Discussion for EIC EOI

Yongsun Kim
(Sejong University)

Korea EIC meeting
2020.09.14

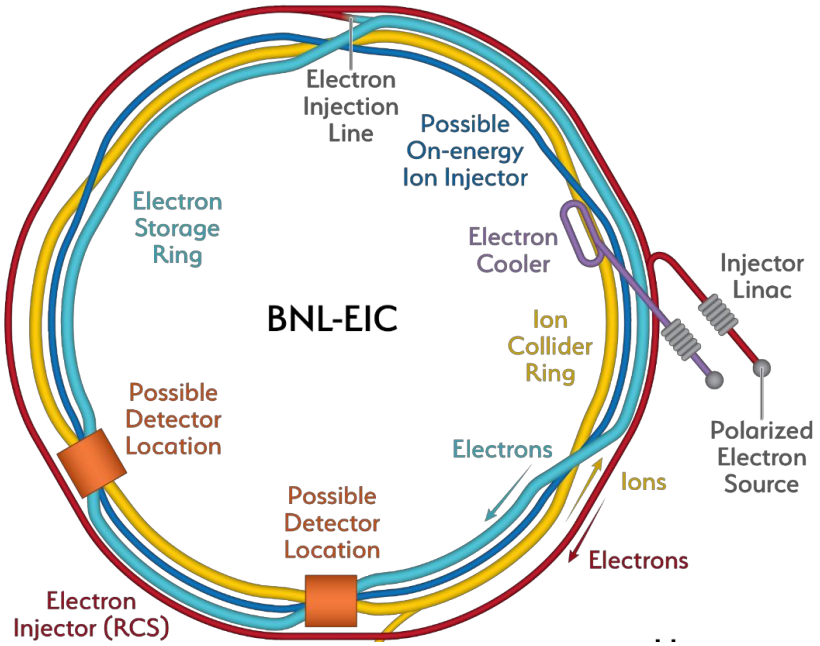
Overview of EIC

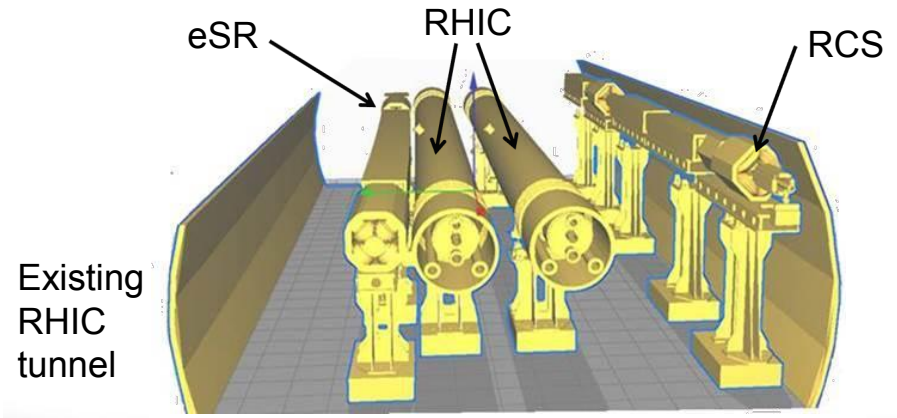
World's first collider for polarized e+p and e+A collicer

- High luminosity ~ 10^{34} $cm^{-2}s^{-1}$
- E_{cm} = up to ~100 GeV
- 2+ interaction points
- To be built at BNL in ~2030

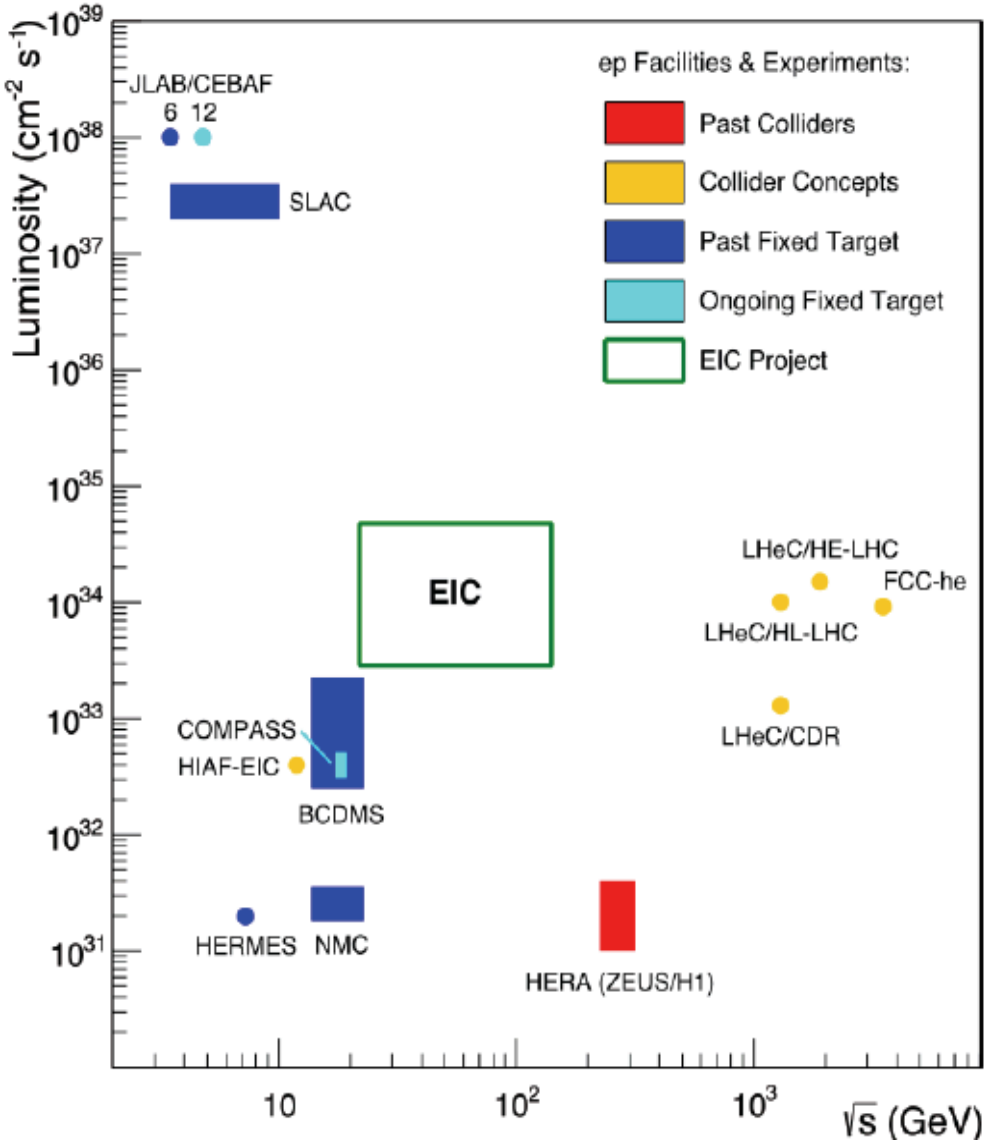
Rich physics programs

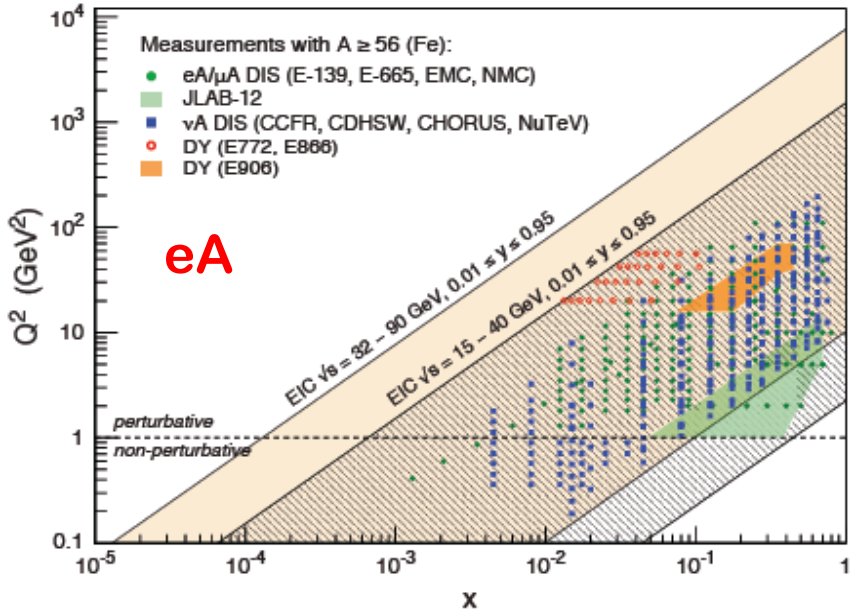
- 3-d tomography of p and A
- Baseline for QGP
- Origin of proton spin
- Test for mass

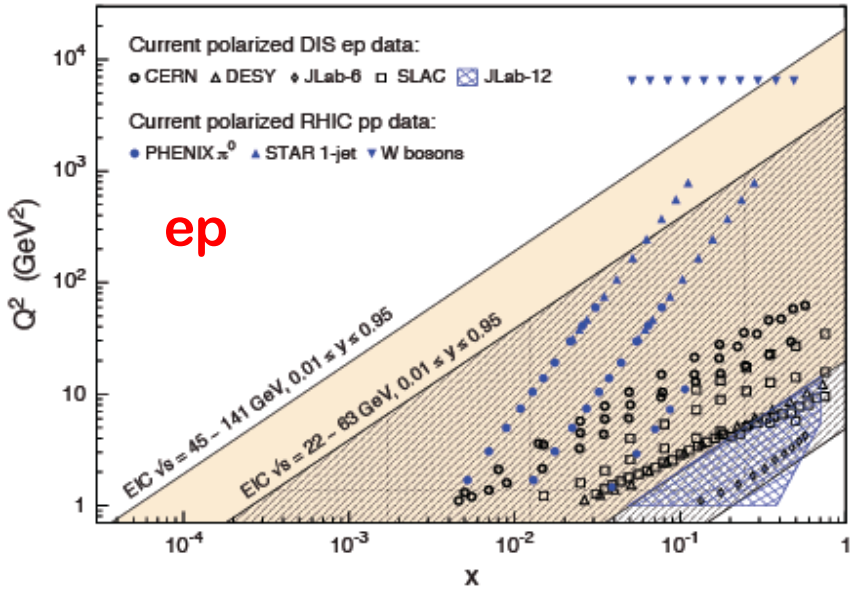




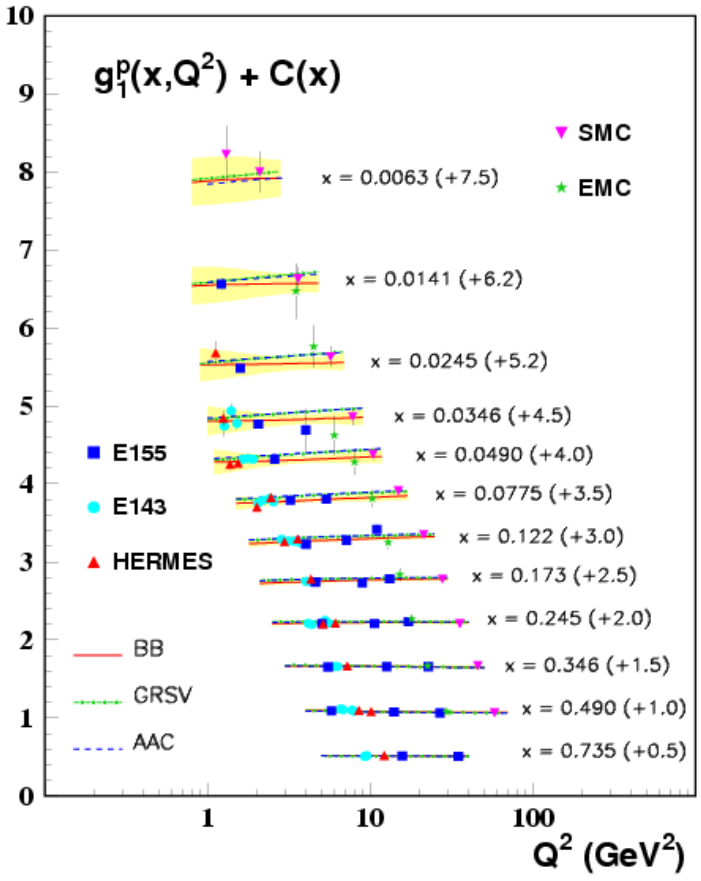
Deep(est) inelastic scattering



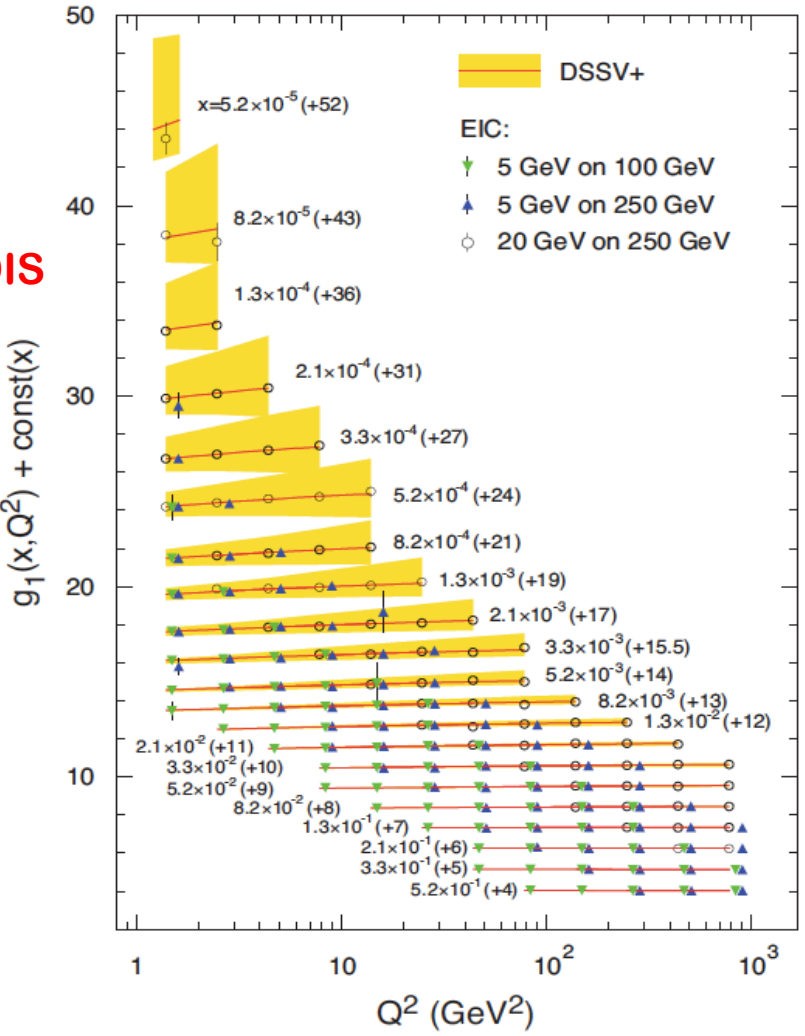




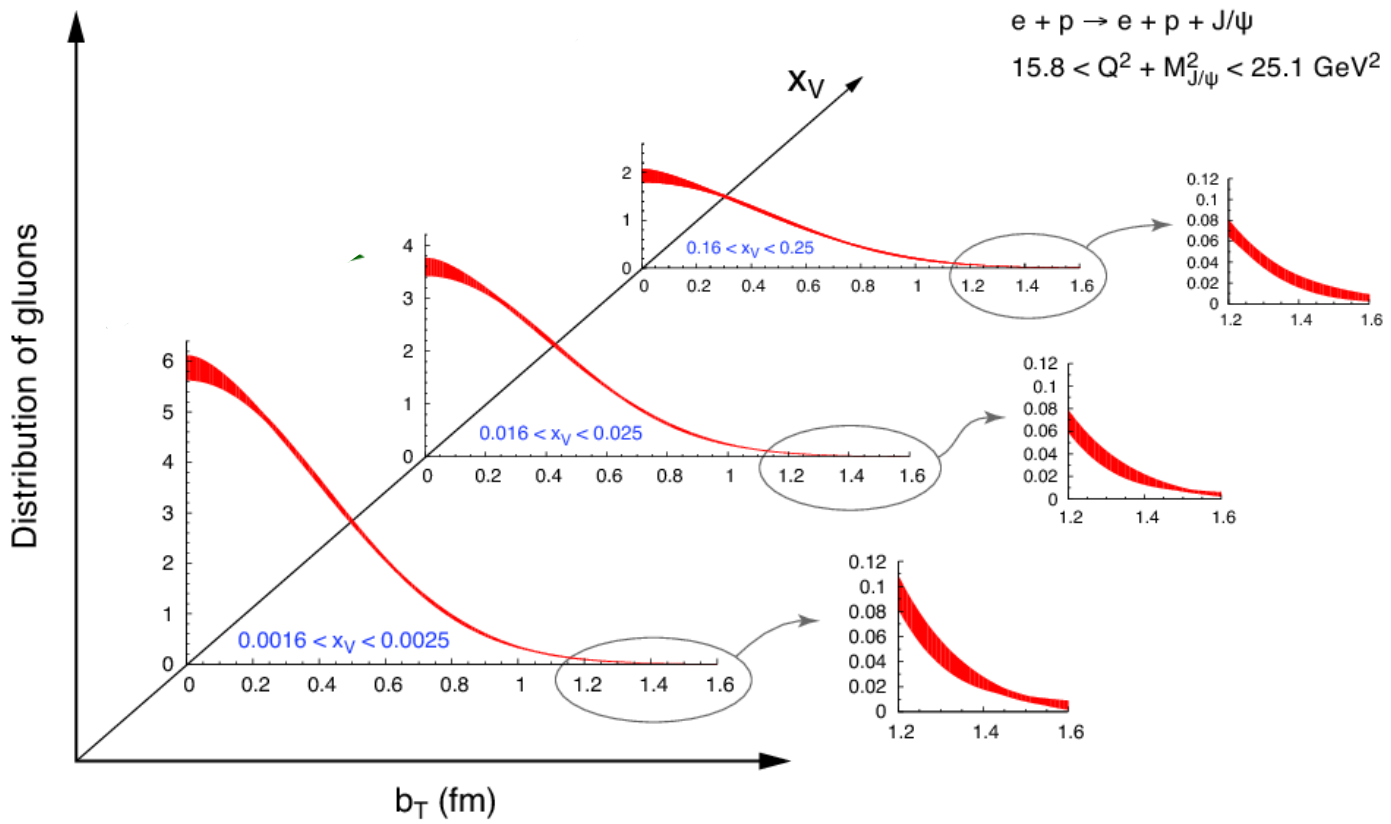
Unprecedented precision for proton spin structure



Polarized DIS at EIC

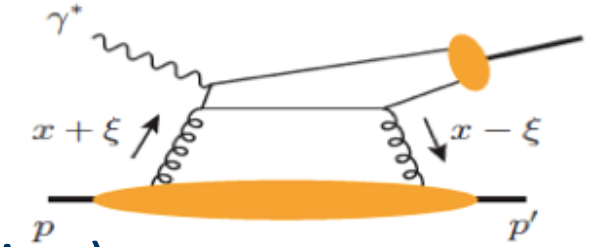


Tomography of nuclei



- GPD : generalized parton distribution
- Imaging gluons with 3 degrees-of -freedom
- Probed by mesons in DVCS(deeply virtual compton scattering)

Meson Production

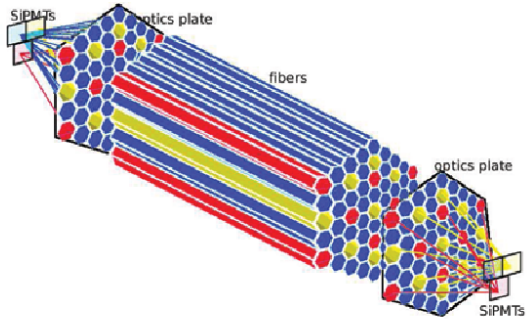


J/ψ, ϕ, ρ, etc.

Preparation for new experiments

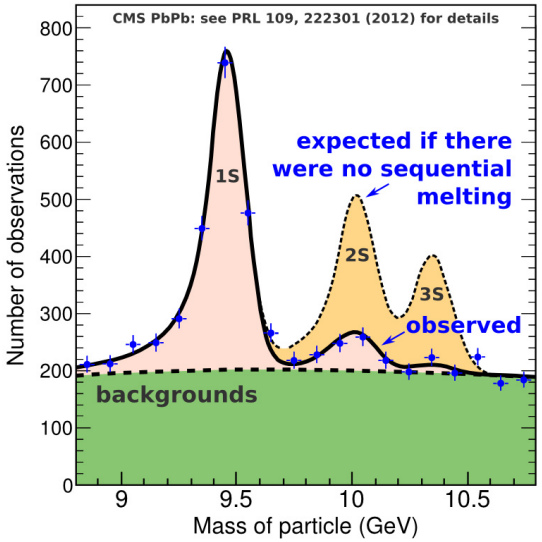
Example 1 : Dual-Readout team

- Future electron-positron colliders to be built at CERN and China
- R&D initiated by KNU and Yonsei U. now covers diverse groups
- Several LoIs for Snowmass



Example 2 : CMS RPC

- Longstanding project in KCMS
- Base for numerous muon-related papers from Korean HI group

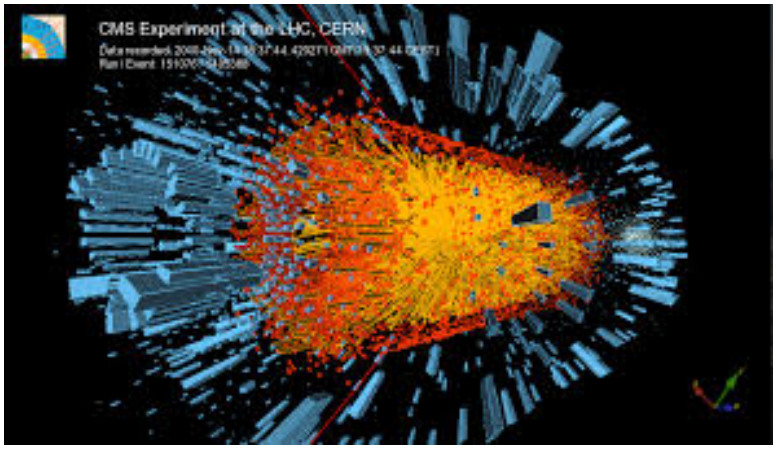


So, we need…

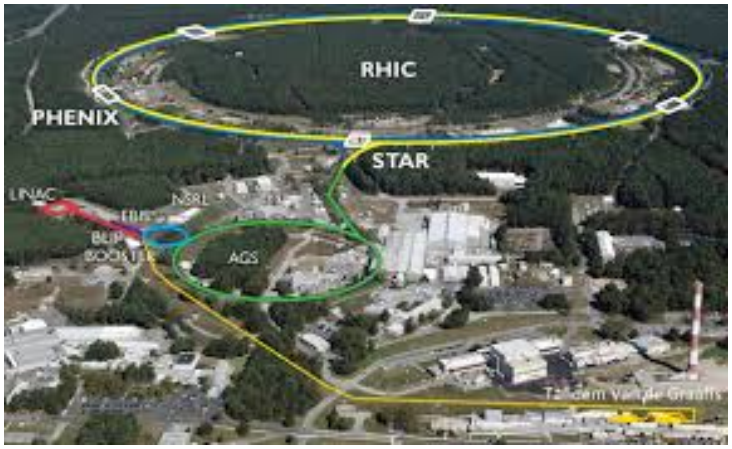
- Strong and clear motivation for epochal discovery
- Hardware R&D plan as the seed for the big umbrella for our division
- It is time

Nuclear experiments associated with K-physicists

LHC – QGP (high-E)

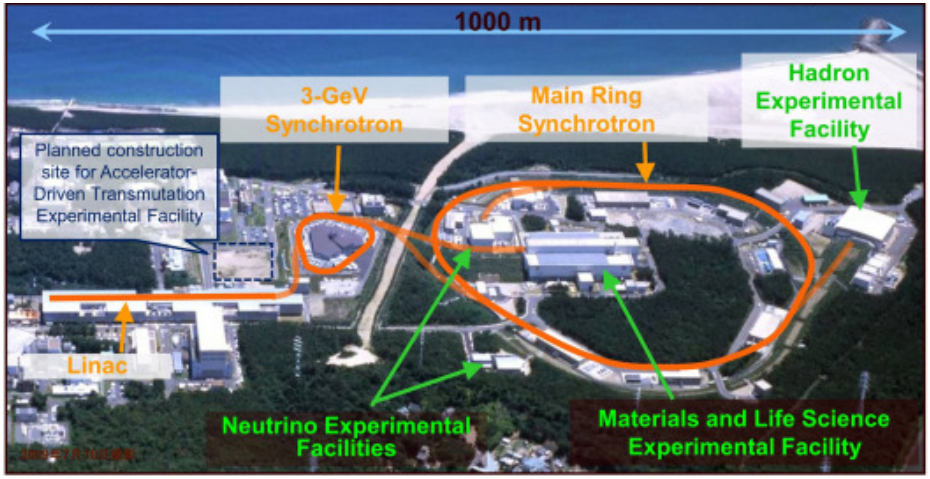


RHIC – QGP (low-E) , spin



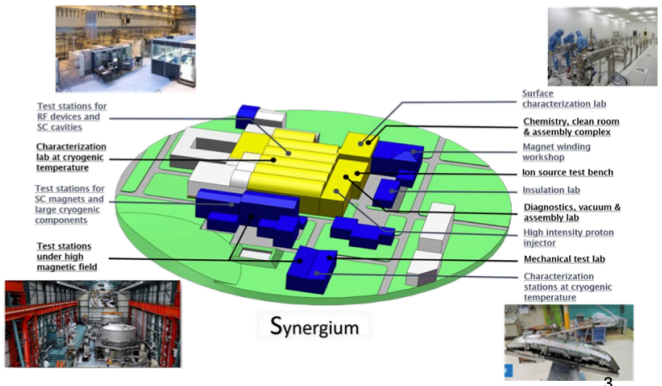
JLab – GPD, TMD

J-PARC – hadron physics



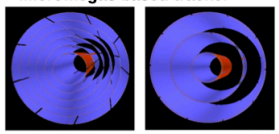
Example: CEA-Saclay

ACCELERATOR AND MAGNETS TECHNOLOGICAL INFRASTRUCTURES (25 000 M²)



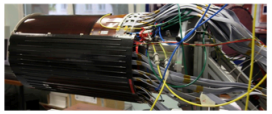
CENTRAL REGION

Micromegas based tracker

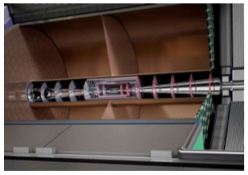


6 equidistant layers — 6 layers arranged as 3×2

- Compact design and low material budget: about 0.3%X0 per layer
- Good resolutions: spatial ~100µm, time ~40 ns
- Curved MM technology already used in CLAS12 and ASACUSA
- Ongoing R&D on readout patterns (M.Revolle)
- Preliminary geometries discussed within YR tracking meetings (Q. Huang)



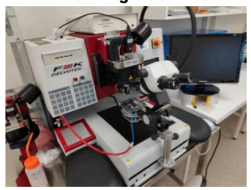
MM based TPC readout



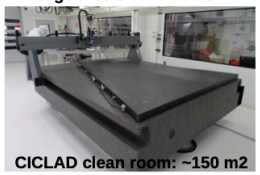
- EIC TPC will require good dE/dX resolution and minimum material budget in the endcaps
- MM provide similar performances as GEM, with less material
- IRFU's experience in TPCs for ILC, T2K, Minos, FCC
- Ongoing R&D for a very low IBF and with a good energy resolution (A. Glaenzer)

(SOME OF THE) ELECTRONICS AND DETECTOR FACILITIES

Wire-bonding machines

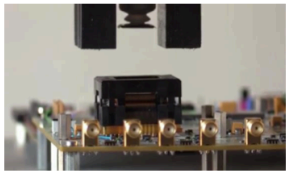


Large area clean rooms



CICLAD clean room: ~150 m2

Robotized test bench for ASIC



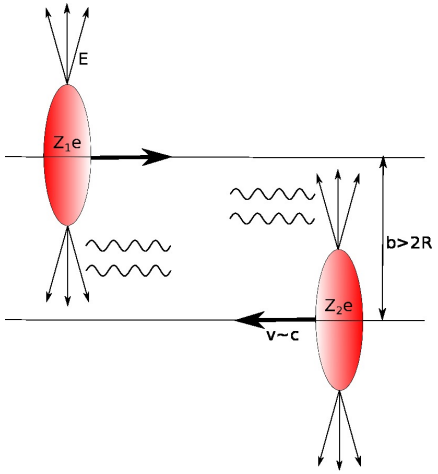
MPGD workshop

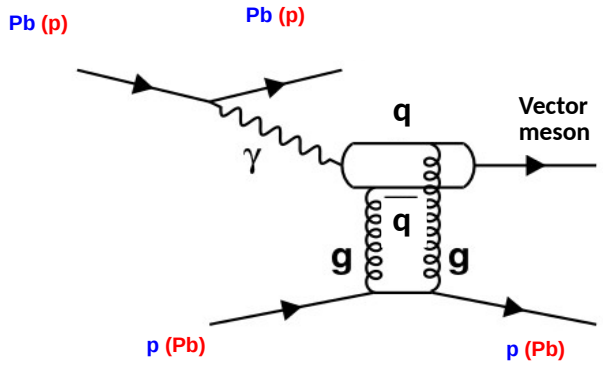
SUMMARY

- The EIC project is in the CEA/Irfu roadmap
- Involvement in YR report activities (physics, tracking and electronics), in LDRD programs and eRD6 recently joined
- Broad interest in many areas:
  - Magnets and accelerator elements
  - Tracking and timing detectors
  - ASICs and readout electronics
- Large facilities at Saclay for magnets and detectors production
- Interest in participation to whole systems development: detectors together with the readout electronics
- Open to collaborate in international consortia

EOI presentations : https://indico.bnl.gov/event/7352/timetable

Ultra-peripheral collision (UPC)





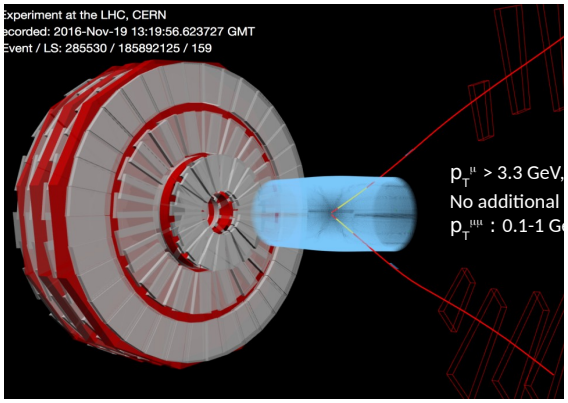
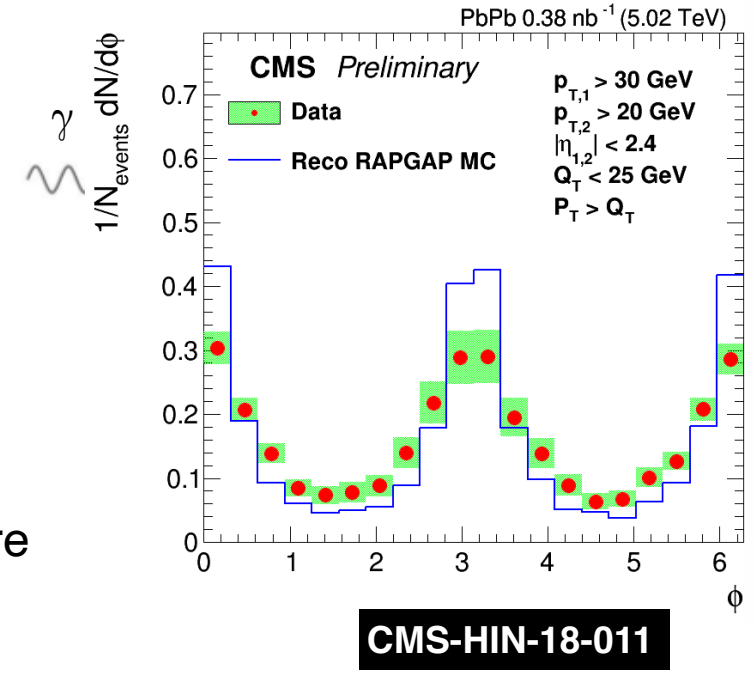


Photo-production of VM, photon and dijet

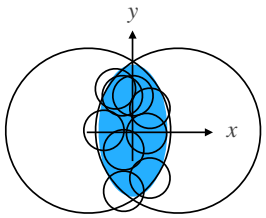
- Most probes go forward
- Can be directly extended in the EIC
- Need trackers and calorimeters with high resolution and granularity
- Useful for spin physics as well
- International network established for hardware development and analysis



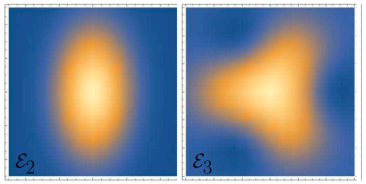
CMS-HIN-18-011

Other interesting HI observables

Collective moment of particles in A+A, p+A and p+p



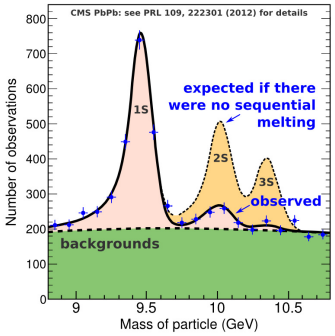
Initial geometry

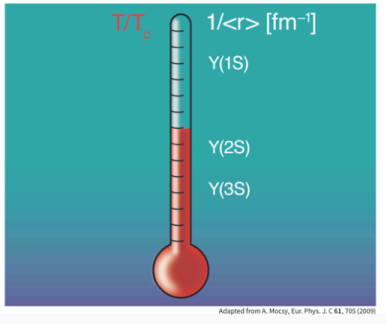


v_2 v_3

What is the collective motion in the very small system in e+A?

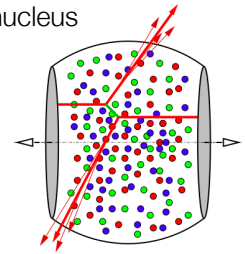
Disassociation of quarkonia by deconfined system

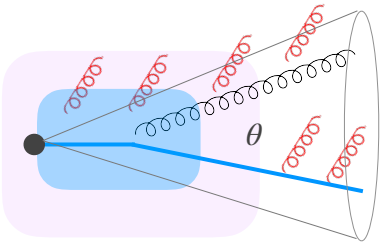




Nuclear modification by cold nuclear matter

Jet quenching





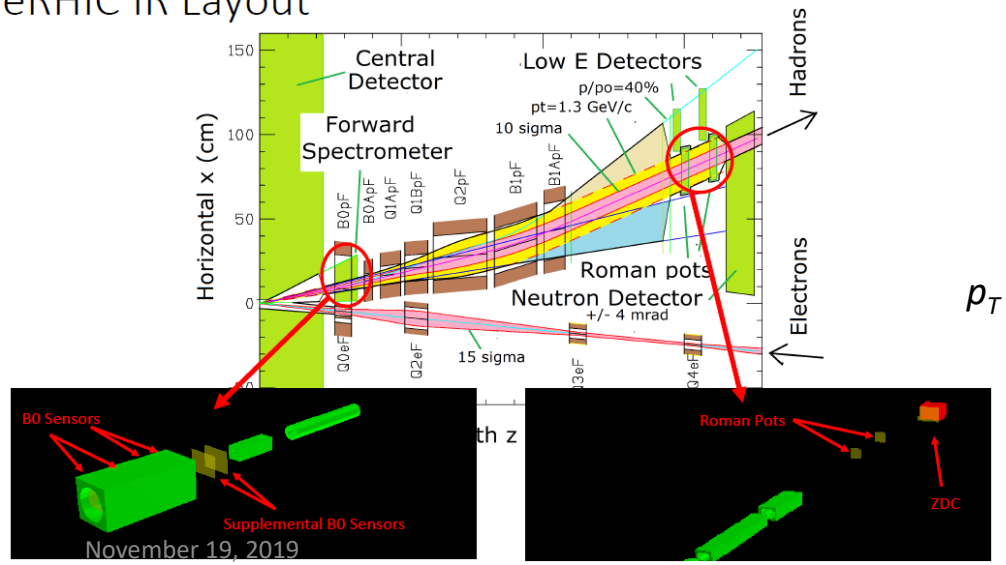
Energy loss and modification of constituent of jet by cold nuclear matter

Proton spectrometer studiedy by RIKEN

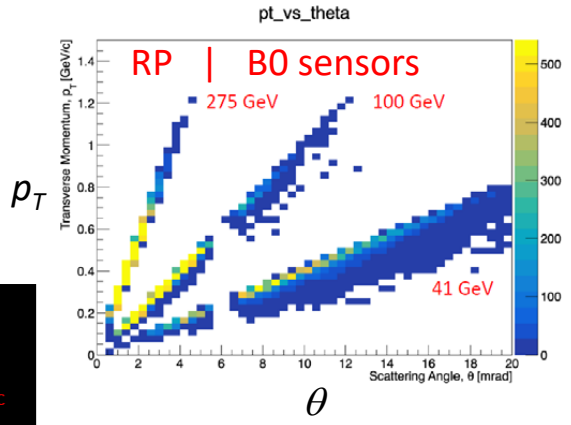
- GPD measurement
  - Normalization (low p_T or $|t|$ coverage)
  - Slope and shape (high p_T or $|t|$ coverage)
- Veto of nuclear breakup events in e+A
  - for proton detection, with ZDC for neutron detection
- Isotope tagging
  - with particle ID
- B0 sensors and Roman pots at eRHIC
  - ± 1.3 GeV/c p_T for 275 GeV proton (Roman pot)

Taken from Goto's slides

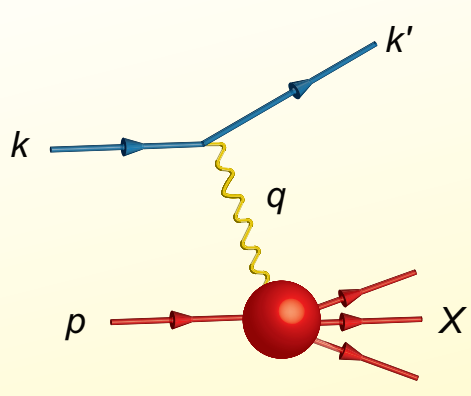
eRHIC IR Layout

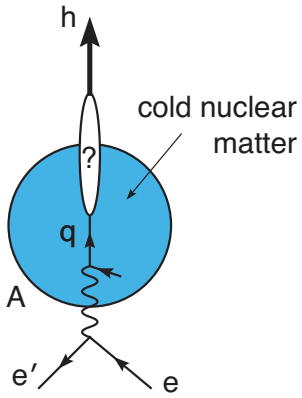


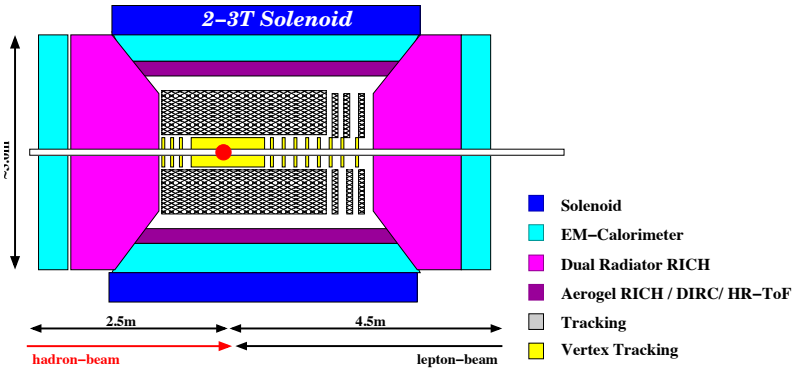
shown by Jentsch



Summary







- EIC is a great opportunity for new physics in our division
  - Can be connected to (most of) your research areas
- EoI to be inclusive and abstract (yet must be clear!)
- Contribution for hardware development in any scope is essential
- Forward calorimeter is chosen as a candidate among heavy ion colleagues
- We are in a good position to consider Dual-Readout technology
- Deadline is Nov. 1st
- Any input will be very useful

Round table discussion

Expression of Interest 준비

- Physics interest 및 hardware 전문성 조사
- Calorimeter, tracker and what else?

장기적이고 조직적인 EIC 준비

- 관련 모든 실험이 함께 할 수 있는 빅텐트 구상
  - QGP, spin, hadron, weak running coupling, etc
- 검출기 R&D에 필요한 예산 확보
  - 한-CERN 사업과 유사한 조직의 구성