# The EIC IR and diffractive eA physics

WAN CHANG

2020/05/21

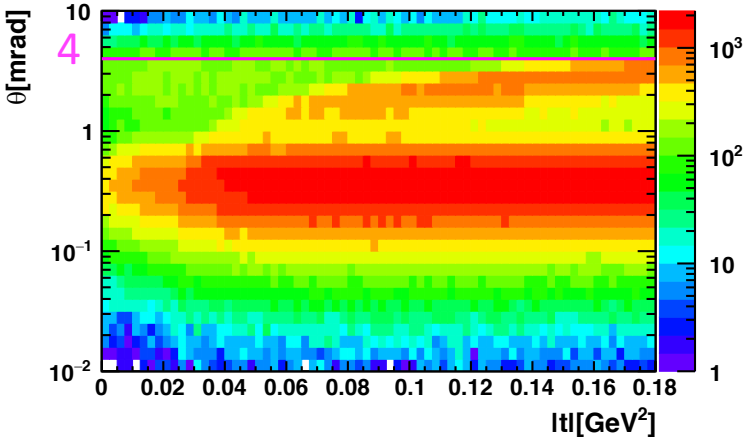
# Data sample

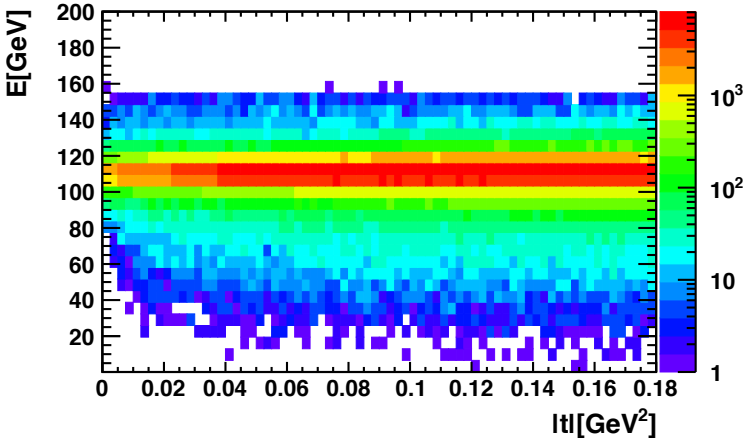
- e+Pb(BeAGLE)
- $18 \times 110$ (GeV)
- $1 < Q^2 < 10$
- $0.01 < y < 0.95$
- 1M events

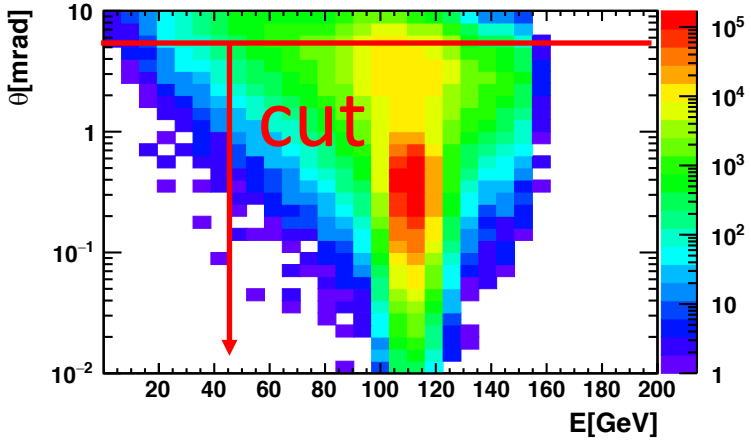
- The goal is to remove all the incoherent diffractive events
- Veto on forward neutrons, photons, protons

# Neutron

Beagle distribution before cuts



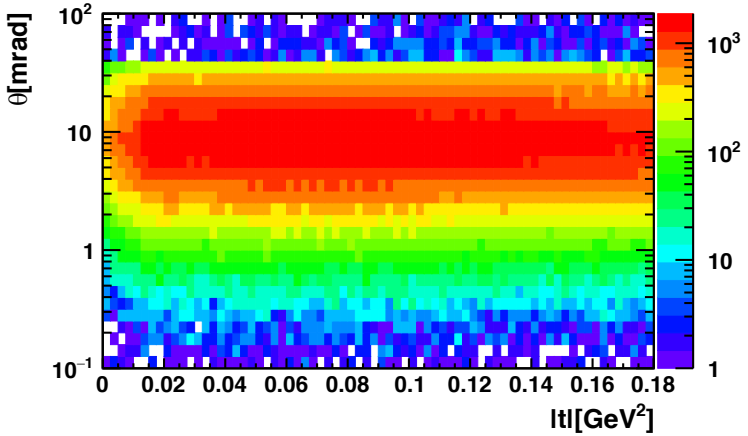



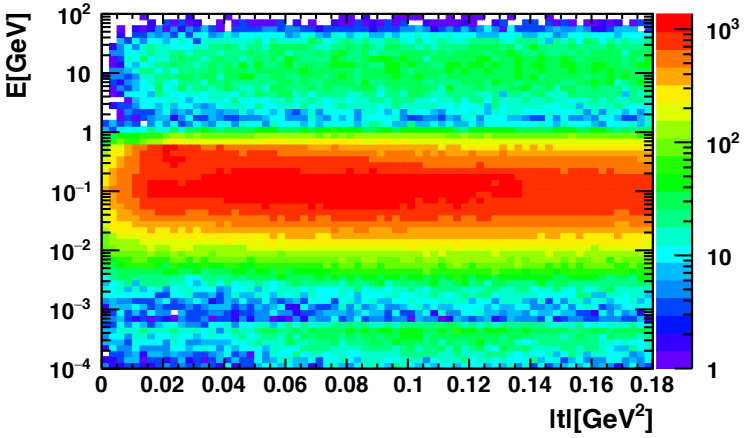



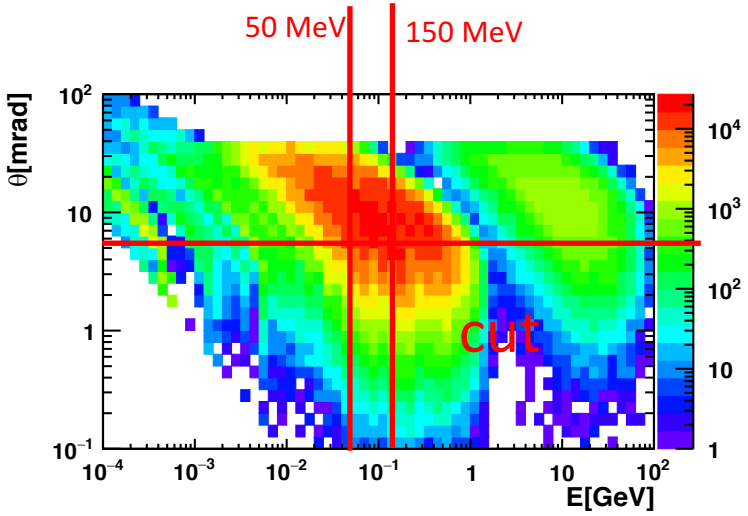

Neutrons to be detected in ZDC: Θ < 5.5 mrad

# Photon

Beagle Distribution before cuts



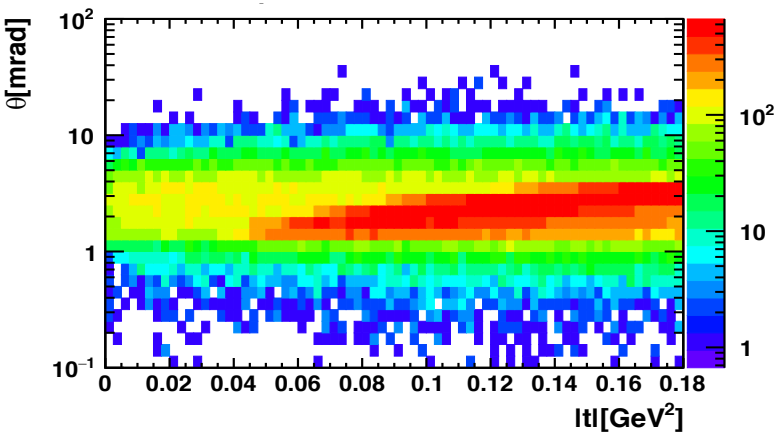



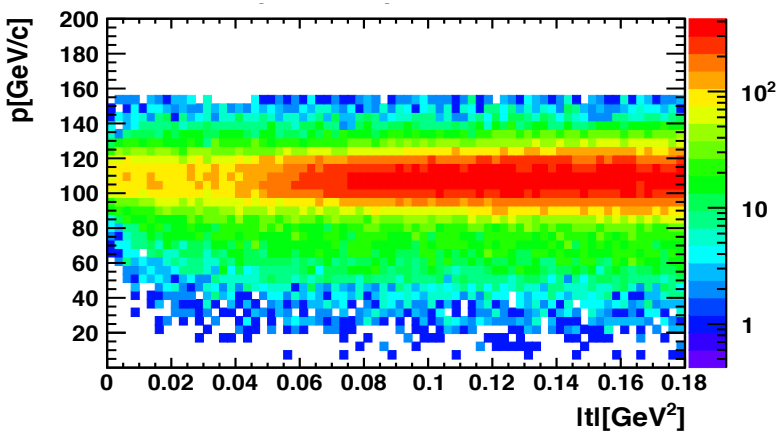

Photons to be detected in ECal part of ZDC Θ < 5.5 mrad

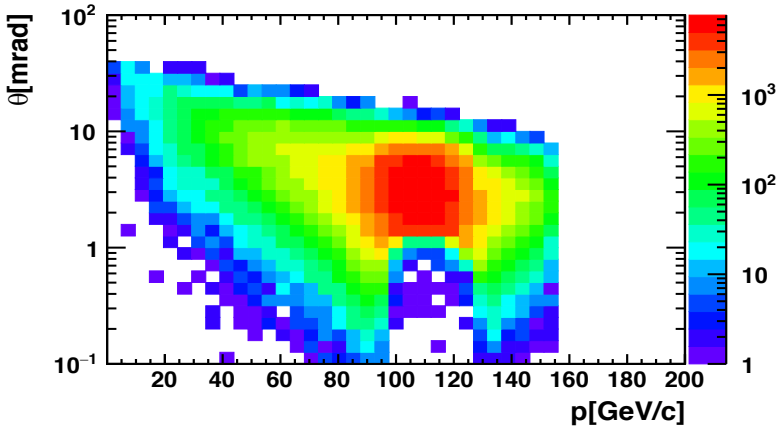
Challenge lowest detectable photon energy

# Proton

Beagle Distribution before cuts



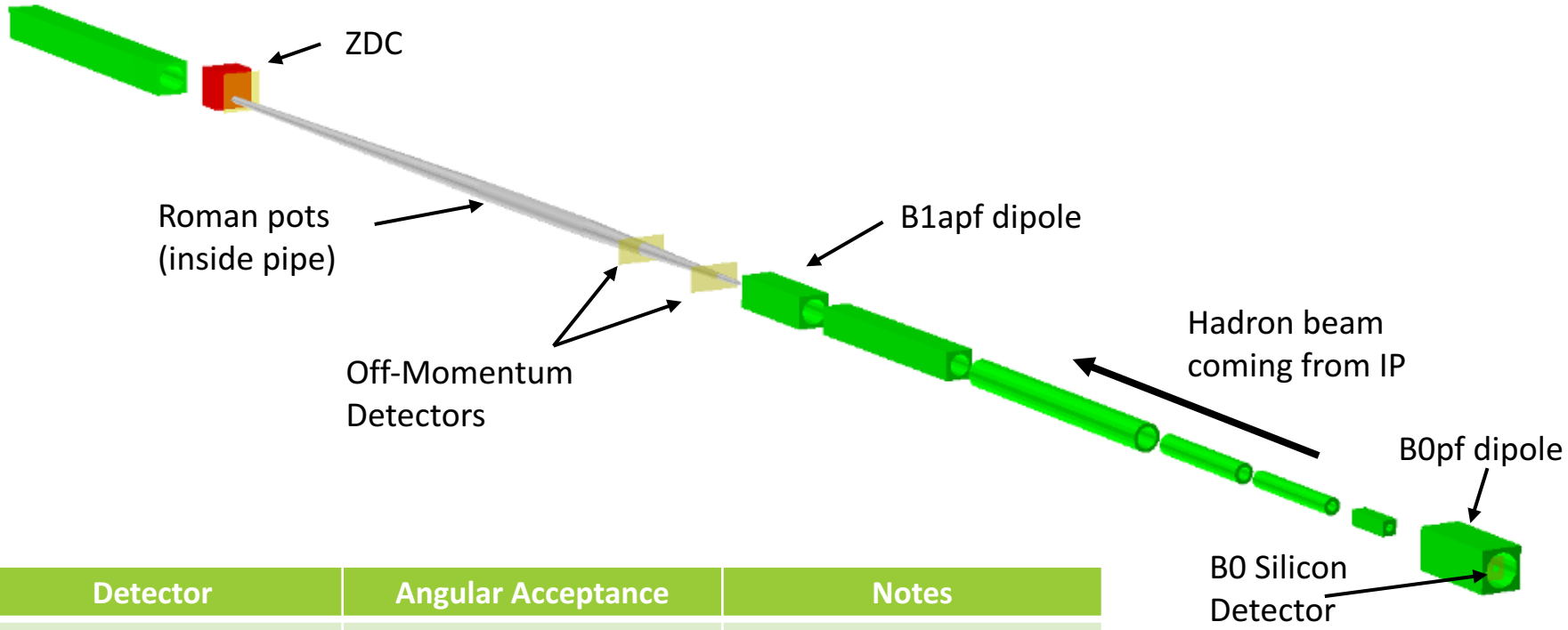




Protons to be detected in

- ❑ Roman Pots: 0 – 5 mrad
- ❑ B0-Si detectors: 5.5 – 20 mrad
- ❑ off-p Si Detectors: 0 – 5 mrad

# IR: Outgoing Hadron Beam

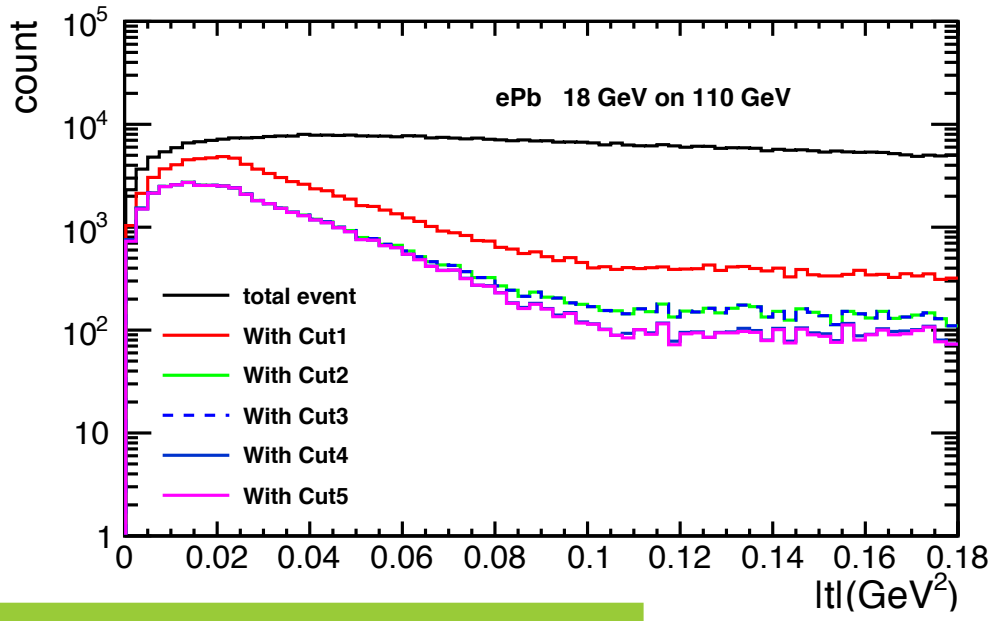
## Layout and Acceptances




| Detector | Angular Acceptance | Notes |
|---|---|---|
| ZDC | $\boldsymbol{\theta}$ < 5.5 mrad | About 4.0 mrad at φ ~ $\pi$ |
| Roman Pots | 0.0 < $\boldsymbol{\theta}$ < 5.0 mrad | Need 10σ cut. |
| Off-Energy Detectors | 0.0 < $\boldsymbol{\theta}$ < 5.0 mrad | .4 < $x_L$ < .6 |
| B0 Sensors | 5.5 < $\boldsymbol{\theta}$ < 20.0 mrad | .4 < $x_L$ < .6 |

$$x_L = \frac{p_{z,nucleon}}{p_{z,beam}}$$

# Event distribution




**The impact of the different detectors is studied by adding one requirement / cut after the other.**

**Cut1:**
- no neutron in ZDC

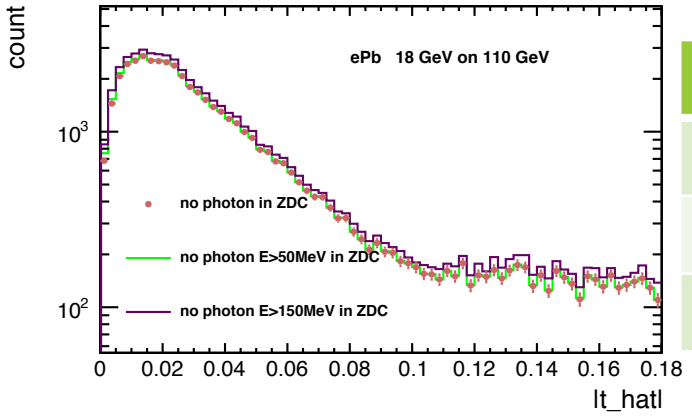
**Cut2 :**
- Cut1 + no photon ***E>50MeV*** in ZDC

**Cut3:**
- Cut2 + no proton in Roman Pots

**Cut4:**
- Cut3 + no proton in off-energy detector

**Cut5:**
- Cut4 + no proton in B0

| Survived event count | |
|---|---|
| Total events | 1000000 |
| Cut1 | 132127 |
| Cut2 | 66101 |
| Cut3 | 66099 |
| Cut4 | 61487 |
| Cut5 | 55792 |




The survived events count after Cut2 with different energy cut on photon:

| Survived event count | |
|---|---|
| E>150 MeV | 71773 |
| E>50MeV | 66101 |
| E>0 MeV | 65278 |

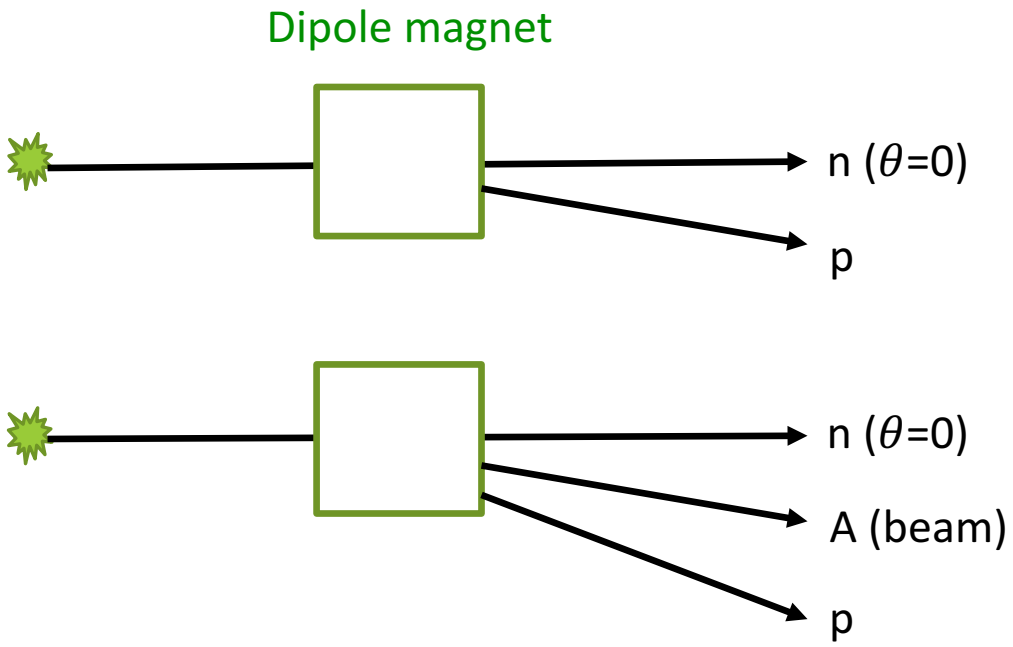
# Back up

# Beam parameters set up

| Species energy [GeV] | ep collision | 18 × 110 |
|---|---|---|
| Beam emittance [mm] | $E_x$ | 33.1E-6 |
| | $E_y$ | 2.4E-6 |
| Beam energy spread $D_p$ :RMS $\Delta p/p$ [mm] | | 6.8E-4 |
| $\beta_x$ at Roman Pots [mm] | | 166E3 |
| $\beta_y$ at Roman Pots [mm] | | 212E3 |
| Dispersion at RP location $D_x$ [mm/E-3] | | -0.21 |

# Rigidity

**rigidity** is the effect of particular magnetic fields on the motion of the charged particles, it refers to the fact that a higher momentum particle will have a higher resistance to deflection by a magnetic field.




$$Rigidity = \frac{p}{q} \sim \frac{A}{Z}$$

$$\frac{mv^2}{r} = qvB$$

$$\frac{p}{q} = Br$$

p: momentum

q: charge

A: mass number

Z: proton number

Pb: A→208, Z→82

Proton: A→1, Z→1

Forward proton acceptance in e+A is DIFFERENT from e+p.