PAC39 2012

Experiment	Contact	Title	Rating	PAC days
C12-11-111	M. Contalbrigo	Transverse spin effect in SIDIS at 11 GeV with a transversely polarized target using CLAS12	A	110
C12-12-009	H. Avakian	Measurement of transversity with di-hadron production in SIDIS with a transversely polarized target	A	110
C12-12-010	L. Elouadrhiri	Deeply Virtual Compton scattering at 11 GeV with transversely polarized target using the CLAS12 detector	A	110

C1 condition: "One has to achieve at least within a factor 2 the figure-of-merit determined by the target design value (I=1 nA, and 60% polarization) and a spin relaxation time of 50 days at 1 nA before the experiments with the transversally polarized target are approved".

All RGH experiments selected among the high impact JLab measurements PAC42 [2014]

RGH experiment status (with HDice) confirmed at PAC48 in 2020 (during jeopardy process)
RGH (without HDice) status modified to C2 in 2024

Access to unique observables in

- SIDIS hadron
- SIDIS Di-hadron
- DVCS

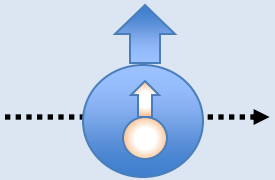
Gather unprecedented information on

- Transversity
- Tensor charge
- Sivers, $h_{1T}^{\perp}$, $g_{1T}^{\perp}$, $H_1^{\perp}$
- CFF and GPD E

ep -> e'hX

$C[h_1(x,k_T) \times H_1^{\perp}(z,p_T)]$

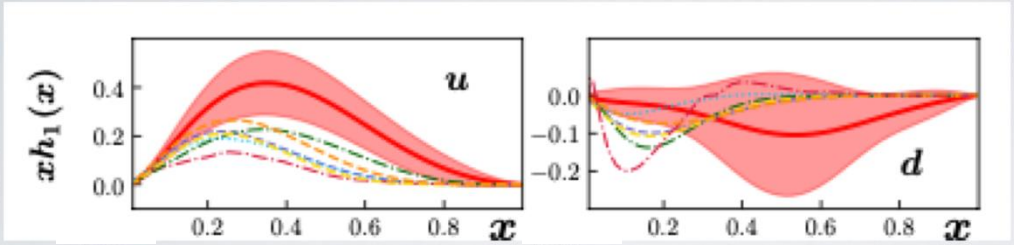
Collins (TMDs)

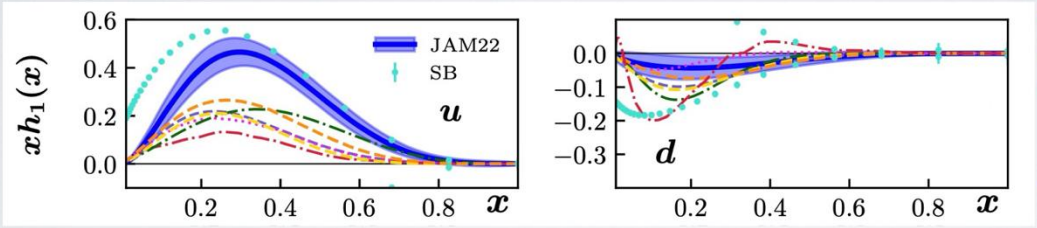


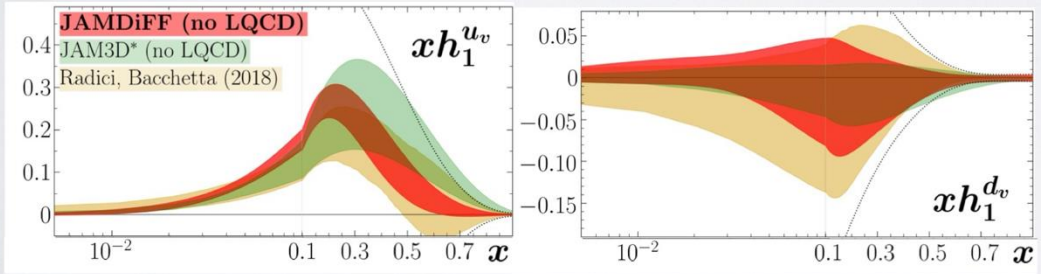
ep -> e'hhX

$h_1(x) H_1^{\sphericalangle}(z, M_{hh})$

Di-hadron (Collinear)



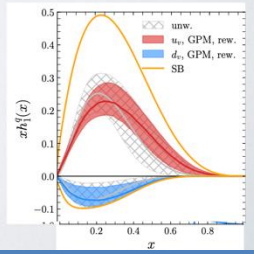




Soffer bound

- JAM20 ✘
- Anselmino 15 ✔
- Kang 16 ✔
- D'Alesio 20 ✔
- Radici 18 ✔
- Anselmino 13 ✔
- Benel 19 ✔
- JAM22 ✔ $\leq \Delta f_1, \Delta g_1$

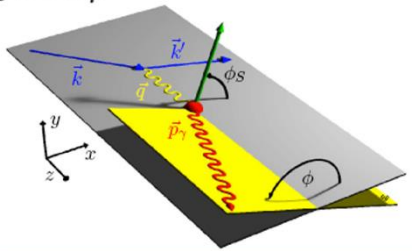
- Anselmino 15
- Boglione 24 ✔ a posteriori
- D'Alesio 20



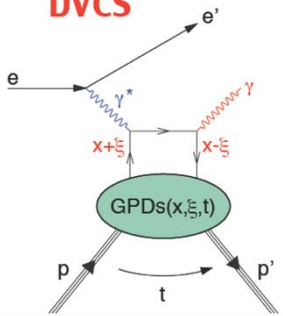
D. Pitonyak, QCD Evolution 24

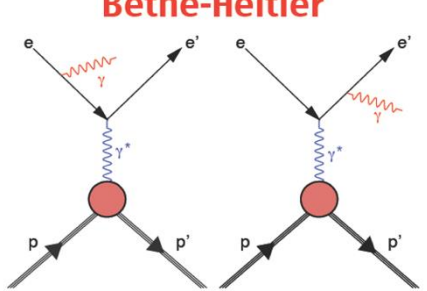
* JAM3D includes $\bar{u} = -\bar{d}$ w.r.t. JAM22

$$\frac{d^4\sigma}{dQ^2\, dx_B\, dt\, d\phi} \propto \left(|\mathcal{T}_{DVCS}|^2 + |\mathcal{T}_{BH}|^2 + \mathcal{I}\right)$$

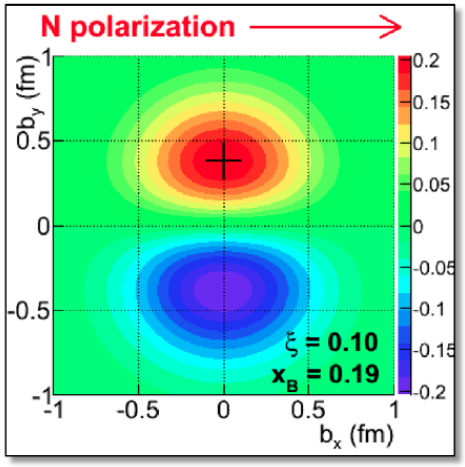


ep → e' γ p'





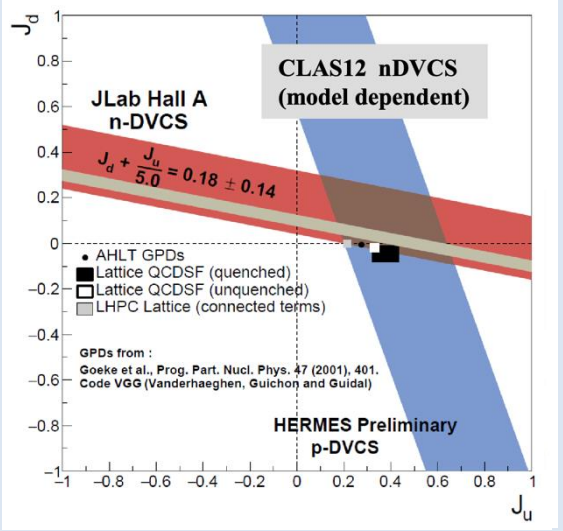
Information on the real and imaginary part of the QCD scattering amplitude



Access to elusive E_p GPD

OAM $L_q = J_q - \frac{1}{2}\Delta\Sigma$ via Ji sum rule

$$\mathcal{J}_q = \lim_{t\to 0} \int_{-1}^{1} dx\, x\left[H_q(x,\xi,t) + E_q(x,\xi,t)\right]$$



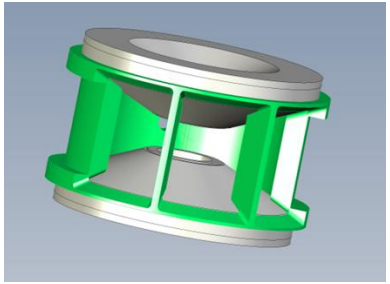
HDice (frozen-spin) did not meet RGH specifications

Most viable solution to prioritize physics vs R&D

Consolidated dynamically polarized NH_3 technology

Designed based on already successful realizations

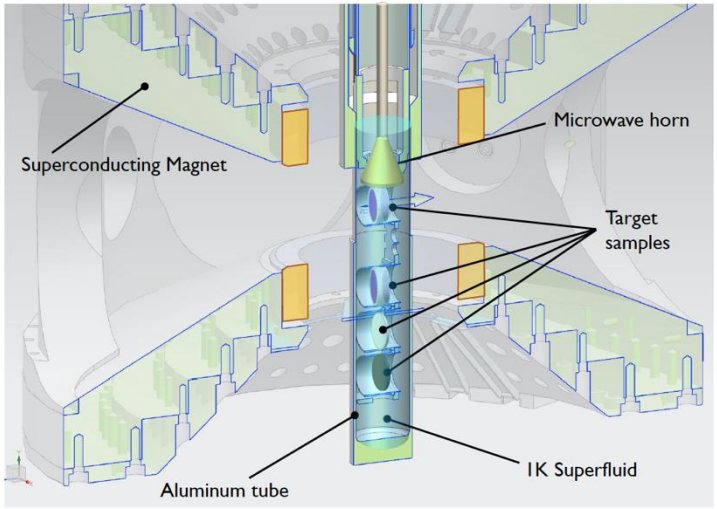
Hall-A G2p-Gep target (copy optimized for HTCC)
Hall-C E12-15-005 magnet (copy optimized for recoil detection)

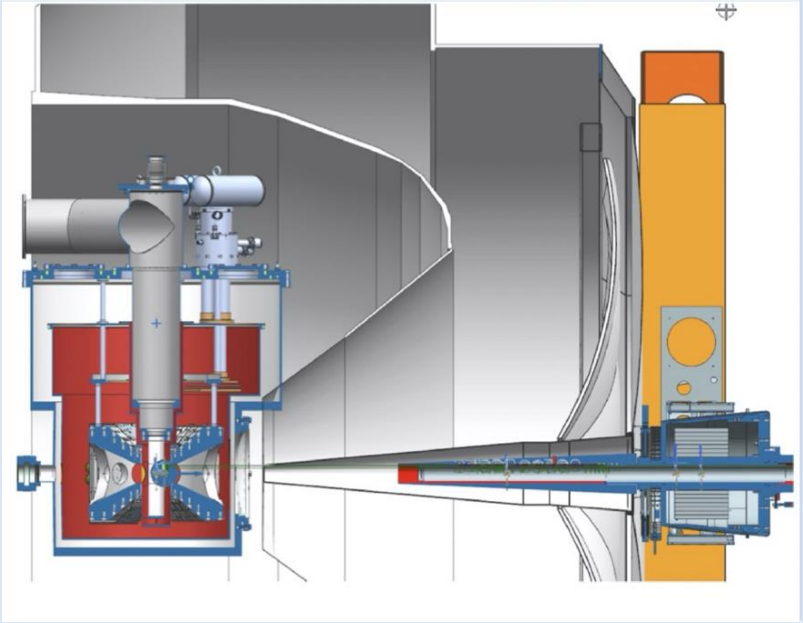


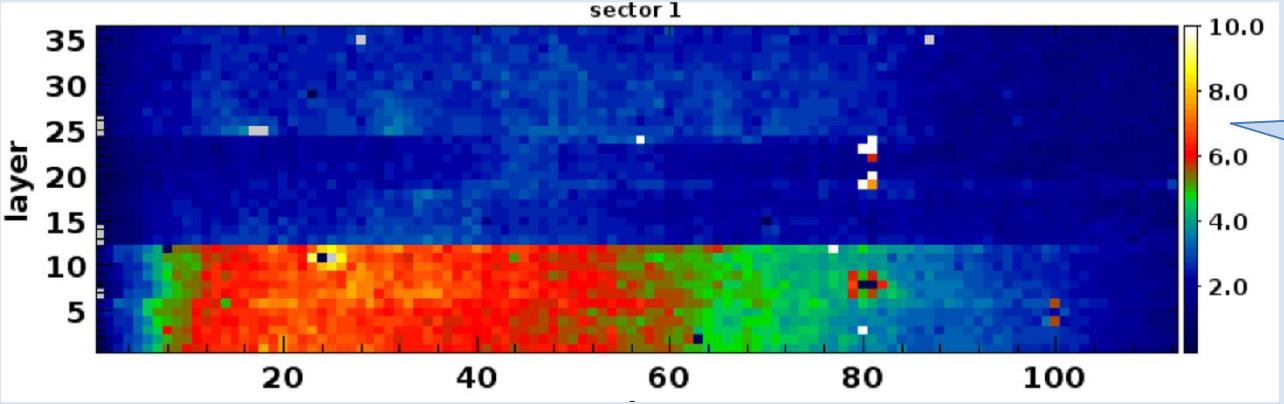
5T dipole acceptance:

$\pm$ 25° horizontal

$\pm$ 65° horizontal





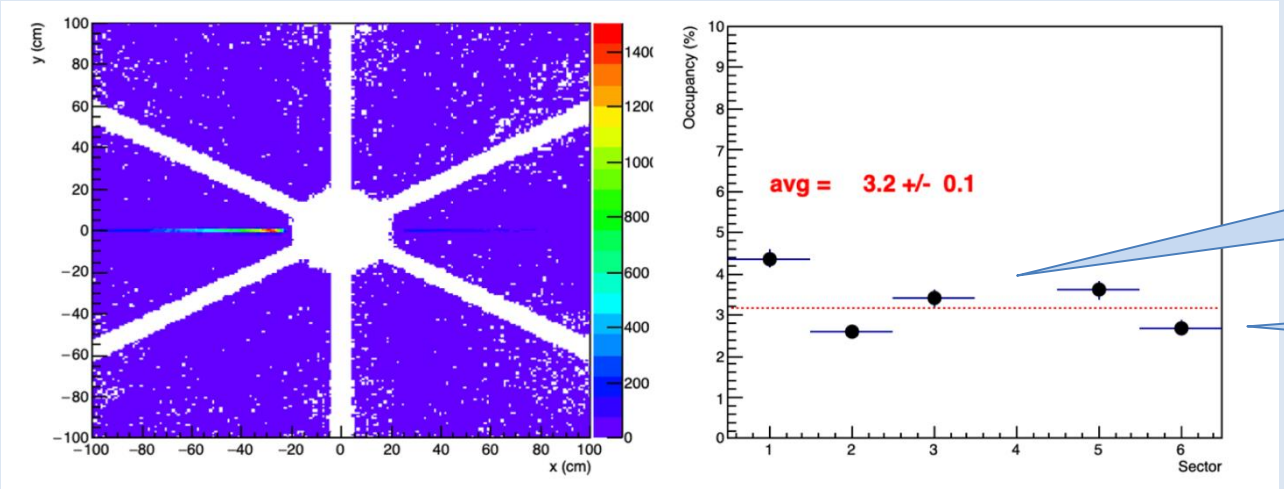


RGC DATA

Present performance*

Typical DC occupancy measured at CLAS12

*No high-lumi



RGH MC

Assume to switch OFF DC in sector 4 RICH in sector 3

x2 with CLAS12 gate

PAC52 Outcome

PAC52 report:

- concludes that scientific case remains strong but details need to be sorted out

- does not differentiate between SIDIS and DVCS experiments

- does not inquiry the feasibility of the new setup

- wants detailed model and full simulation:

  - beamline
  - recoil
  - background vs systematics

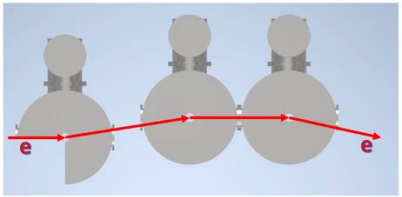
- wants the scientific impact to be clarified:

  - update phenomenology vs CLAS12 phase space
  - PAC days vs acceptance

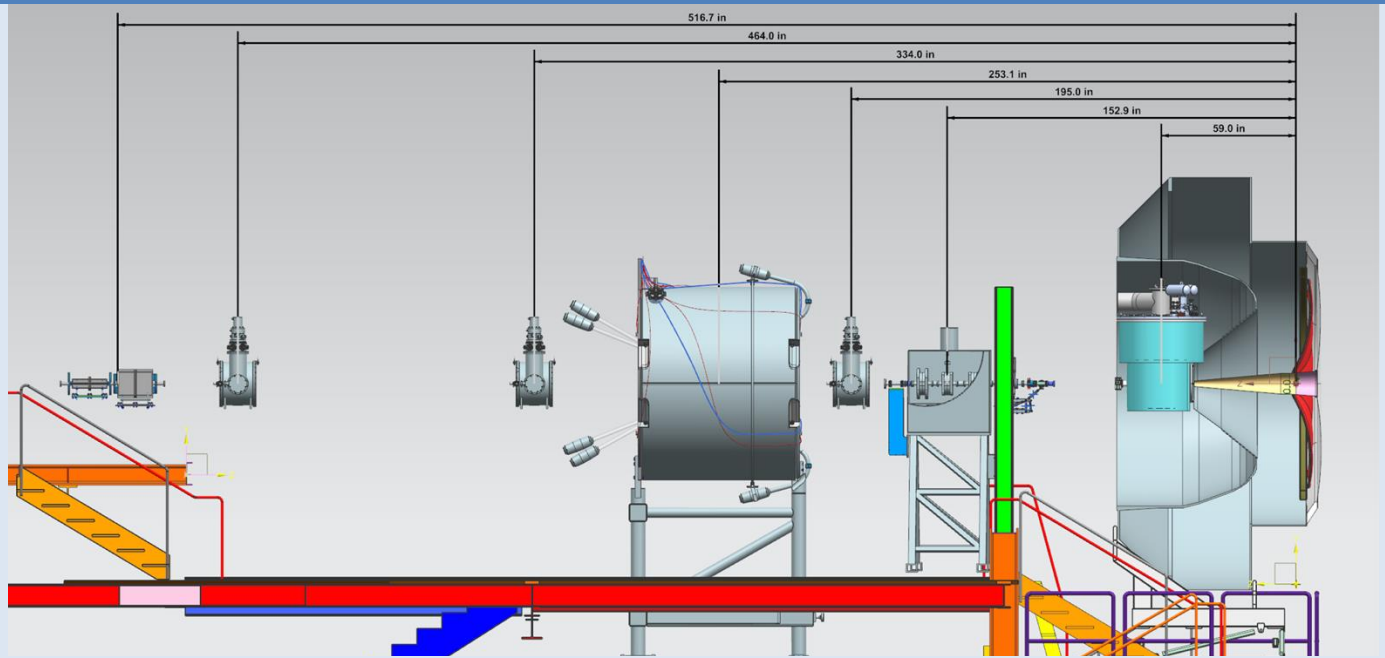
Based on

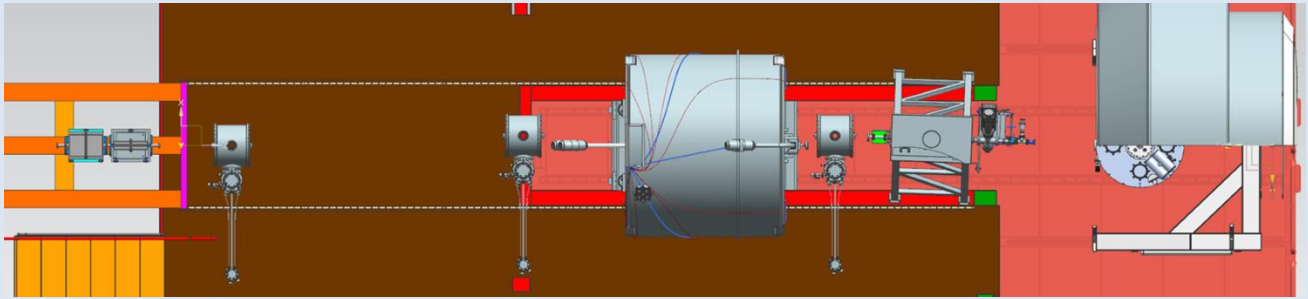
existing 0.7 mm raster

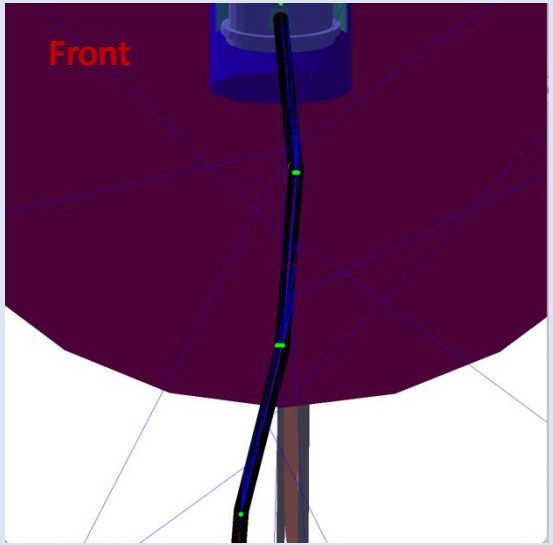
commercial 7.5T magnets



- ✓ space
- ✓ synchrotron radiation
- ✓ beam rastering

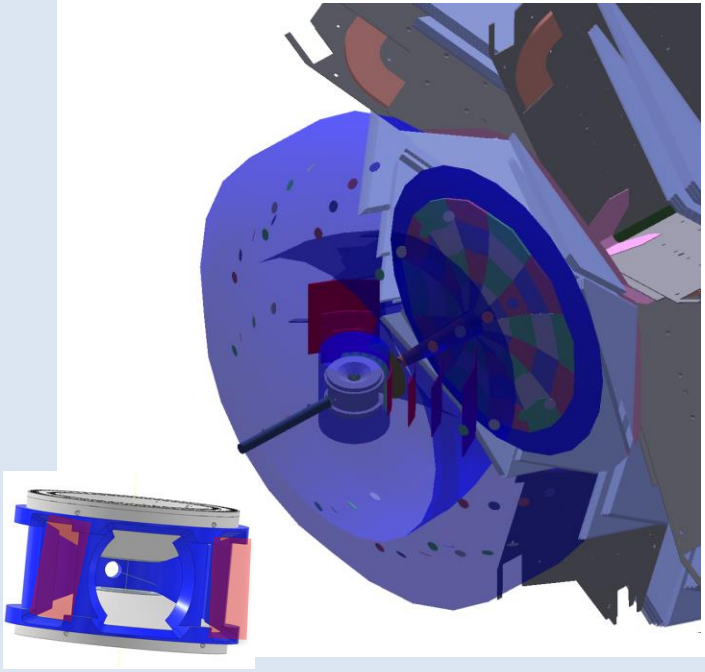






With pipe and 15 mm lead, synchrotron bckgr provides a negligible contribution to DC occupancies at 5 10^{33} cm^{-2} s^{-1} luminosity

Recoil concept (left-right)
3 tracking layers + 1 TOF layer (50 x 50 cm^2)

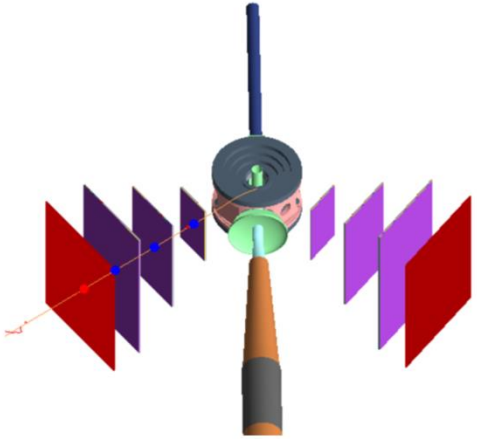


Simulated recoil resolution for

$\sigma_{x,y}$ O(100 μm)

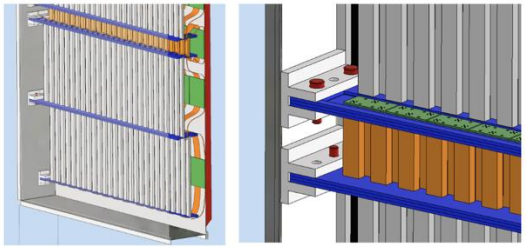
σ_t O(100 ps)

and CLAS12 FD tracking resolution

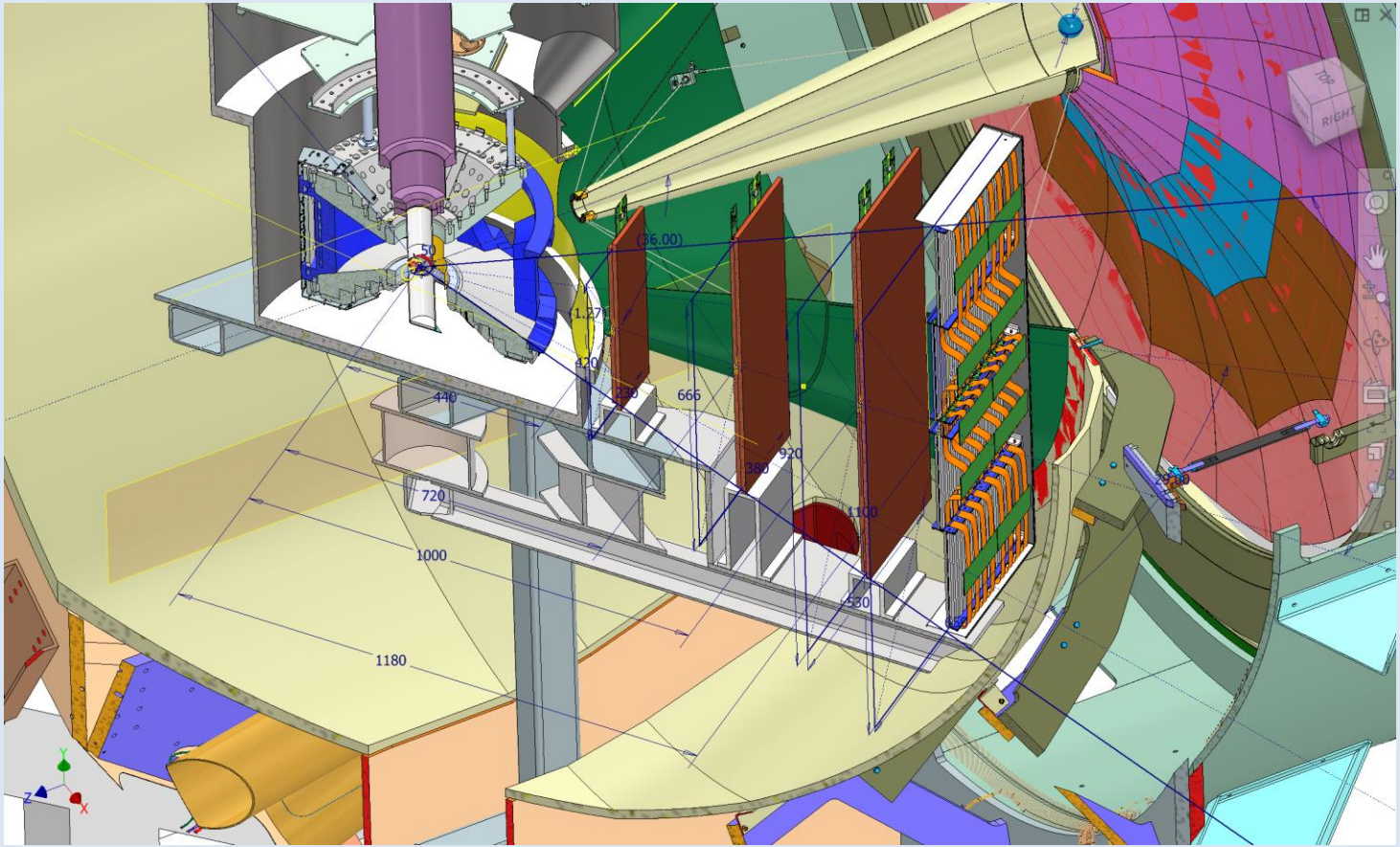


uRwell tracking

Scintillation bars + SiPM TOF



Recoil Detector Support



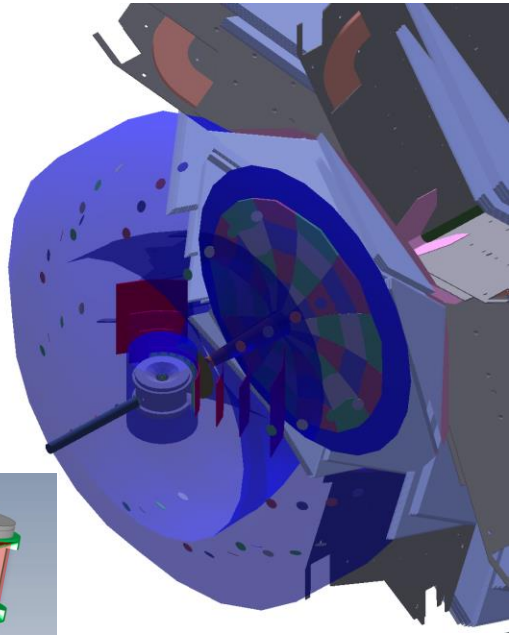
Task	Cost (k$)	Leading Institution	Expertise
μRwell detector	120	INFN-RM2, INFN-CT	CLAS12 upgrade, ePIC tracking
μRwell readout	40*	INFN-GE, INFN-RM1	SBS GEM tracking readout
TOF detector	70	DUKE, Orsay	EIC KLM, CLAS12 CND
TOF readout	60*	INFN-GE, INFN-FE	CLAS12 FT and RICH readout
Mechanics	30	INFN-LNF	CLAS12 RICH mechanics
Integration	100	JLab	Hall-B infrastructure and beam

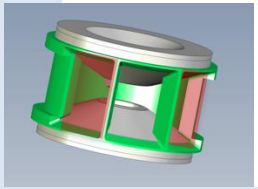
Costs are based on recent quotations or productions

The asterisks indicate optional costs for performance upgrade

Good case for a MRI application

Recoil concept (left-right)
3 tracking layers + 1 TOF layer (50 x 50 cm^2)





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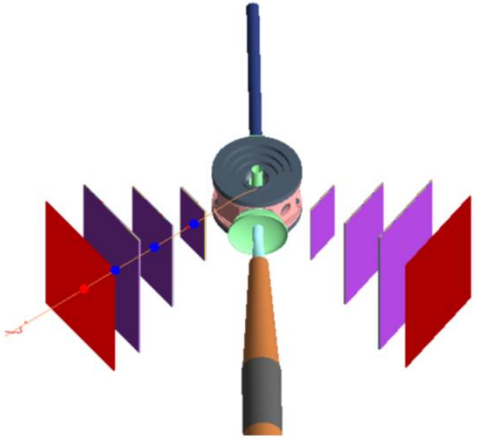
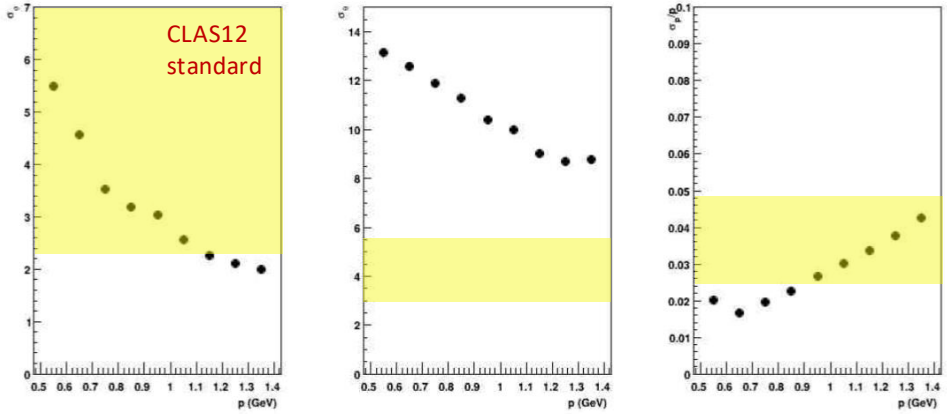
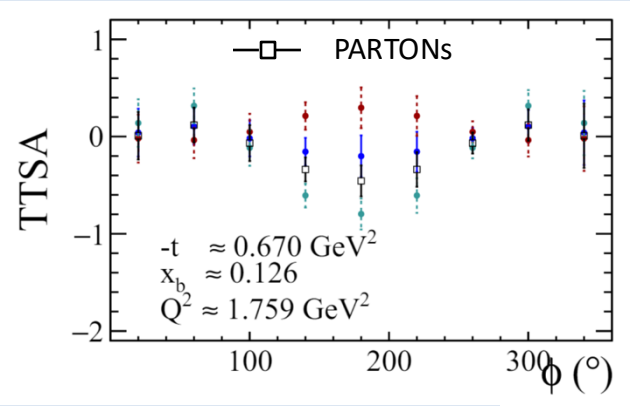
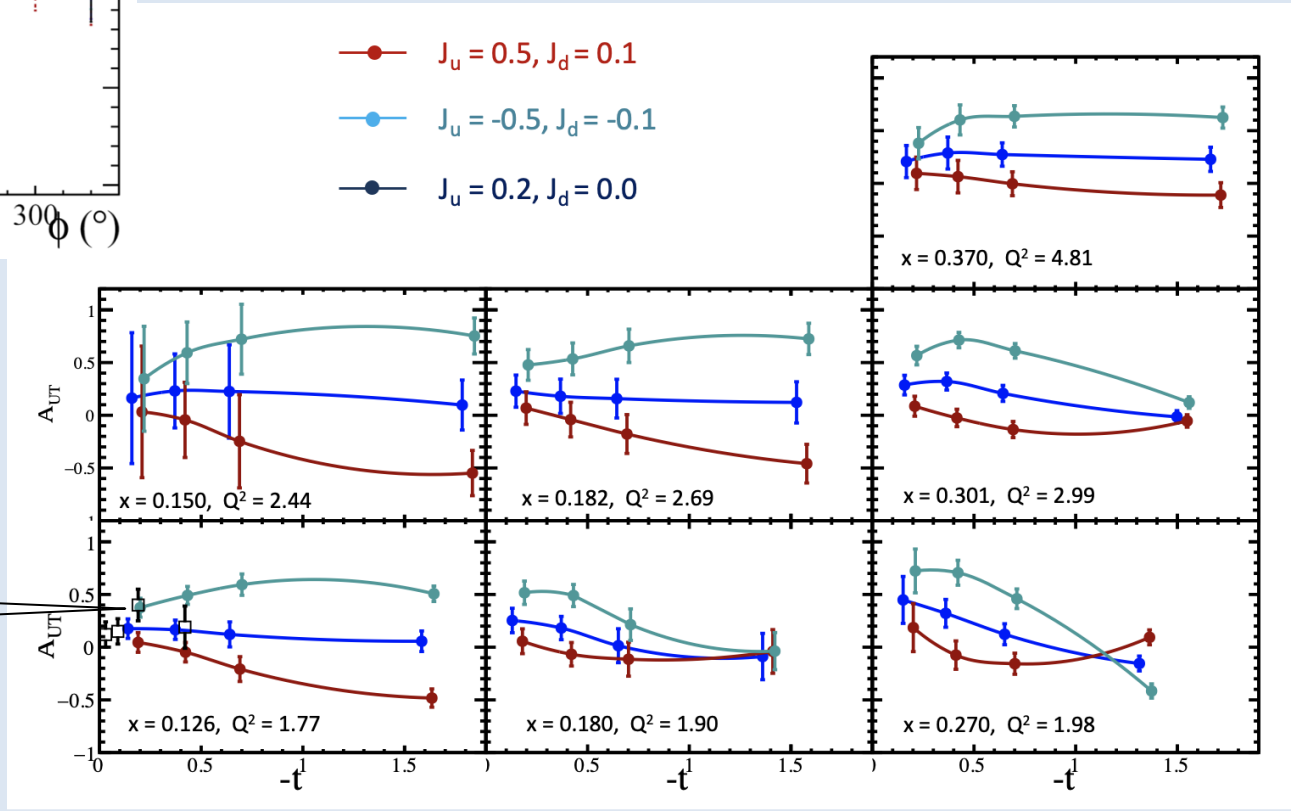


Resolution is adequate (GEANT simulation)





$$Y_{RGH}(i) = Y_{RGA}(i) \cdot \frac{Acc_{RGH}(i)}{Acc_{RGA}(i)} \cdot \frac{L_{RGH}}{L_{RGA}} \cdot \frac{3}{17}$$



Superior discrimination power between various OAM model hypotheses

HERMES

Projections with and without CLAS pseudo-data (with lattice inputs)
100 PAC days request to be competitive to lattice for δu