Strangeness

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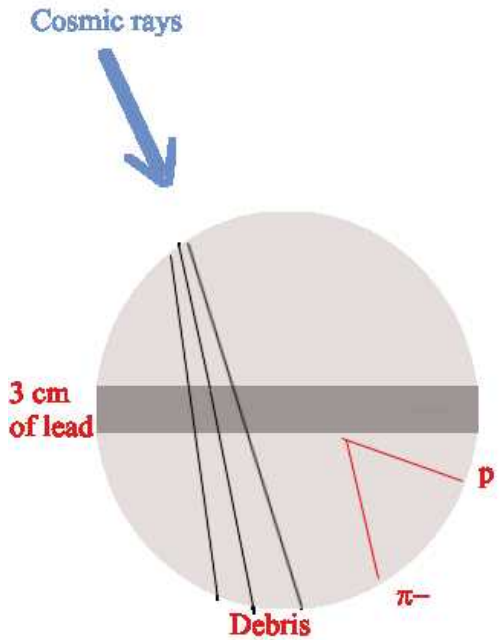
History

* 1947 :

Rochester and Butler's Cloud chamber picture.

The K^0 was first known as the V^0 and later as θ^0.



* 1952 :

First modern particle accelerator (the Brookhaven Cosmotron)

$$K^0 \rightarrow \pi^+ + \pi^-$$

Properties

They are produced copiously (on time scale of about 10^{-23} sec), but they decay relatively slowly (typically about 10^{-10} sec).

The strange particles are produced by the strong force, but they decay by the weak force.

Properties

Kaons are examples of particles which carry strangeness. They are quark-antiquark combinations containing an *s* or an anti-*s*.

$$\left|K^{+}\right\rangle = \left|u\bar{s}\right\rangle \quad , \quad \left|K^{0}\right\rangle = \left|d\bar{s}\right\rangle$$
$$\left|K^{-}\right\rangle = \left|\bar{u}s\right\rangle \quad , \quad \left|\bar{K}^{0}\right\rangle = \left|\bar{d}s\right\rangle .$$

Baryons like Λ , Σ , Ξ , and Ω particles, containing *s*-quarks, are collectively known as *hyperons*.
They have strangeness -1, -2, -3, and their anti-particles have strangeness +1, +2, +3, respectively.

Experiments (1)

The study of strangeness production in relativistic heavy-ion collisions has been of continuing interest as strangeness is predicted to be enhanced by the formation of a quark gluon plasma (QGP).

Experiment E917 at the AGS at Brookhaven measured Au+Au collisions at beam kinetic energies of 6, 8 and 10.8 AGeV in 1996-97. It measures a wide variety of strangeness-carrying particles including $K^+, K^-, \Lambda^+, \overline{\Lambda}$ and ϕ-mesons.

1997-98

Experiments (2)

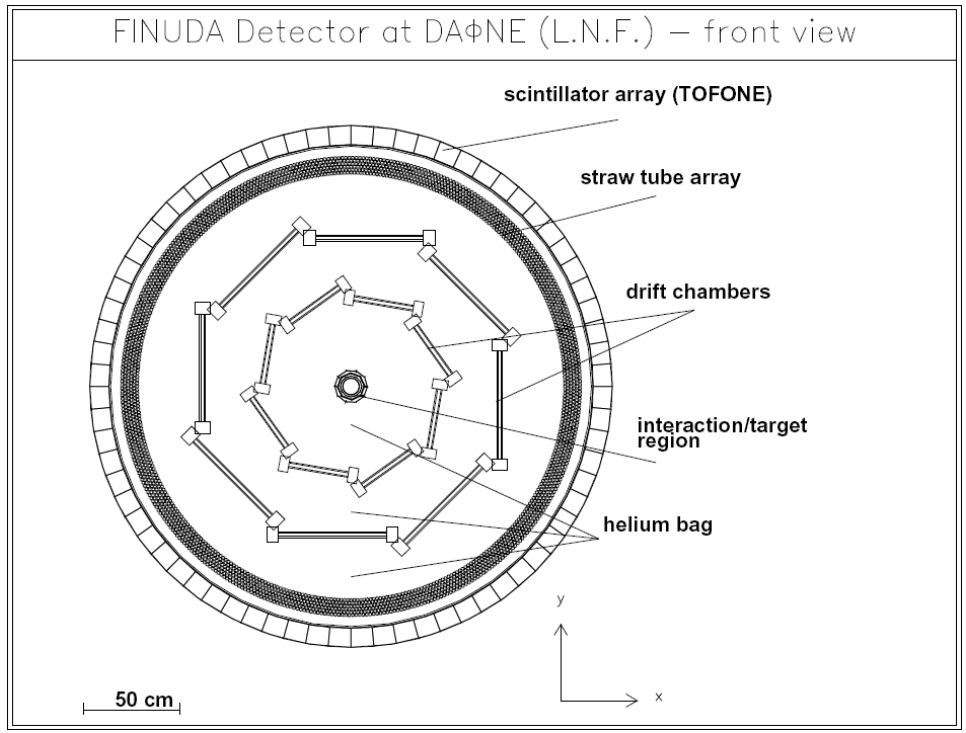
Strangeness in nuclear matter at DAΦNE

Low energy kaons from the ϕ-meson produced at DAΦNE offer a unique opportunity to study strangeness in nuclear matter.

$$\phi(s\bar{s}) \rightarrow K^{-}(s\bar{u}) + K^{+}(u\bar{s})$$

$$\phi(s\bar{s}) \rightarrow \bar{K}^{0}(s\bar{d}) + K^{0}(d\bar{s})$$

- Hypernuclei production and decay
- Kaons scattering on nucleons
- Kaonic atoms formation



FINUDA (FIsica NUcleare a DAΦNE)

J. Phys. G, **23** (1997) 2151

1998-2000

Experiments (3)

Strangeness production at ANKE facility (COSY, Germany)

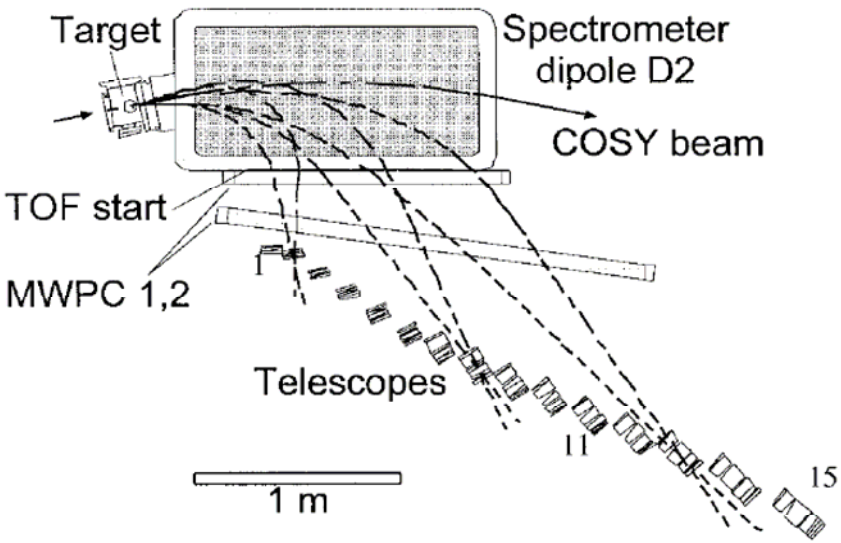
Target: carbon (~50 μg/cm^2) or diamond (~ 400 to 20.000 μg/cm^2)

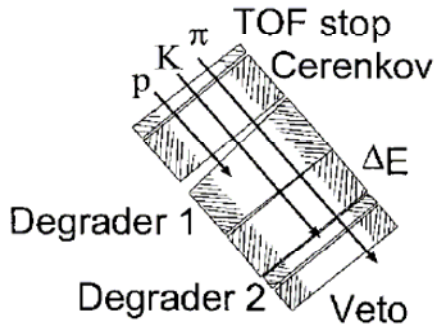
Beam: proton

$$pp \rightarrow pK\Lambda$$

$$K^+ \rightarrow \mu^+ \nu_\mu$$

$$K^+ \rightarrow \pi^+ \pi^0$$



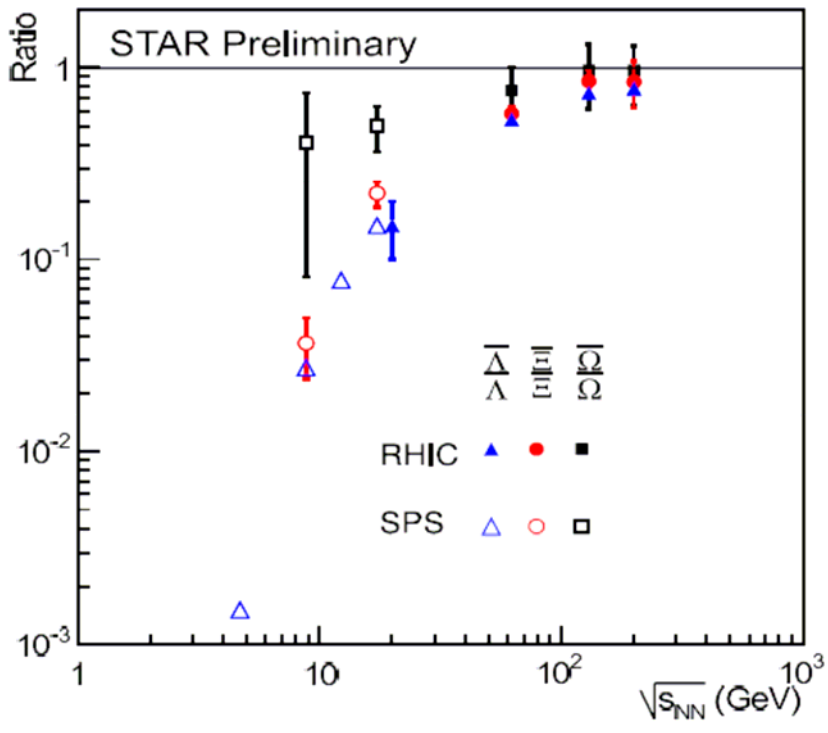


2006

Experiments (4)

Strangeness production at RHIC, STAR collaboration

Due to large acceptance, the STAR experiment has acquired data on strangeness production for a variety of collisions systems and energies, from p+p to Au+Au.



Nucl-ex/**0608017** (2006)

2005-2014

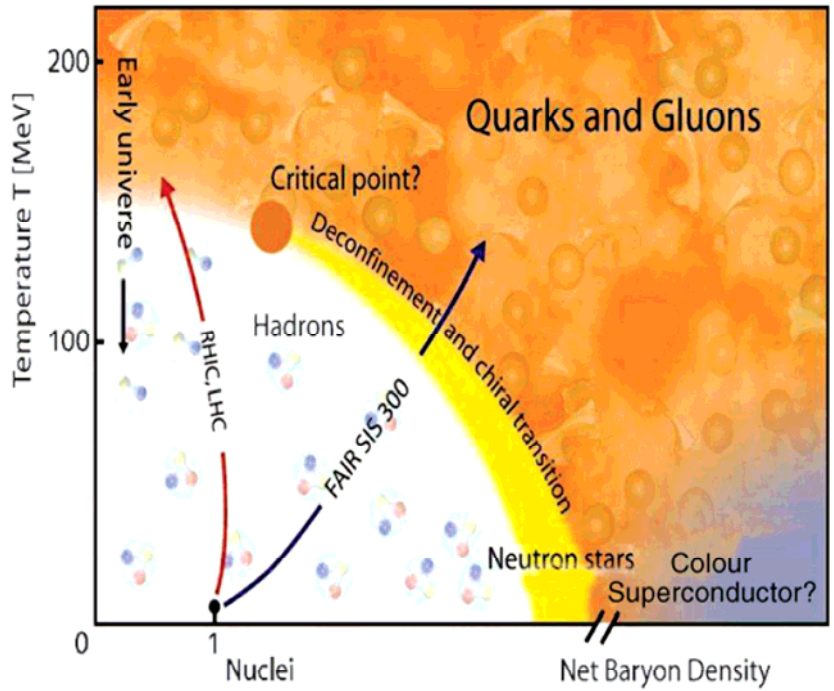
Experiments (5)

Strangeness in the CBM experiment at FAIR

CBM (Compressed Baryonic Matter)

FAIR (Facility for Antiproton and Ion Research)

The experiment will cover both hadronic and leptonic observables.



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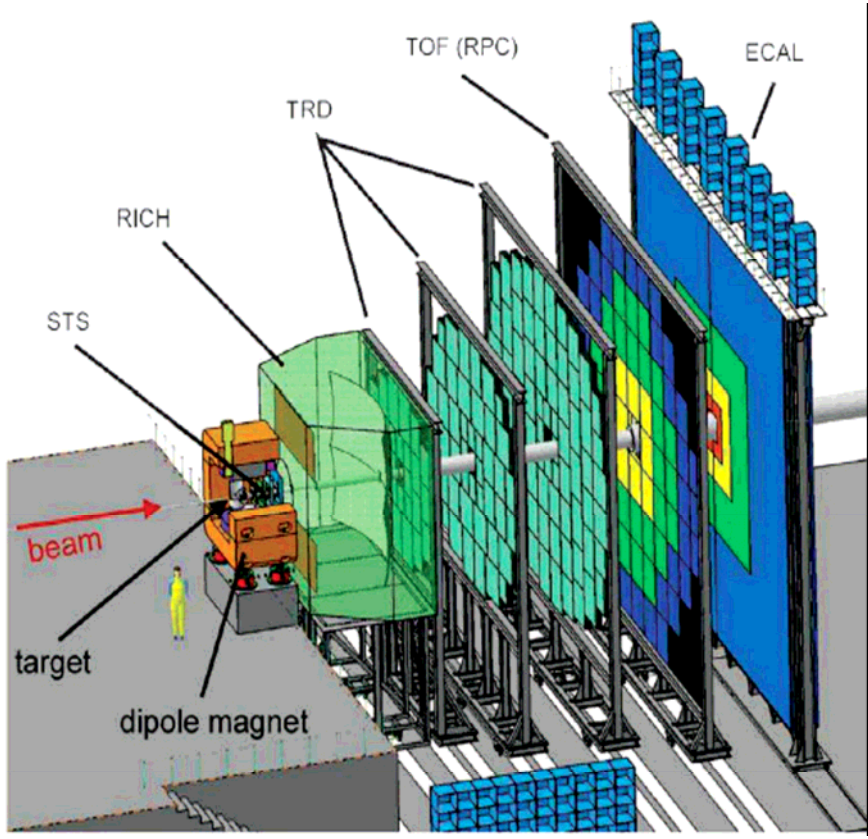
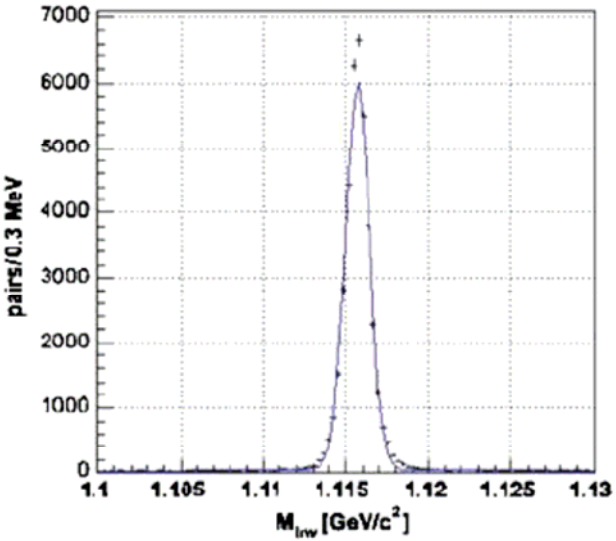
Charged hadrons will be identified by the time-of-flight measurement in the RPC wall located at about 10 m from the target. With an anticipated resolution of 80 ps or better, kaons can be separated from pions up to 4.6 GeV.

For the measurement of hyperons, the topology of their weak decay into charged hadrons will be employed.

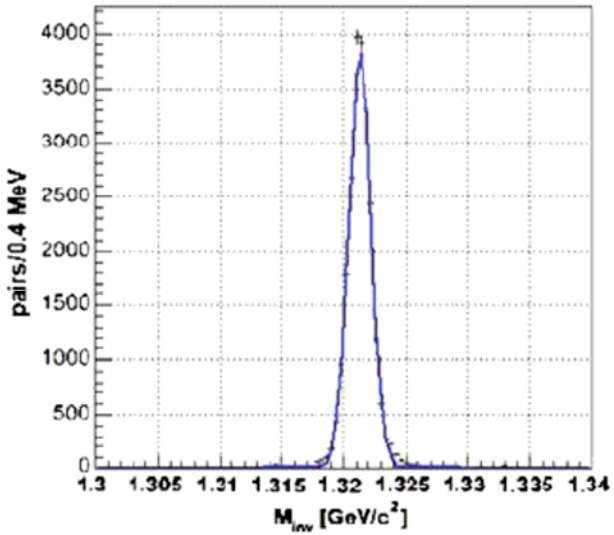


2005-2014

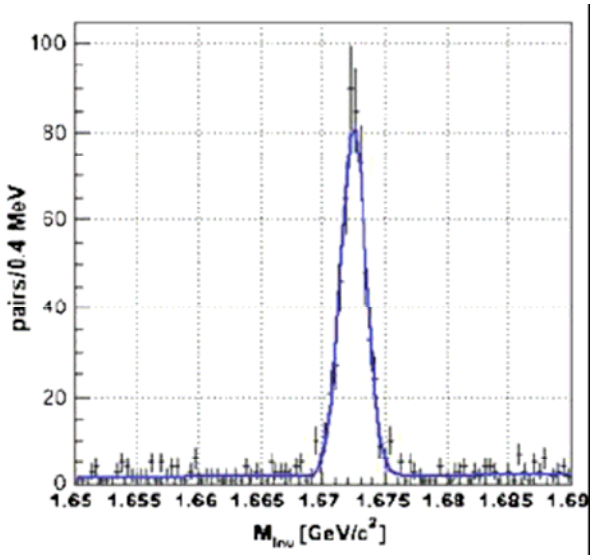
Invariant mass signals (Simulation)



$\Lambda \to p\pi^-$



$\Xi^- \to \Lambda\pi^- \to p\pi^-\pi^-$



$\Omega^- \to \Lambda K^- \to p\pi^- K^-$