Coherent diffraction: RHIC experience for EIC

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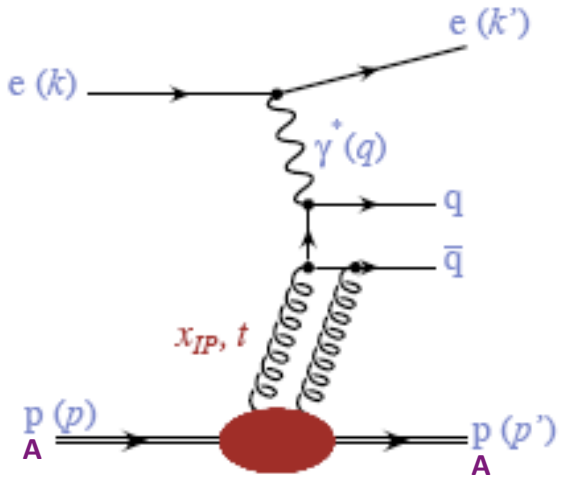
- Motivation
- Realization at RHIC
- Summary

Motivation

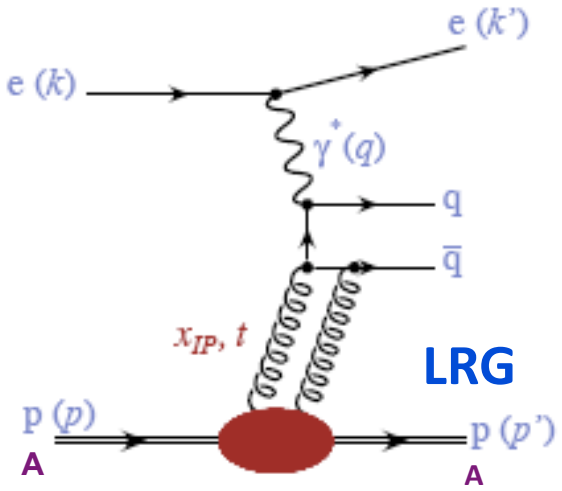
- Measurement of coherent diffraction in eA collisions is considered one of the golden measurements at EIC:

  eA→eVA or eA→eVA' - where V is a vector meson



Motivation

- Because of the small four momentum transfer (t) the kinematics of the interaction makes it is experimentally impossible to measure scattered nucleus A (for large A), as its scattering angle is too small to be distinguished from the beam particles.
- The only feasible method is to use a Large Rapidity Gap (LRG) technique, where one requires that there are no particles in the event except for e and V

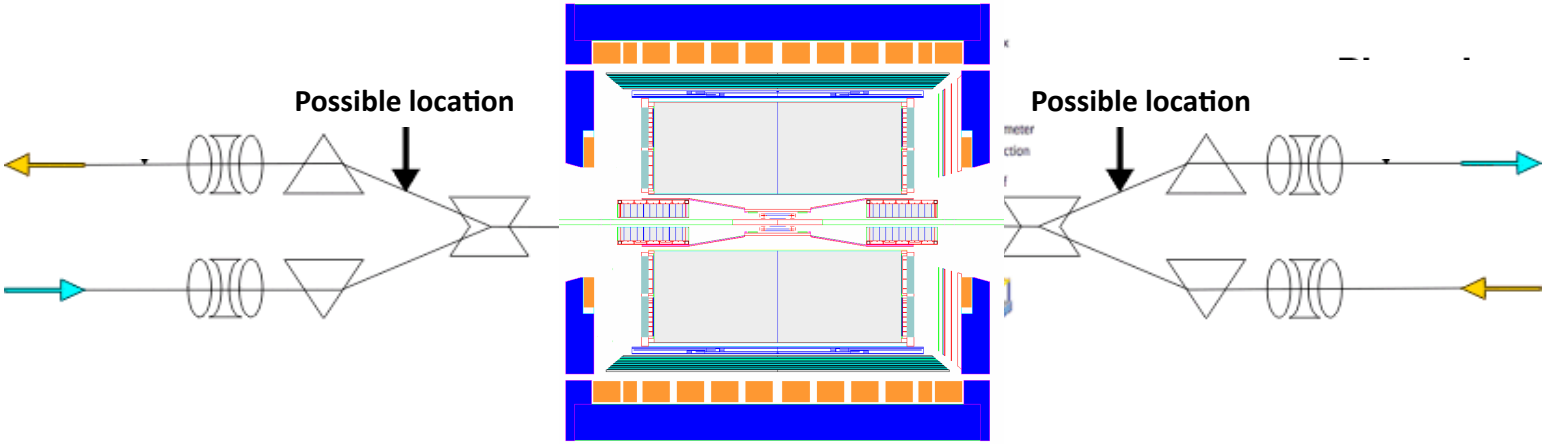


What can be done at RHIC

- Need to understand production of nuclear fragments in eA interaction focusing on the small-*t* processes where the ion A is intact or fragmented.
- Find benchmark measurements that can be done at RHIC with its heavy ion beams.
- Those benchmark measurements will guide the detector design at RHIC, which can be performed utilizing ultra peripheral collisions (UPC) of heavy ions.
- If the nucleus breaks up into several or many fragments in the collisions it may be possible to observe them with a detector system placed beyond the DX magnet.
- The most likely candidate is a Roman Pot system that needs to be tailored to answering the questions outlined in this proposal.
- Design, build and install a detector system at RHIC, which could allow for some results before the design of detectors and the collision area for the eRHIC facility is finalized.

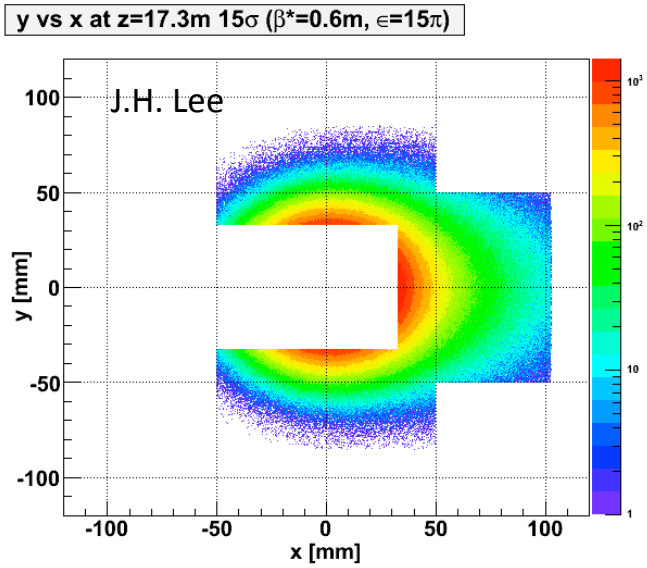
What can be done at RHIC – detector system

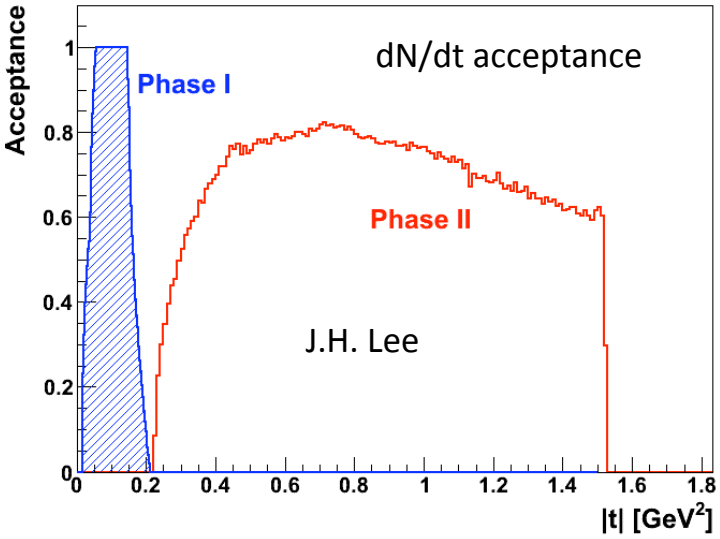
- Explore possibility whether a Roman Pot type device, similar to the one used in the pp2pp experiment at STAR, can be used effectively for that purpose.
- Roman Pot detector now installed at STAR has been used successfully in previous measurements in the pp2pp experiment at RHIC. Its design and interaction with the beam optics is well understood.
- This design needs to be adapted to satisfy the main criterion for the detector is to measure protons and charged fragments from fragmented ion.



What can be done at RHIC – upgrade setup at STAR

Geometrical and |t| acceptance of detectors at RHIC – 250 GeV/c protons





Summary

- Measuring exclusive reactions is very difficult for small |t| in eA case.
- One needs to use large rapidity gap (LRG) technique, and another object (vector meson) to constrain the reaction.
- AA collisions at RHIC are a great testing ground to develop techniques for this measurement
- There is interesting physics that can be done at RHIC while developing the methods
- The expertise exists at BNL to do this.

RHIC → eRHIC