

# Hadron polarimeters: home in EIC ring

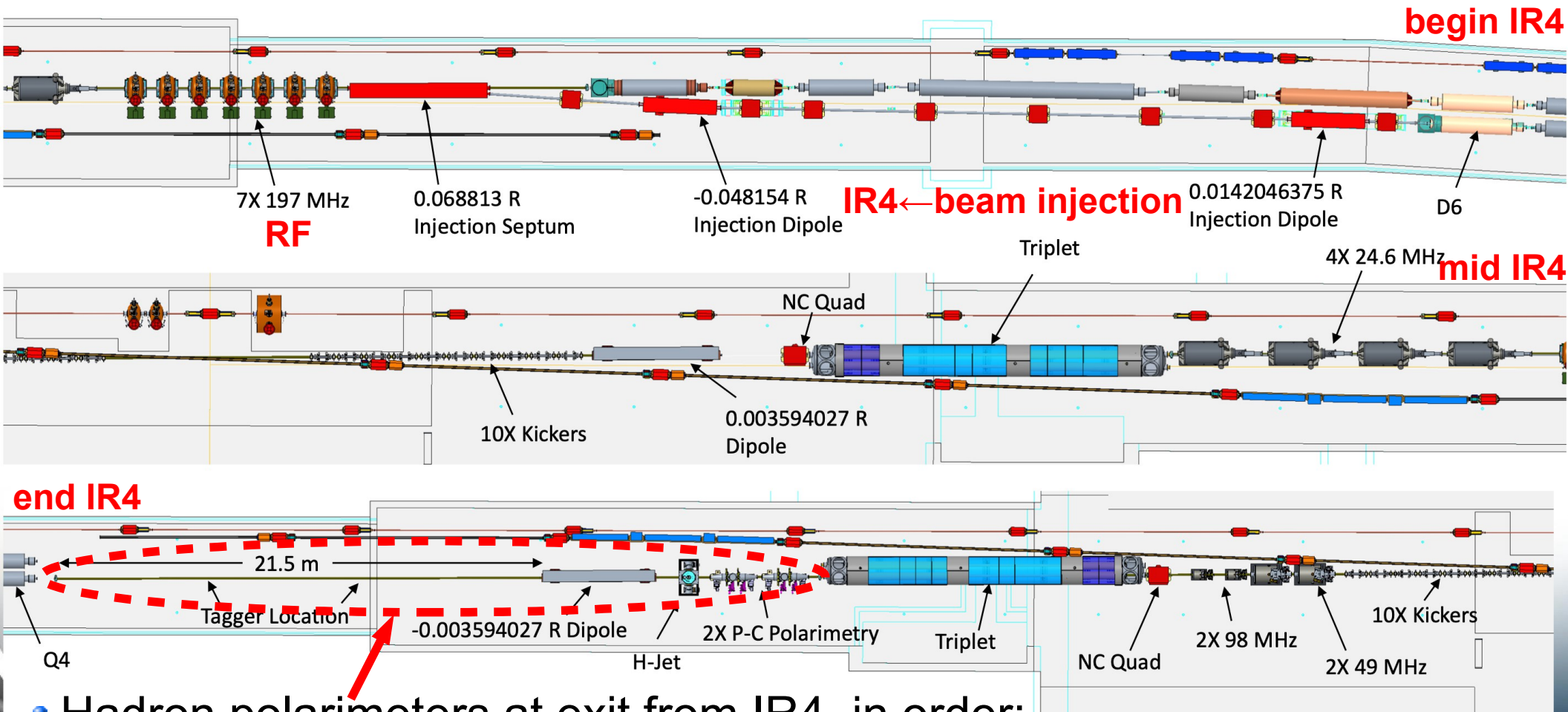
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EICUG polarim. mtg.  
07.09.2022

## Main polarimeters for beam optimization, physics analyses

- Follow RHIC model:
  - polarized jet target (**H-jet** polarimeter)  
absolute polarization scale
  - relative polarimeters, carbon targets (**pC** polarimeters)  
P time dependence, profile, spin vector direction
- New requirements @ EIC:
  - absolute polarimeter  $^3\text{He}$  breakup tagging
  - jet $\leftrightarrow$ carbon polarimeters adjacent, same spin tilt
- Numerous meetings with EIC straight section design group
  - polarimetry input spearheaded by Elke
  - $^3\text{He}$  breakup simulations by Z. Zhang  
DMPJet model for breakup  
beam element files from design group

# IR4 overview

- 3 segments IR4, hadrons counter clockwise, top to bottom (few 100 m)

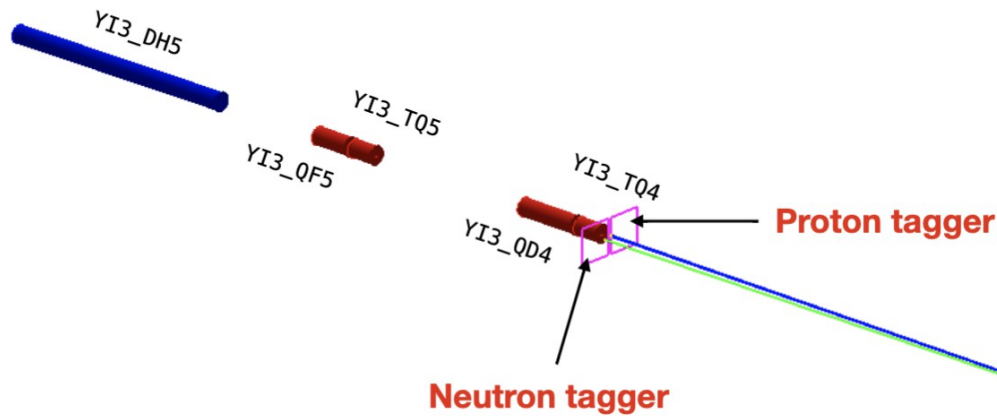
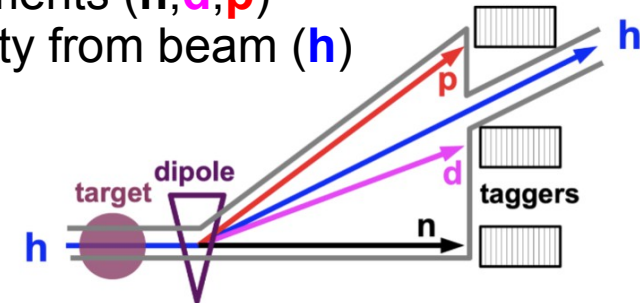


- Hadron polarimeters at exit from IR4, in order:
  - pC polarimeters
  - H-jet
  - dipole → drift space
  - breakup taggers

# The layout of the HJET (Version 4)

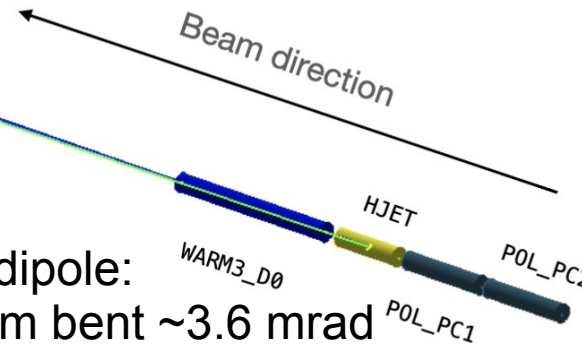
- We need dipole and drift space to separate the breakup fragments from the beam line.

breakup fragments (n, d, p)  
different rigidity from beam (h)



Beam size:  
 $10 \cdot \sigma_x = 0.98\text{cm};$   
 $10 \cdot \sigma_y = 0.23\text{cm};$

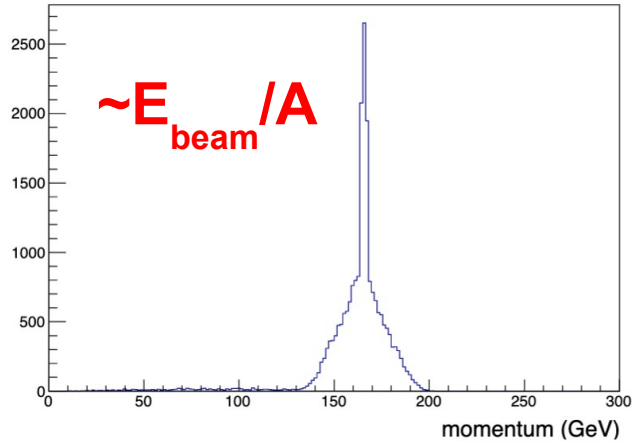
D0 dipole:  
 beam bent  $\sim 3.6$  mrad  
 (to the right)



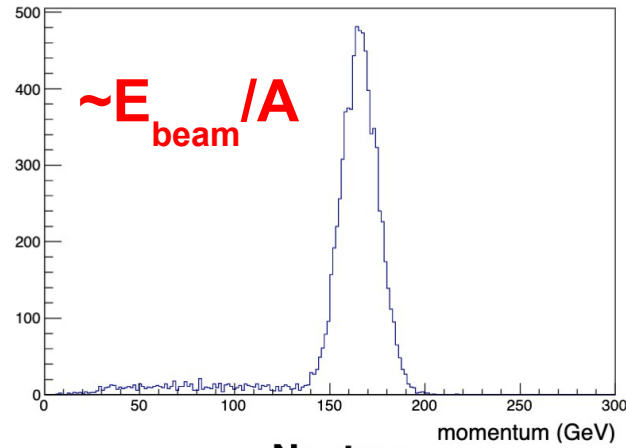
# Decayed particles from break beam He3

Only beam He3 break up

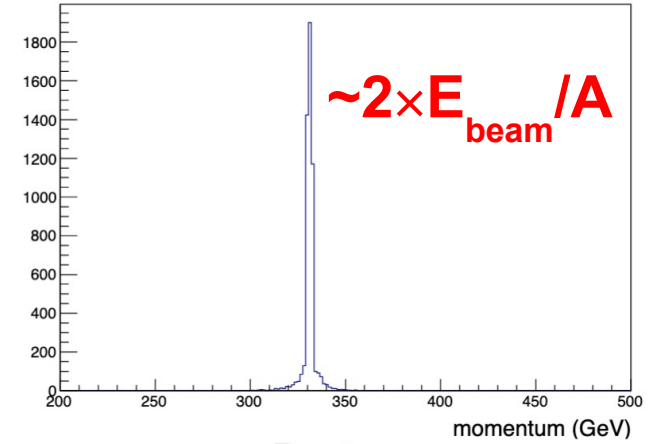
166GeV



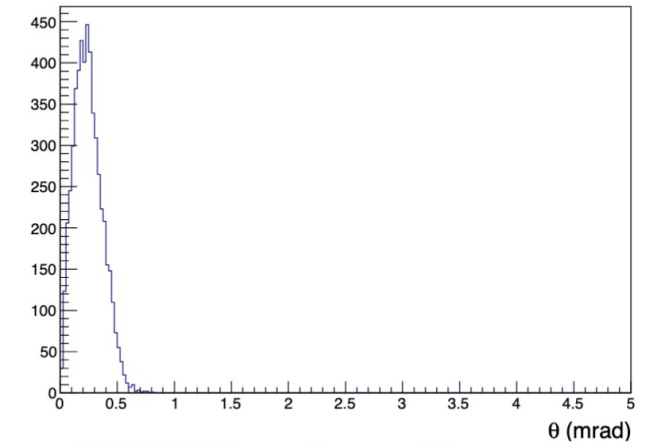
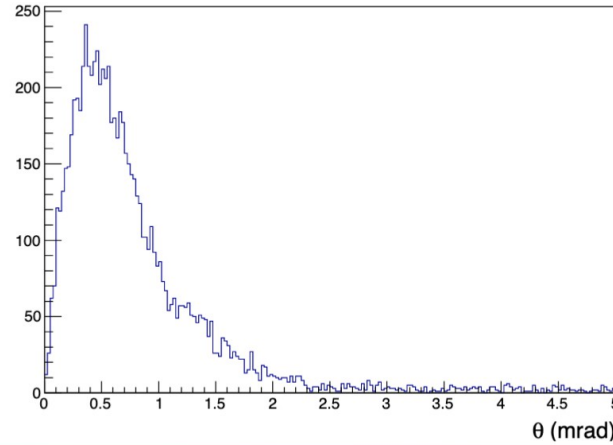
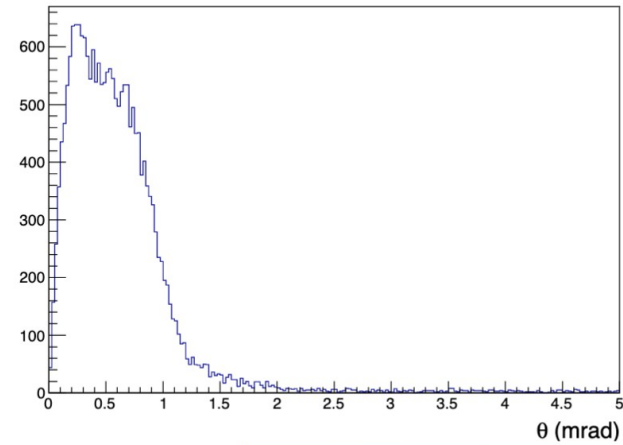
Proton



Neutron



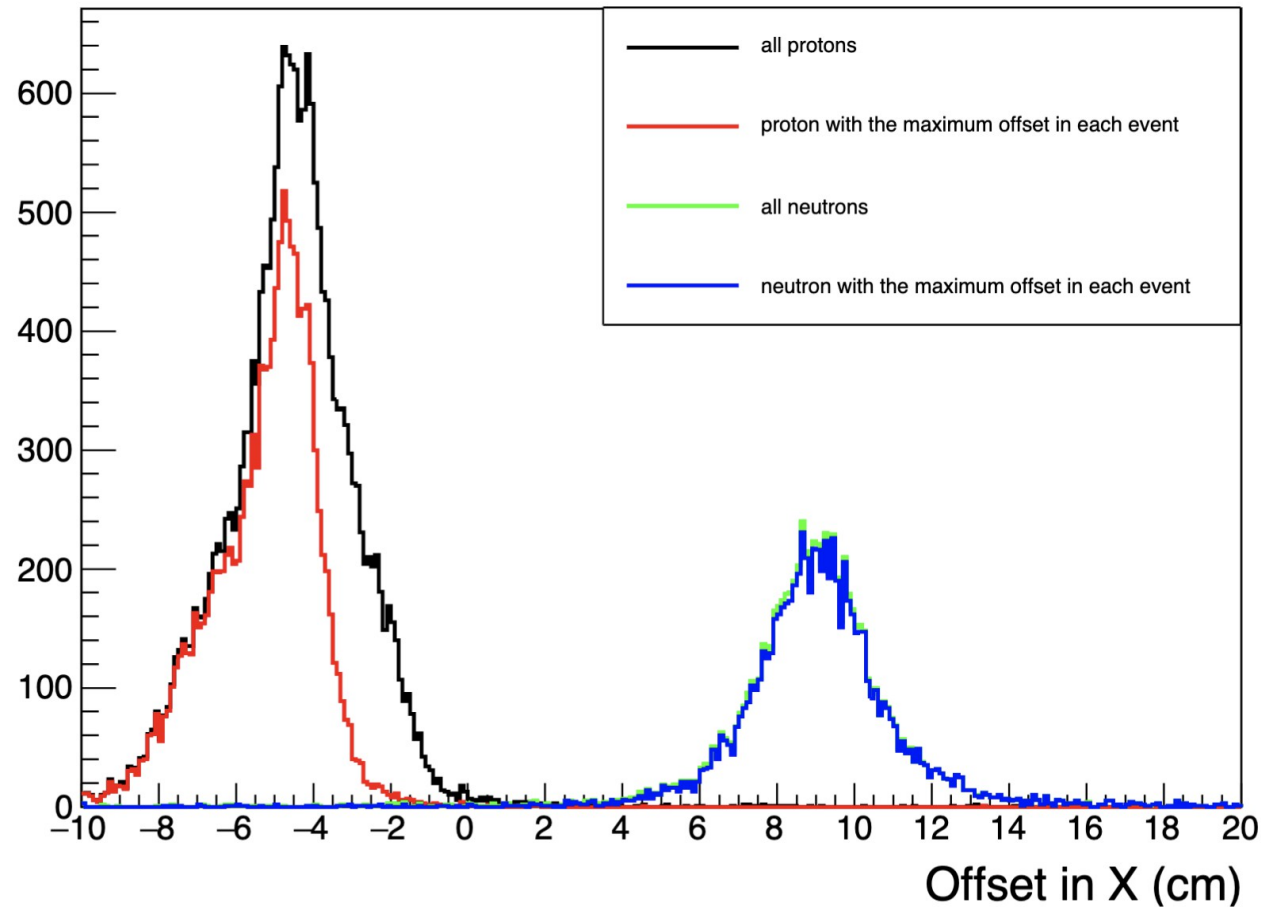
Deuteron



## Offset in X for protons and neutrons

Only beam He3 break up

166GeV



- We show the X (cm) offset in the taggers for the produced protons and neutrons. Here the event only has the beam He3 breaking up;
- For the red line case, we only choose the proton which has the maximum offset in each event;
- 99.4% events have at least one proton;
- 57.8% events have at least one neutron

## Tagging efficiency


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Taggers with the offset of the beam line		1.5cm	2.0cm	3.0cm	4.0cm
<b>Only beam He3 break sup 166GeV</b>	Tag at least one proton	97.6%	97.3%	95.6%	83.9%
	Tag at least one neutron	56.6%	56.6%	56.5%	56.3%
	Tag at least one proton or neutron	98.3%	98.2%	97.8%	90.4%
<b>Only beam He3 breaks up 110GeV</b>	Tag at least one proton	96.5%	95.5%	91.3%	81.3%
	Tag at least one neutron	79.3%	79.1%	78.4%	77.3%
	Tag at least one proton or neutron	97.5%	97.3%	96.0%	92.7%

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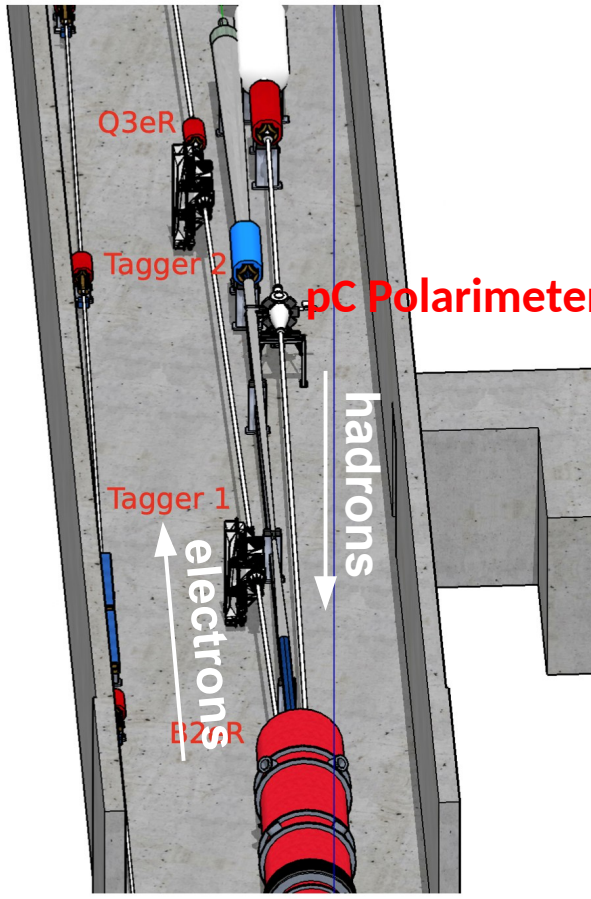
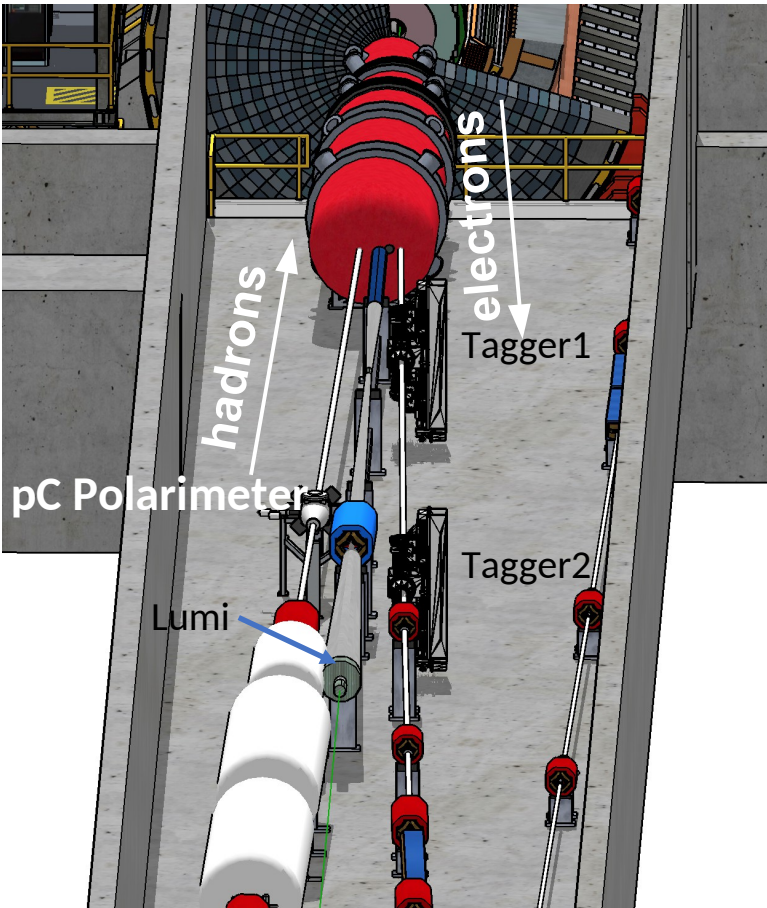
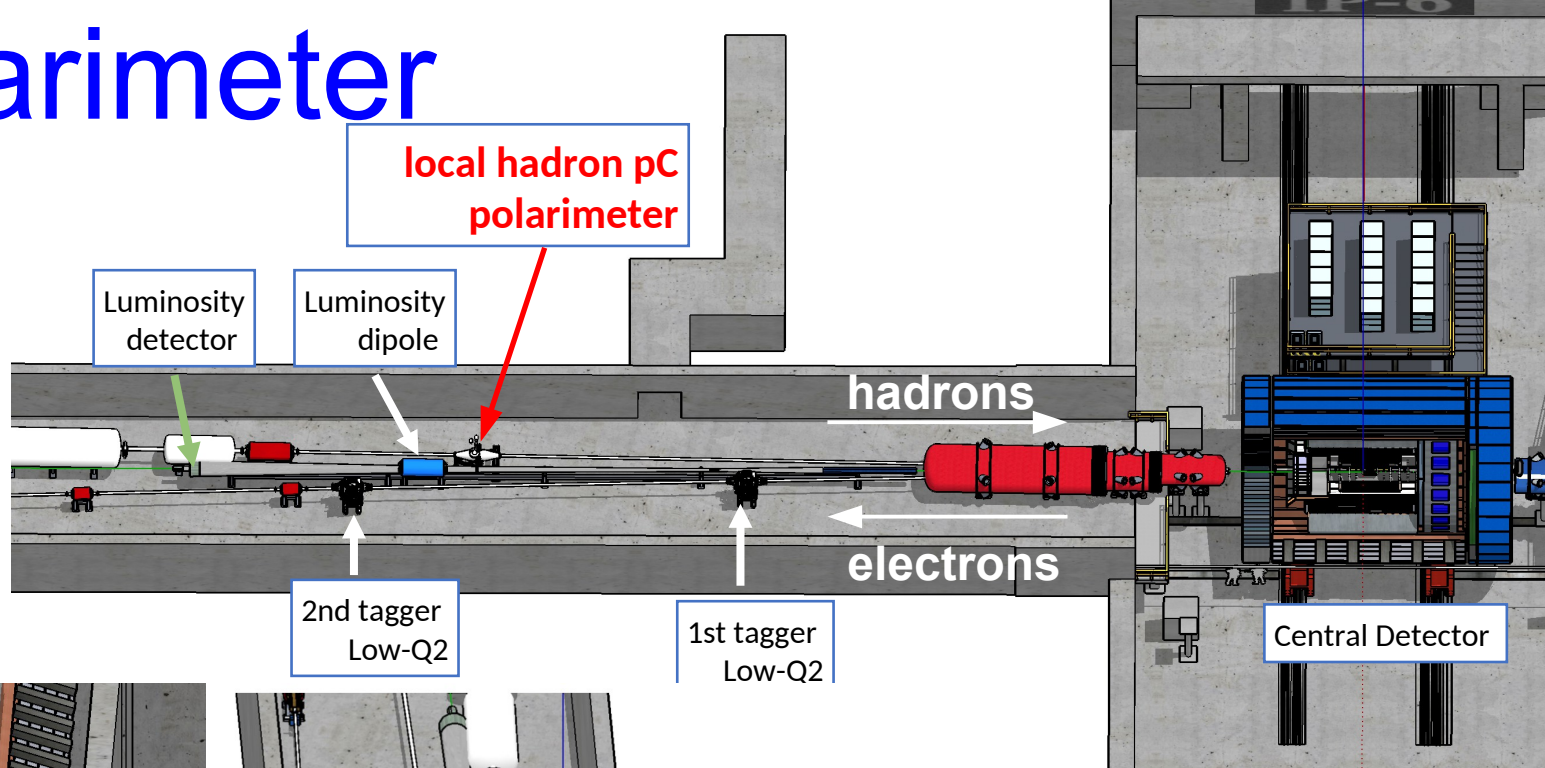
- **Breakup tagging efficiency  $>\sim 95\%$  ✓**

# Local polarimeters

- Need polarimeters near collider experiments:
  - verify transverse spin direction
  - ensure no transverse spin component for longitudinal spin (spin rotator tuning)
- At RHIC use process  $pp \rightarrow Xn$ :
  - neutron transverse spin asym. in Zero Degree Calorimeters
  - no analogous process for ep, eA physics
- At EIC:
  - place pC relative polarimeter close to IP
  - measure spin direction
  - location @ IR6 identified 

# Local polarimeter @ IR6

(slightly out-of-date  
CAD drawings)



- Incoming hadron / outgoing electron side
- Neighborhood of luminosity detectors, low- $Q^2$  electron taggers
- Adequate space for pC around, along incoming hadron beam