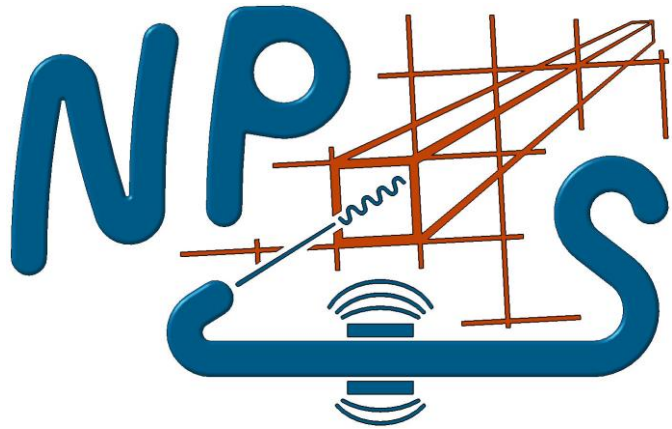


# NPS Collaboration Meeting



Remote due to Covid-19

1-2 February 2021

Tanja Horn





# History of NPS Meetings

- ❑ *10 November 2012*: Workshop on 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<sub>4</sub> 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](#))

# Experiments Overview



Experiment	Exp #	Beam	Target	PAC Days	Rating
$\pi^0$ SIDIS	<a href="#">E12-13-007</a>	$\vec{e}^-$	L H <sub>2</sub>	(26)	A <sup>-</sup>
DVCS and Exclusive $\pi^0$	<a href="#">E12-13-010</a>	$\vec{e}^-$	L H <sub>2</sub>	53	A
Wide Angle Compton Scattering (WACS)	<a href="#">E12-14-003</a>	$e^-, \gamma$	L H <sub>2</sub>	18	A <sup>-</sup>
Wide Angle Exclusive $\pi^0$ photoproduction	<a href="#">E12-14-005</a>	$e^-, \gamma$	L H <sub>2</sub>	(18)	B
DVCS – days moved from Hall A	<a href="#">E12-06-114</a>	$\vec{e}^-$	L H <sub>2</sub>	35	A
$A_{LL}$ & $A_{LS}$ Polarization Observables in WACS at large s, t, and u	<a href="#">E12-17-008</a>	CPS: $\vec{\gamma}$	$N\vec{H}_3$	46	A <sup>-</sup>
Timelike Compton Scattering (TCS) off a Transversely Polarized Proton	<a href="#">C12-18-005</a>	CPS: $\vec{\gamma}$	$[N\vec{H}_3]_T$	35	C2

- Scheduling request submitted for E12-13-010/E12-13-007 (NPS Phase-I)
- Could run as soon as 2023 (Thia's talk from Hall C Collaboration meeting)
- Discussion: integrate E12-06-114 in run plan NPS Phase-I? Scheduling request?

# NPS Project Status Overview



See talks by:

- Magnet** – mapping at 25% of max current complete, central part only Charles
- Frame** – delivered at Jlab in January, planning assembly later in 2021 Emmanuel
- Crystals** – characterization, stacking strategy Vladimir
- Infrastructure Hall C** – cables, mechanical design, platforms, etc. Paulo/Steven
- Infrastructure Hall C** – HV, DAQ and electronics Brad/Chris
- Infrastructure Hall C** - HV Dividers Fernando
- Infrastructure Hall C** - Controls and monitoring Aaron
- Simulations and software development** – background, calibration, etc Carlos Y./Steve
- Assembly and installation** planning
- Prospects glass scintillators**



# NPS 2020 To Do List (1)



- Mechanical Design **This meeting**
  - Check and document all kinematics with latest requirements for interferences, e.g. shelf plates on SHMS and new experiment DVCS from Hall A
  - Document time estimate for rotating the magnet, moving the NPS detector and cabling, moving NPS from one side to the other
  - Identify and document items that can be done in advance, e.g. weld plates on SHMS
- Detector Frame (goal: deliver to Jlab August 2020)
  - Finalize quotes, e.g. for quartz and mu metal
  - Implement the new magnetic shielding design – includes ordering all parts (honeycomb, mu metal, iron shielding, aluminum plates, supports), assembly, and testing
  - Re-check the center of gravity of the updated design
  - Decide on how to attach the NPS frame to the JLab fixture, e.g. bolts, weld
  - Send temperature control information to Brad to figure out readout (include in alarm handler, but no feedback, no interlock)
  - Determine needs for operating chiller in Hall C, e.g. radiation hardness, shielding, order spares
  - Send crystal wrapping material for pre-shaping to Jlab
  - Check uniformity of fiber transmittance after cut/polish
  - Test for LED system cross talk for adjacent PMTs
  - Should Kapton tape be used around the PMT to insulate it from the mu metal cylinder
  - Determine if there is a way to monitor thickness increase of crystals when adding tape

## NPS 2020 To Do List (2)



- Crystals/glass
  - Send 10 CRYTUR crystals and full-size glass to Orsay for irradiation test
  - Should have 650 CRYTUR crystals at JLab by August 2020, then 30 per month more. Should have 250 more (900 total) CRYTUR crystals by April 2021.
  - Check with CRYTUR if they can expedite outstanding crystal delivery for 250 crystals purchased recently and possible early FY21 procurement for 200 more

This meeting

- Decide on final stacking configuration – current nominal configuration is two outer layers on top, bottom and ‘away-from-beam’ side SICCAS, rest CRYTUR (184 and 896 crystals, respectively)



- NPS Magnet – mapping and running
  - Check measurements vs 3D calculations (takes ~1-2 months)
  - Make table of fringe fields vs. current and check simulations for physics impact
  - Decide on what fraction of maximum current to run the magnet for first run group – will also determine impact on HMS optics and mitigation needs



- High voltage dividers – complete by summer 2020
  - Check on the method to measure anode current, e.g. in Hall C
  - Further analyze existing anode current data from Hall D
  - Decide on final HV divider gain
  - Determine need for additional resources and/or funding beyond what was planned to make changes to HV dividers

## NPS 2020 To Do List (3)

- ✓
  - DAQ/Electronics/Cabling/LCW
    - Continue procurements (computer hardware, VXS crates, modules, patch panel hardware)
    - HV cabling/connectors: count available channels from, e.g. G0, BigCAL, and decide on type of connectors to procure
    - Decide on patch panel location
    - Work with designers on cable runs and cable motion strategy
    - Check with designers on need for feedthrough cabling, decide on modification of existing roof block or new roof block with penetration
    - Develop DAQ firmware (VTP, F250, TI/TM, CODA ROC driver) – FE/DAQ group
    - Develop LED control system (HW interface, firmware+SW) – FE/DAQ group
    - Confirm with DSG the development of slow control SW (start from Comcal GUI, HV, temp display, calo protection)
    - Start Analyzer development (multi-block decoding, high level NPS class integration)
    - Double check required magnet current – LCW and power supply available for 800A
- ?
- ✓
  - Simulation and software development
    - Include mu metal shielding details in simulation
    - Continue studies of calibration methods
      - Elastics: determine where the proton goes with NPS/electron angle fixed – can one place an additional small detector at backward angles?
      - Optimize kinematics if this is possible



## NPS 2020 To Do List (4)

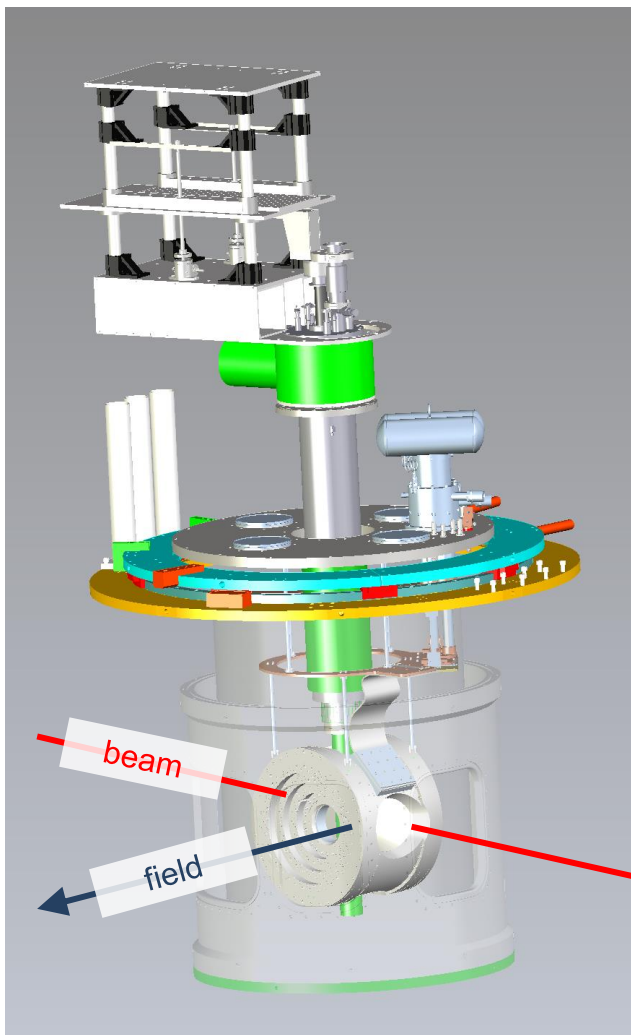
- ✓ • NPS Science – Timelike Compton Scattering
  - Determine quantitatively if low energy protons can be measured after the polarized target high magnetic field – do they leave the field? Do they leave the scattering chamber?
    - Make a 3D simulation and for selected bins show the trajectories of proton (and electron) and where they hit the detector in  $t$ ,  $\phi$ , etc., in particular at low momentum
    - Check the simple example of  $\phi$  plot correlations: plot  $\phi=0/\theta=0$ ,  $\phi=0/\theta=45$ ,  $\phi=0/\theta=90\text{deg}$ , etc., and see if the correlation, and where the detector is hit, changes
  - ? ○ Show how one can select exclusive TCS events with photon beam energy unknown and detection of positron, electron and proton in area of large background.
  - ? ○ Show how certain particle backgrounds can be reduced in the data analysis ( $\pi^0$ ,  $\gamma$ ,  $\pi^{+/-}$ )
  - Quantify the unique impact of TCS with polarized target on hadron imaging studies
  - Show how TCS with polarized target complements other approved Compton Scattering experiments (DVCS, TCS, WACS) at JLab.
  - See if other group of people is interested to see if small TCS experiment with unpolarized target adds value as compared to approved Hall B and Hall A/SoLID experiments
- PAC-48 report: The proposal does not give enough details about what the signal to background ratio is, and which cuts are most effective to suppress it. Also questions on: 1) radiation load; 2) impact of  $dE/dx$  (or lack thereof for  $P_p > 0.5$  GeV) on physics impact; 3) full GEANT for EMCAL  $e/\pi$ ; 4) experiment details (timing, GEM in trigger?)



# Transverse Polarized Target Status (C. Keith)



- ❑ Required for E12-17-008 (polarized WACS) and C12-18-005 (TCS)



Solid  $\text{NH}_3$  &  $\text{ND}_3$  dynamically polarized at 1 K & 5 T

- ❑ New superconducting 5 T magnet **on order**
  - ❑ 67% larger aperture in transverse orientation ( $\pm 25^\circ$ )
  - ❑ Horizontal or vertical field direction
  - ❑ cryogen-free: cooled by one or more cryocoolers
- ❑ Existing infrastructure from previous g2p/GEp experiments
  - ❑ 1K refrigerator
  - ❑ vacuum chamber
  - ❑ microwaves
- ❑ New JLab NMR system for polarization measurement
- ❑ New 12,000  $\text{m}^3/\text{h}$  pumping system

Expected operation in three experimental halls

- ❑ Hall C (NPS/CPS)
- ❑ Hall B (Run Group H)
- ❑ Hall A (SoLID)

# Goals of this meeting



- Discuss To-Do list for completion and assembly of NPS
  
- Getting Ready for the first NPS run
  - Discuss test plans 1) before moving to the hall, 2) in the hall
  - Path forward towards commissioning of NPS
  - Discuss start of runplan for NPS Phase-I (with or w/o E12-06-114?)
  
- Discuss what needs to be done for an NPS Phase-2 (scheduling request, ERR, unpolarized WACS only, with CPS?).
  - Transverse Polarized Target magnet ordered, at lab late 2021
  
- Formulate 2021 action items for NPS installation and science