ϕ meson production in Au+Au collisions at RHIC

- Current status and outlook -

Tatsuya Chujo (BNL)
for the PHENIX Collaboration

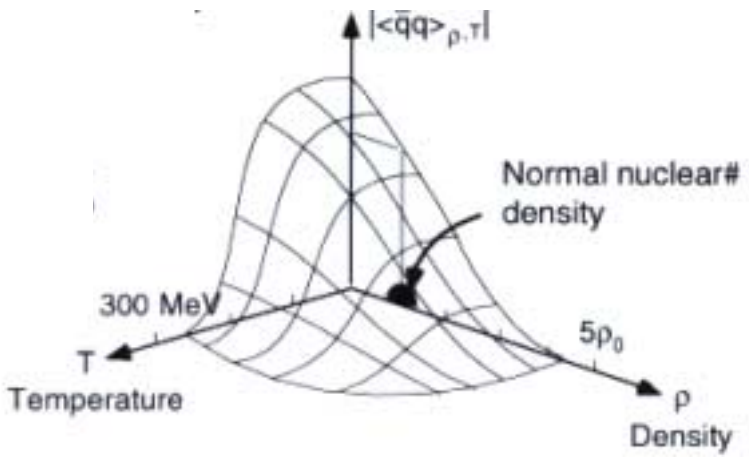
BROOKHAVEN NATIONAL LABORATORY

managed by Brookhaven Science Associates
for the U.S. Department of Energy

ϕ meson physics @ RHIC

- **In dense and hot matter, the modification of properties of vector meson (e.g. mass shift, branching ratio) is predicted, due to the partial chiral symmetry restoration.**

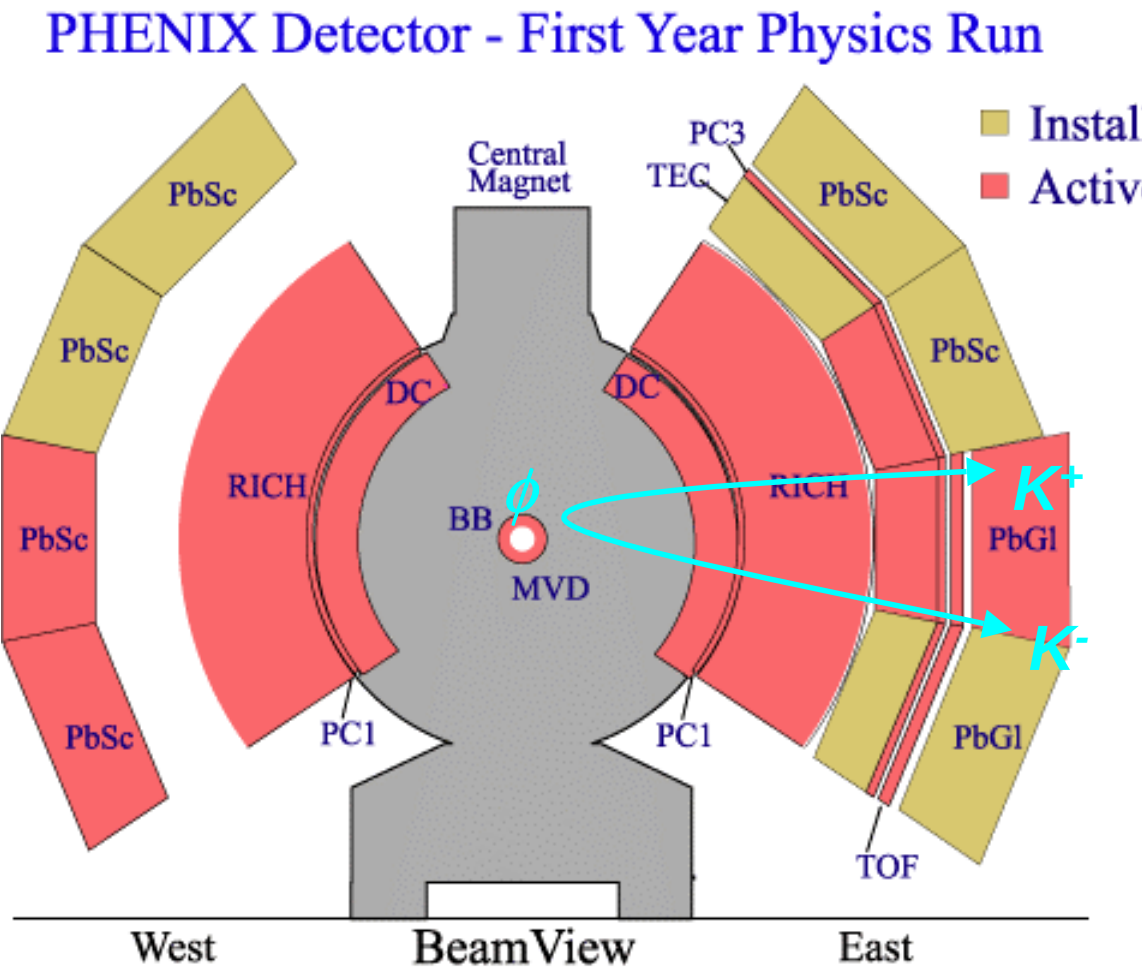
(T. Hatsuda et al. PRC 46 (1992) R42,
E.G. Drukarev et al., Nucl. Phys. 27 (1991) 77)

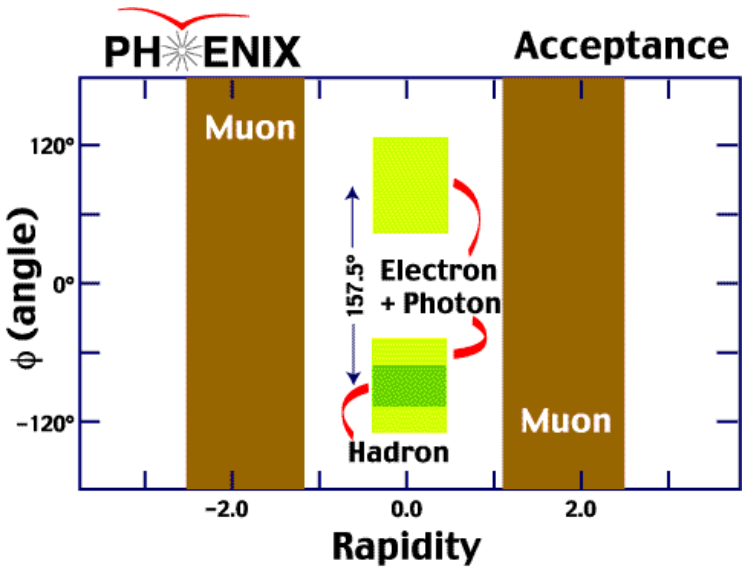


- **In Au+Au at RHIC energy,**

1. **Invariant mass distribution** —*if it's changed*→ ***Possible signature of QGP***
2. **Simultaneous measurements of different decay channel ($\phi \rightarrow K^+K^-$, e^+e^-)** → ***Constraint of freeze-out condition***
3. **Centrality dependence of yields and p_T distribution** → ***Constraint of freeze-out condition***

PHENIX acceptance for $\phi \rightarrow K^+K^-$ @ TOF

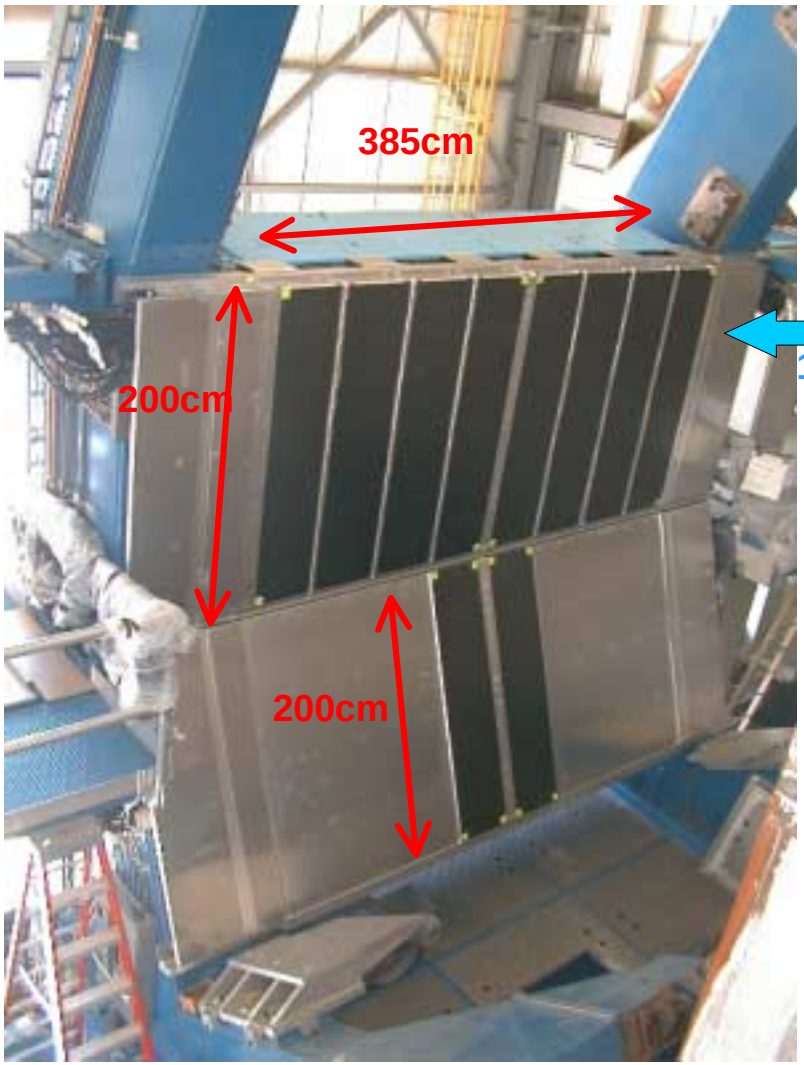


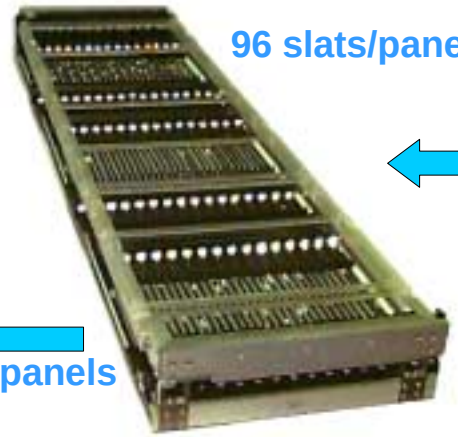


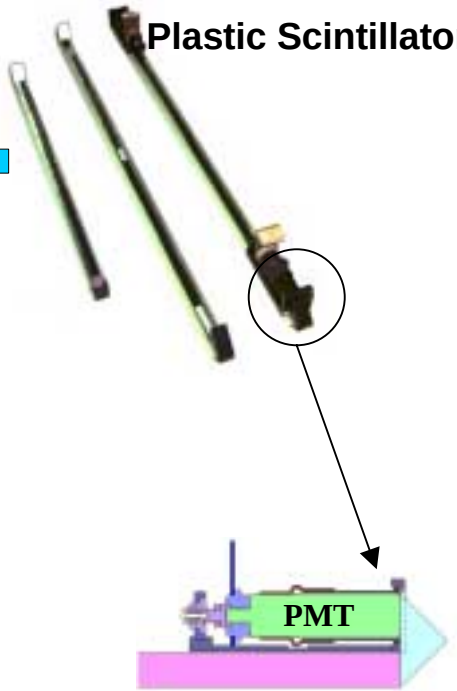
- ***TOF Acceptance***
  $\Delta\theta$ = 40 deg. ($\Delta\eta$ = 0.7) ,
  $\Delta\phi$ = 45 deg.

TOF was designed to cover ϕ meson acceptance and HBT measurement

PHENIX-TOF





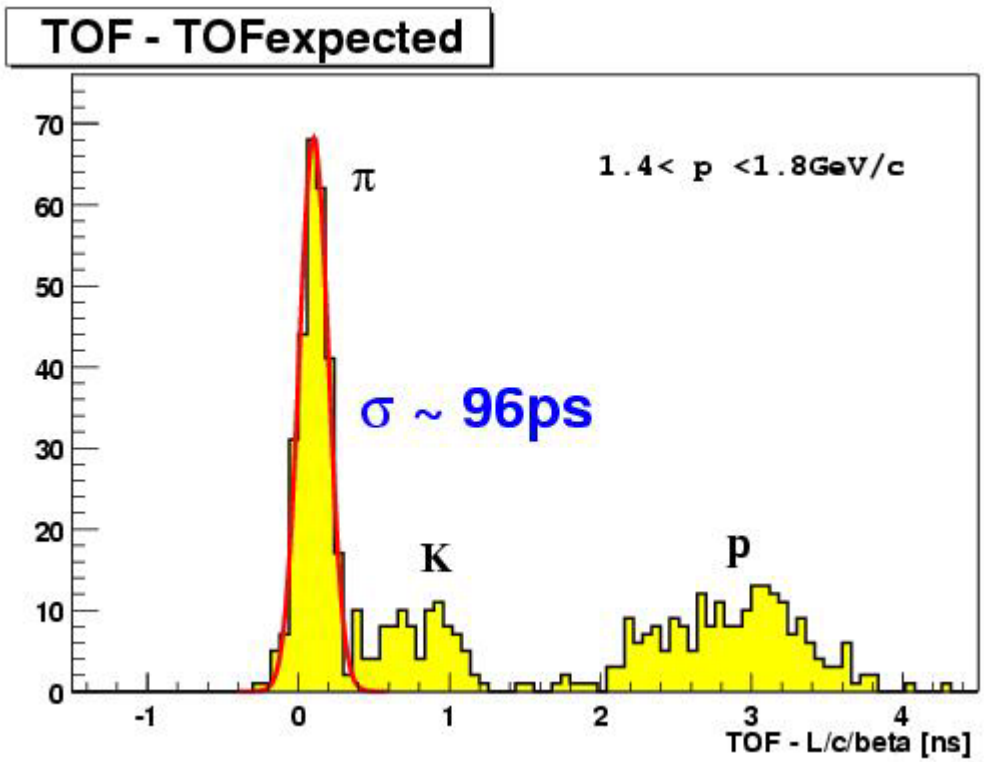


- Consists of 960 plastic scintillators
- PMT readout at both ends of scint. (1920 ch.)

⇓

Enough granularity to reduce the double hit probability in the same slat (Occupancy < 10%)

TOF Resolution Update



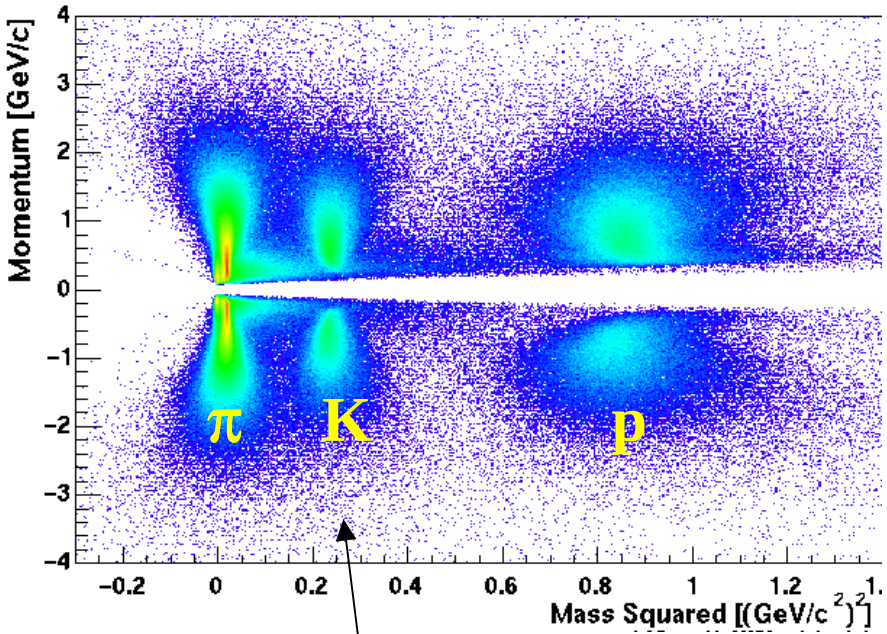
- **Overall Time-of-Flight resolution**
  σ_{TOF} **< 96 ps** (@ Oct. 2001)
- **Flight path length : ~ 5m**
  - **K/π separation : < ~2 GeV/c**
  - **p/K separation : < ~4 GeV/c**

Achieved timing resolution of less than 96 ps!

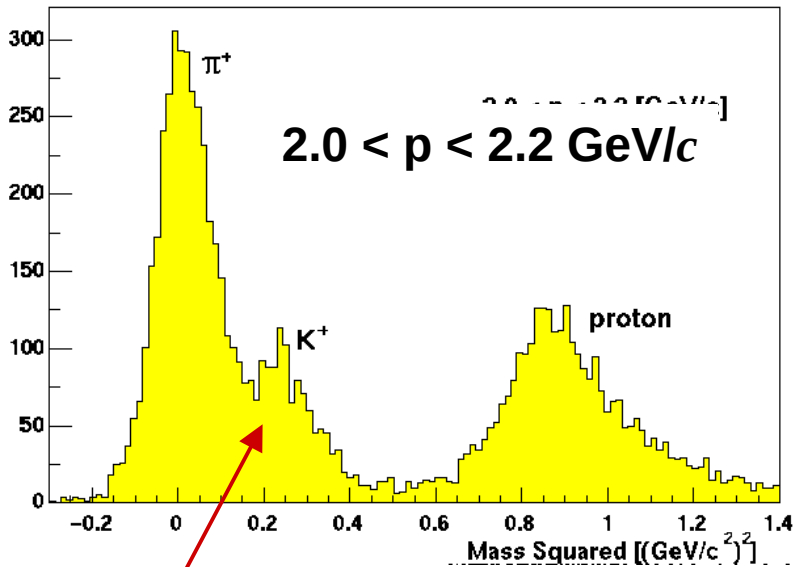
(improvement of slewing correction and run dependent timing offset.)

Mass Squared Distribution

m^2 vs. momentum



Mass squared distribution

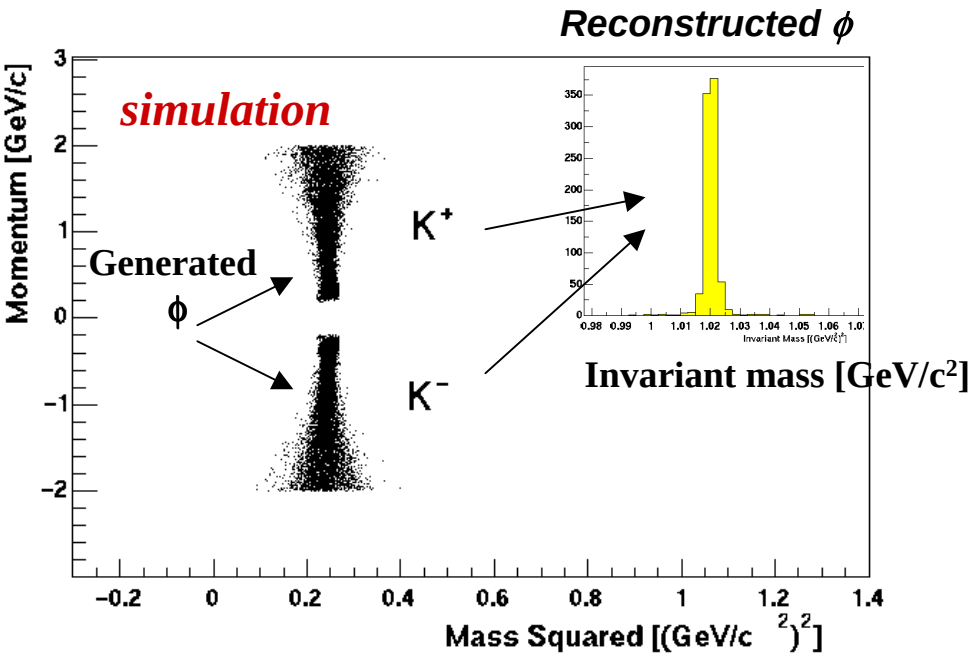


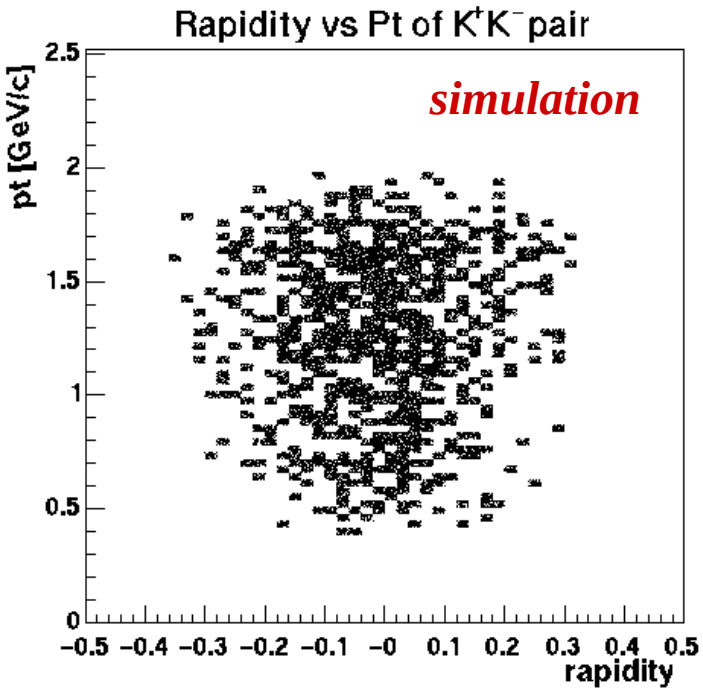
π/K separation up to ~2.2 GeV/*c*

Introduced 3σ cut in ($m^2 - m_0$) for Kaon PID

Single Particle Simulation ($\phi \rightarrow K^+K^-$)

- MC simulation of single ϕ meson including PHENIX detector response.
- Forced to decay to K^+K^- channel.
- Exponential + flat Pt distribution for ϕ meson.





* Momentum cut off 0.2 < p < 2.0 GeV/c

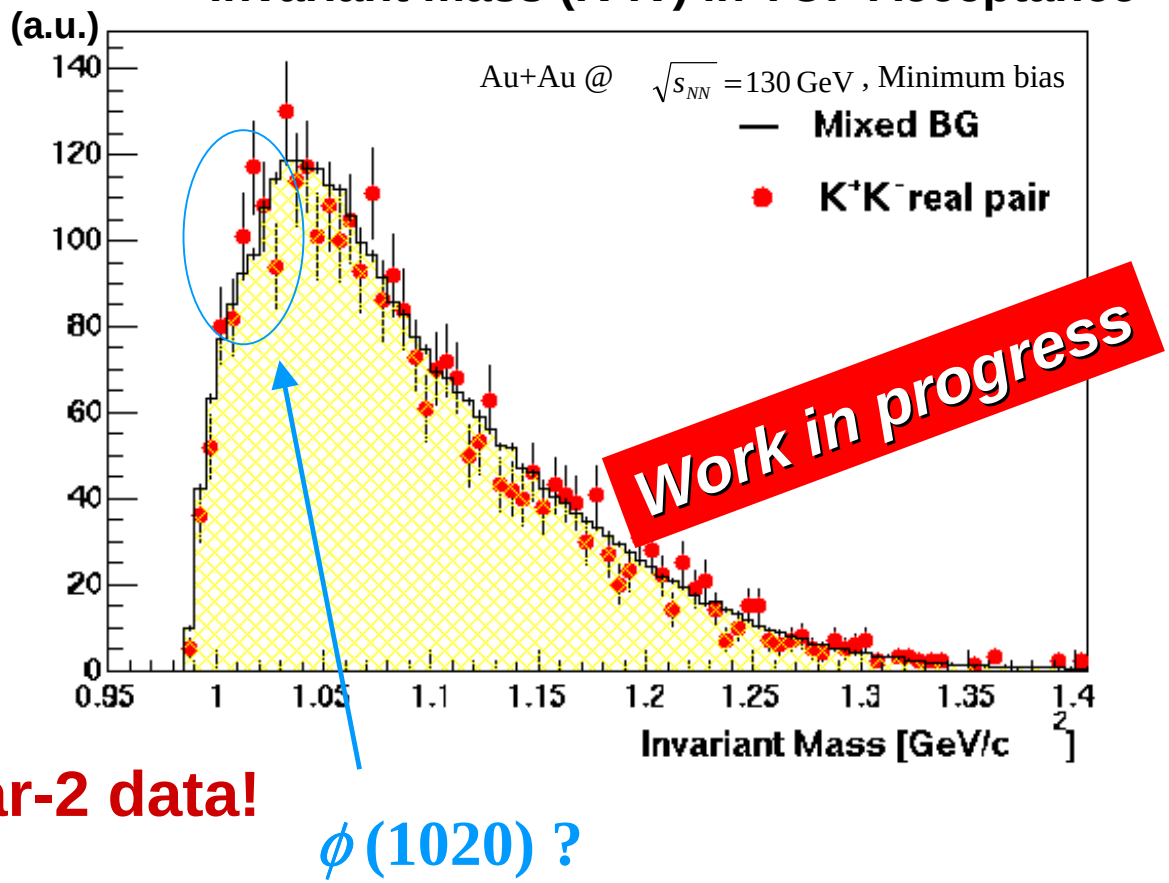
Invariant Mass ($\phi \rightarrow K^+K^-$) from Year-1 Data

Difficulties due to..

- **Statistical limitation**
- **Limited Acceptance**
- **Drift Chamber inefficiency in year-1 data in TOF acceptance**

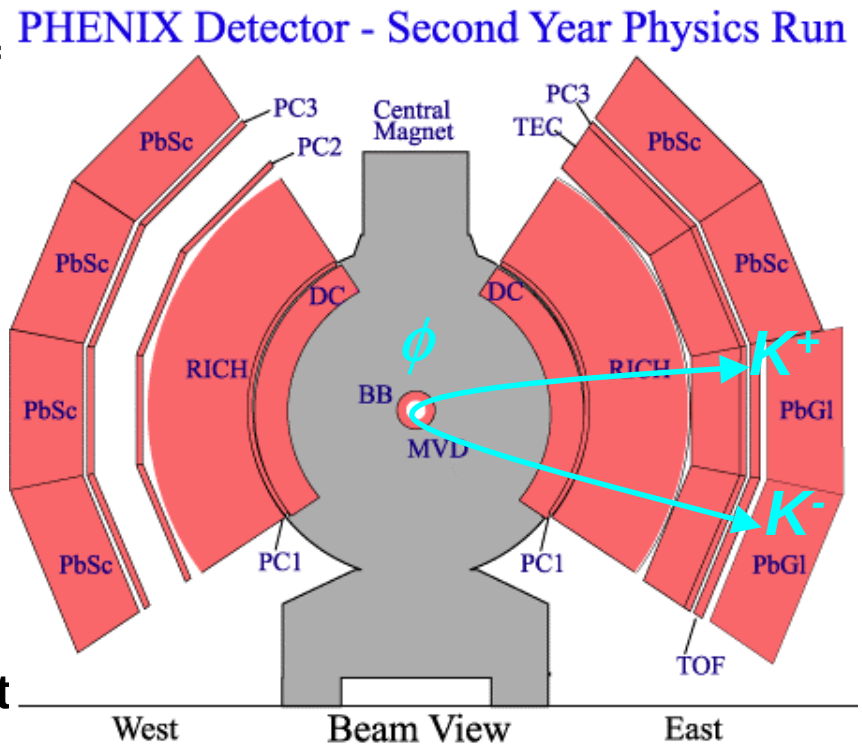
Improvement in Year-2 data!

Invariant mass (K^+K^-) in TOF Acceptance



Outlook of Run2001 data

- Expected the drastic improvement of ϕ statistics in this year's data. (integrated luminosity in Au+Au will be 300 μb^{-1} Au+Au)
- Full central arm acceptance using the EMC (PbSc, PbGl) in this year.
- Good Dch efficiency in TOF acceptance in this year.



Physics:

1. Centrality dependence of yield and pt distribution of ϕ at RHIC full energy.
2. Measurements of branching ratio using the full central arm acceptance (EMC-RHIC).

$$N(\phi \rightarrow K^+K^-)/N(\phi \rightarrow e^+e^-)$$

Event reconstruction is now in progress