ Formulate 2024 action items for NPS next experiments and science and for NPS RG1a Analysis

Agenda

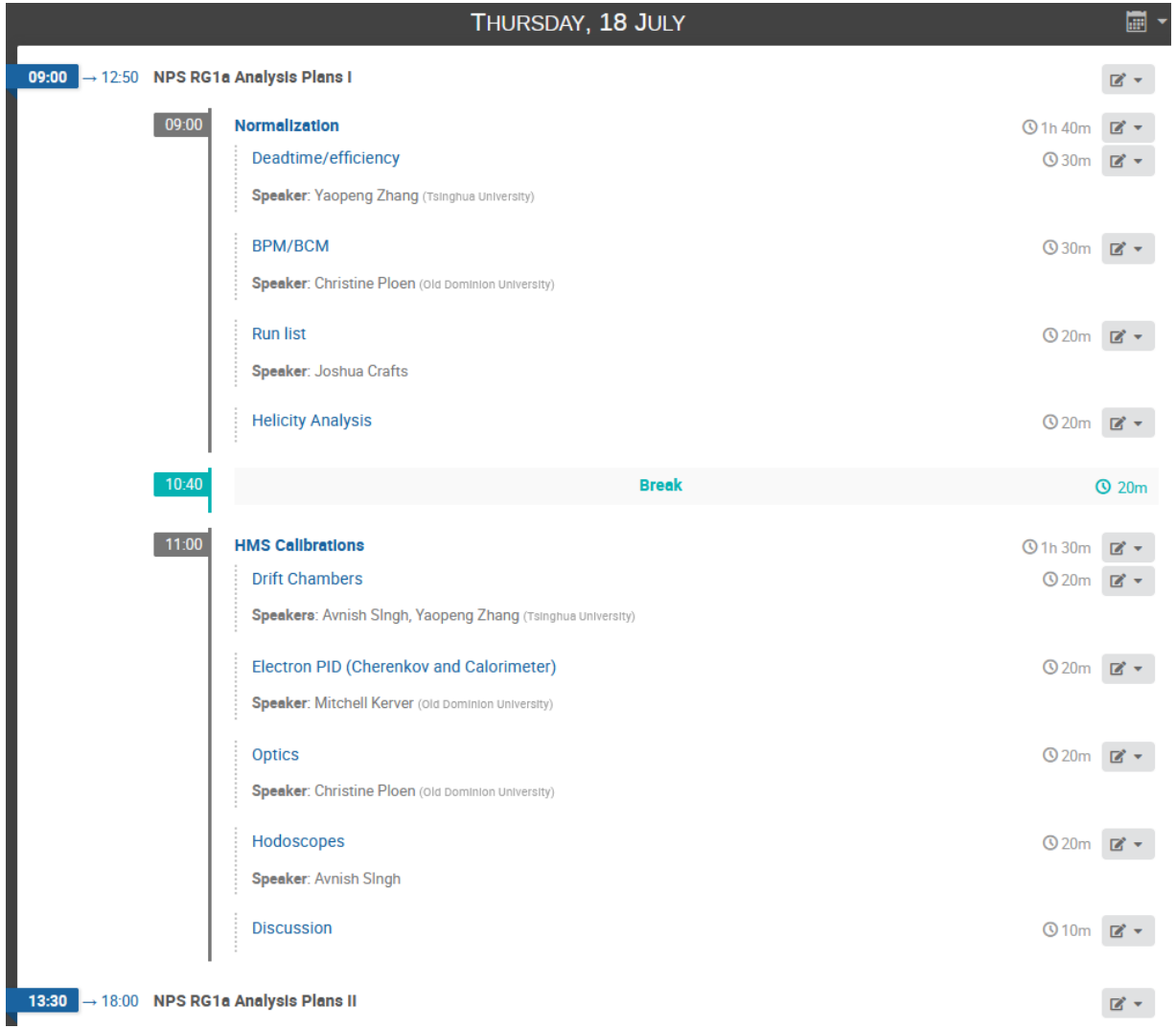
[Indico Link to the agenda]



WEDNESDAY, 17 JULY

08:00 → 12:30 **Monday morning - Lessons learned, outlook, and new experiments**

- 08:00 **Welcome and Plan for the Day** — 10m
  - **Speaker**: Tanja Horn (Catholic University of America)
- 08:10 **Lessons learned from 2023/24 run and Outlook I** — 1h 20m
  - NPS hardware status — 30m
    - **Speakers**: Jerry Nines, Steven Lassiter (JLab)
  - CPS Status — 20m
    - **Speaker**: Steven Lassiter (JLab)
  - Trigger review and update — 20m
    - **Speaker**: Benjamin Raydo (Jefferson Lab)
  - Electronics/DAQ Update — 20m
    - **Speaker**: Brad Sawatzky (Jefferson Lab)
- 09:30 **Coffee Break** — 20m
- 09:50 **Lessons learned from 2023/24 run and Outlook II** — 1h
  - Target Update — 10m
    - **Speaker**: David Meekins (Jefferson Lab)
  - Target flow rate simulations — 20m
    - **Speaker**: Silviu Covrig Dusa (Jefferson Lab)
  - NPS refurbishment — 30m
    - **Speaker**: Charles Hyde (Old Dominion University)
- 10:50 **Coffee Break** — 20m
- 11:10 **Next Experiments** — 1h 20m



THURSDAY, 18 JULY

09:00 → 12:50 **NPS RG1a Analysis Plans I**

- 09:00 **Normalization** — 1h 40m
  - Deadtime/efficiency — 30m
    - **Speaker**: Yaopeng Zhang (Tsinghua University)
  - BPM/BCM — 30m
    - **Speaker**: Christine Ploen (Old Dominion University)
  - Run list — 20m
    - **Speaker**: Joshua Crafts
  - Helicity Analysis — 20m
- 10:40 **Break** — 20m
- 11:00 **HMS Calibrations** — 1h 30m
  - Drift Chambers — 20m
    - **Speakers**: Avnish SIngh, Yaopeng Zhang (Tsinghua University)
  - Electron PID (Cherenkov and Calorimeter) — 20m
    - **Speaker**: Mitchell Kerver (Old Dominion University)
  - Optics — 20m
    - **Speaker**: Christine Ploen (Old Dominion University)
  - Hodoscopes — 20m
    - **Speaker**: Avnish SIngh
  - Discussion — 10m

13:30 → 18:00 **NPS RG1a Analysis Plans II**

In preparation (?): a paper on DSG PWO thermal analysis

Thermal Analsyis of PWO

Abstract

Lead tungstate (PWO) crystals have been the most c
ments with electromagnetic reactions, such as at mul
to temperature. To achieve the desired crystal perfor
system and any thermal stabilization. Typically therr
cooling aided by airflow. In this paper we evaluate the
that the temperature of the innermost crystals depend
methods used.

Keywords: PbWO4, crystals, Tracking, Calorimetry,

Preprint submitted to Nuclear Instruments and Methods A

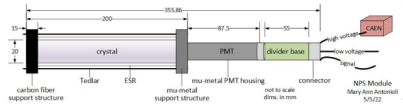


Figure 1: The caption.

Component	Property	Value
$PbWO_4$ crystal	Size	20x2x2 cm
$PbWO_4$ crystal	Thermal conductivity *x*- and *y*-axis	2.4 W/m·K (*x*- and *y*-axis)
$PbWO_4$ crystal	Thermal conductivity *z*-axis	2.0 W/m·K (*z*-axis)
Carbon fiber dividers	Thermal conductivity	0.5523 W/m·°C
Mu-metal dividers	Thermal conductivity	19 W/m·K
Copper cooling shell	Temperature	10°C
Ambient air	Temperature	20°C

Figure 2: The caption.

constant temperature to within 0.1^{o}C to guarantee 0.5% energy stability for absolute calibration and resolution. In this paper we perform a thermal analysis of the NPS design and evaluate the major challenges for keeping a wall of crystals at constant temperature.

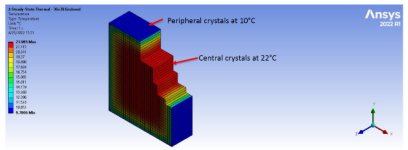
2. Method

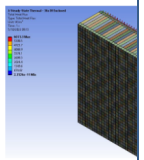
2.1. NPS Module Dimensions Model

The NPS design may be categorized into three zones. The crystal zone that contains the 1080 PWO crystals that will be kept at 18 degC ±0.1 degC, the intermediate zone that consists of the photosensors (glass and vacuum of the PMTs) and thermal insulator and cold copper plate, and the heating zone that consists of the readout electronics and produces 500 mW/channel for a total of 540 W. All three detector zones are surrounded by the external zone that is kept at the ambient temperature of 20-22 degC. Figure 1 shows the dimensions of one crystal module assembly. The assembly components are part of each of the three zones described above.

2.2. Ansys Steady-State Thermal Analysis and Thermal Calculations

Our thermal analysis consists of several activities and components. The thermal model is a physical model that closely represent the real NPS system being modeled. We also assign numerous properties and boundary conditions assigned to the thermal model. A table of the components and their thermal properties are shown in Table 2. These properties and boundary





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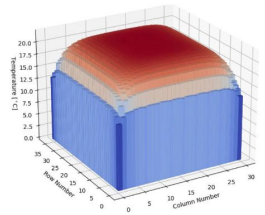

Figure 5: The caption.

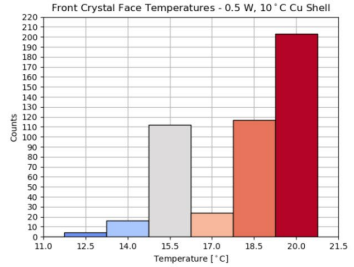

Figure 6: The caption.

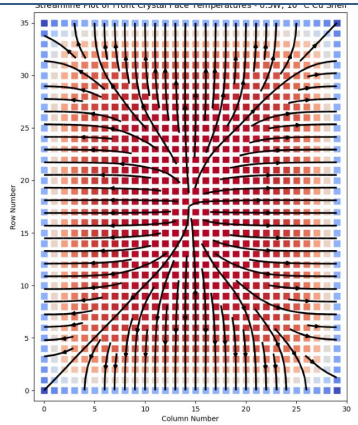

Figure 7: The caption.