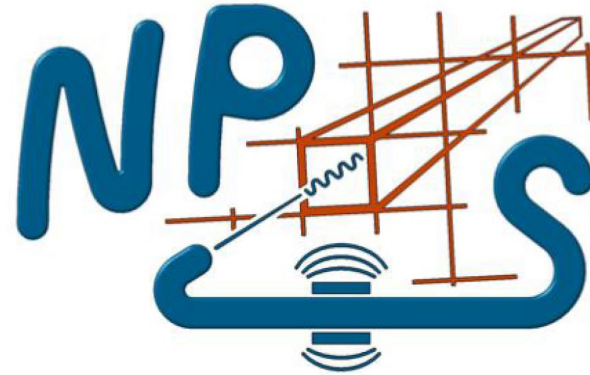


The Neutral Particle Spectrometer Science Program in Hall C



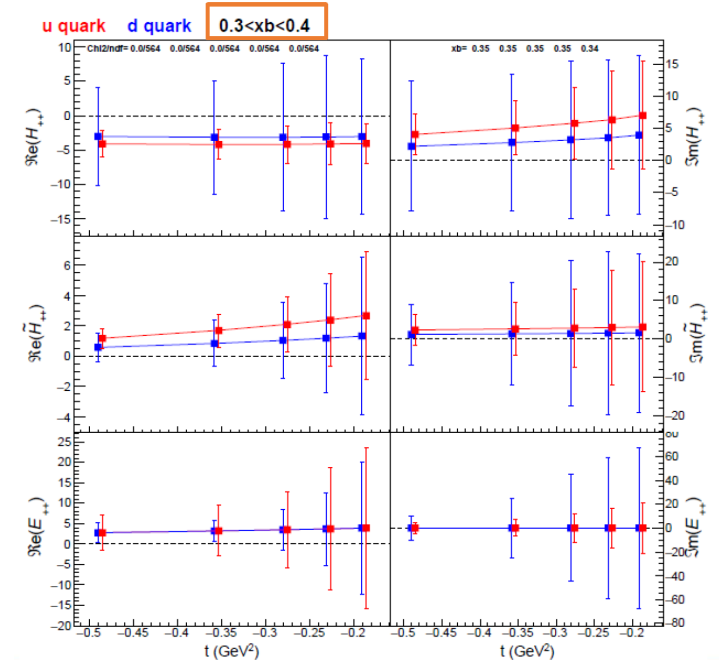
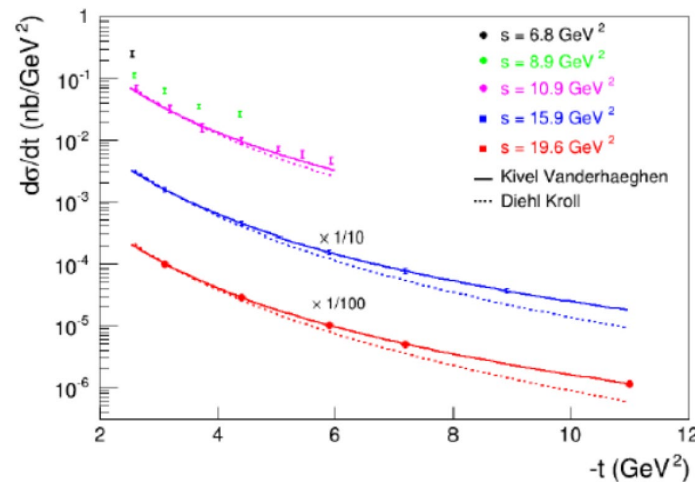
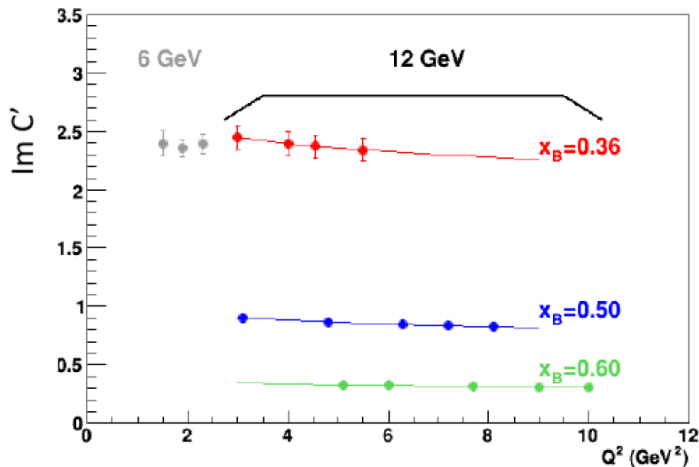
NPS was constructed with support of an NSF/MRI grant: PHY-1530874



Neutral Particle Spectrometer Science – Planned



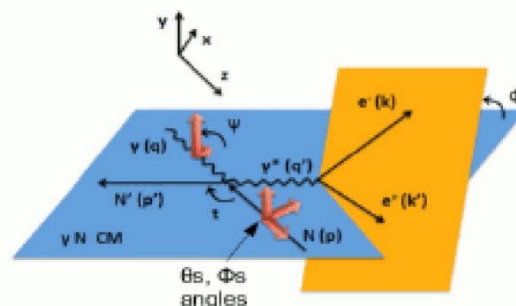
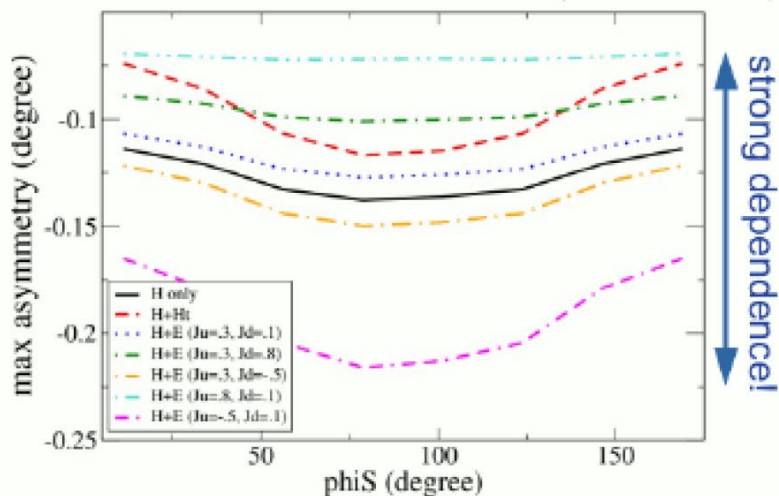
- ❑ Motivation of NPS Experiments: Validation of Reaction mechanism for TMDs & GPDs through measurements such as deeply-virtual compton scattering off proton and deuteron targets, semi-inclusive deep-inelastic scattering with π^0 , (polarized) wide-angle compton scattering (WACS), etc.
- ❑ 6 approved experiments to date: DVCS p+n & SIDIS ($e, e' \pi^0$), WACS, (γ, π^0) & polarized WACS
- ❑ NPS provides a unique EM calorimeter to detect e^- , γ and π^0 enabling precision exclusive measurements at the luminosity frontier – only accessible at Jefferson Lab.
- ❑ NPS would also be used for experiments using positron beams, e.g., for a conditionally-approved DVCS exp
- ❑ NPS was constructed by an international collaboration and will see its first series of experimental runs in 2023 at Jefferson Lab to measure DVCS p+n & SIDIS ($e, e' \pi^0$).



Neutral Particle Spectrometer Science – Future

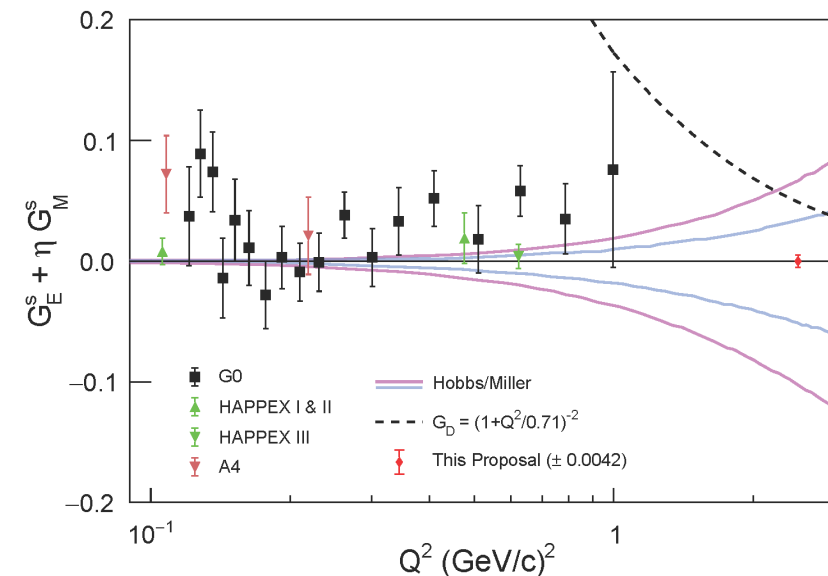
- ❑ Because of the unique nature of this science program, many new physics ideas exist to access exclusive measurements at the luminosity frontier that will **benefit from NPS detector extensions**:
 - Time-like Compton Scattering (TCS) on a transverse polarized target – unique to constrain the Compton form factor E closely related to quark orbital angular momentum, Double DVCS, measurement of the strangeness form factor G_S at high Q^2 , etc.
- ❑ Many of these exclusive measurements would reach higher Q^2 (or s) scales with a Jefferson Lab energy upgrade, and again **only** be possible at Jefferson Lab.

Sin(ϕ) moment of transverse spin asymmetry vs ϕ_S ,
Dependence in GPD E and $J^{u,d}$ (VGG model)



TSA as a function of ϕ and ϕ_S

- Sensitive to $\text{Im}(\text{interference})$, BH cancels
- Strong dependence in angular momenta, Sensitivity to GPD E (also to H, Ht)



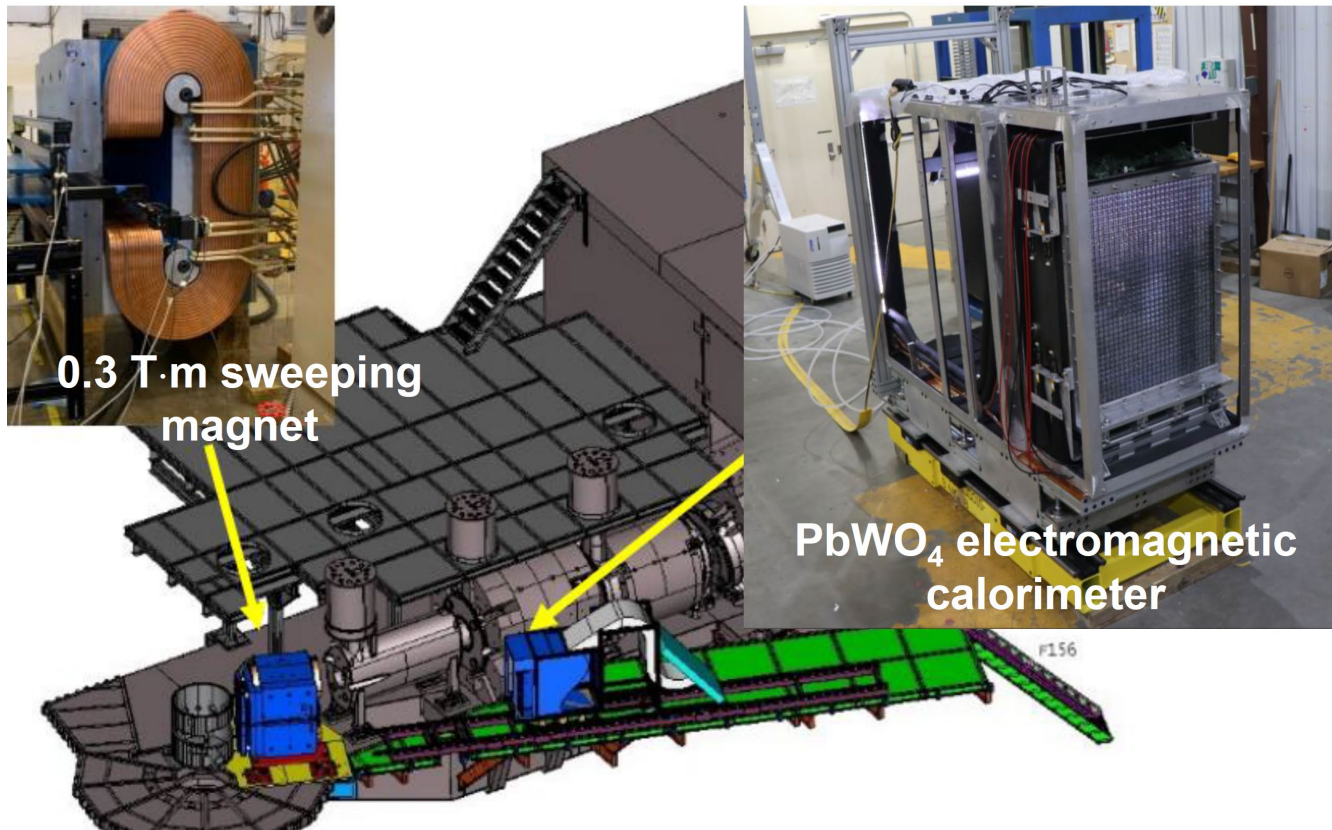
Neutral Particle Spectrometer – Construction Complete



NPS is a ~25 msr Neutral Particle detector which consists of :

- **1080 PbWO_4 crystals (30x36 matrix)** in a temperature controlled frame including gain monitoring and curing systems
- A vertical-bend sweep magnet for EM background suppression

The whole system sits on the SHMS frame in Hall C and can cover detection angles between 6° and 57° .



Opportunities for many early-career scientist
contributions for radiator, design/construction,
simulation, readout:

- PbWO_4 crystal properties and performance tests
NIM A 956 (2020) 163375
- Beam test program in Hall D with 12x12 NPS
prototype
Baseline tests completed in 2019
Streaming readout tests in 2020