EIC BACKGROUND SIMULATIONS

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(others also working on background issues)

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- Yulia Furletova (JLab)
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- Alexander Kiselev (BNL)
- Vasiliy Morozov (JLab)

- Amethyst Maps (ODU)
- Nikolay Markov (UConn)
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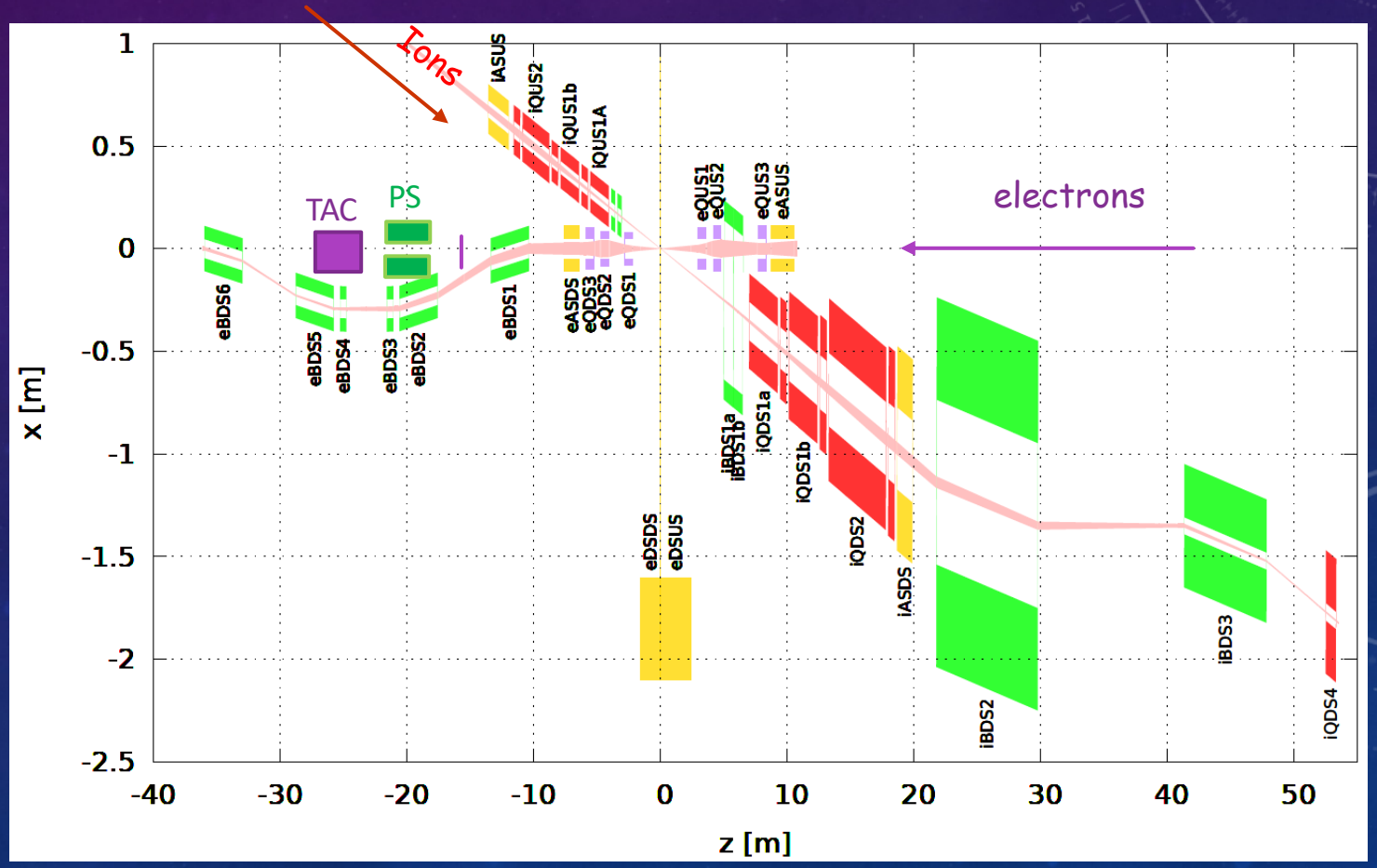
- Christine Ploen (ODU)
- Youri Sharabian (JLab)
- Marcy Stutzman (JLab)
- Mike Sullivan (SLAC)
- Mark Wiseman (JLab)

INTRODUCTION

- Detailed simulations of the EIC machine related backgrounds in the Interaction Region (IR) are crucial for proper design of the beam pipe, pumping system, detectors and front-end electronics
- Mitigating the backgrounds is an important aspect of the Machine-Detector Interface (MDI).

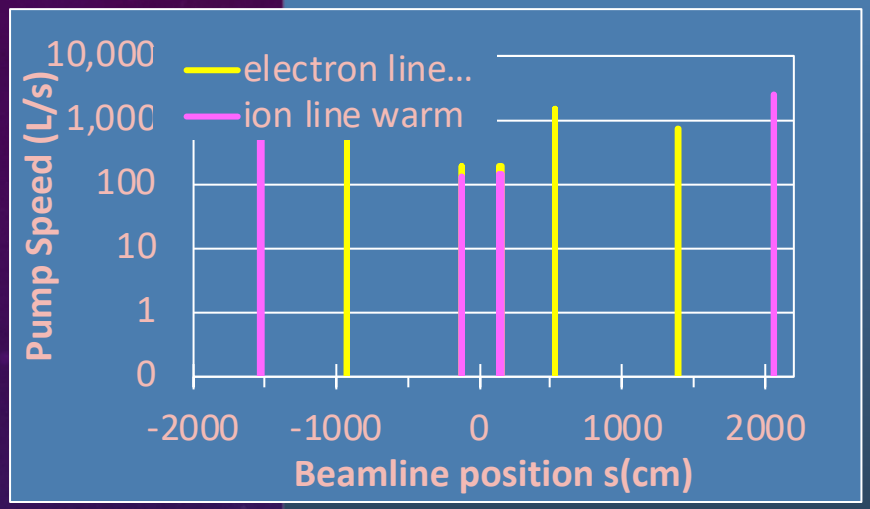
JLEIC INTERACTION REGION



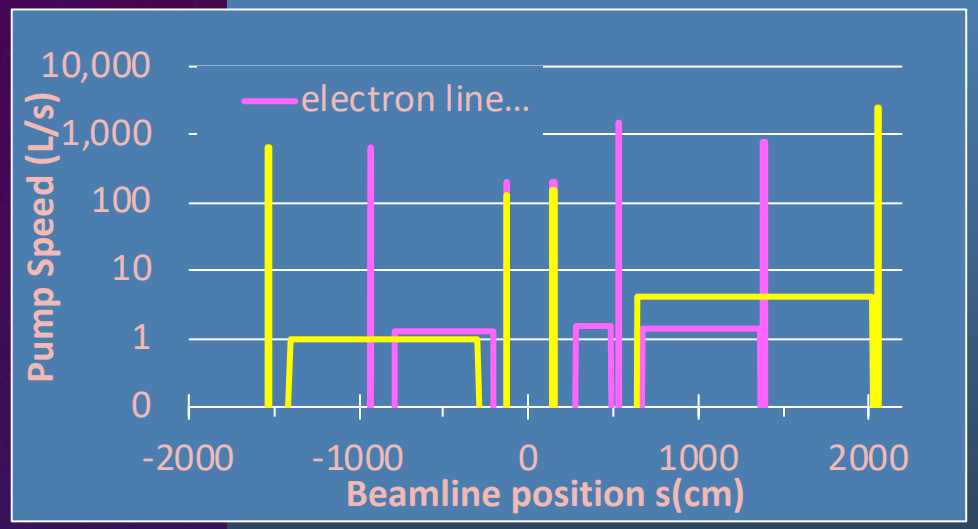
ISSUES UNDER STUDY

- Vacuum Studies:
  - Beam-Pipe, Pumping
- Beam Gas Interactions
- Synchrotron Radiation
  - Kilowatts of power generated by electron FFQ
    - Collimate upstream, Free passage through IR

JLEIC VACUUM PROFILE, MAGNETS AT 298 K



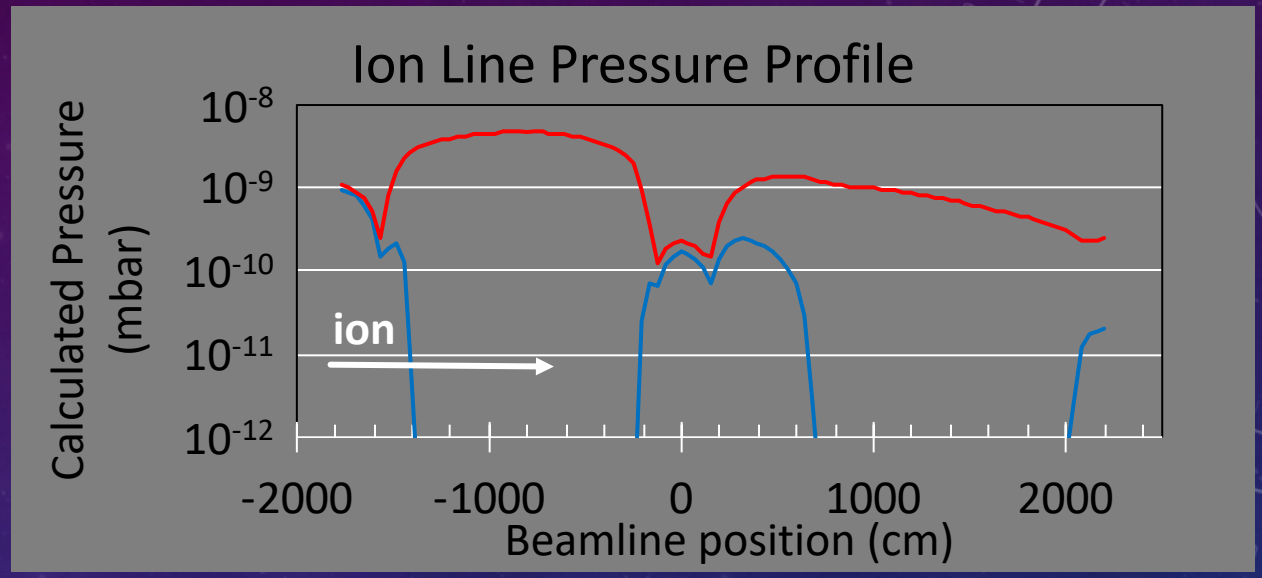
VACUUM PROFILE, MAGNETS AT 4 K

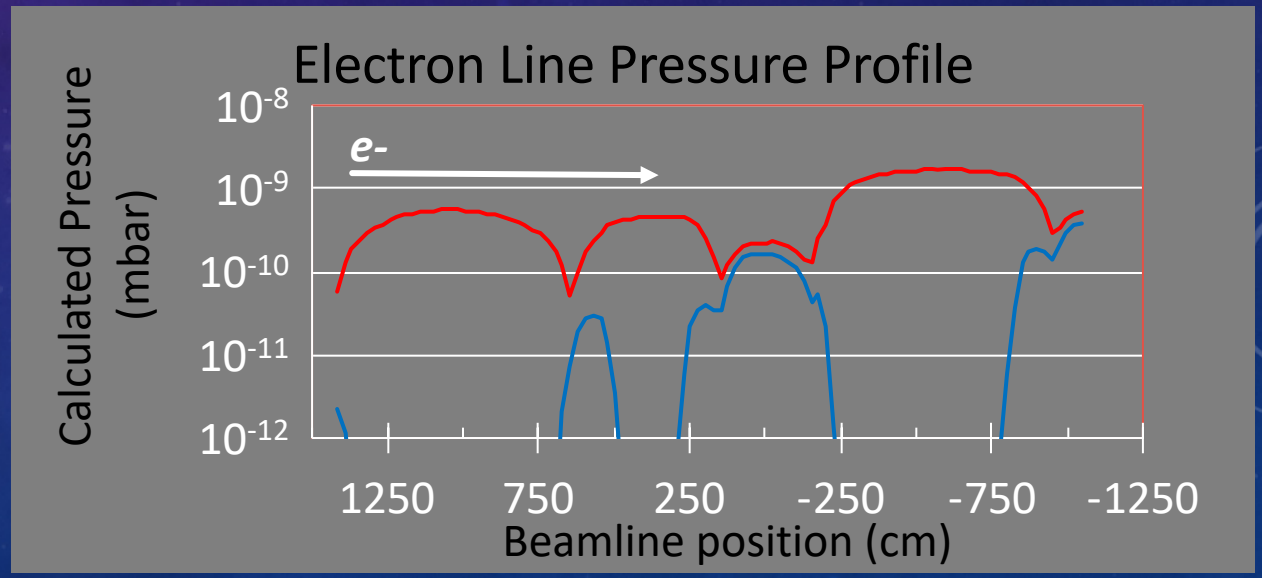


- Cryogenic transition: 293 to 4.5K
  - Approximated as 77 K
  - Sticking factor 0.01
- Cryogenic sections at 4.5K
  - Outgassing rate ~ 0
  - Sticking factor ~ 0.1 (underestimate)

VACUUM PROFILES

- Red: Magnets 298 K
- Blue: cold bore magnets (4 K).
- Realistic vacuum studies complete with Molflow
  - Required NEG pumping speeds identified
  - To do: Engineering design of NEG pumping



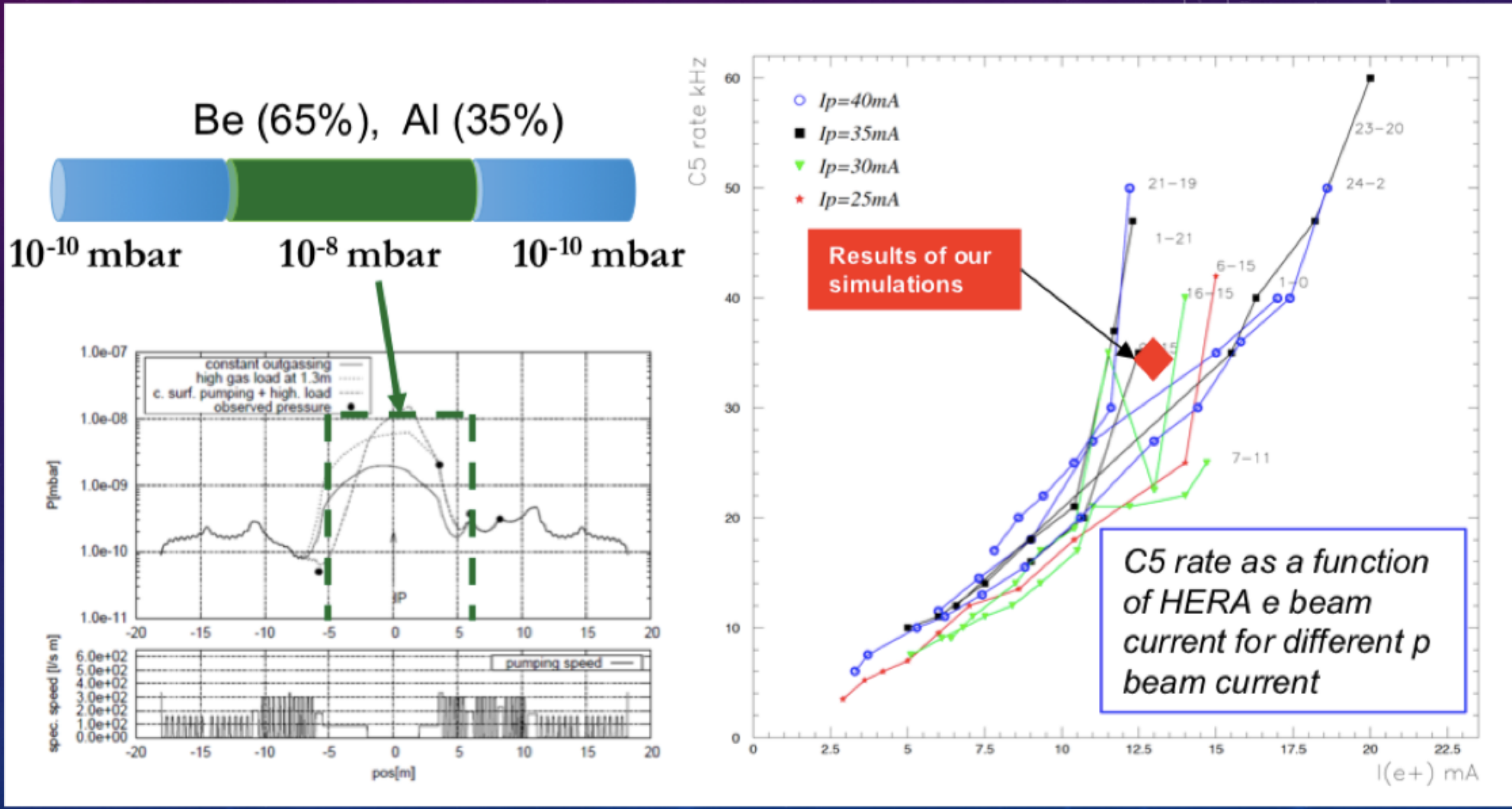


BEAM GAS INTERACTIONS

- Local studies completed to-date, and calibrated against HERA-II data
  - Vacuum in IR region only (±1.5 m upstream of IP)
    - This is the dominant vacuum “bulge”
    - Rates much less than HERA
- In Process:
  - Extend to entire ion straight section upstream of IP
    - Include upstream iron yoke of Detector solenoid.
    - Far upstream small angle scattered particles can make it into central detector.
  - Pavel Degtiarenko & Vitaly Baturin starting on FLUKA simulations of “neutron gas”
    - P. Degtiarenko previously completed site radiation hazard study for 2014 JLEIC design.

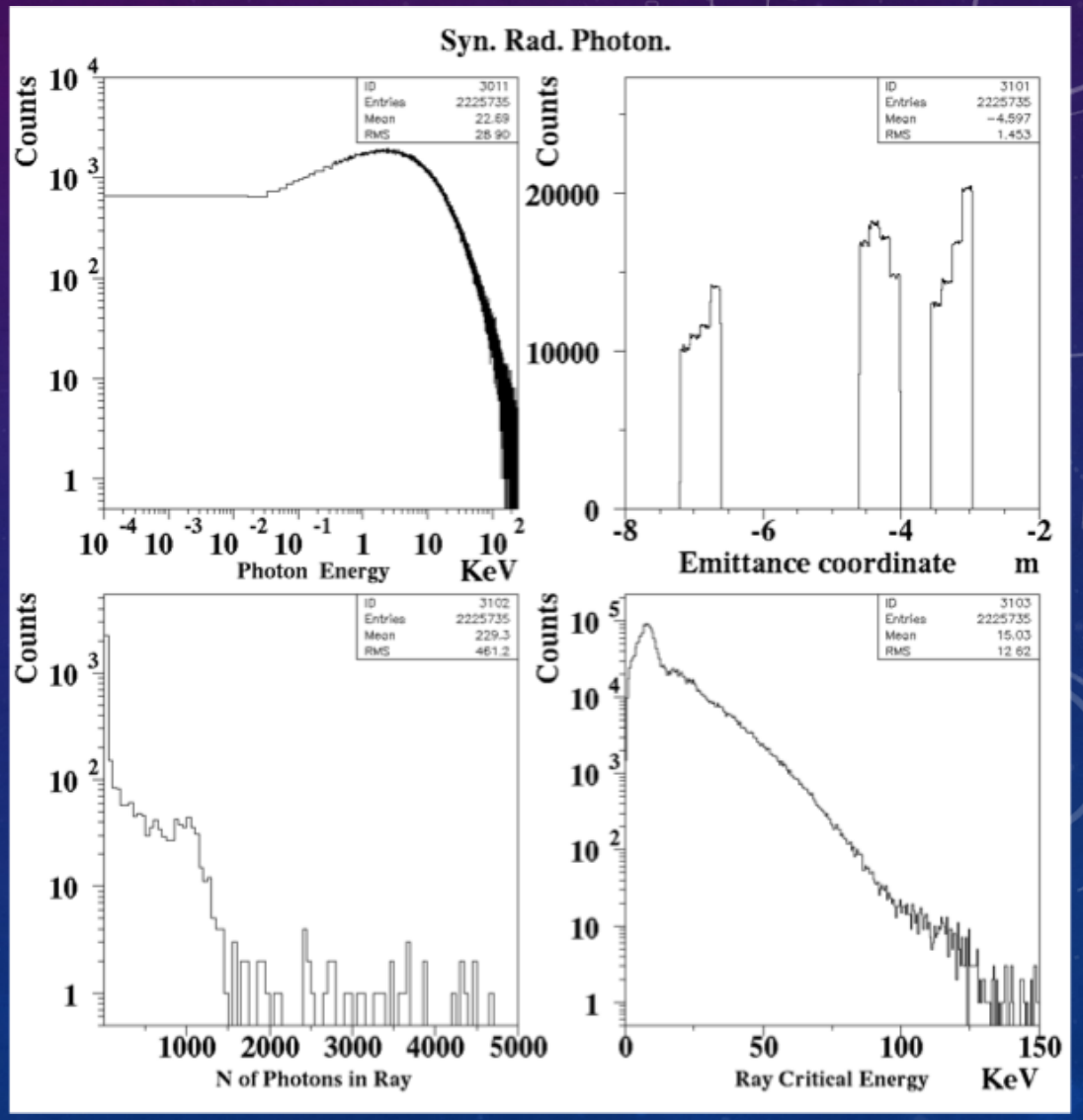
HERA-II COMPARISON

- Initial HERA-II vacuum degraded by synchrotron radiation
- EIC Vacuum ~100x lower at IP



SYNCHROTRON RADIATION FLUX FROM FFQ

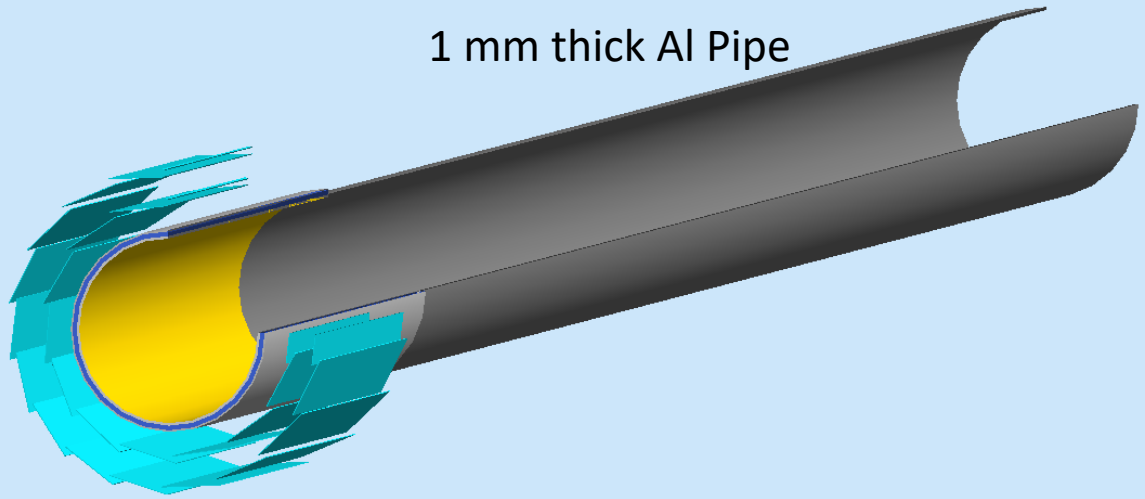
- Synrad code (M. Sullivan) ported from SLAC to Jlab.
  - Semi analytic generation of synchrotron raditation flux
  - Synchrotron radiation per 10^{10} electrons (including beam tail modelled from PEP-II experience).
  - Updating/improving user interface
- Post-processor generates “Lund file” of photons for input to GEANT4.



SYNCHROTRON RADIATION

- Photons passing 12mm radius Cu mask at *z=1*m input to GEANT4
  - 64 mW deposited into walls of central chamber
  - Occupancy in Si Vertex Tracker
  - 1.5 KW in zero degree Total Absorption Calorimeter at ~10 m

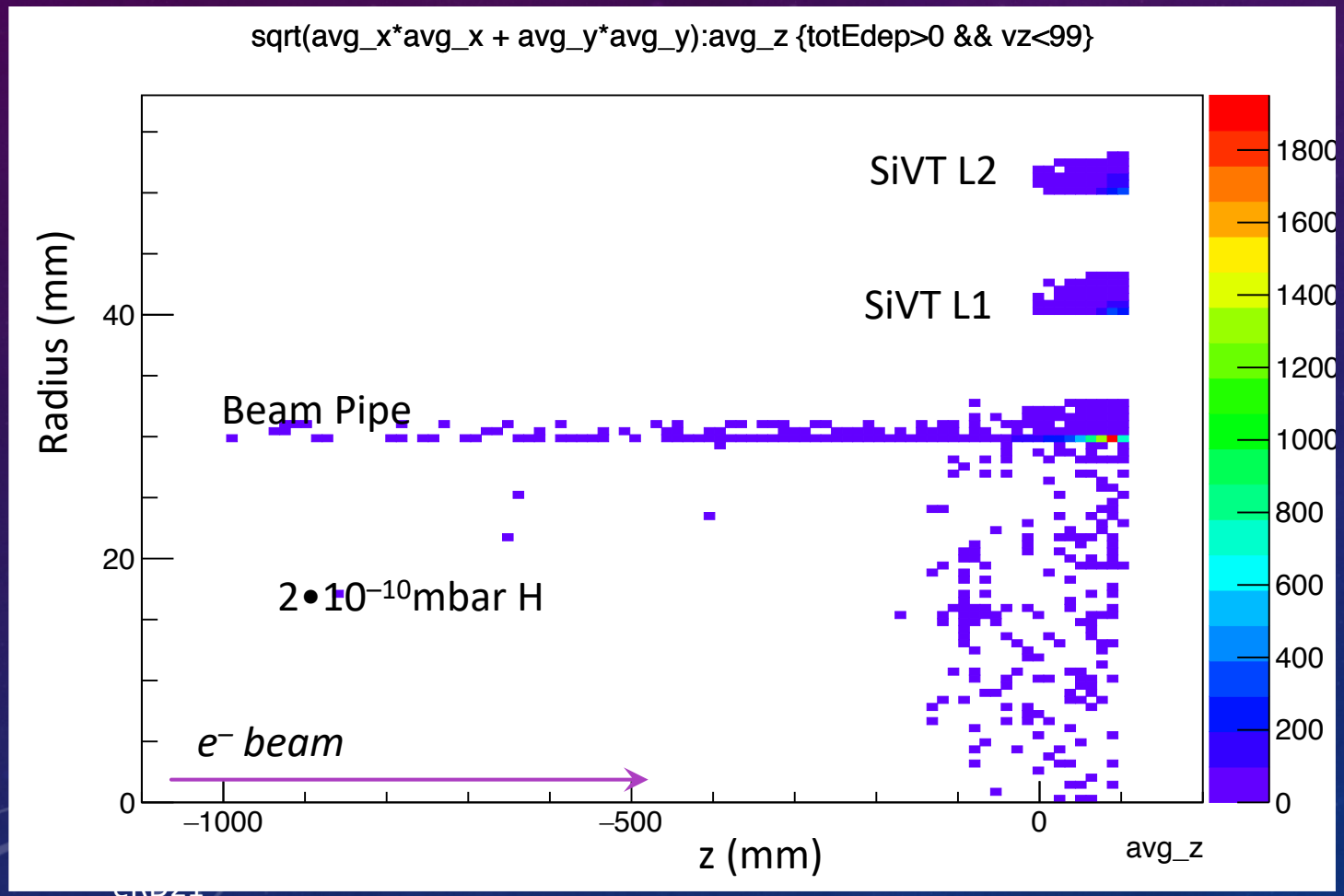
SR Photons Originate @ Pipe Entrance
(Exiting Mask at z = -1.00 m)

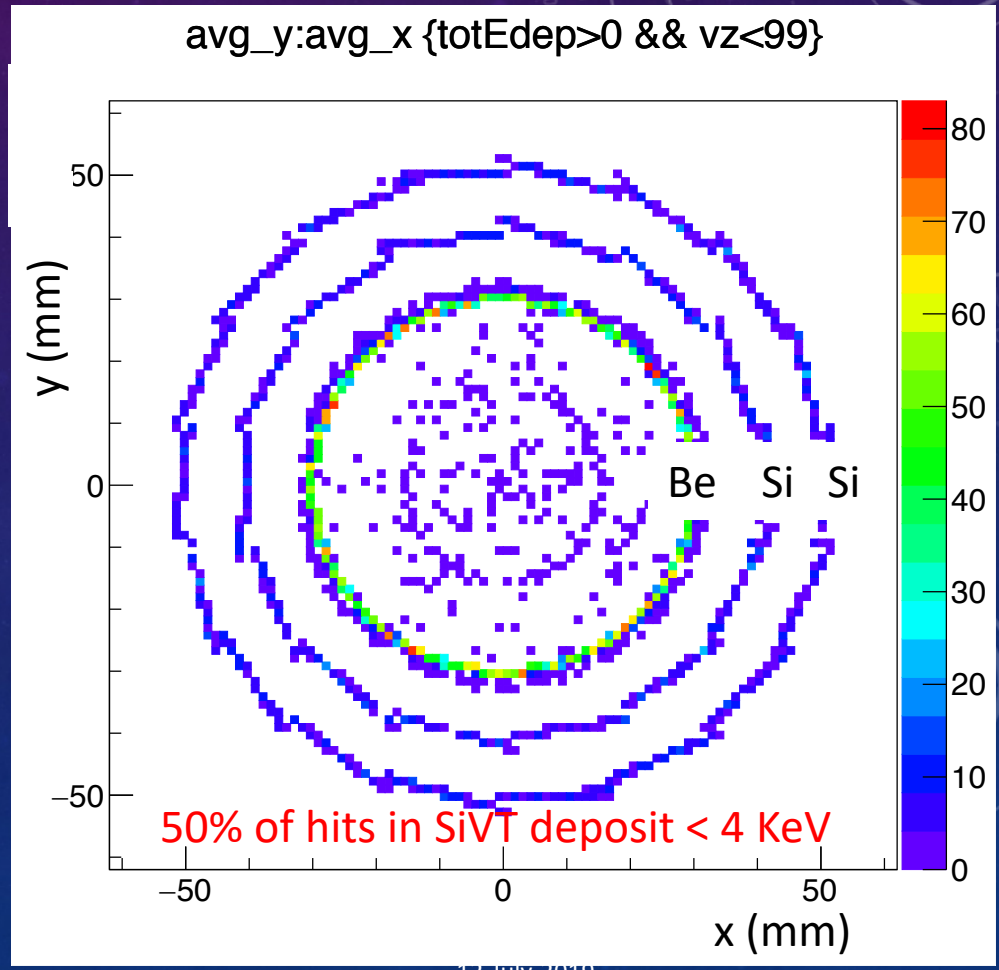


Central BeamPipe
|z|<10 cm
0.004 mm Au coating
0.83 mm Be
1.48 mm H_2O
0.53 mm Be

BEAM PIPE & SILICON VERTEX TRACKER: RAW HITS

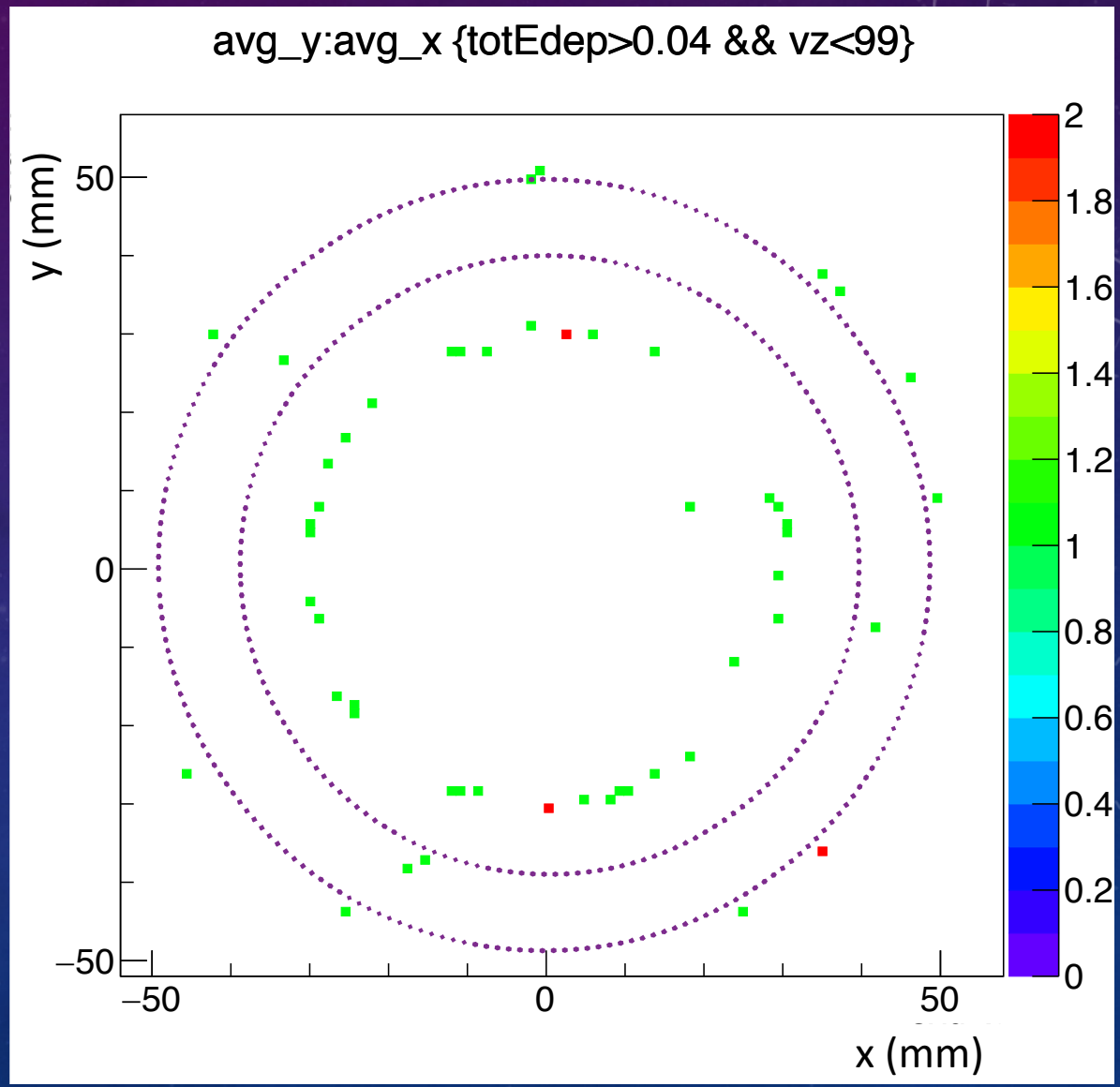
- X-Rays from $5 \bullet 10^{8}$ e^{-} *@ 10.5* GeV
- JLEIC: $5 \bullet 10^{9}$ e^{-} */nsec @ 10.5* GeV





BEAM PIPE & SVT: SYNCH RAD HITS ABOVE 40 KEV

- Dotted lines at SVT
- Actual hits higher:
  - Pileup of primary/secondary & multiple photons.
- Next Steps:
  - Compute energy deposition per cm^2 per sec.
  - Add disk SiVT and outer barrel
  - Include support materials of SiVT



CONCLUSIONS

- Work underway on several topics
- Contributions/collaborations welcome
- What are your specific questions about backgrounds that we can help you answer?