

HADES

The **High Acceptance Di-Electron Spectrometer HADES** is a fixed target detector located at SIS18 at Helmholtzzentrum für Schwerionenforschung in Darmstadt, Germany.

Physics program:

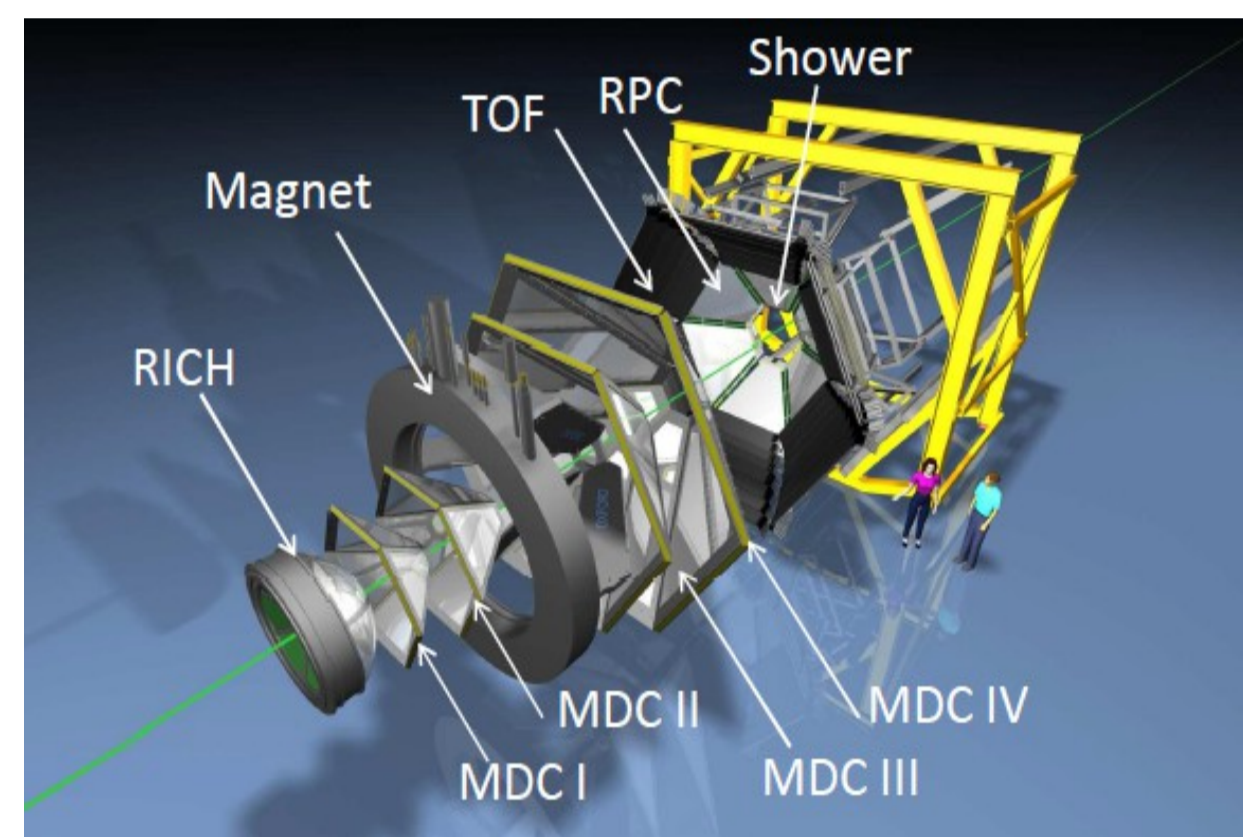
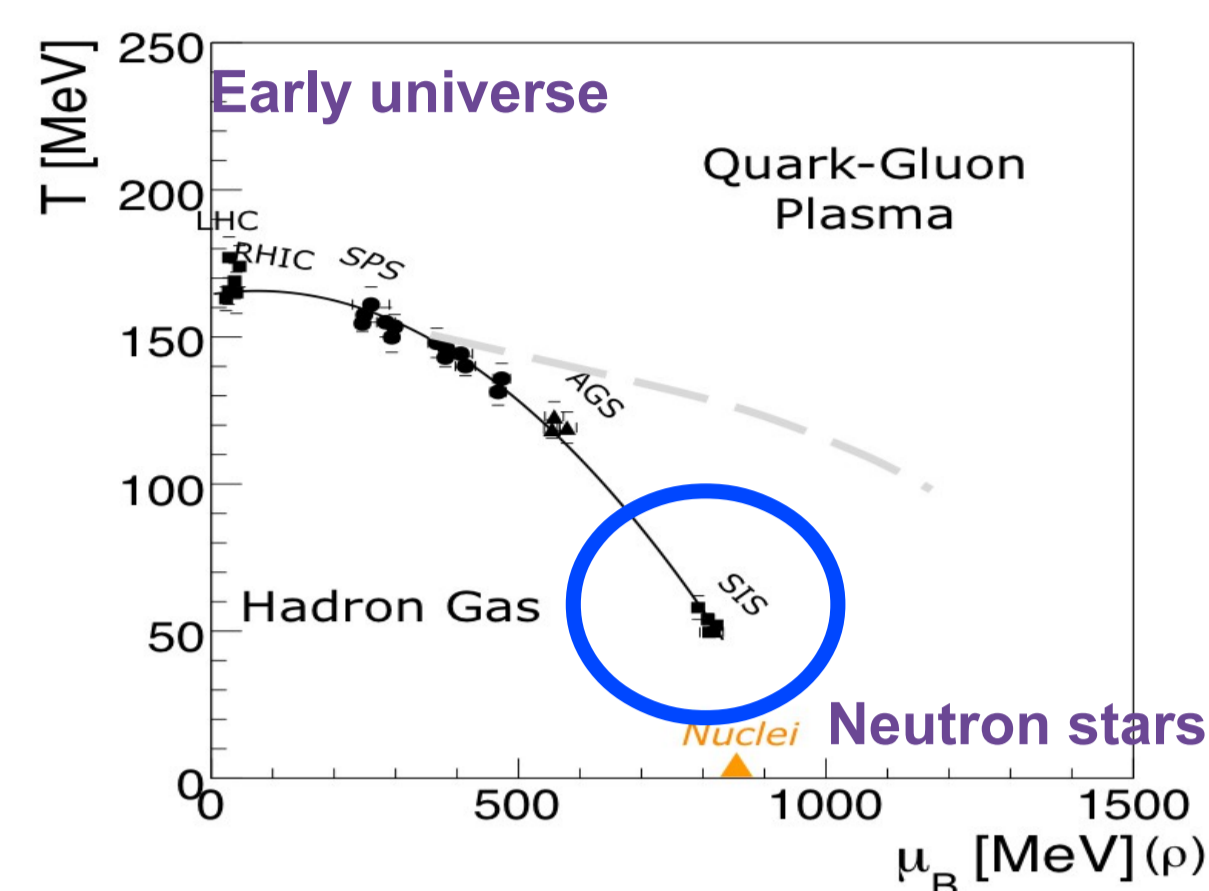
- Heavy-ion collisions
- Elementary reactions (p+p, d+p, π+p, π+A, p+A)

Acceptance:

- Full azimuthal angle
- Polar angle 18° - 85°

Detector components:

- RICH and SHOWER detector for lepton identification
- Multi-wire drift chambers (MDC) combined with a magnetic field for momentum measurement and tracking information. In addition energy loss information
- Time of flight detectors (TOF, RPC) for timing and energy loss information



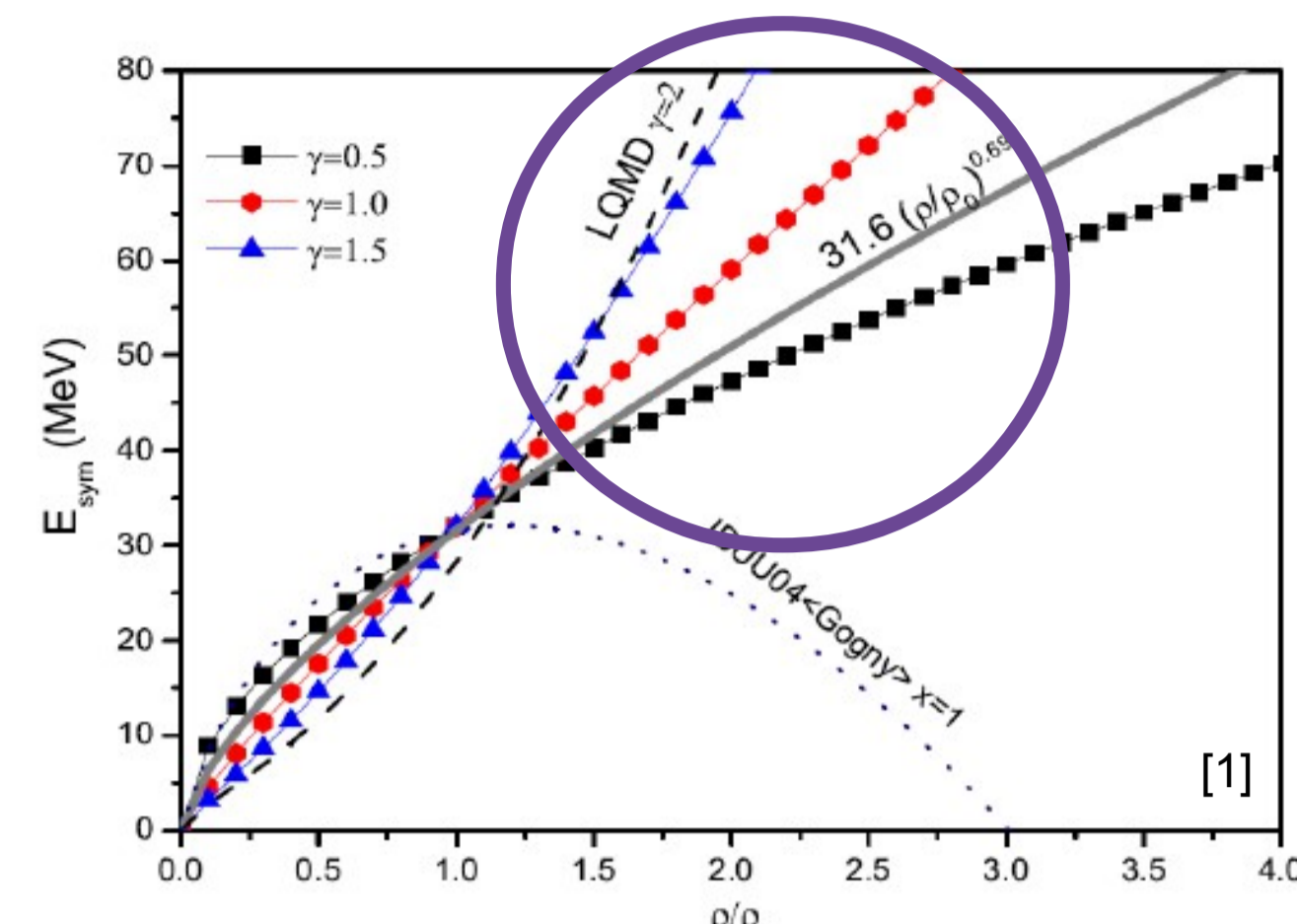
Motivation

Access to EOS (E) and E_{sym} with Heavy-Ion Collisions (HIC) at SIS18 energies:

$E(\rho, \alpha) = E(\rho, \alpha = 0) + E_{sym}(\rho)\alpha^2 + \mathcal{O}(\alpha^4)$
with baryon density ρ , isospin asymmetry parameter α and

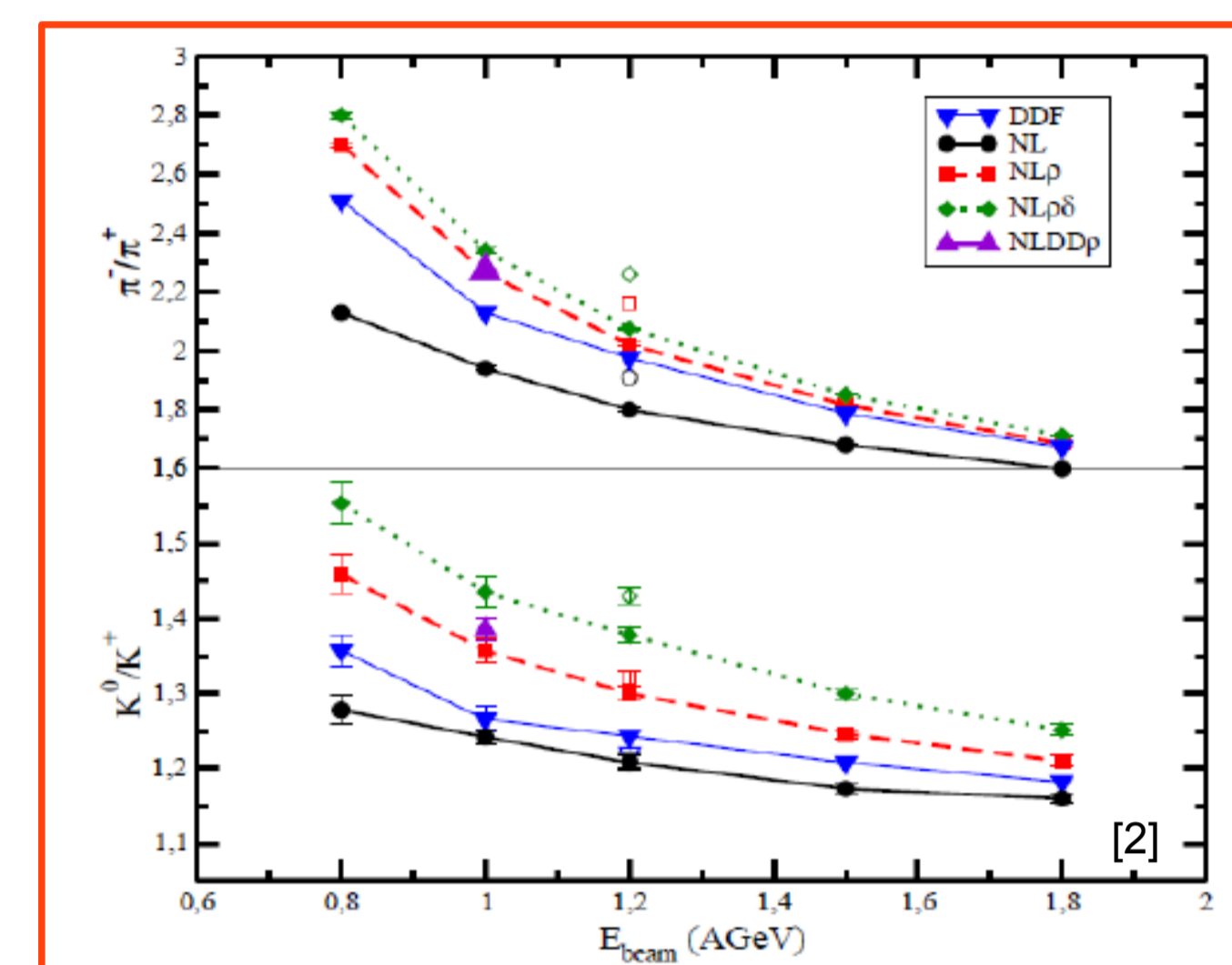
$$E_{sym} = 22\text{MeV} \cdot (\rho/\rho_0)^\gamma + 12\text{MeV} \cdot (\rho/\rho_0)^{2/3}$$

- Densities: $\rho_{max}/\rho_0 \approx 2-3 \Rightarrow$ Sensitive to EOS stiffness γ [1].
- Proposed experimental observable: Measurement of ratio π^+/π^- & K^+/K^0 in isospin asymmetric systems (Au+Au) [2].
 \Rightarrow Difference in production rate dependent on asymmetry parameter α .
- Subthreshold production of kaons
- Larger sensitivity in K^+/K^0 ratio

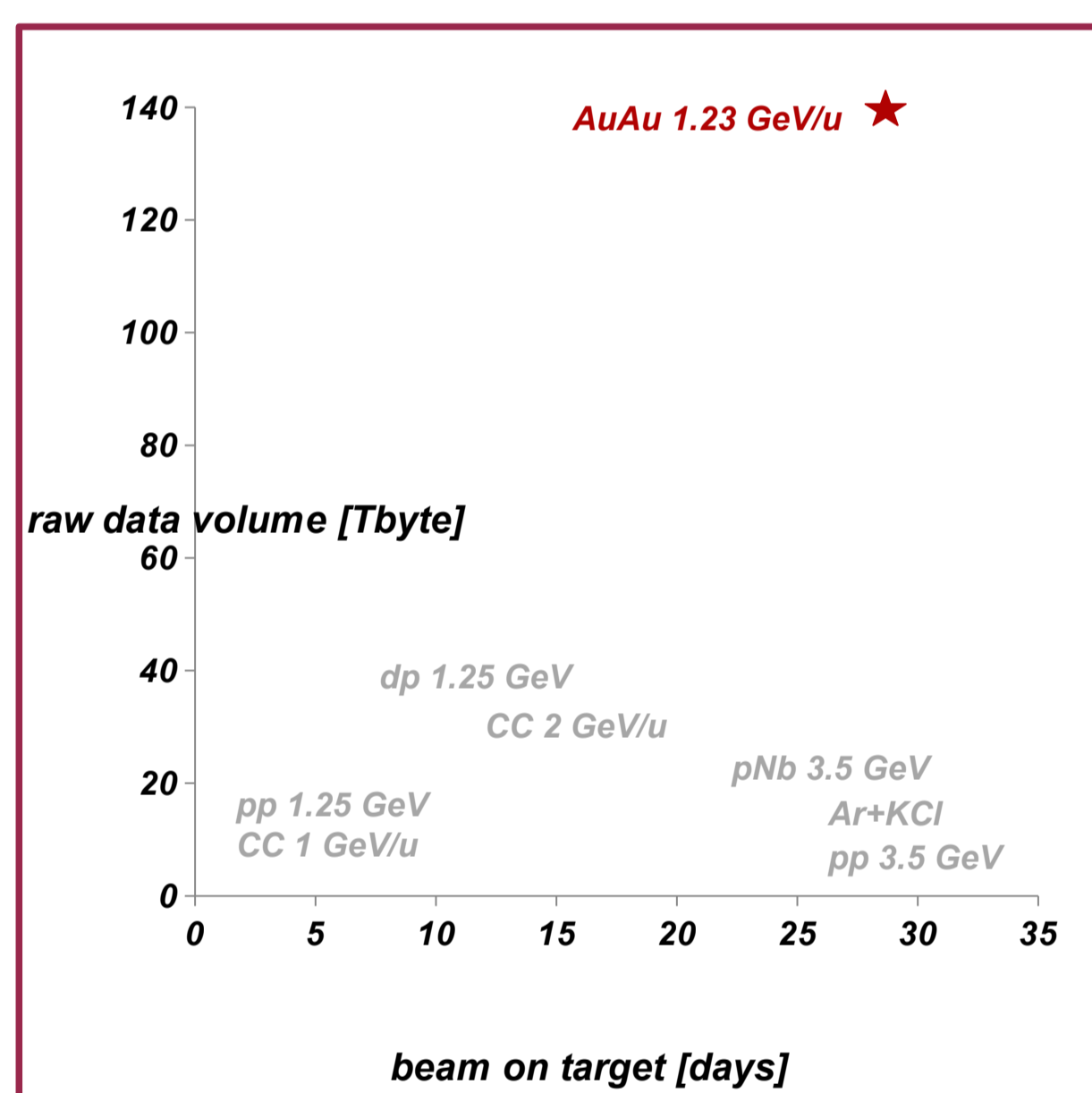


[1] Q. Li, M. Bleicher, Probing the density dependence of the symmetry potential in intermediate energy heavy ion collisions. J. Phys. G 31, 1359(2005).

[2] G. Ferini, M. Colonna, T. Gaitanos, M. Di Toro, Aspects of particle production in isospin asymmetric matter. Nucl. Phys. A762 147-166 (2005).

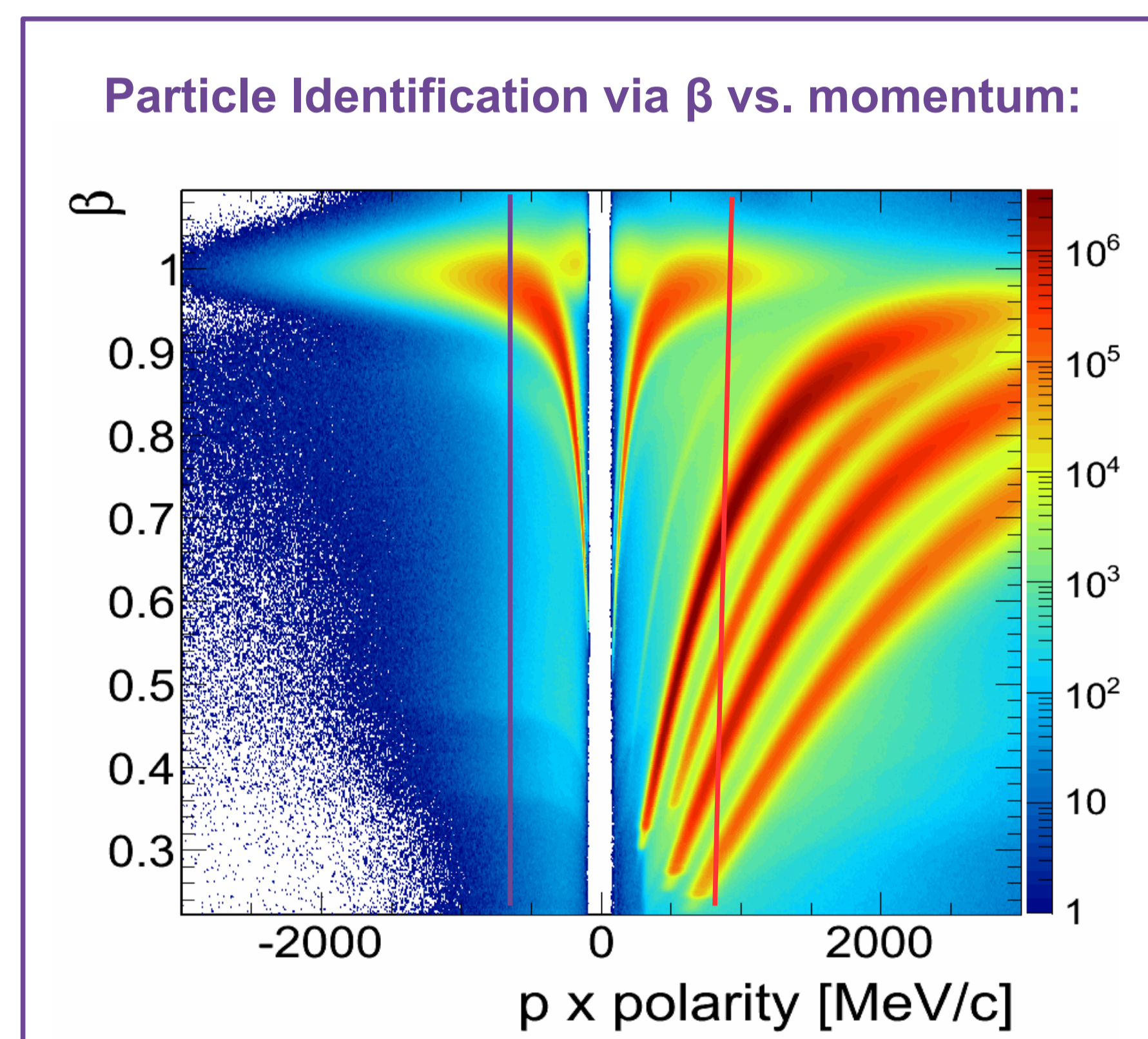
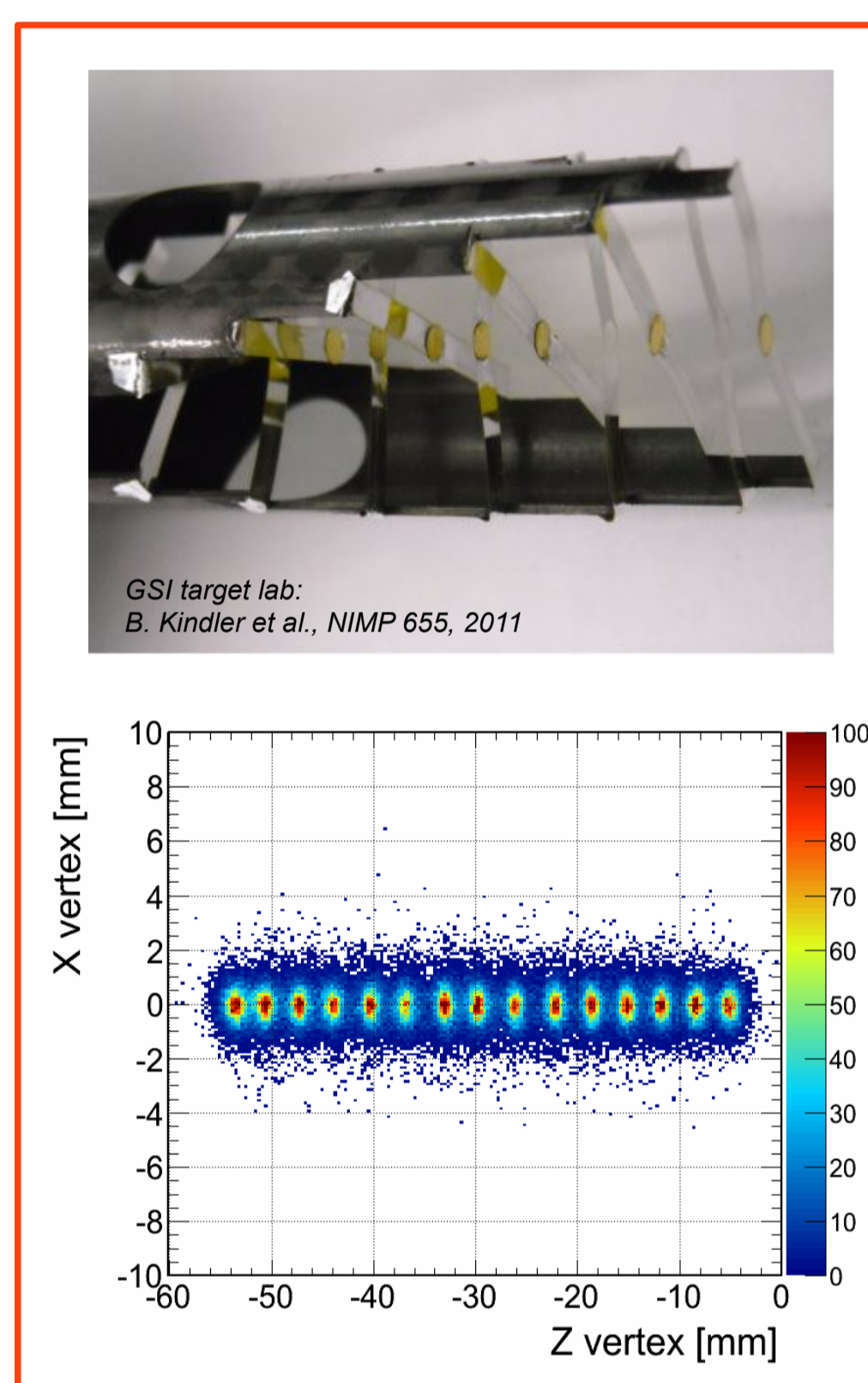


Au+Au at 1.23 AGeV Beam Time Performance



HADES DAQ Performance:

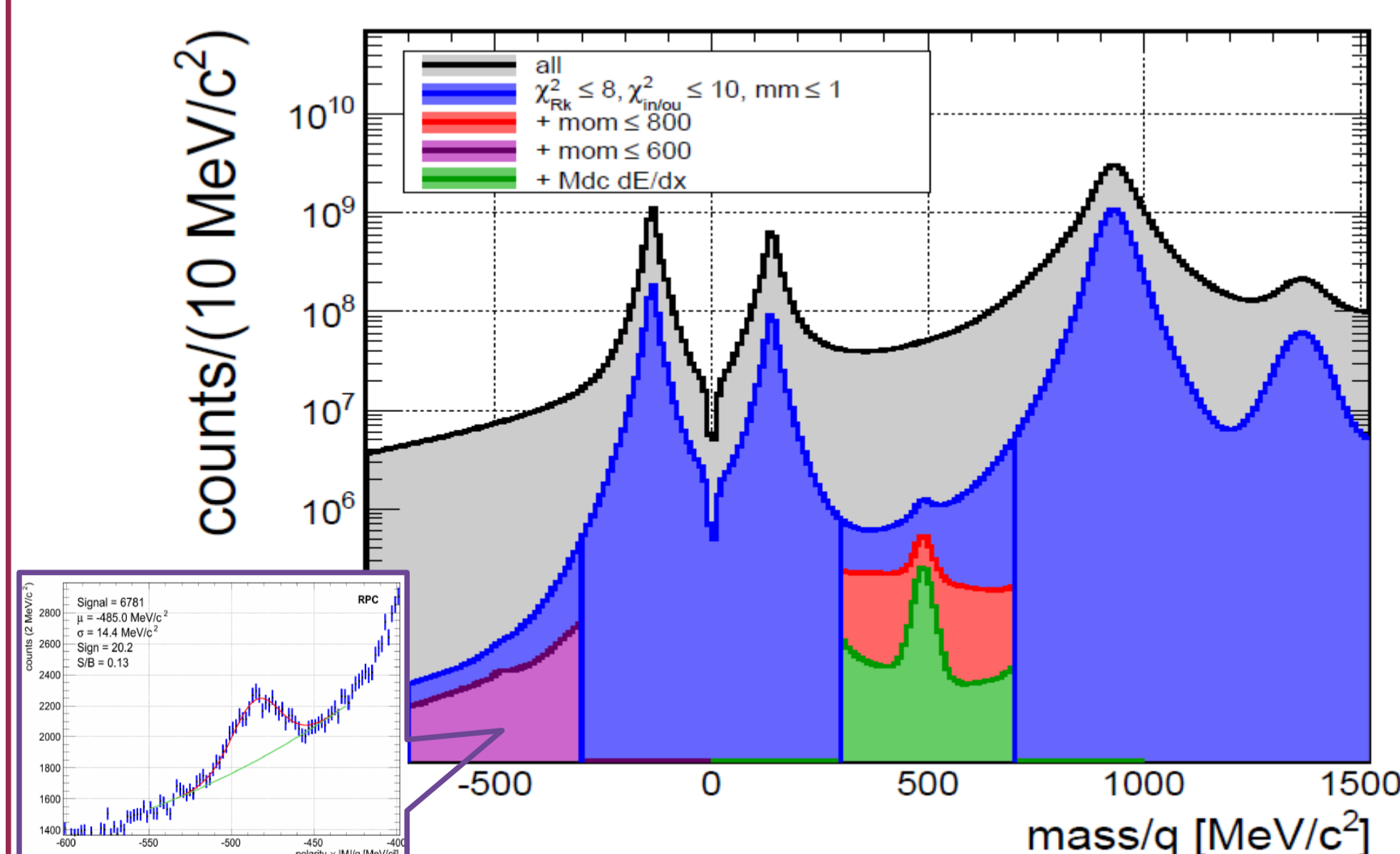
- 557 hours Au beam on Au target
- $(1.2 - 1.5) \times 10^6$ ions per second
- 8 kHz trigger rate
- 200 MByte/s data rate
- 7.3×10^9 events \Rightarrow 140 TByte of data
- Beam energy 1.23 AGeV
- Segmented Au target
- Trigger on multiplicity in TOF ≥ 20 (PT3)
 $\Rightarrow b_{max} \approx 9$ fm



Kaon Analysis

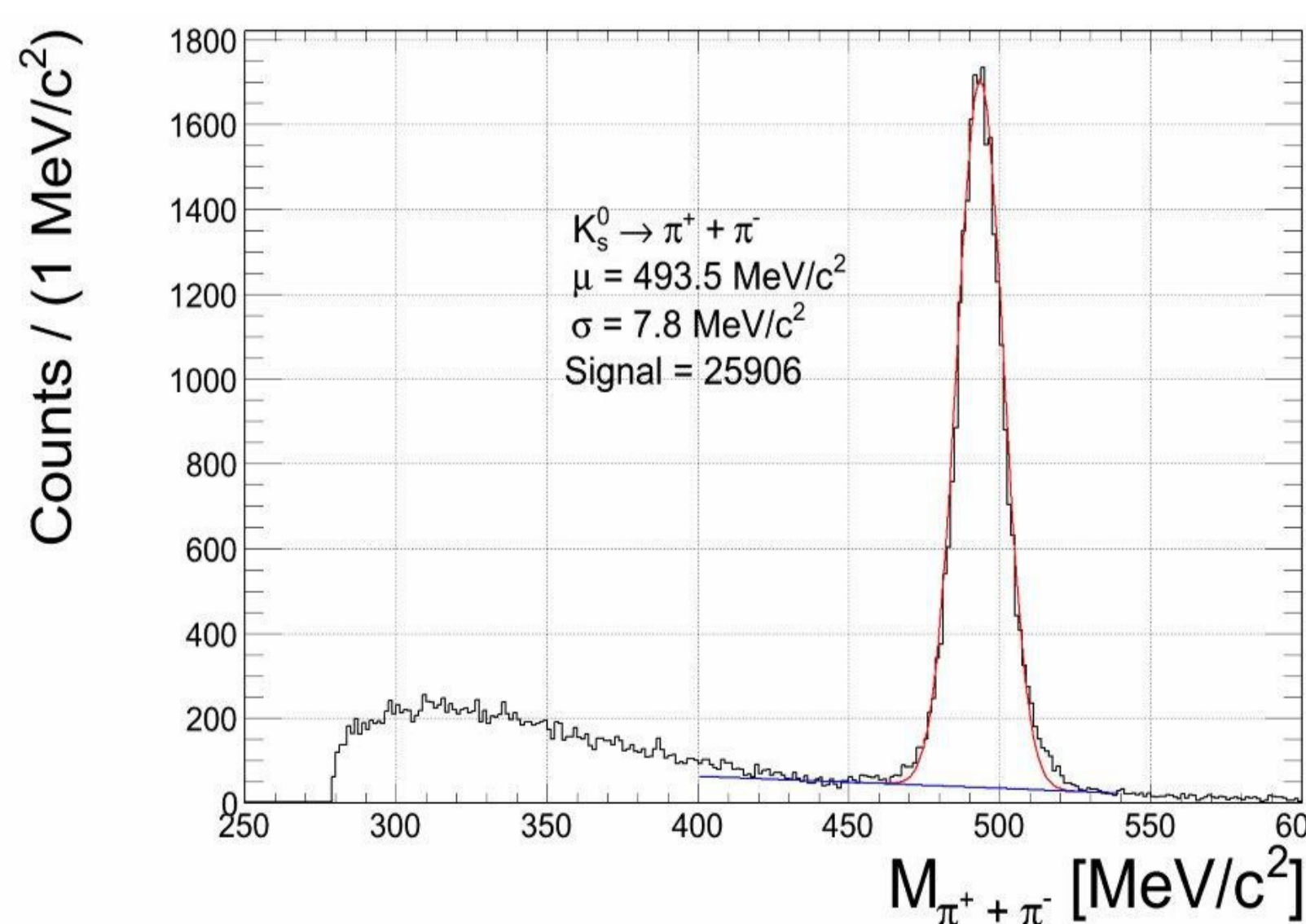
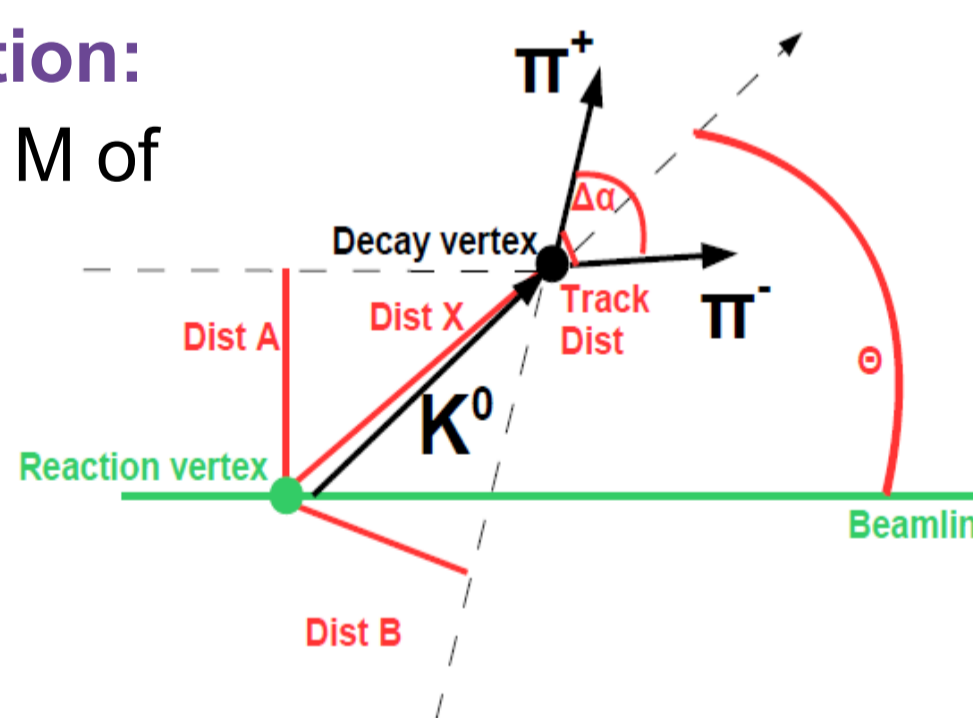
Charged Kaon Identification:

- Combining momentum and time of flight measurements
 \Rightarrow Mass spectrum
- Cutting on track quality variables
 \Rightarrow K^+ signal visible
- Upper limit for particle momentum and cuts on the energy loss (in MDC) of the particle (only K^+)
 \Rightarrow Clear K^+ and K^- signal

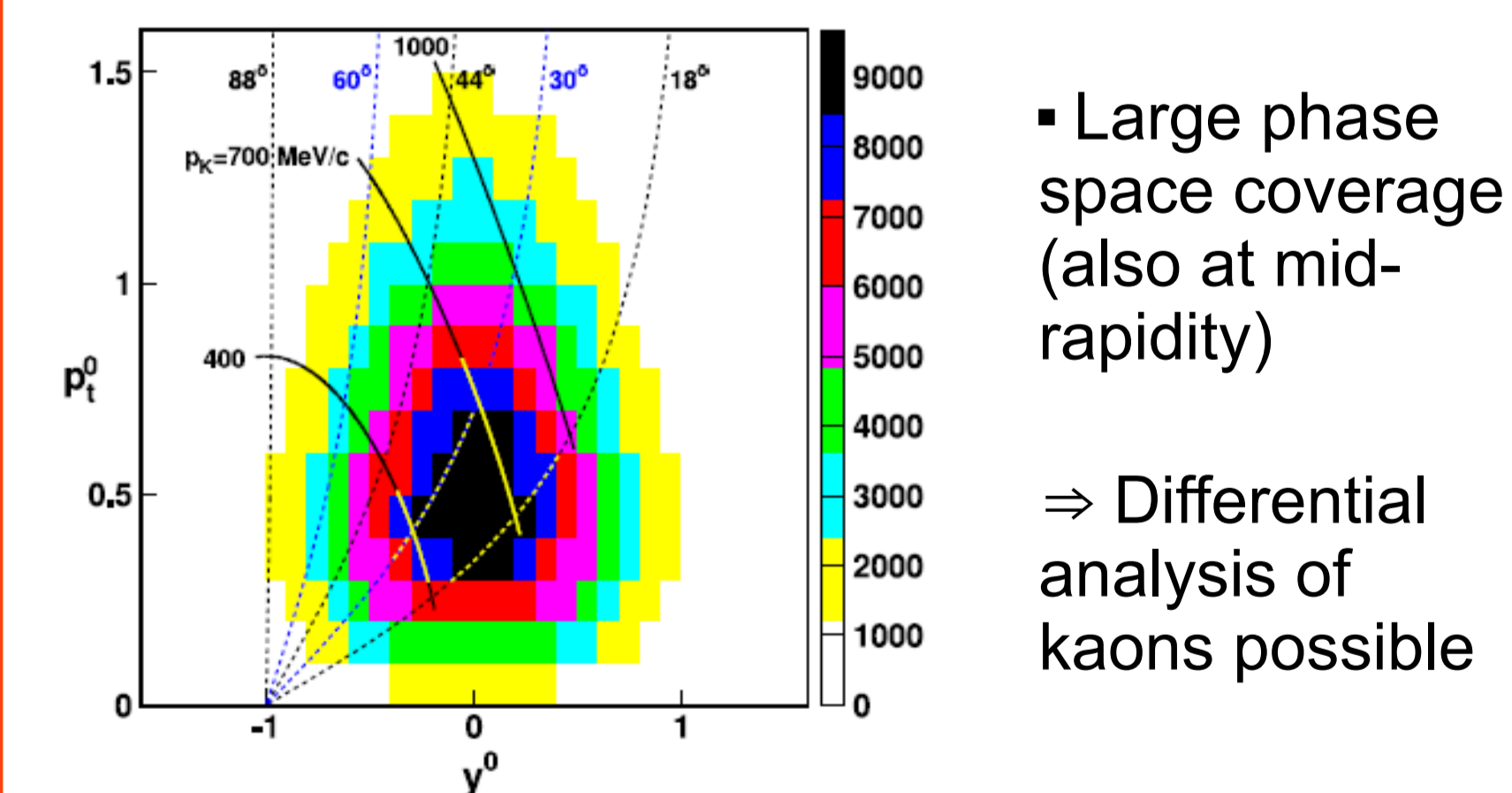


Neutral Kaon Reconstruction:

- Calculate invariant mass M of decay products $\pi^+ \pi^-$
- Cuts on decay topology
 \Rightarrow Almost background free K^0_s -signal



HADES Acceptance for Kaons:



Summary

- The K^+/K^0 ratio is a promising observable to investigate the EOS symmetry term
- HADES has excellent capabilities to identify charged and neutral kaons in isospin asymmetric Au+Au collisions at 1.23 AGeV, where matter is assumed to be compressed up to $\rho_{max}/\rho_0 \approx 2-3$.