Poster #324

Studying high-density baryonic matter at J-PARC Heavy-Ion Project

Hiroyuki Sako (JAEA / U. Tsukuba) for J-PARC-HI Collaboration

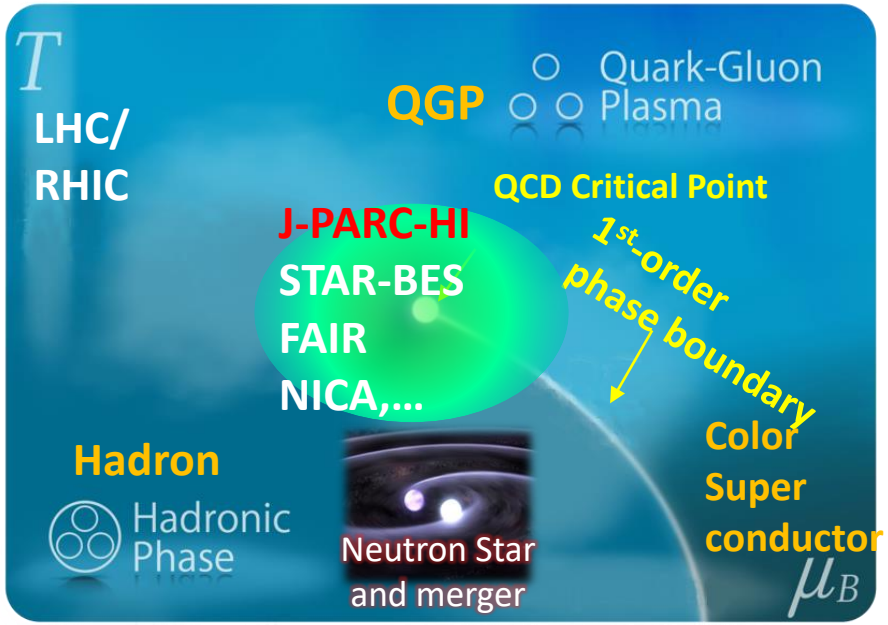
Goals of J-PARC-HI (I)

Exploring dense matter

- Search for QCD Phase structures
  - 1st order phase transition, QCD Critical Point, Color superconductor
  - Event-by-event fluctations, dileptons
- Properties of dense matter
  - Maximum density, EOS, transport properties (viscosity), etc.
  - Flow

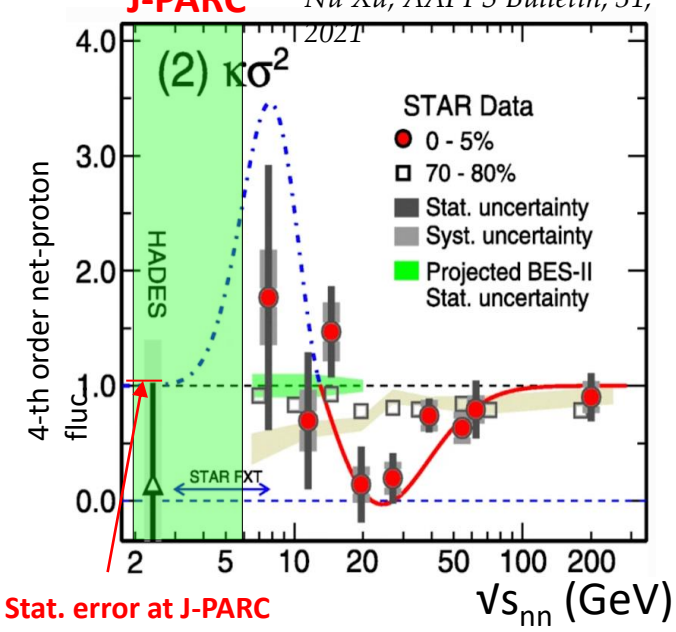
  → Studies of neutron stars
- Chiral symmetry restoration
  - Medium modification of vector mesons
  - Dileptons

QCD Phase diagram



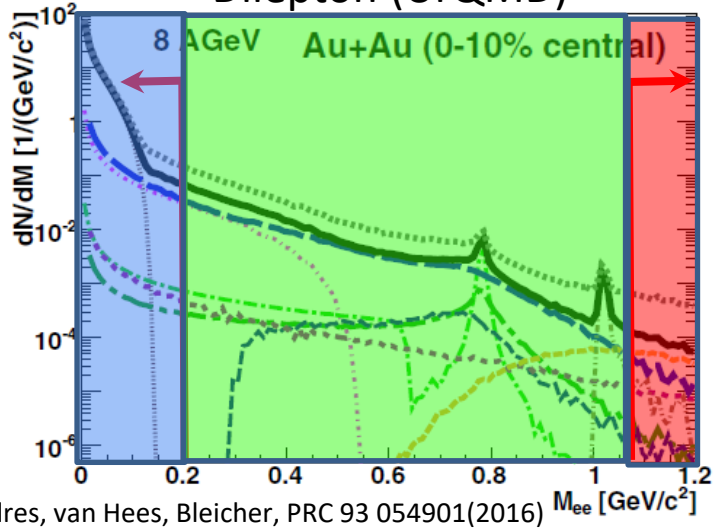
J-PARC

Nu Xu, AAPPS Bulletin, 31, 2021



Stat. error at J-PARC

Dilepton (UrQMD)



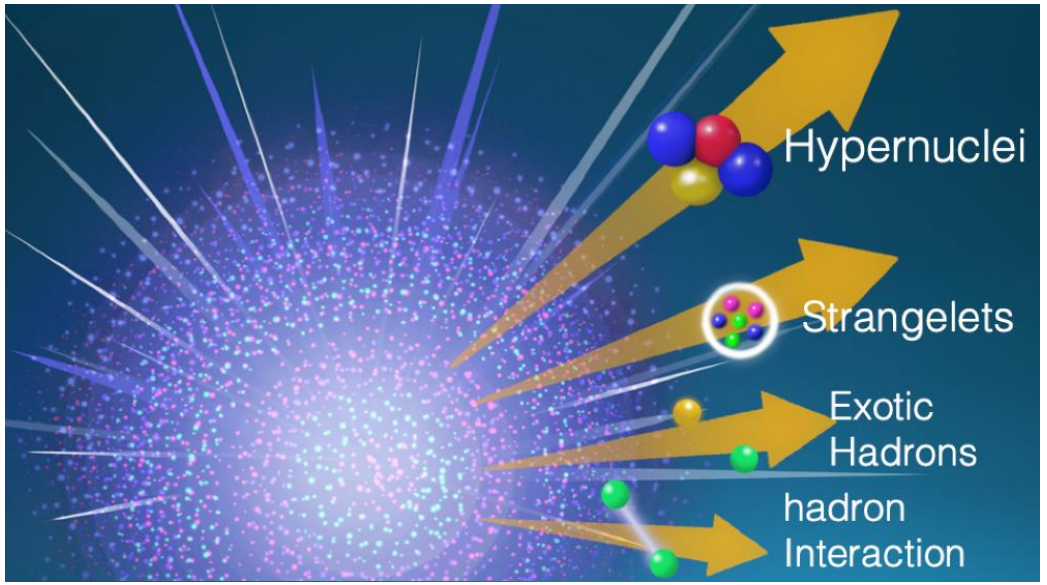
Endres, van Hees, Bleicher, PRC 93 054901(2016)

Goals of J-PARC-HI (II)

Studies of multi-strangeness production

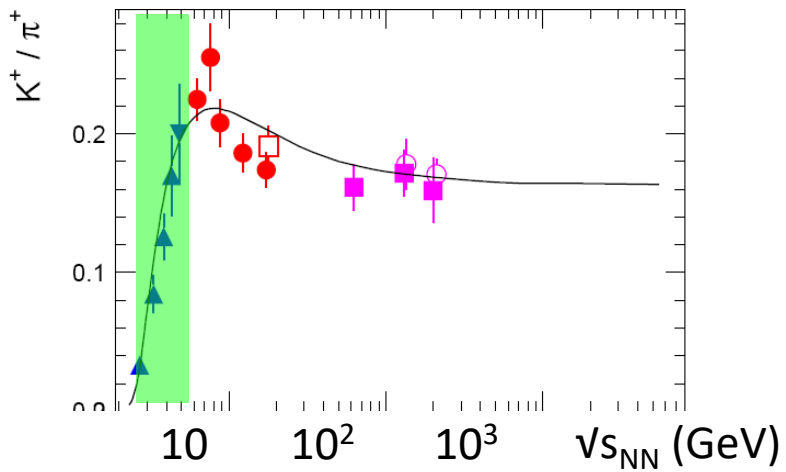
- Efficient production of strangeness at J-PARC
- Search for rare multi-strangeness systems
  - Hypernuclei, strangelet, dibaryons, etc.
- Study of hyperon interactions
  - Femtoscopy

→EOS of strange hadronic/quark matter



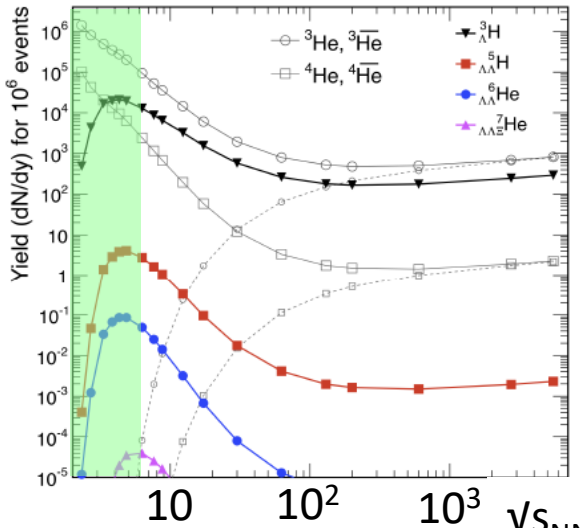
Hypernuclei

J-PARC-HI



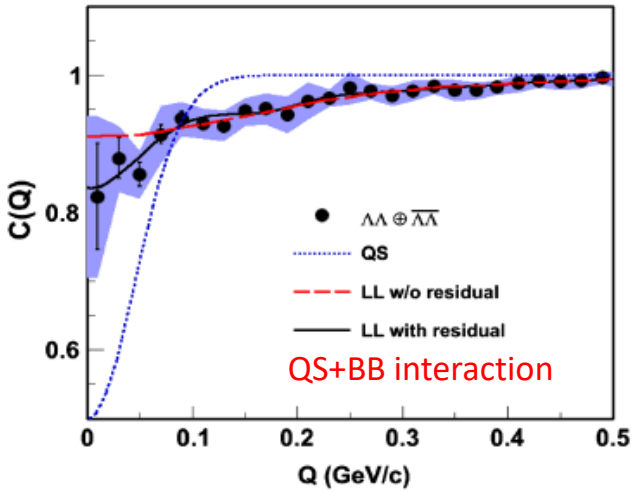
A. Andronic, et al, Nucl. Phys. A 837 (2010) 65

J-PARC-HI



A. Andronic, PLB697 (2011) 203

ΛΛ correlation function



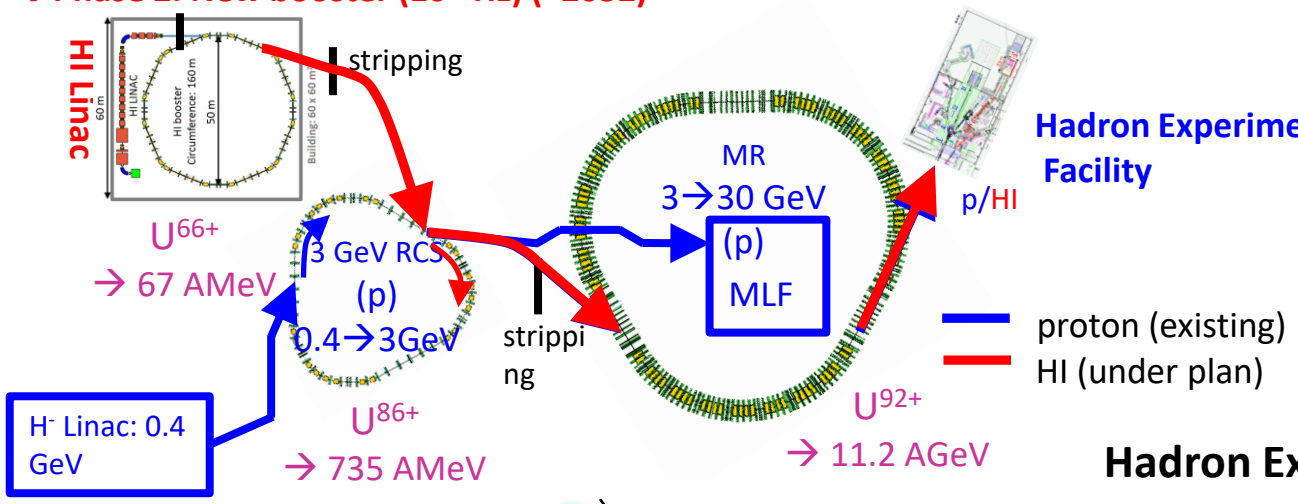
STAR, PRL114 (2015) 022301

Accelerators and experiments for J-PARC-HI

HI Booster Ring

Phase 1: KEK-PS booster (10^8Hz) (~2026)

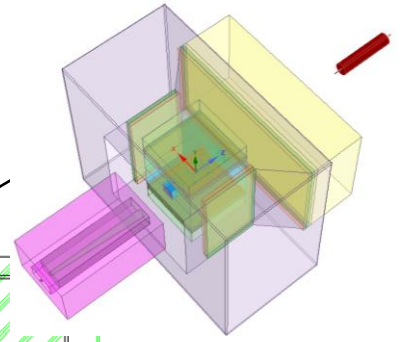
→Phase 2: New booster (10^{11}Hz) (~2032)

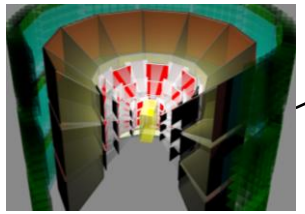


- HI beam rate ~10^{11} Hz (World's highest intensity beam)
- E_{lab} (U) = 1-12 AGeV
- $\sqrt{s_{NN}}$ (U) = 1.9-4.9 GeV

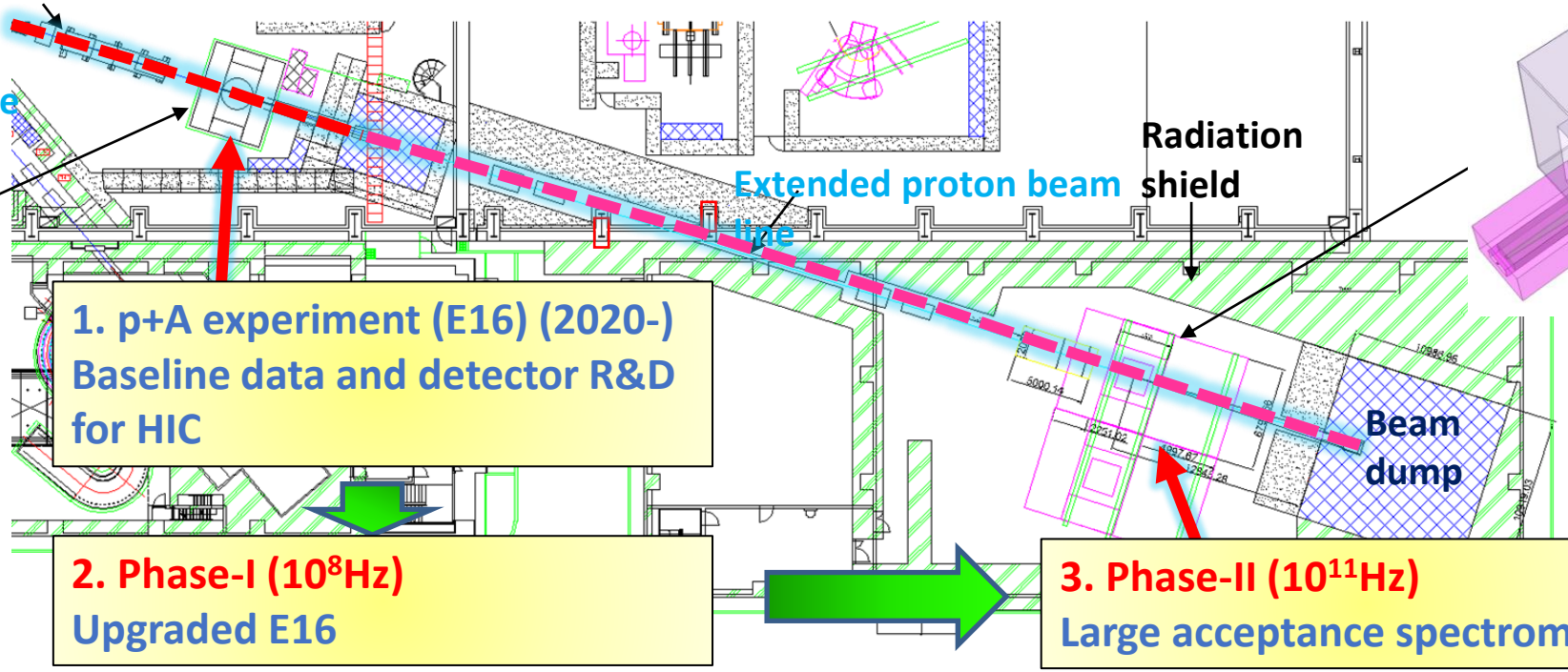
Hadron Experimental Facility

J-PARC-HI spectrometer

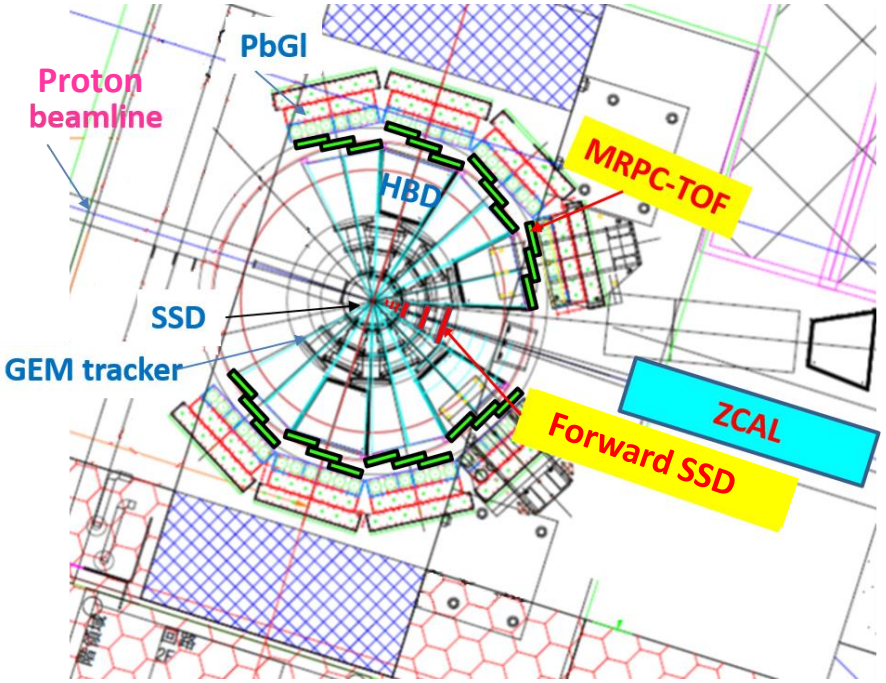


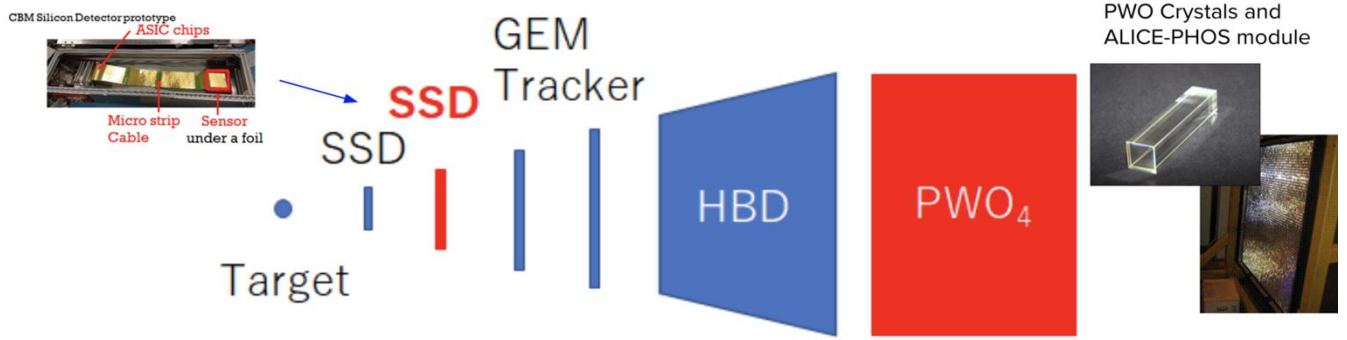


E16 spectrometer



Di-electron measurement at Phase I

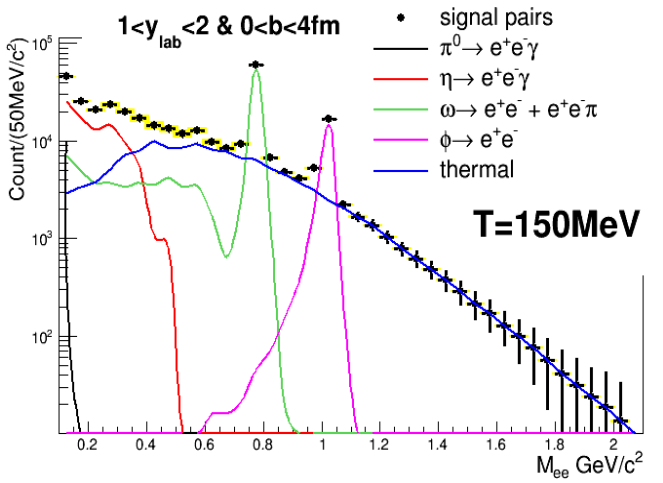


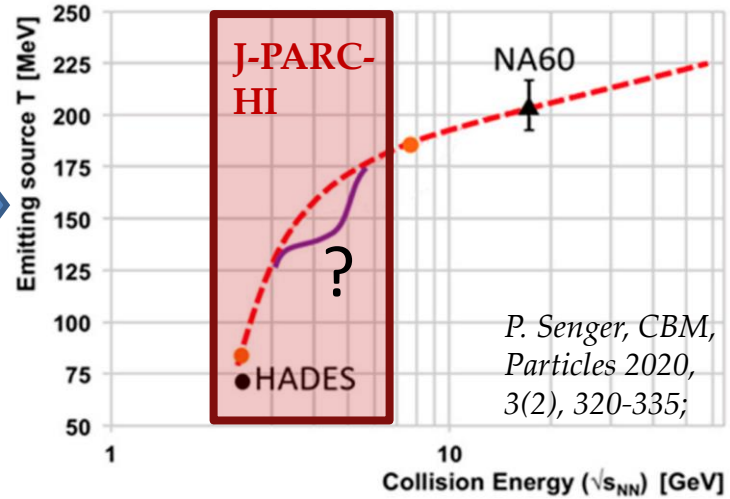


Upgraded E16 spectrometer (p+A) for HIC

- Forward trackers
- EM calorimeter: PbGl→PWO_4
- Zero degree calorimeter

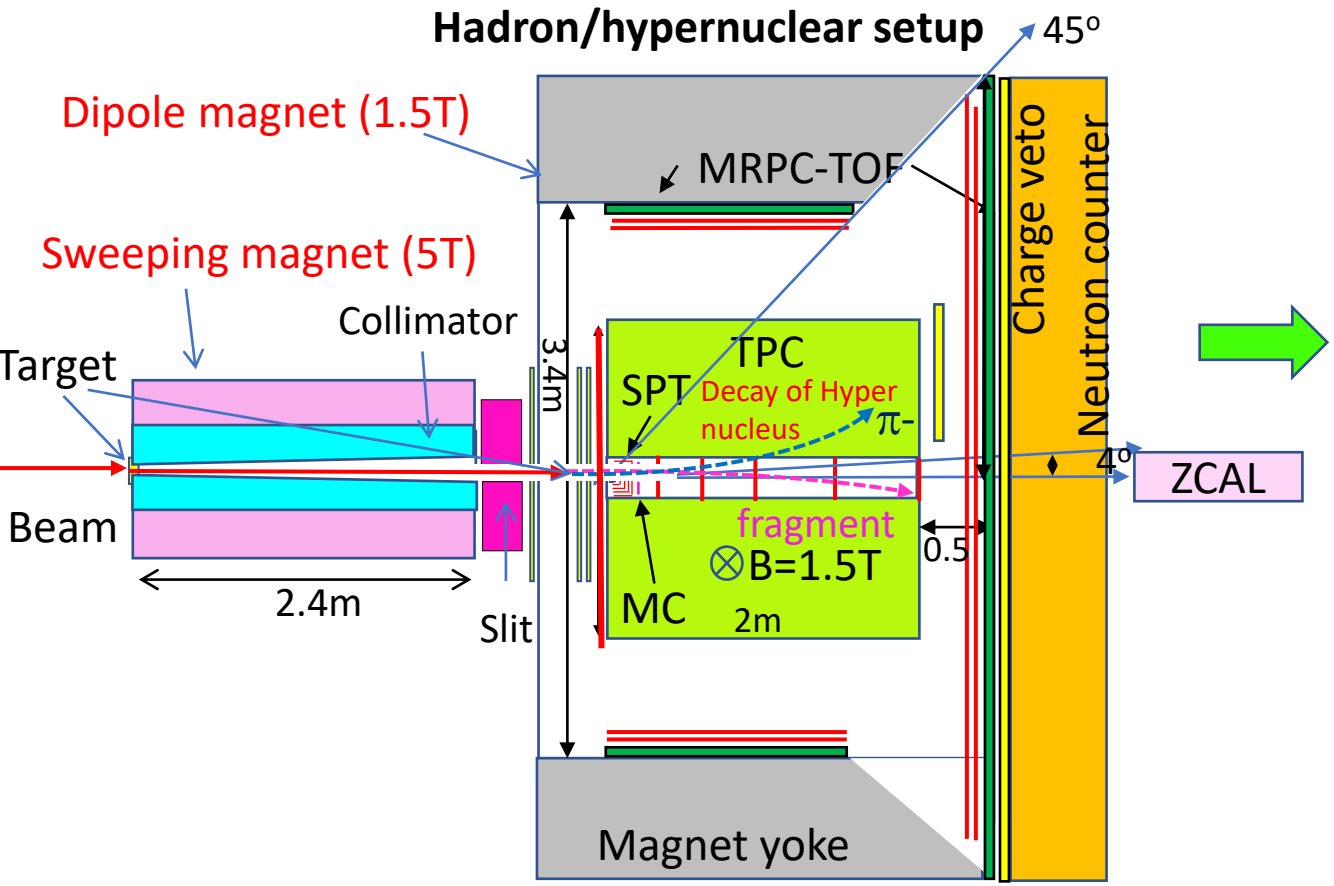
100 days run, 0.1% sys error assumed for combinatorial background subtraction (PHENIX, ALICE)

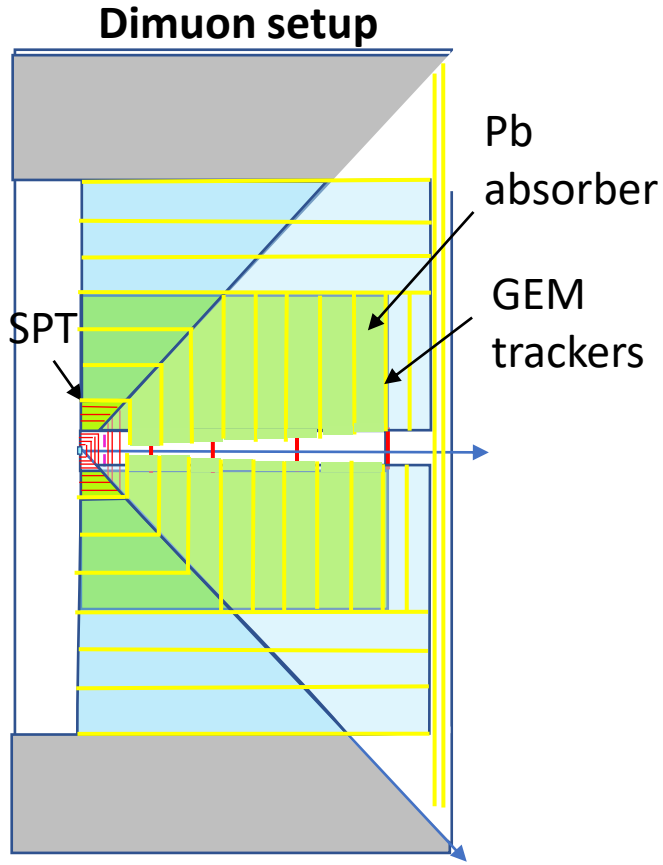




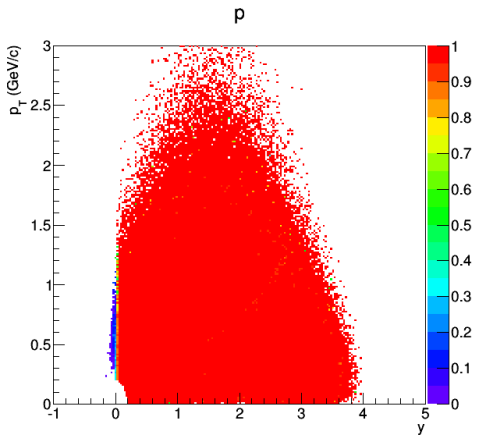
- **Proposal submitted in July 2022**
- **T with ~6% stat. errors can be expected from M_{ee}>1.1 GeV/c^2 of T ~ 150 MeV**

Phase II experiments

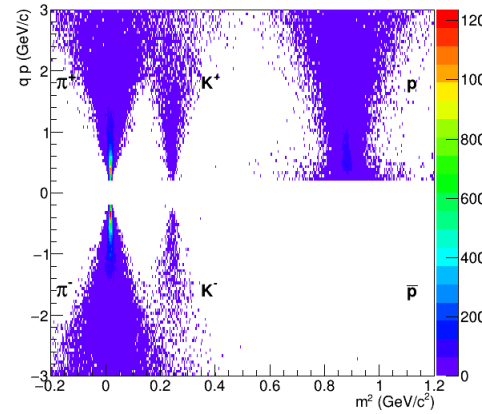




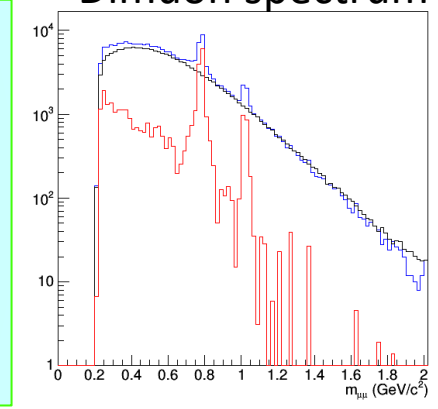
y-p_T Acceptance



PID with TOF



Dimuon spectrum



- Identified charged particles⇔Dimuon
- ~4π acceptance
  - Silicon Pixel Tracker and TPC
  - Pb absorbers and GEM trackers
  - MRPC-TOF
- Interaction rate : <=10 MHz
  - Triggerless DAQ system
- Centrality : Multiplicity counter + Zero-degree calorimeter
- Hypernuclei with closed geometry setup

Summary and outlook

J-PARC-HI : Studies of QCD phase structures of dense matter and multi-strangeness systems with world's highest-rate HI beam of 10^{11} Hz

Measurements of fluctuations, dileptons, and multi-strangeness systems

Staging: p+A at E16 → A+A at Upgraded E16 (Phase I) → Large acceptance spectrometer (Phase II)

- Di-electron experiment in p+A (E16) started in 2020 (→ Talk by M. Ichikawa (Apr. 7))
- ϕ→K+K- in p+A (E88) being prepared (Poster 3T 11_1 by S. Sato (Apr. 8))
- First experimental proposal submitted (July 2021) (Poster 3T 15_2 by Y. Morino (Apr. 8))

Aiming for the start of the Phase-I experiment after Hadron Hall Extension (~2026)