NPS Collaboration Meeting

Tanja Horn

Jefferson Lab

5 – 6 July 2025

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)
- ***5 – 6 May 2025*: 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

Getting ready for the next Run Group, NPS Refurbishment, and RG1a Analysis

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

NPS RG1a complete – analysis updates later today

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)

Many additional ideas: see discussion session today

Today: planning for the next NPS experiment(s)

Goals of this meeting

- ❑ Preparing for the next experiments (Run Group 1b, 2, …)
  - Longer term scheduling in Hall C
  - NPS refurbishment planning
  - Additional equipment status (e.g., CPS)
- ❑ NPS Hardware paper(s)
  - NPS NIM paper, paper on thermal PWO analysis
- ❑ New physics ideas with NPS
- ❑ RG1a Analysis Status and Outlook
  - Challenges and solutions
  - Planning towards next replay
- ❑ Additional discussion

➢ Formulate 2025 action items for NPS next experiments and science and for NPS RG1a Analysis

Agenda

[Indico Link to the agenda]

MONDAY 5 MAY

09:00 → 13:00 **NPS Collaboration Meeting: NPS Collaboration Meeting Day 1 morning (Cebaf Center F113)**

General Session

- 09:00 **Welcome and plan for the meeting** 10m
  Speaker: Tanja Horn (Catholic University of America)
- 09:10 **Discussion CPS status and plans** 30m
  Speaker: Steven Lassiter (JLab)
- 09:40 **Discussion NPS refurbishment and preparation for next run group** 1h
  Speakers: Bogdan Wojtsekhowski (Jefferson Lab), Charles Hyde (Old Dominion University)
- 10:40 **Hall C schedule and longer term plans** 30m
  Speaker: Mark Jones (Jefferson Lab)
- 11:25 **Discussion NPS hardware paper** 45m
  Speaker: Carlos Munoz Camacho (IJCLab, Orsay (CNRS/IN2P3))
- 12:10 **New Physics Ideas** 50m
  Speaker: Debaditya Biswas (Virginia Tech)
  - TCS proposal update 20m
    Speaker: Debaditya Biswas (Virginia Tech)
  - DDVCS proposal update 20m
    Speaker: Debaditya Biswas (Virginia Tech)

14:30 → 18:00 **NPS RG1A Collaboration Meeting: NPS RG1A Day 1 Afternoon (Cebaf Center F113)**

- 14:30 **NPS Calorimeter Elastic Analysis** 30m
  Speaker: Wassim Hamdi (Faculty of Sciences of Monastir)
- 15:00 **NPS Calorimeter Wave Form analysis: MultiThreading** 30m
  Speaker: Mitchell Kerver (Old Dominion University)

TUESDAY 6 MAY

08:30 → 13:00 **NPS RG1A Collaboration Meeting: RG1A: Luminosity (Cebaf Center L102)**

- 08:30 **Scaler analysis** 30m
  Speaker: Yaopeng Zhang (Tsinghua University)
- 09:00 **Luminosity Scan analysis** 20m
  Speaker: Yaopeng Zhang (Tsinghua University)
- 09:20 **Luminosity Scan analysis 2** 20m
  Speaker: Avnish Singh
- 09:40 **BCM calibration** 30m
  Speaker: Christine Ploen (Old Dominion University)
- 10:10 **Elastic analysis** 20m
  Speaker: Avnish Singh
- 10:30 **Coffee break** 20m
- 10:50 **DIS analysis** 30m
  Speaker: Mark Mathison (Ohio University)
- 11:20 **HMS detector efficiency** 30m
  Speakers: Avnish Singh, Joshua Crafts, Yaopeng Zhang (Tsinghua University)
- 11:50 **NPS triggers deadtime and efficiency** 30m
  Speaker: Po-Ju Lin (CEA - Université Paris-Saclay / IJCLab - Orsay)

14:00 → 18:00 **NPS RG1A Collaboration Meeting Day 2 afternoon: NPS RG1A: Towards Physics Analysis (Cebaf Center L102)**

- 14:00 **SIMC-single-arm+NPS Geant4** 30m
  Speaker: Mr Hao Huang (Université Paris-Saclay)
- 14:30 **SIMC-SIDIS (how much overlap with Josh and Avnish's talk later?)** 30m

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

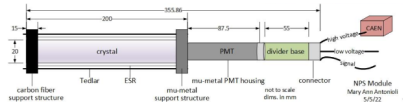


Figure 1: The caption.

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.

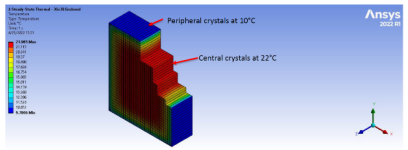
2. Method

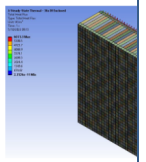
2.1. NPS Module Dimensions Model

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





value Q=0.5W is ass
of the heat produced
The heat flux is ill
heat flux scale model
in the mu-metal.
Figure 5 shows the
The inner 210 cry
These are illustrated
from the central sec
rings of crystals (ap
grees C down to 12
summary is presente
Figure 7 is a strea
data extracted from
plot shows the heat
central zone is warm
coolant temperature
Next we include t
a heat exchanger in
typical heat exchang
are used in the calcul

- A generated hea
- The maximum a
is 20 degC.
- The coolant tem
- The initial temp

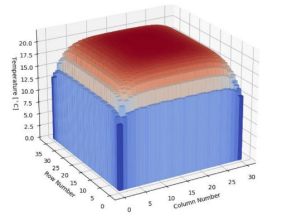


Figure 5: The caption.

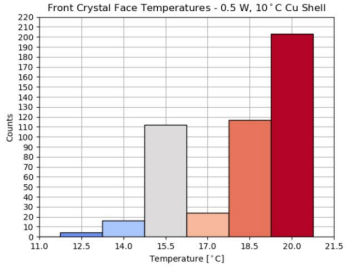


Figure 6: The caption.

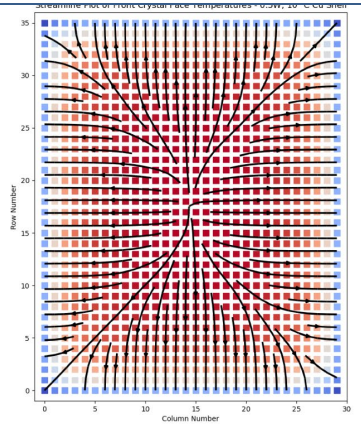


Figure 7: The caption.