A Brief Summary of Simulation Related to IR8 from the EIC Detector Proposal Stage

Wenliang (Bill) Li

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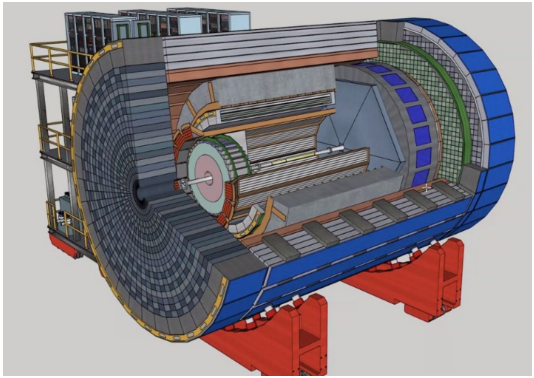
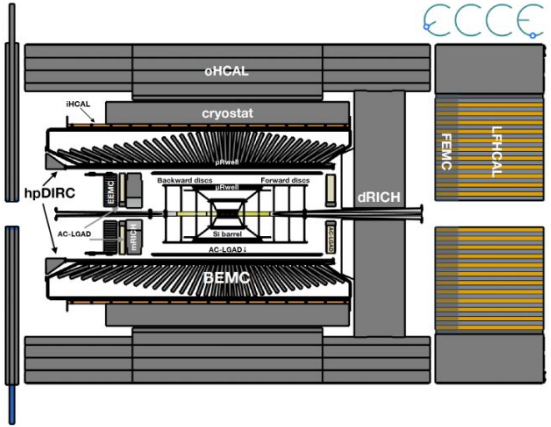
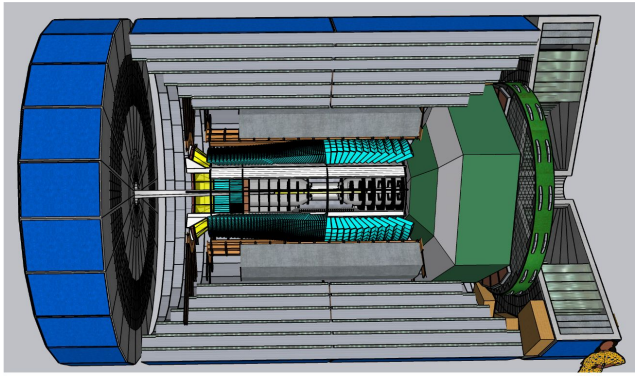
Outline Line

- Currently available Full Simulation for IP8
- Summary of IP8 physics and R&D studies
- My recommendation to EICUG 2nd detector effort

Full Simulation Package from Proposal Stage







Athena: DD4Hep

IP6

ECCE: Fun4all

IP6 **IP8**

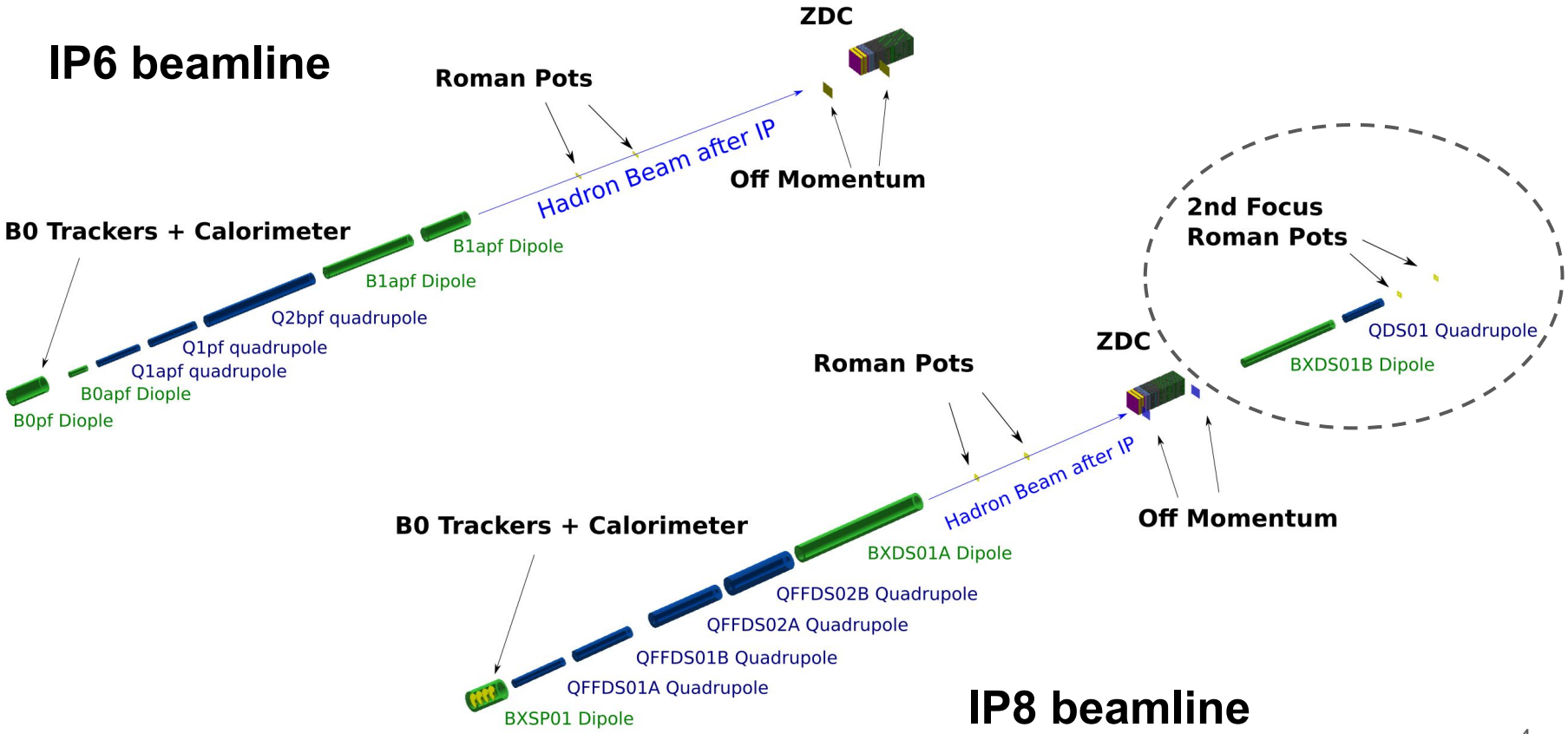
CORE

In the late proposal stage

ECCE @ IP8
(Obsolete)

Core @ IP8
(Still active)

IP6 vs IP8: almost identify but different



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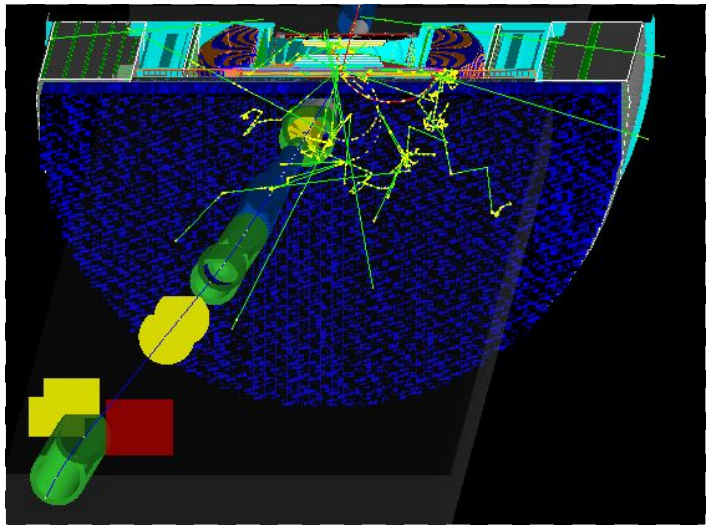
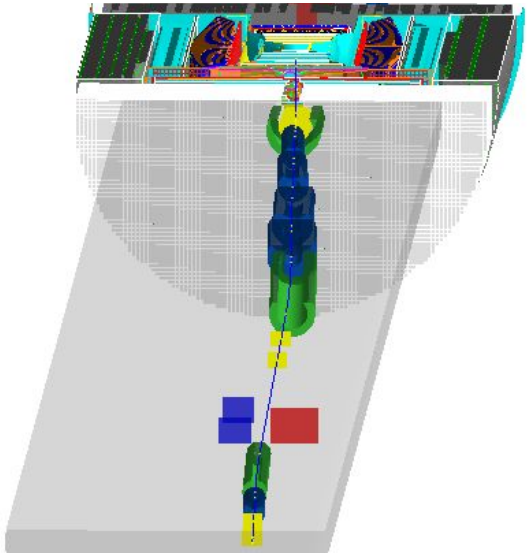




IP6:

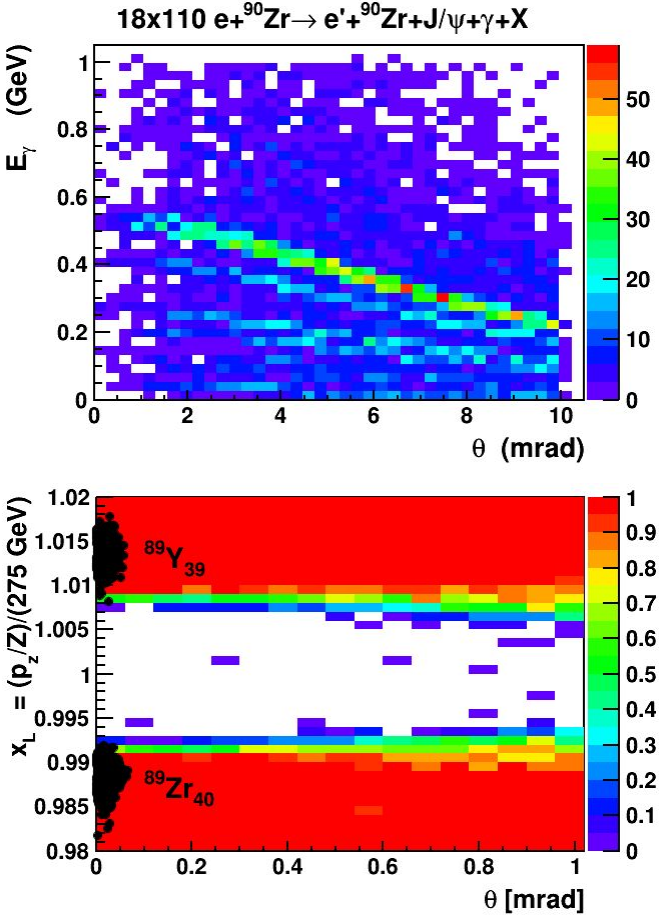
- 25 mrad e+p crossing angle
- ZDC Acceptance: -4.5 to +5.5

IP8:

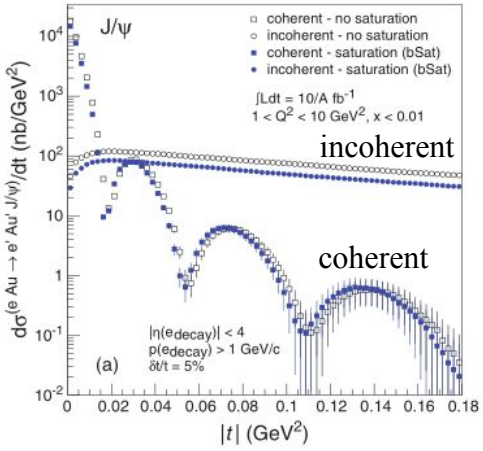
- 35 mrad e+p crossing angle
- Second focus
- ZDC Acceptance: +-5 official design
  - potentially +-7

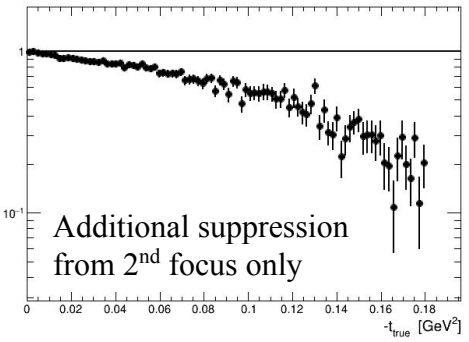
Slides borrow from P. Nadel-Turonski

Simulations of coherent diffraction with ^{90}Zr



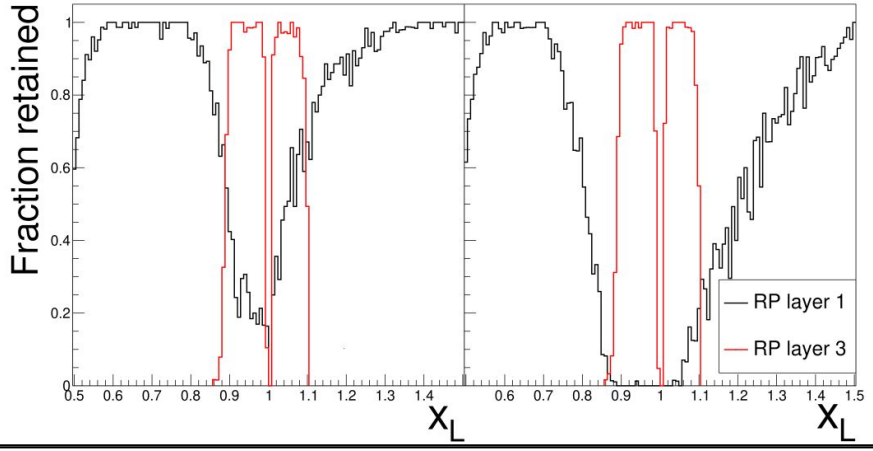
- Extended forward photon detection is synergetic with the 2nd focus in IR8.
- ^{90}Zr is ideal for benchmarking:
  - The ability to tag A-1 nuclei in the 2nd focus and detect a large fraction of nuclear photons has the potential to significantly improve the suppression of incoherent backgrounds in coherent diffraction.
  - The photon detection will also help to distinguish reactions where the final nucleus was in the ground state or an excited state.
  - The figures on the left show the photons and A-1 fragments from ^{90}Zr
  - The figures on the right show the additional suppression at high t from the 2nd focus





Study by M. Baker and others

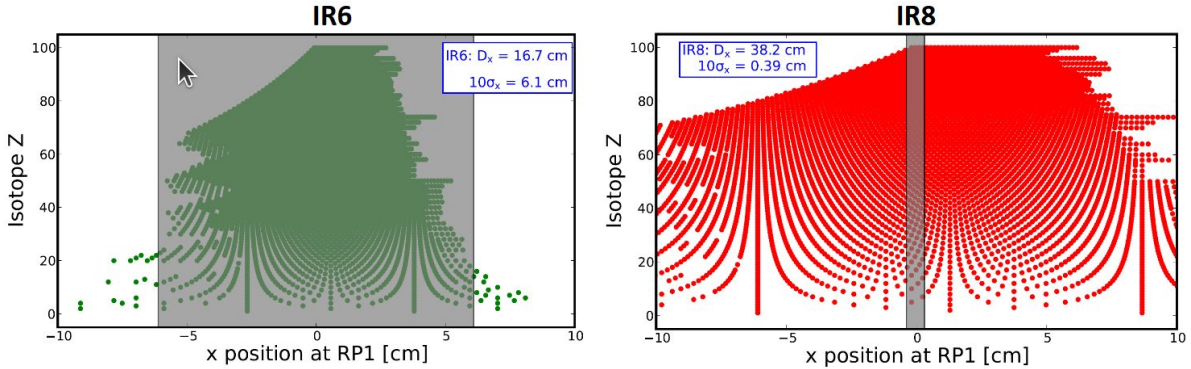
In terms of PD acceptance



Rigidity fraction of eA diffractive process:

- with 2nd focus: black + red
- without 2nd focus: black

Study by M. Baker and others



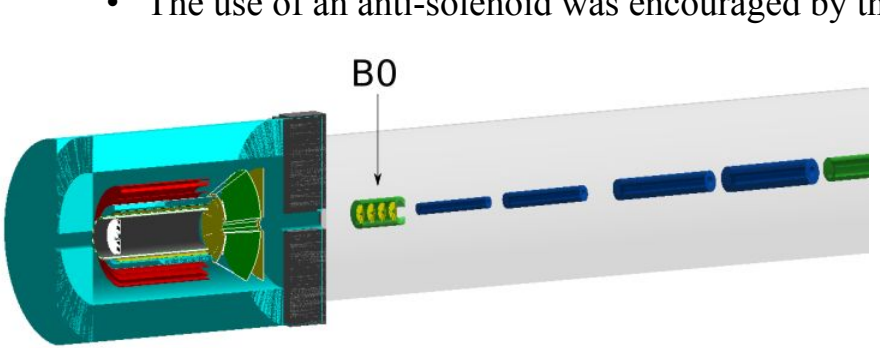
Heavy isotop detection at Roman Pot

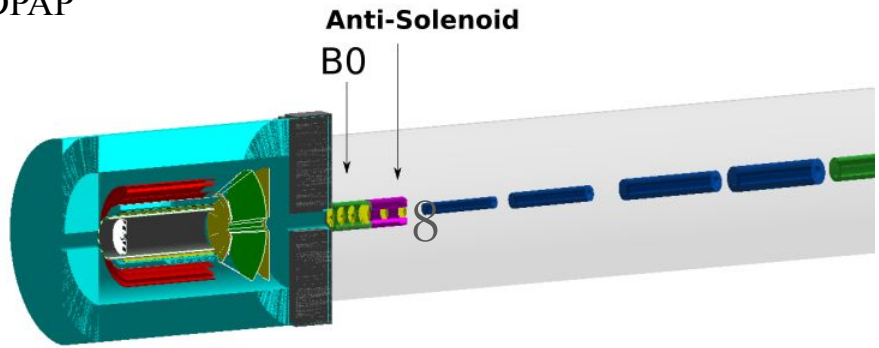
Study by B. Moran and others

Slides borrow from P. Nadel-Turonski

Motivation – overview

- Compensation of the field of the detector solenoid is necessary, and can be done either using a large number of skew quads or an anti-solenoid on each side of the detector, each compensating half the field.
  - Anti-solenoid: solenoid with opposite polarity to the main detector solenoid
  - Skew quad: quadrupole magnet / winding rotated by 45 degrees in azimuth
- The use of an anti-solenoid offers significant benefits for the accelerator and provides additional space behind the small B0 dipole for improved detection in the 5-20 mrad range.
  - An anti-solenoid was part of the original (JLab) IR concept that IR8 is based on
  - The use of an anti-solenoid was encouraged by the DPAP





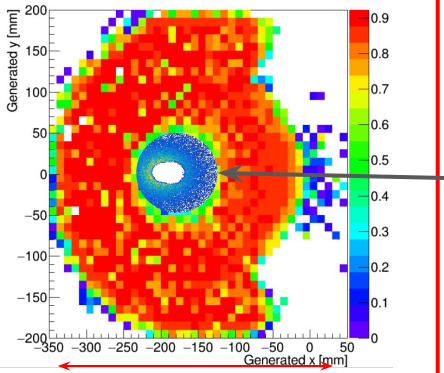
- An anti-solenoid can fit in the space in front of the ion FFQs (blue), located 7.5 m from the IP.

In terms of Far Forward Acceptance

- The increase to ZDC acceptance from +-5 to +-7 marginally increases the recoil nucleon acceptance:
  - e+p 5x41 GeV pion structure study: 20% increase in terms of nucleon detection efficiency

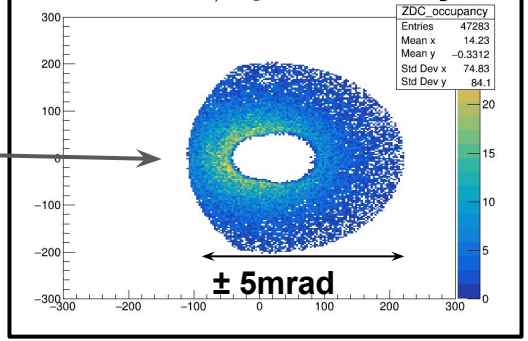
- Instrumentation of a full calorimeter inside B0 will significantly boost the forward acceptance: from +- 5 mrad to +-28 mrad !

ZDC + B0 calorimeter



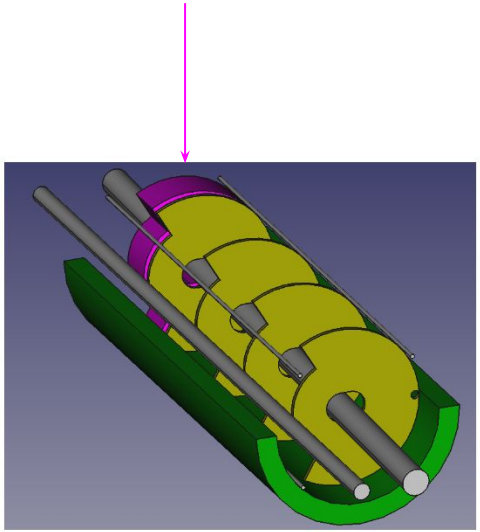
± 28mrad !

ZDC Acceptance only



± 5mrad

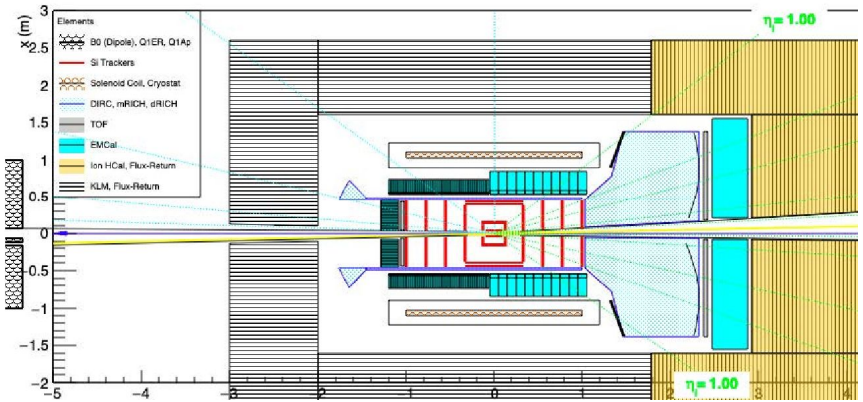
B0 Calorimeter

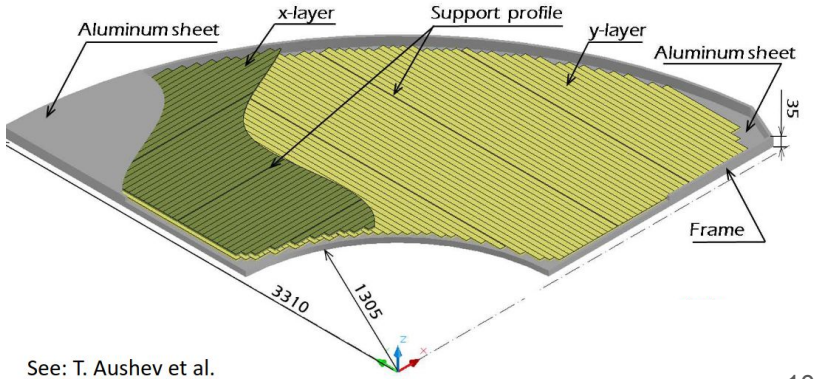


A 2nd Detector Software Framework is Needed for Future R&D Project

- A 2nd Detector Software Framework is Needed for Future R&D Project
- As an example, for the approval Generic R&D, KLM project was proposed to use Fun4All based software
- A clear statement from the EICUG 2nd detector effort will help

2.2 m





See: T. Aushev et al.

Recommendation to EICUG 2nd Detector Effort

- **Although there is an existing IP8 Simulation package, it is beneficial to switch to the single stack ePIC software**
  - **Current IP8 software is un-welcome to the new users**: Fun4All has a steep learning curve.
  - **XML based geometry file is the future trend**: ePIC's DD4Hep geometry is relatively easy to configure
  - **More and more users will be trained with DD4Hep geometry**:
    - initial beamline setup in DD4Hep could happen relatively quickly