Measurement of Invariant Mass Spectra of Vector Meson Decaying in Nuclear Matter

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- Introduction
- E325 Setup
- Prelimirary Result of 2002 data analysis
- Summary

Physics

The Origin of Quark Mass...

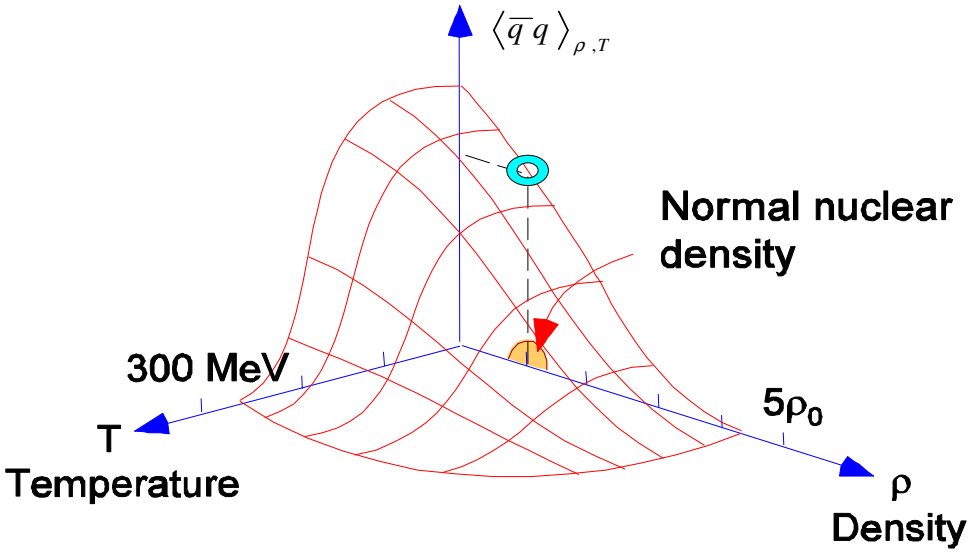
In QCD vacuum

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

Chiral Symmetry restoration

In HOT/DENSE Matter

$$m_u \cong m_d \cong 5MeV$$
$$m_s \cong 150MeV$$



How to detect the quark mass modificatoin?

Vector Mesons

Vector Meson

Mass of Vector Mesons, ρ , ω and ϕ

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

ρ / ω

Mass Modification will be relatively large

~ 150MeV

ϕ

Mass Modification *20~40MeV*

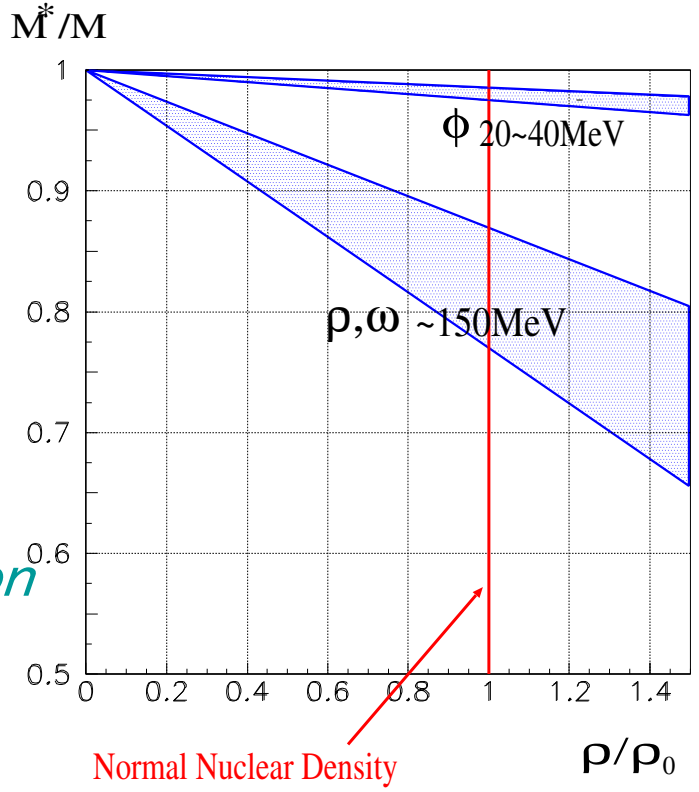
Narrow Width ~ 4.4MeV

→*Sensitive to the Mass Shape Modification*

Small Q value (Q_{KK}=32MeV)

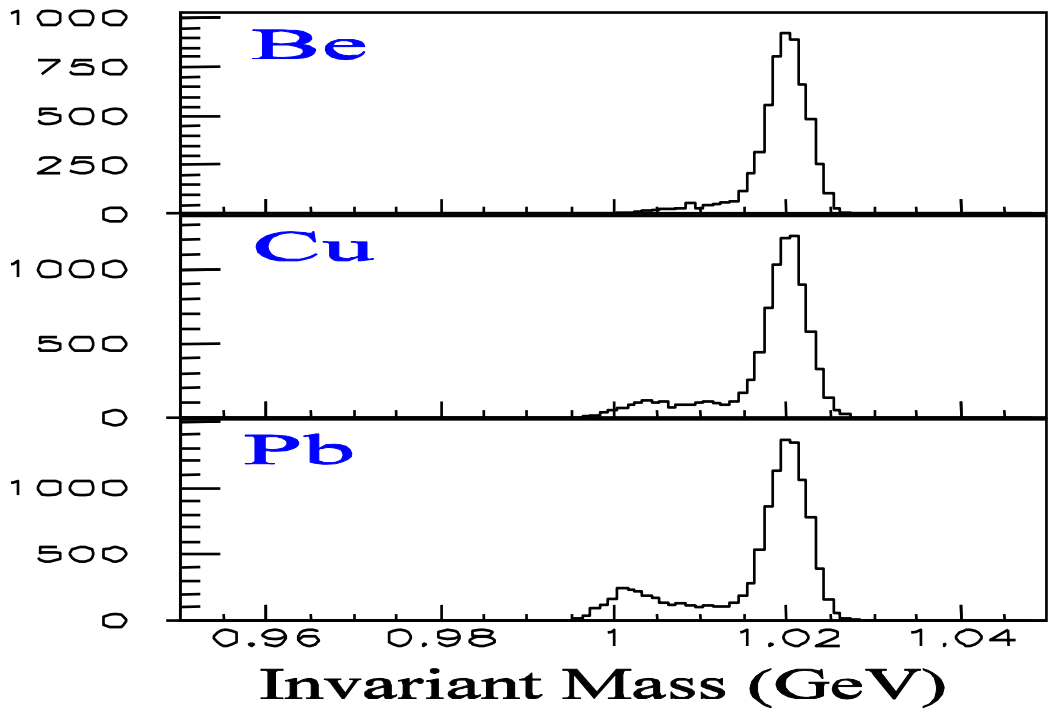
→*Branching ratio* $\Gamma\ \phi \to K^+K^- / \Gamma\ \phi \to e^+e^-$

will be another good probe



KEK-PS E325 -Expected Signals-

We measure Vector Meson Decay Inside a Nucleus,
in 12GeV p+A → ρ, ω, ϕ + X.

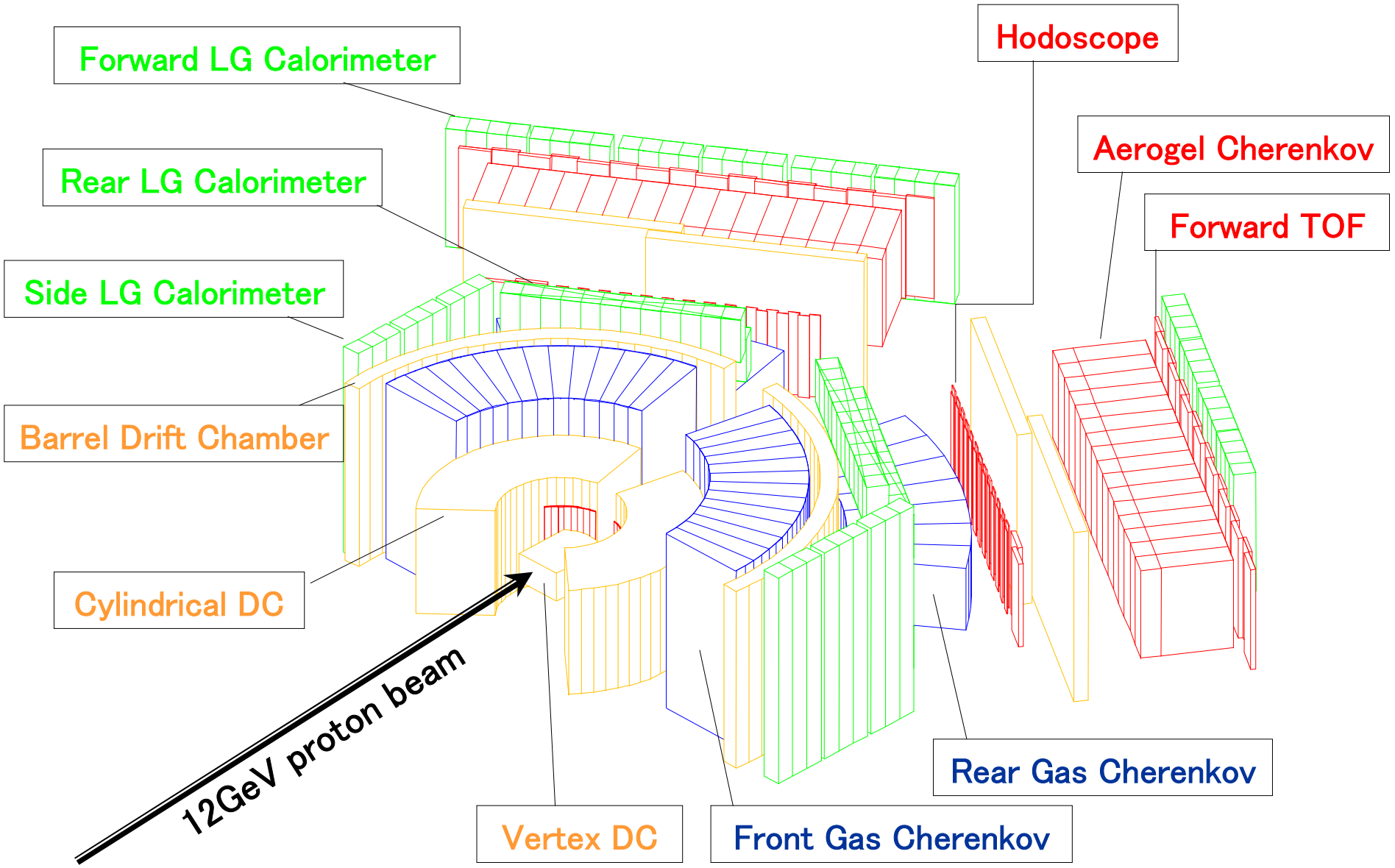


Expected Signals of $\phi \rightarrow e^+e^-$ Invariant Mass Spectrum
(Simulation using Hatsuda's prediction)

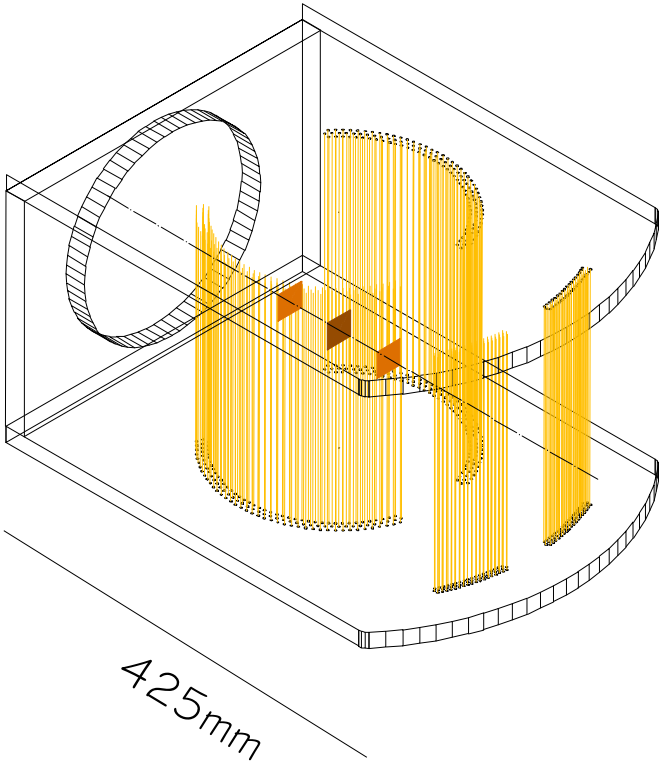
History

		$\phi \to K^+K^-$	$\omega \to e^+e^-$ $\phi \to e^+e^-$
1997 June	First Physics Run with K^+K^-	99	
1998 May	Already Published (P.R.L. 86 (2001) 5019)		95 12
1999 July	Hawaii JPS/QM2002/PANIC02	178	~700 ~125
2000 June Dec.	Production Run with newly installed Vertex Chamber & Lead Glass Calorimeter		
2001 Nov.	Production Run	~570	~4800 × 2 ~930 × 2
2002 Feb.	LAST Production Run		

Set up


Forward LG Calorimeter
Rear LG Calorimeter
Side LG Calorimeter
Barrel Drift Chamber
Cylindrical DC
12GeV proton beam
Vertex DC
Front Gas Cherenkov
Rear Gas Cherenkov
Hodoscope
Aerogel Cherenkov
Forward TOF

New Detectors

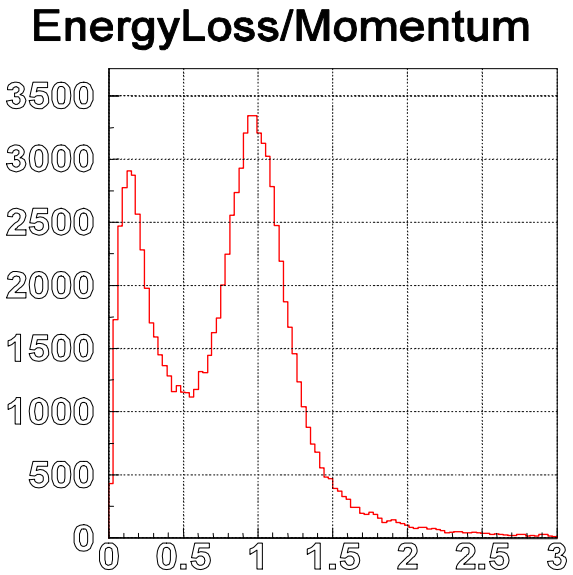


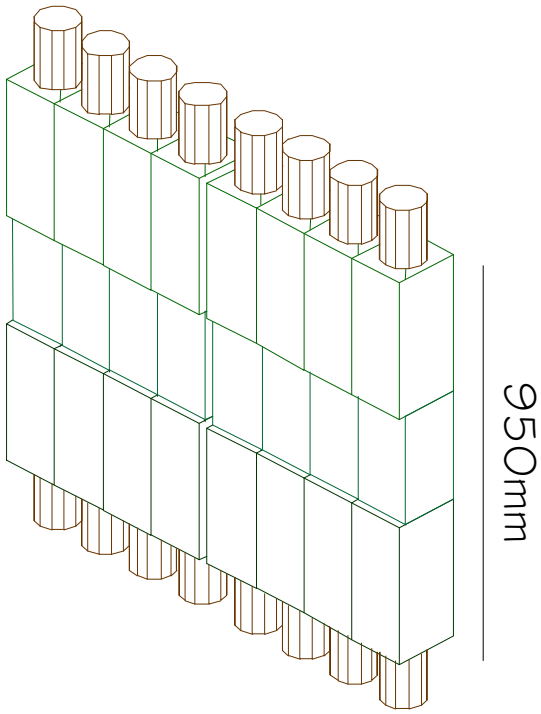
Vertex Drift Chamber

- momentum resolution
- vertex resolution

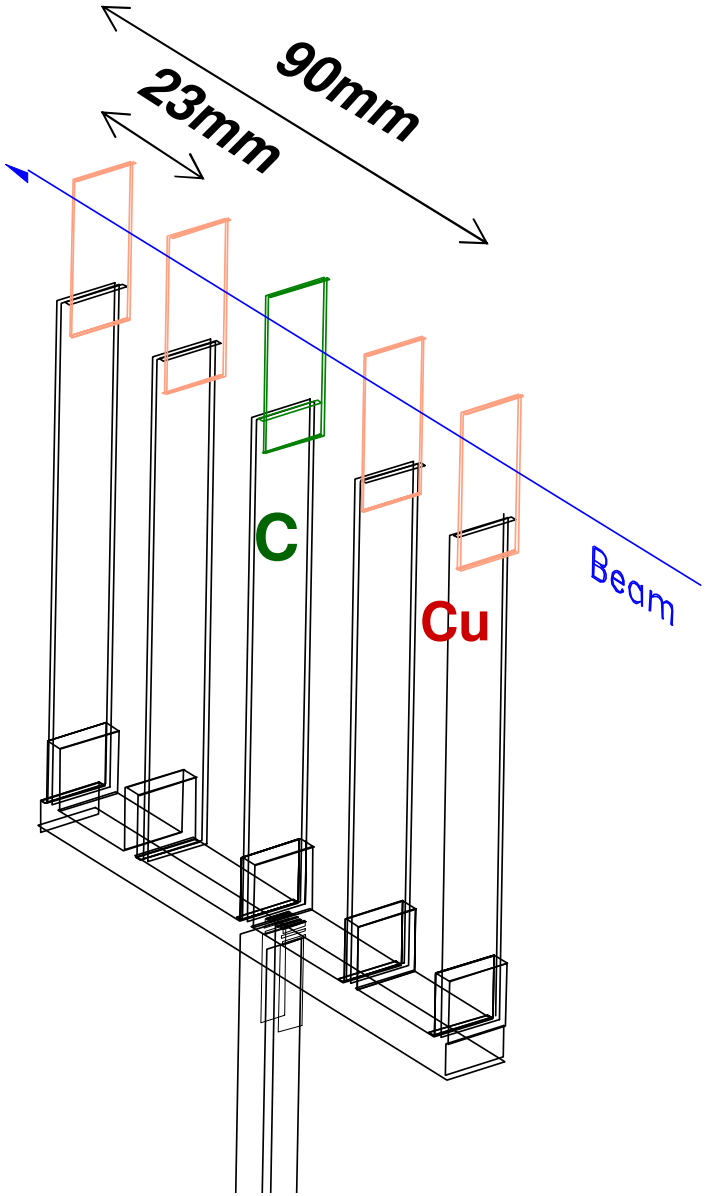
Forward EM Calorimeter

-electron ID efficiency

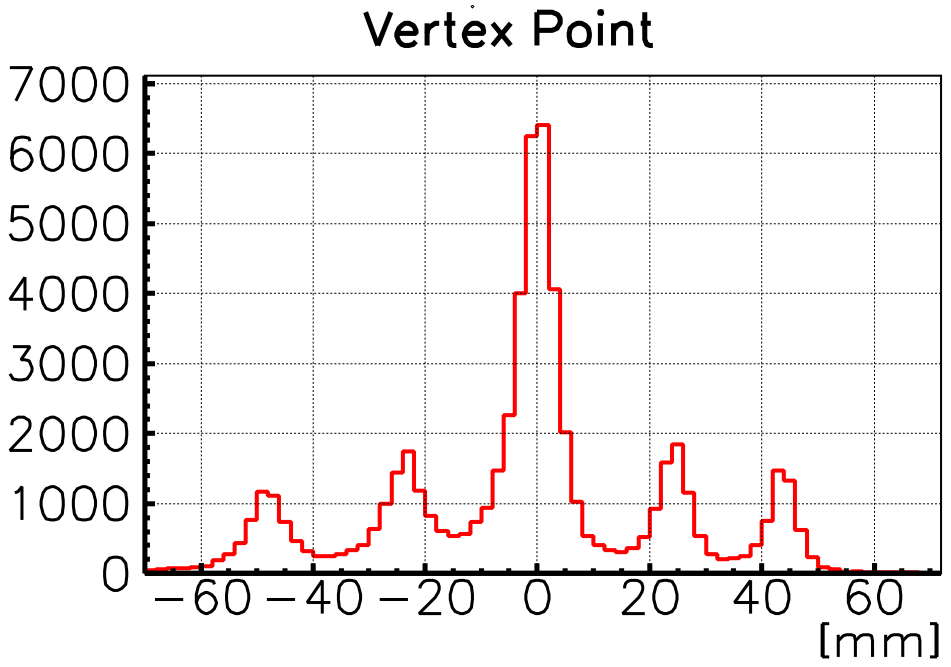




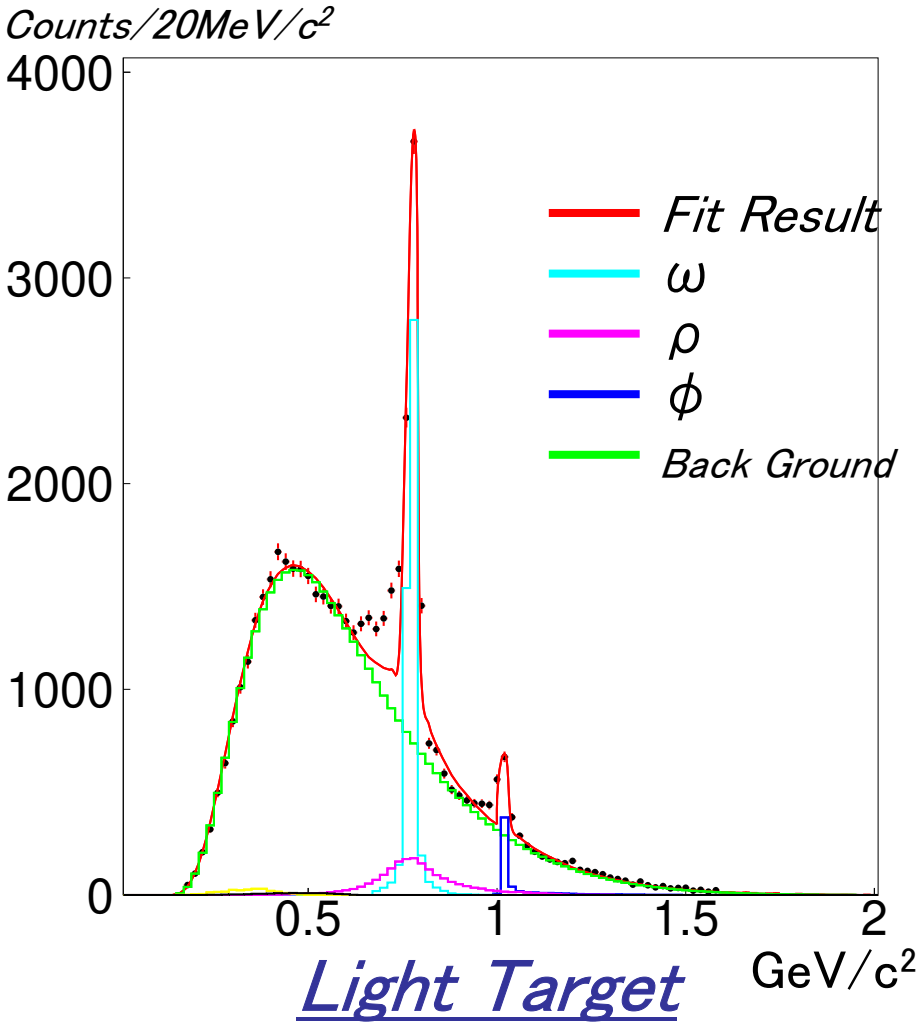
Target



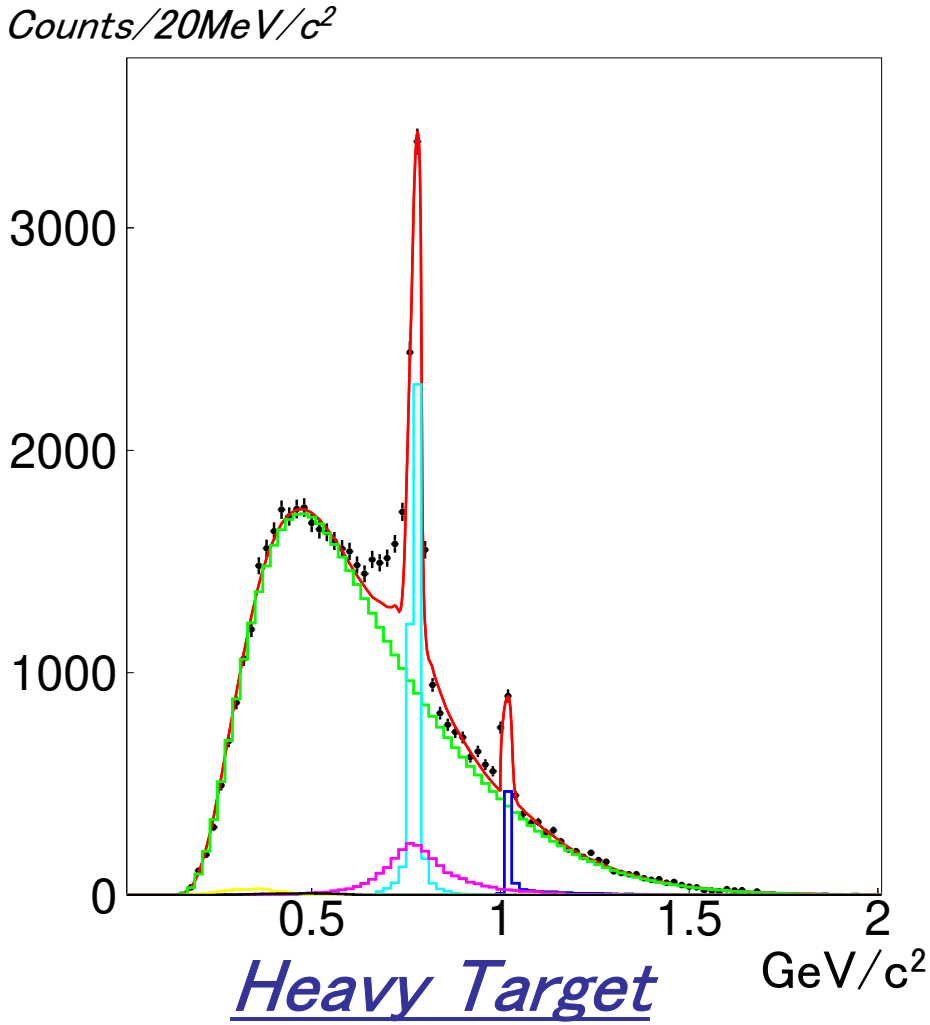
year	material	beam intensity	Interaction length	radiation length
'97	CH_2/C/Pb	1.3×10^{8}	0.6%	4.9%
'98	CH_2/C/Cu	1.6×10^{9}	0.12%	0.4%
'99	CH_2/C/Cu	0.9×10^{9}	0.24%	0.8%
'00-'01	C/Cu(2)	$\sim1\times10^{9}$	0.22%	1.4%
'02	C/Cu(4)	$\sim1\times10^{9}$	0.42%	2.2%



Invariant Mass Spectrum of e^+e^- ('02 Data)

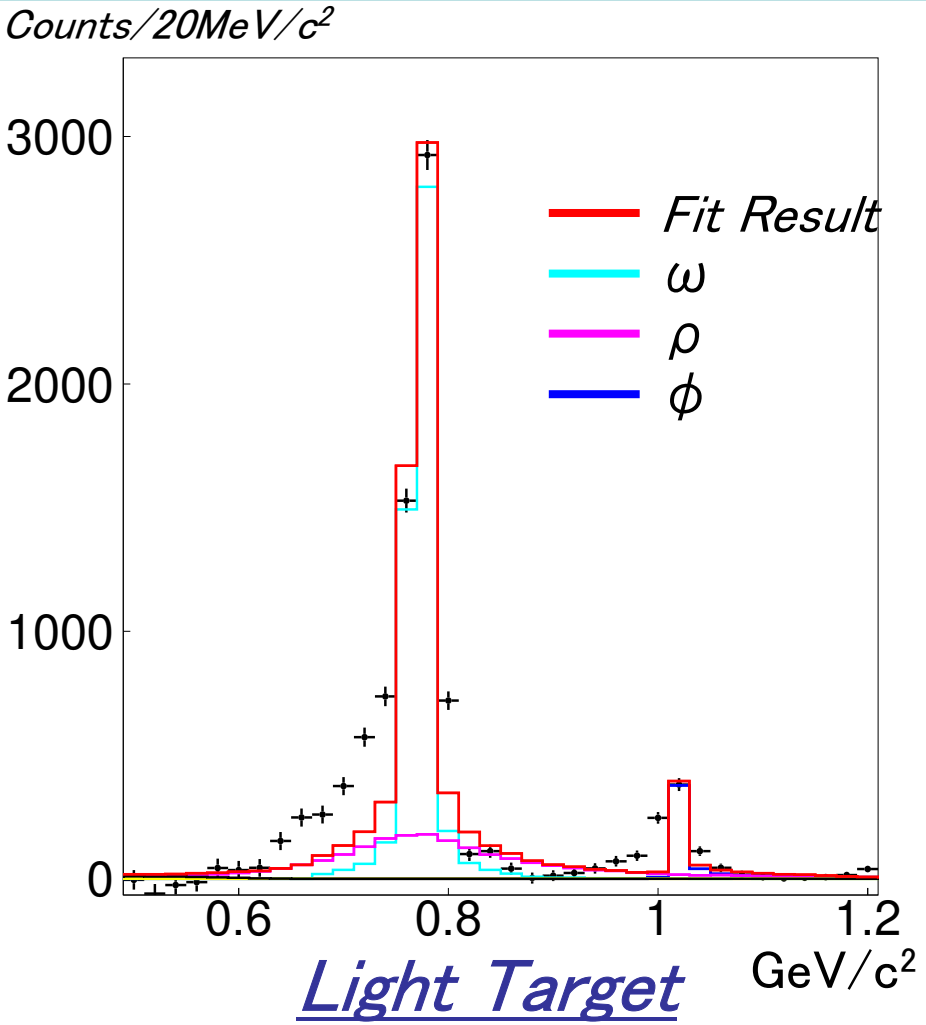


Light Target
(Carbon)

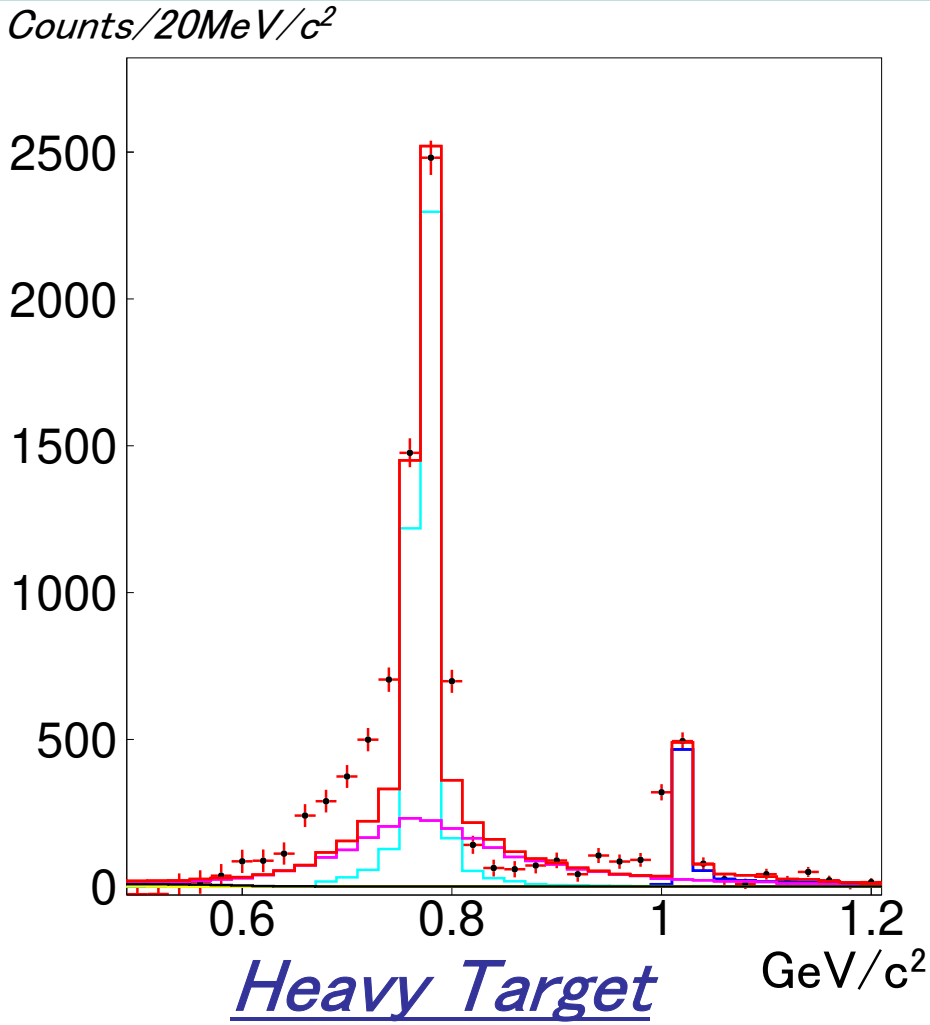


Heavy Target
(Copper)

BackGround Subtracted Invariant Mass Spectrum of e^+e^- ('02 Data)



Light Target
(Carbon)



Heavy Target
(Copper)

Summary

- KEK PS-E325 detects 12GeV p+A$\rightarrow \rho, \omega, \phi$+X reactions in both K+K- and e+e- channel. We measure the shape of the invariant mass and the branching ratio.
- In the 2002 e+e- data, we have observed excesses over the known hadronic sources below the ω peak. Obtained ρ / ω ratio support that this excess is mainly due to the modifications of ρ meson.
- Some hint on ϕ meson modifications is seen.
- In near future, statistics will be about 2 times larger. We plan to obtain the dependence of the momentum of vector mesons.