Physics Motivation

Effective Quark Mass

Chiral Symmetry Breaking

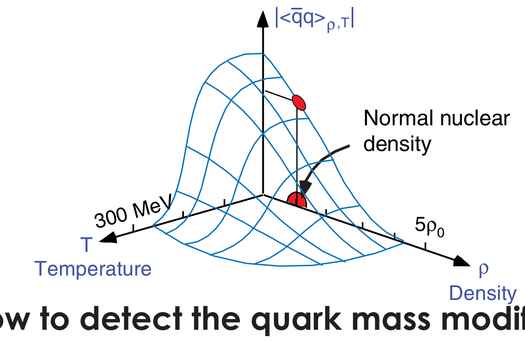
In QCD Vacuum

$m_u \fallingdotseq m_d \fallingdotseq 300MeV$
$m_s \fallingdotseq 500MeV$

In HOT/DENSE Matter

$m_u \fallingdotseq m_d \fallingdotseq 5MeV$
$m_s \fallingdotseq 100MeV$

Chiral Symmetry Restoration



How to detect the quark mass modificatoin?

Vector Meson

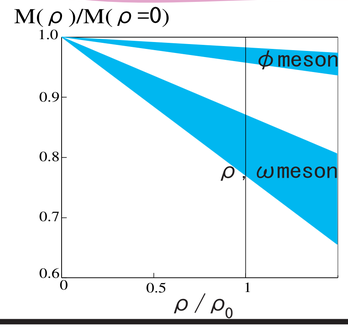
Mass of Vector Mesons ρ , ω , φ

$M_V \fallingdotseq 2 \times M_q$ + small Interaction term

T.Hatsuda, S.H.Lee, Phys. Rev. C46, R34 (1992).
T.Hatsuda et al., Prog. Theor. Phys. 94, 1009 (1996).

ρ / ω expected mass modification ～150MeV
large cross section

φ expected mass modification 20～40MeV
small decay width (4.4MeV/c^2)
→sensitive to mass modification

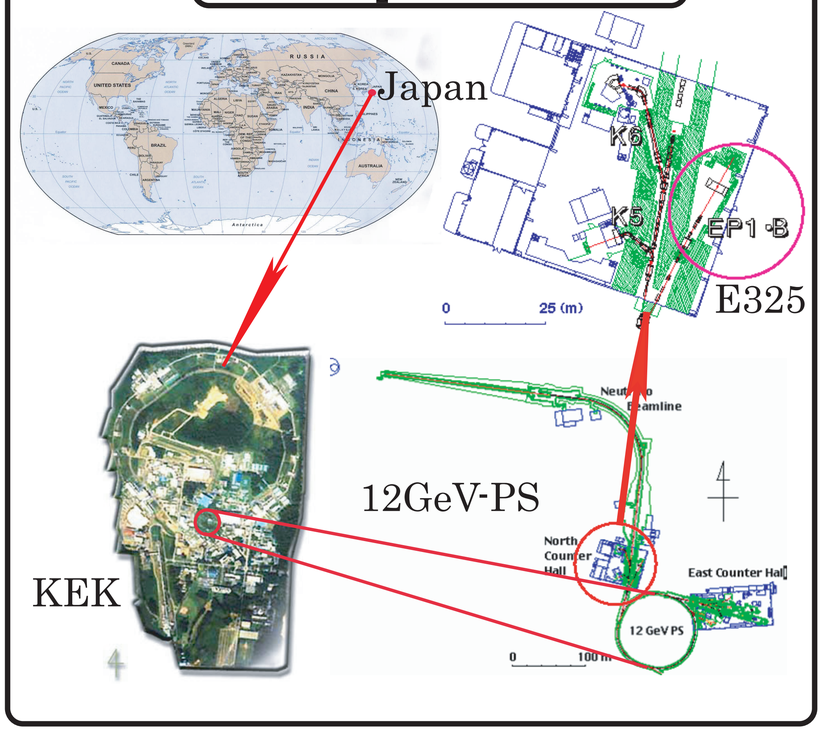


$$\frac{m^*_{\rho,\omega}}{m_{\rho,\omega}} = 1-(0.16\pm0.06)\frac{\rho}{\rho_0}$$

$$\frac{m^*_{\phi}}{m_{\phi}} = 1-(0.15\pm0.05)y\frac{\rho}{\rho_0}.$$

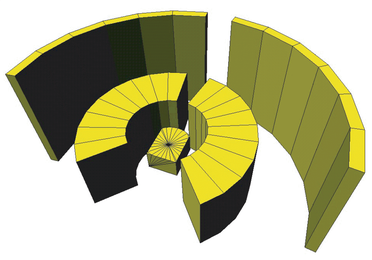
(y is the OZI breaking parameter in QCD $y \equiv \frac{2<s\bar{s}>_N}{<u\bar{u}+d\bar{d}>_N}$, y=0.1~0.2)

KEK-PS E325 Experiment

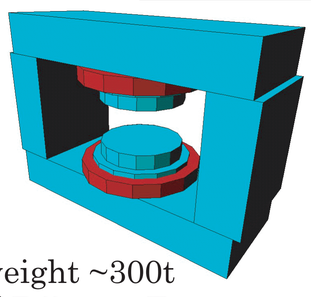


Tracking

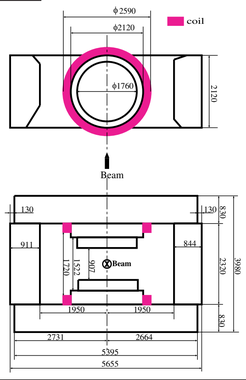
typical resolution ~300 μ m



Magnet

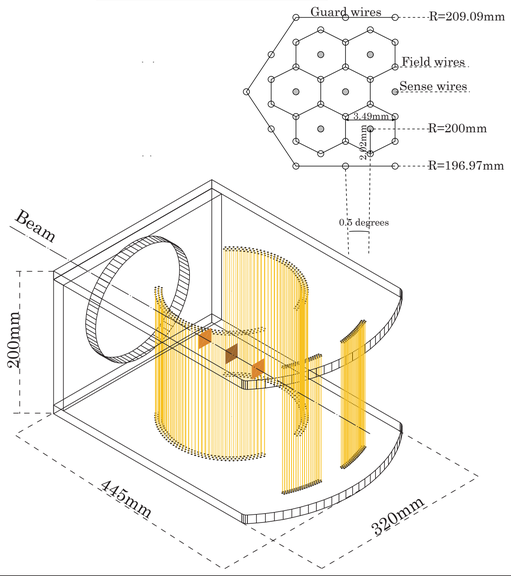


weight ~300t
∫ Bdl=0.81Tm
B_{center}=0.71T

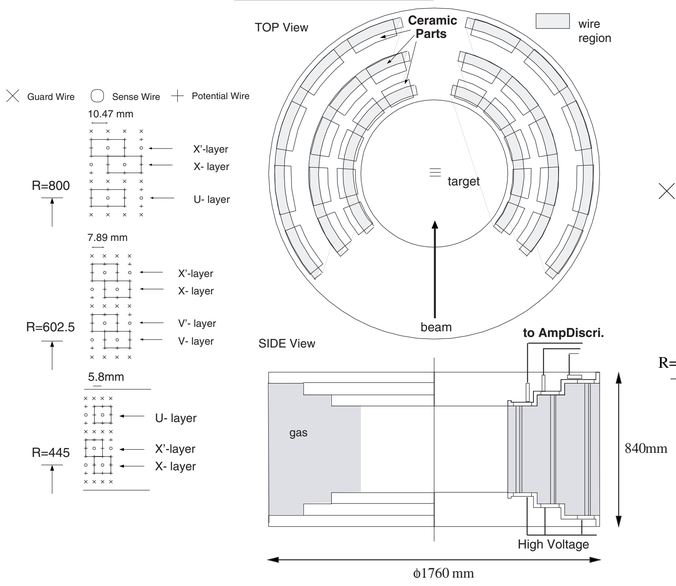


Ar:C_2H_6 = 50:50 @1atm

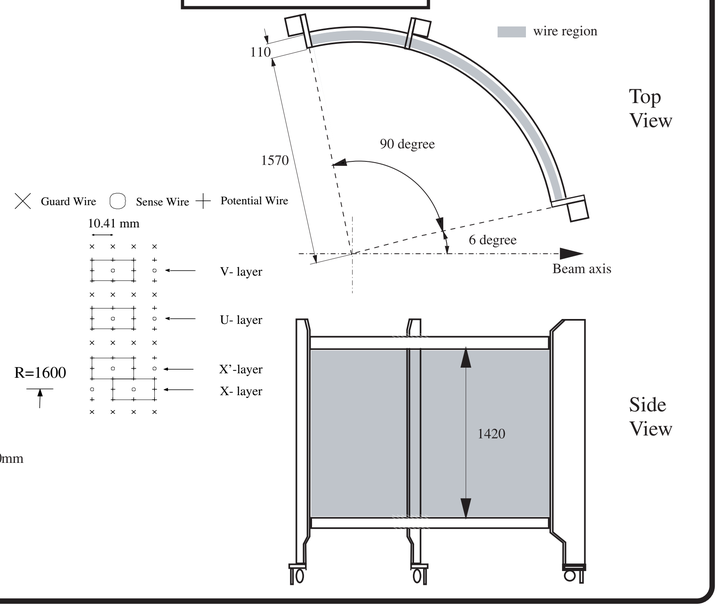
VTC
with 1.8mm DriftLength



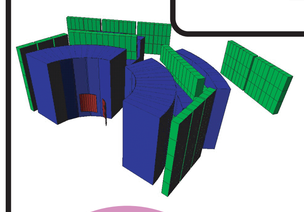
CDC
with Ceramc plates



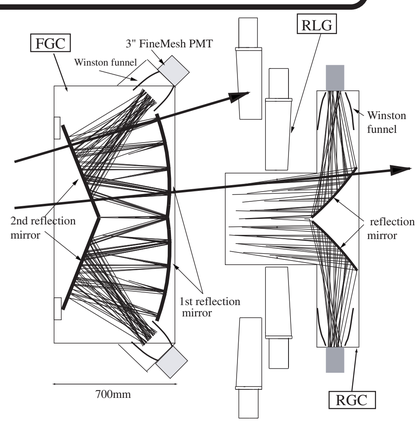
BDC
with minimized materials

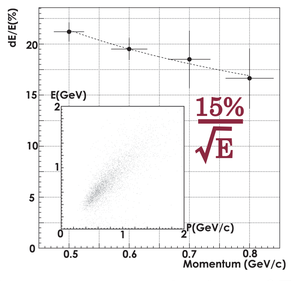


Electron ID



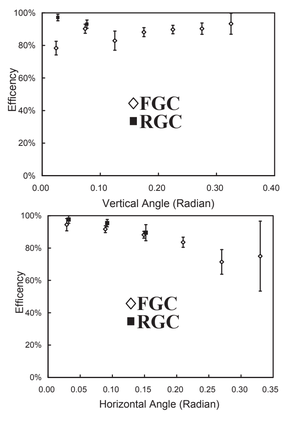
GC Gas is used
Iso-Butane
(reflactive index
n=1.0019@STP)
π threshold = 2.3GeV/c



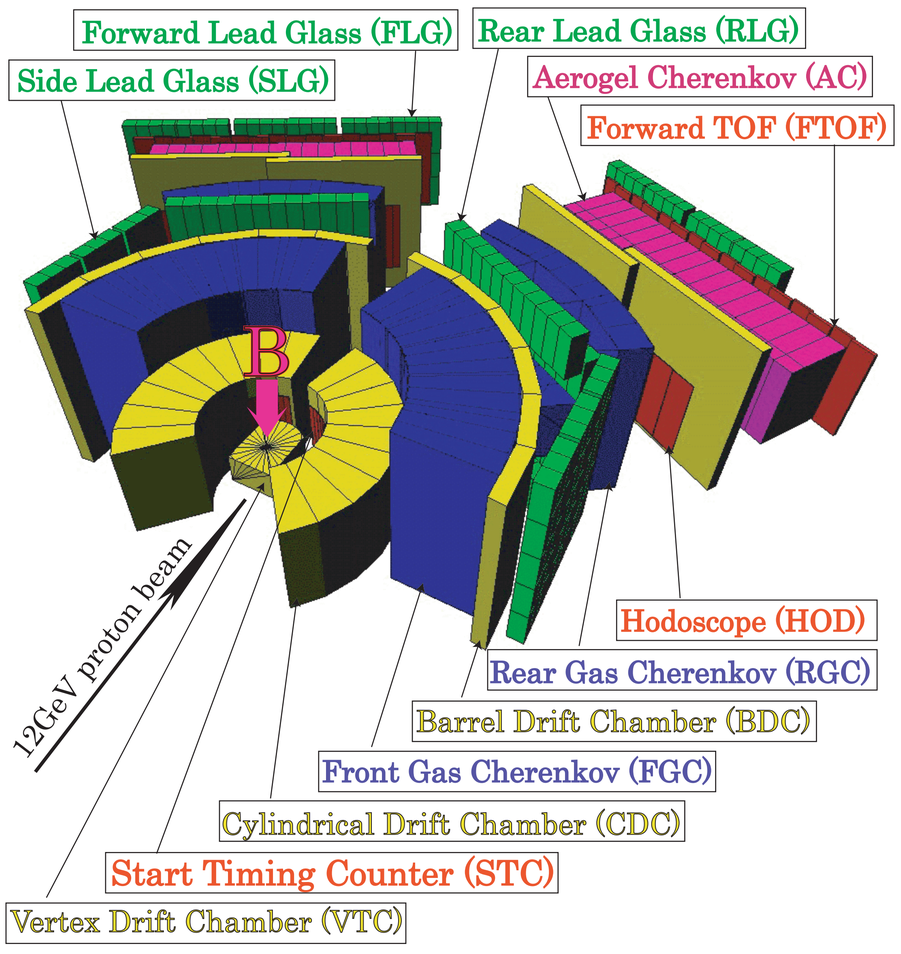


The energy resolution of RLG

Uniformity of electron efficiencies of Gas Cherenkov Counters

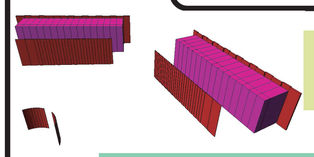


electron eff. of FGC,RGC ~83%,93%
pion rejection of FGC,RGC ~1%,2%
energy resolutin of LGs ~15%/√E



M.Sekimoto et al., Nucl. Instr. and Meth. A516, 390 (2004).

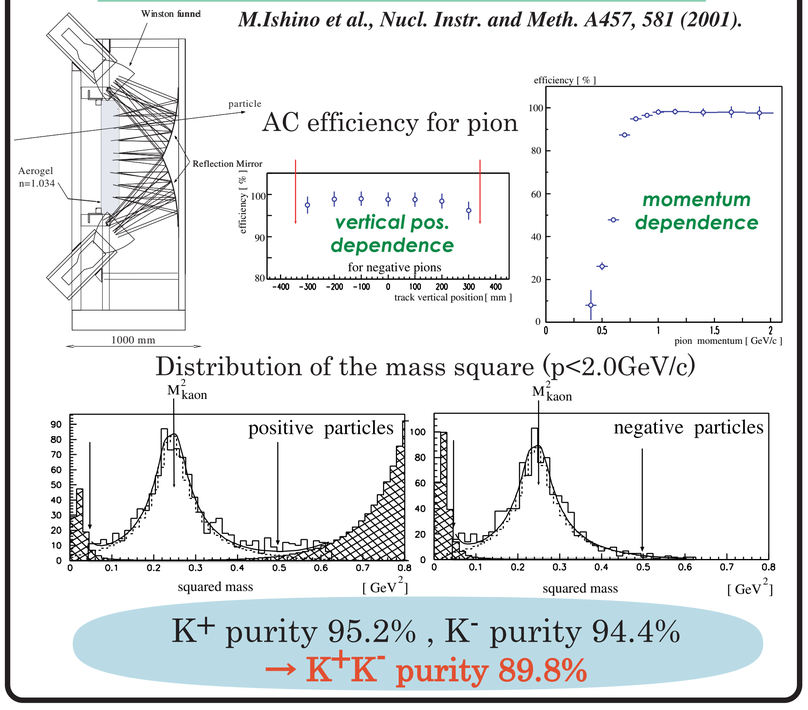
Kaon ID



Using STC-HOD-FTOF,
TOF resolution ~360ps

To trigger kaons, we use AC.
(Reflactive index of Silica aerogel n=1.034)
π ,K threshold = 0.53GeV/c, 1.88GeV/c

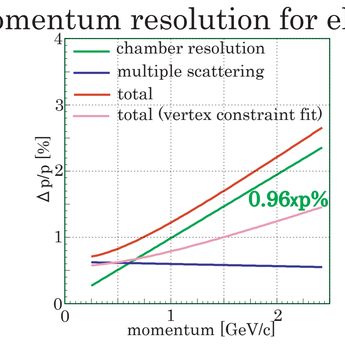
M.Ishino et al., Nucl. Instr. and Meth. A457, 581 (2001).



K^+ purity 95.2% , K^- purity 94.4%
→ K^+K^- purity 89.8%

Spectrometer Performance

momentum resolution for electron

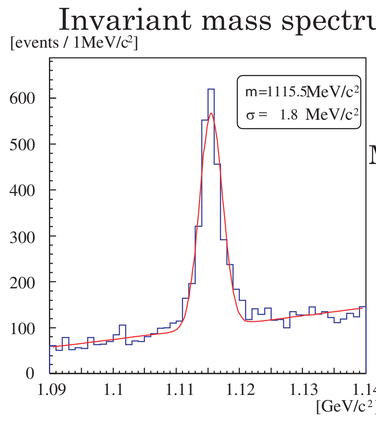


electron identification eff.
and pion rejection capability

counter	$e^{\pm}$	$\pi^{\pm}$
FGC	0.825±0.010	0.0142±0.00006
RGC	0.93±0.011	0.0212±0.0008
SLG	0.87±0.03	0.009±0.001
RLG	0.97±0.01	0.031±0.001
Two stage coincidence	0.78±0.01	0.00027±0.00001

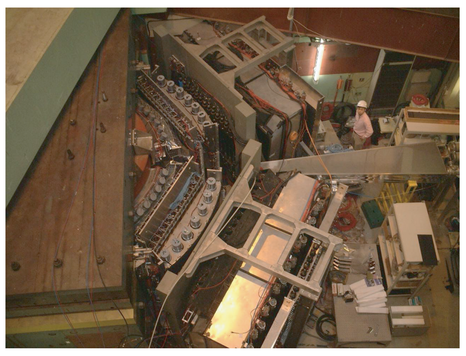
In final e^+e^- sample
$e^+\pi^-$ and $e^-\pi^+$ background ~19%
$\pi^+\pi^-$ background ~1%

Invariant mass spectrum of $\Lambda \rightarrow p\pi^-$

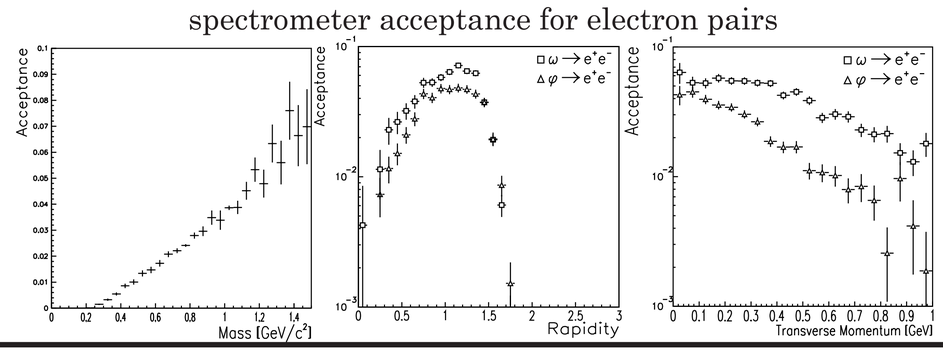


M_Λ = 1115.5MeV/c^2
(PDG 1115.7MeV/c^2)

σ_Λ = 1.8MeV/c^2
(Sim. 1.9MeV/c^2)

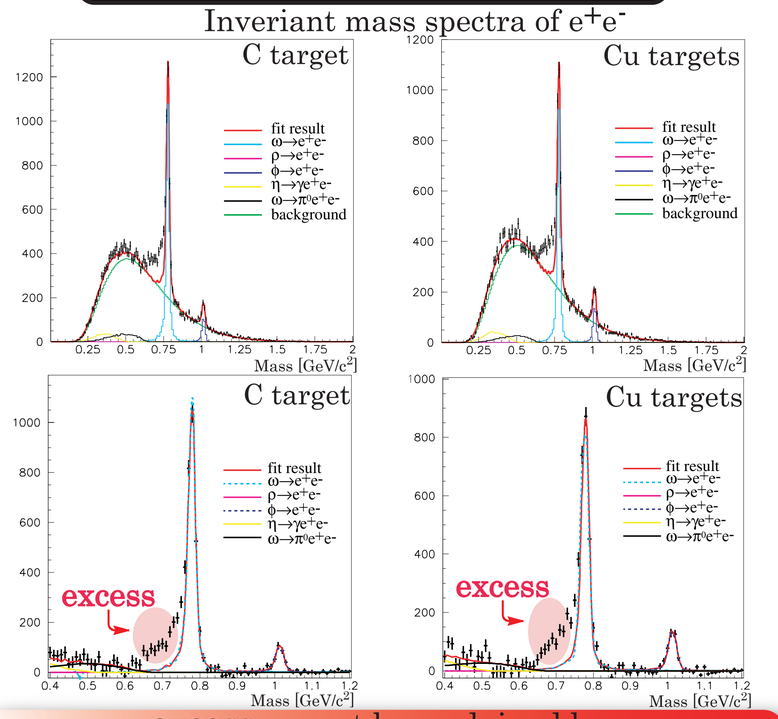


spectrometer acceptance for electron pairs



e^+e^- Spectrum

Inveriant mass spectra of e^+e^-



excess cannot be explained by
any known physical process or experimental effects !