# ***Future Calorimeter in Hall C based on NPS***

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(for NPS collaboration)

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# ***NPS Science Motivation***

A Neutral Particle Spectrometer (NPS) is required to carry out the JLab 12 GeV Hall C program of precision cross section measurements and L/T separations, extending the charged-particle (p, $\pi^{+/-}$, $K^{+/-}$) measurements to neutral particles ($\gamma$ and $\pi^0$). It will open new opportunities in Hall C, utilizing the HMS, SHMS or BigBite spectrometers

Proposals benefitting from the NPS facility, so far:

- E12-13-007, Measurement of Semi-Inclusive $\pi^0$ Production as Validation of Factorization. (25 days, PAC40 approved, A- rating, running with E12-13-010).

- E12-13-010, Exclusive Deeply Virtual Compton and Neutral Pion Cross-Section Measurements in Hall C. (53 days, PAC40 approved, A rating).

- E12-14-003, Wide-Angle Compton Scattering at 8 and 10 GeV photon energies. (18 days, PAC42 approved, A rating).

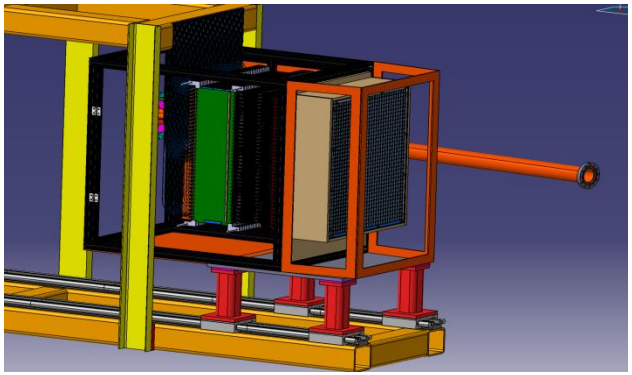
- E12-14-005, Wide Angle, Exclusive Photoproduction of $\pi^0$ Mesons. (18 days, PAC42 approved, B rating).

- E12-17-008. Polarization Observables in Wide-Angle Compton Scattering at large s, t and u. (46 days, PAC45 approved, A- rating).

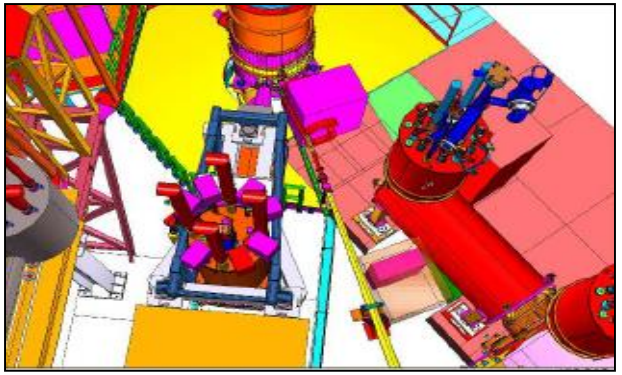
# ***Experiments using NPS Spectrometer***

All currently approved experiments will use combination HMS+NPS

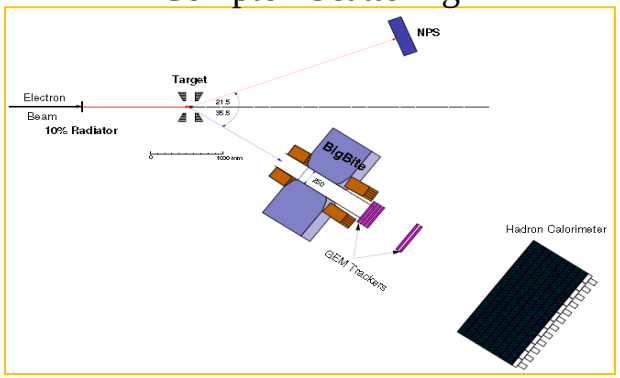
*NPS Calorimeter general view (ORSAT group design)*



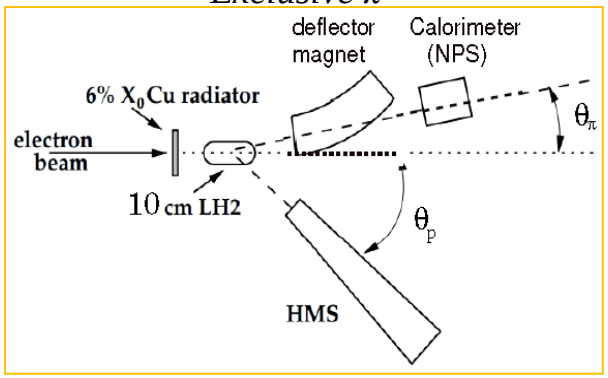
*E12-13-007: Semi-Inclusive $\pi^o$ Production , and E12-13-010: DVCS and $\pi^o$*



E12-17-008 Polarized Wide-Angle Compton Scattering



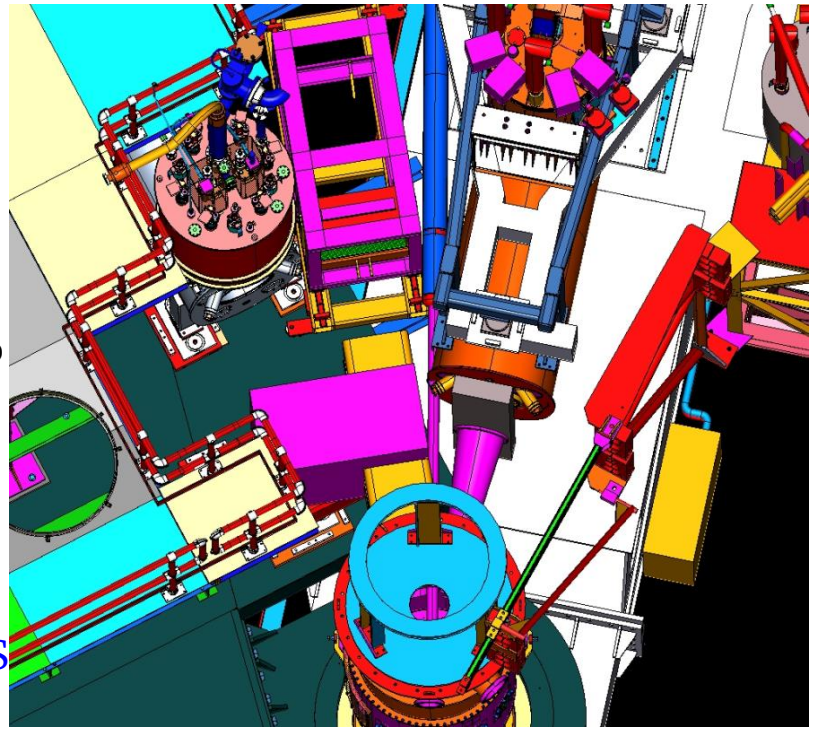

E12-14-005: *Wide-Angle Exclusive $\pi^o$*



# NPS Facility

**The NPS is an efficient and economical way to meet all of the presently known experimental requirements. It will consist of the following components:**

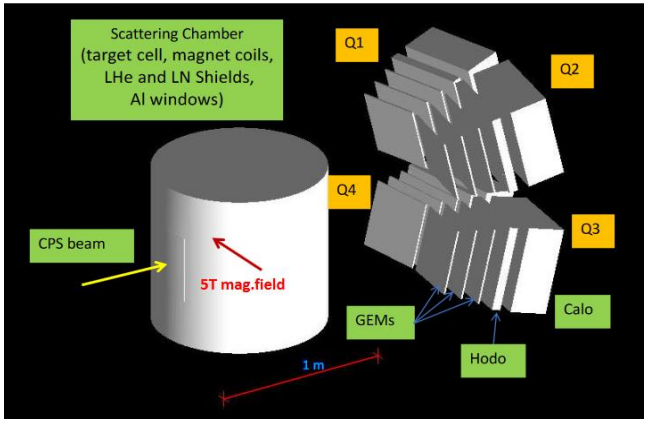
- Solid angle ~25 msr at distance 4 m
- ~1200 $PbWO_4$ crystals, each 2.05×2.05×20 $cm^3$
- Temperature controlled frame (18 ±0.1 °C)
- HV distribution bases (without amplifiers ?) for operation in a high-rate environments with reduced number dynodes
- Essentially dead-time-less digitizing electronics to independently sample the entire pulse form for each crystal – JLab-developed Flash ADCs (fADC)
- Sweeping magnet of ~0.3-0.6 Tm field strength
- Cantilevered platforms to allow for precise, remote rotation in the range 5.5°-30° (on the SHMS carriage), and between 25° and 60° range
- A light monitoring (and curing) system to monitor (and restore) crystal optical properties
- Energy resolution ~(2-3)%/√E
- Position resolution ~2-3 mm



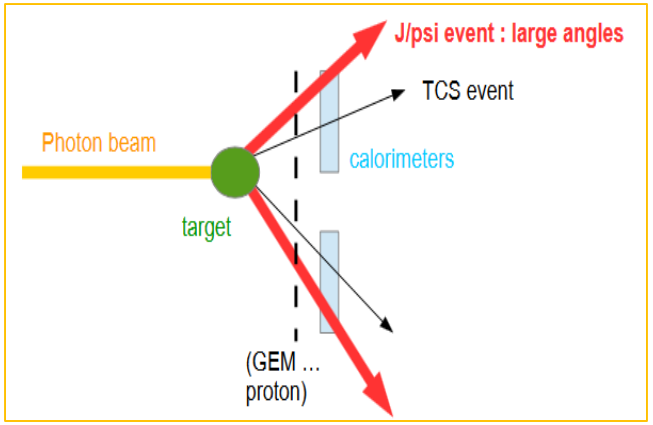
# *New Ideas using NPS and more in Hall C*

- Proposed TCS setup (V. Tadevosyan)

$\gamma + p \rightarrow \gamma^* (e^+ + e^-) + p'$

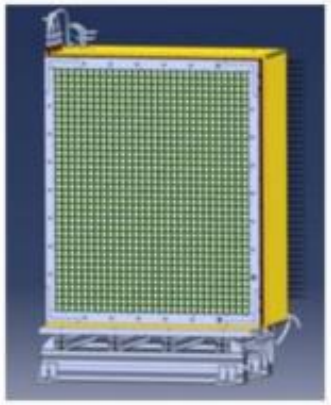



J/psi with NPS/CPS : transverse proton spin asymmetries (M. Boer & students)

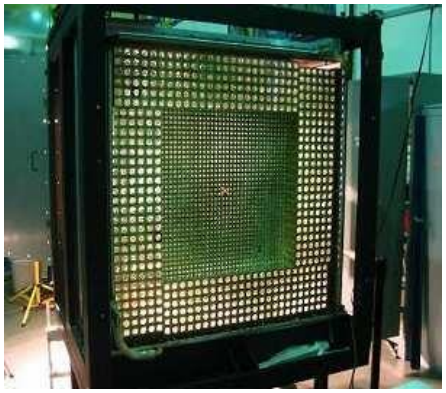



- Transversely Polarized TCS, M. Boer
- Double Deeply Virtual Compton Scattering (DDVCS), M. Boer

**Hybrid Calorimeter based on NPS**



NPS Calorimeter (~1200 PbWO)



Hybrid Calorimeter similar to PrimEx HYCAL (PbWO + SciGlass)

# ***Future calorimeters in Hall C***

Life shows that any good idea becomes a reality at best 5-10 years after the proposal

So, if we want some new detector/calorimeter in Hall C before 2030, must start Today !

- NPS required calorimeter with about 1200 PbWO4 crystals, each 2.05×2.05×20 $cm^3$
- TCS will require combination of four calorimeters, each 529 $PbWO_4$ crystals, (or 2116 $PbWO_4$)
- Future experiments may require large acceptance calorimeter similar to BigCal. In principle, we may cover such big solid angle combining several small NPS type calorimeters.
- We may build several (4-6) TCS type calorimeter and use their different combination
- Or calorimeter with a more complicated design
- Let discuss and see what ideas will come up ?
- Of cause, Today we will not come to even very preliminary conclusion, but better to start !
- New physics project we must expect with progress of CEBAF 24 GeV upgrade
- ??