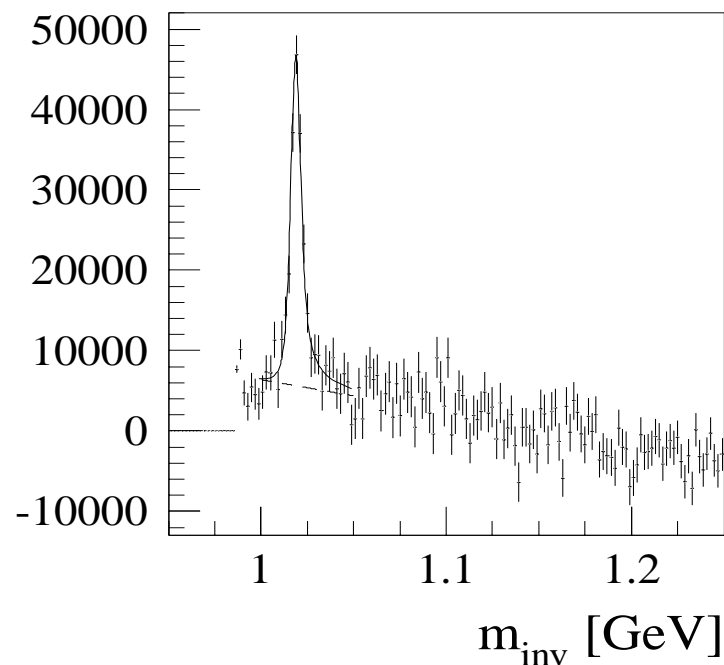


# $\phi$ -Production in Central Pb+Pb Collisions at 158 AGeV

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## Note on $\phi \rightarrow e^+ e^-$

- NA50 results
- (Close to) final status  $\phi \rightarrow e^+ e^-$
- To-Do



## NA49:

Multiplicity:

$7.6 \pm 1.1$

Mass:

$1018.7 \pm 0.5$  MeV

## PDG:

1019.4 MeV

Width  $\Gamma_0$ :

4.4 - 6.0 MeV

4.46 MeV

$\sigma_m$ :

1.2 - 1.6 MeV

Ref.: NA49: Phys.Lett. B491 (2000) 59

## Selected decay channels (PDG):

$K^+ K^-$   $(49.2 \pm 0.7) \times 10^{-2}$  (NA49)

$e^+ e^-$   $(2.91 \pm 0.07) \times 10^{-4}$  (NA49)

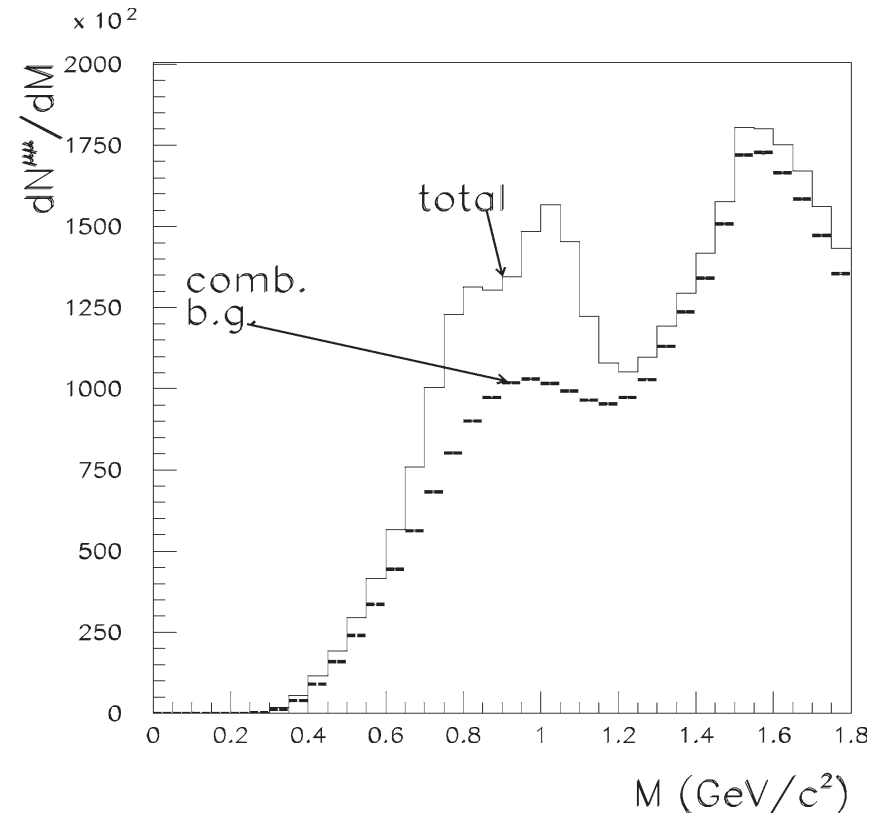
$\mu^+ \mu^-$   $(3.7 \pm 0.5) \times 10^{-4}$  (NA50)

**NA50:**

- Huge number of events: 170 million
- Approximately 130k reconstructed  $\Phi \rightarrow \mu^+ \mu^-$  mesons

**Acceptance:**

- High  $m_t$  1.5 GeV to 3 GeV
- Mid-rapidity:  $0 \leq y_{CM} \leq 1$



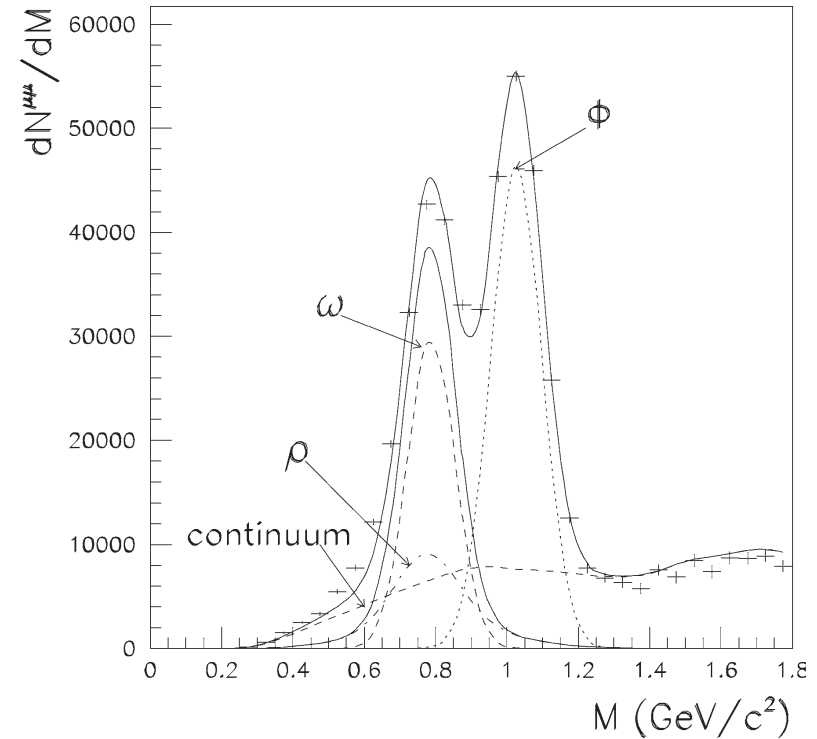
Ref: Physics Letters B 555 (2003) 147-155

### Characteristics:

- Muon spectrometer
- Multiple scattering of  $\mu$  in absorber
- Mass resolution constant:  $70 \text{ MeV}/c^2$

### Acceptance:

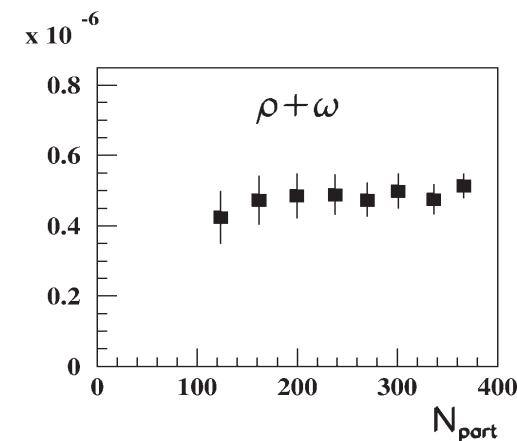
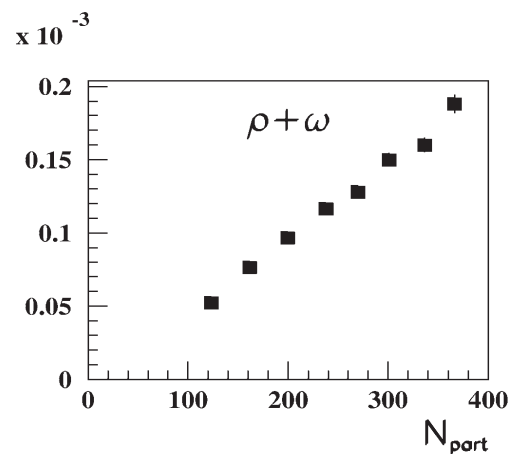
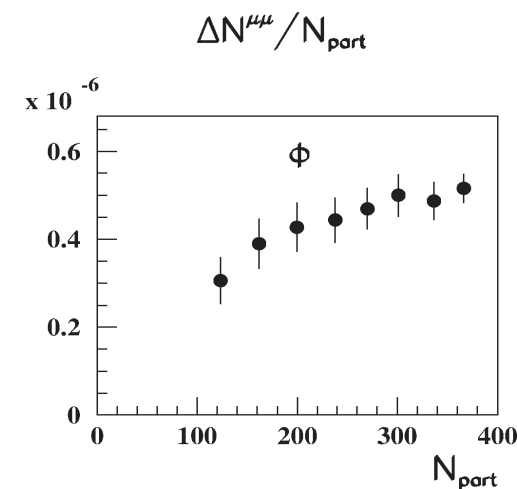
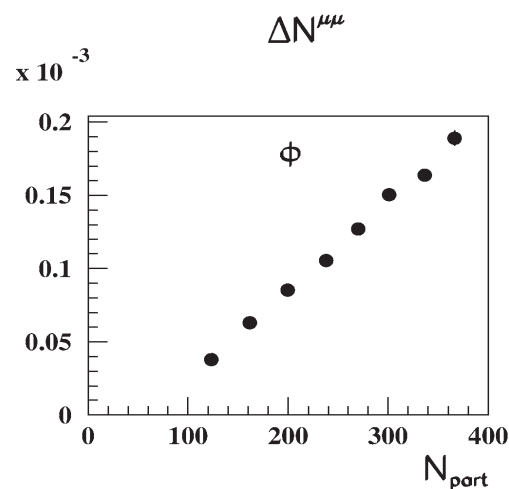
- High  $m_t$  1.5 GeV to 3 GeV
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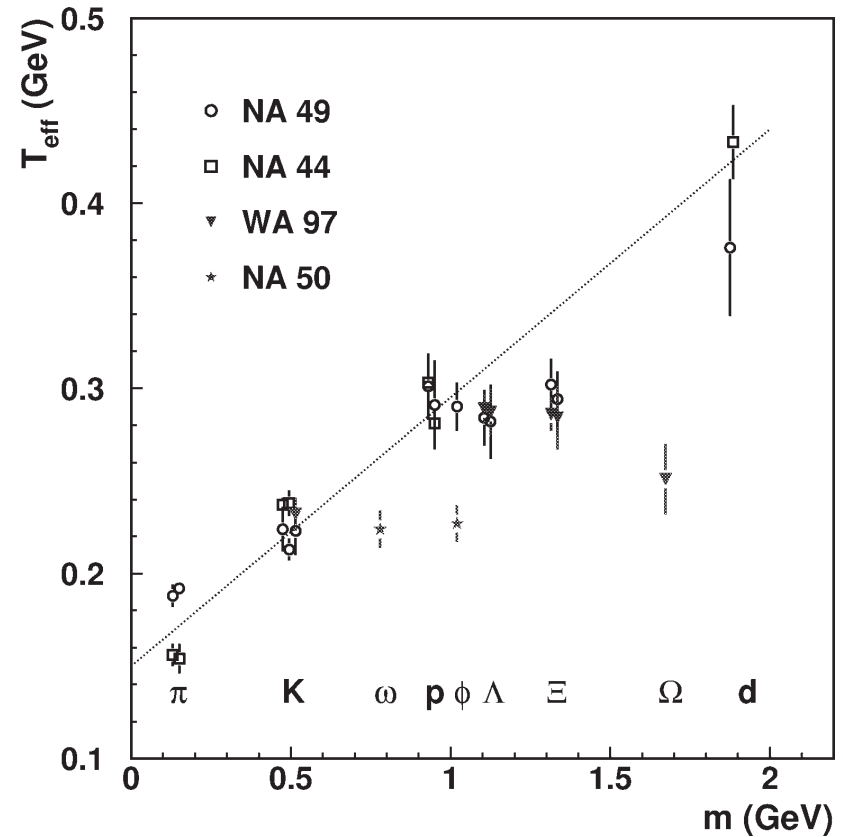
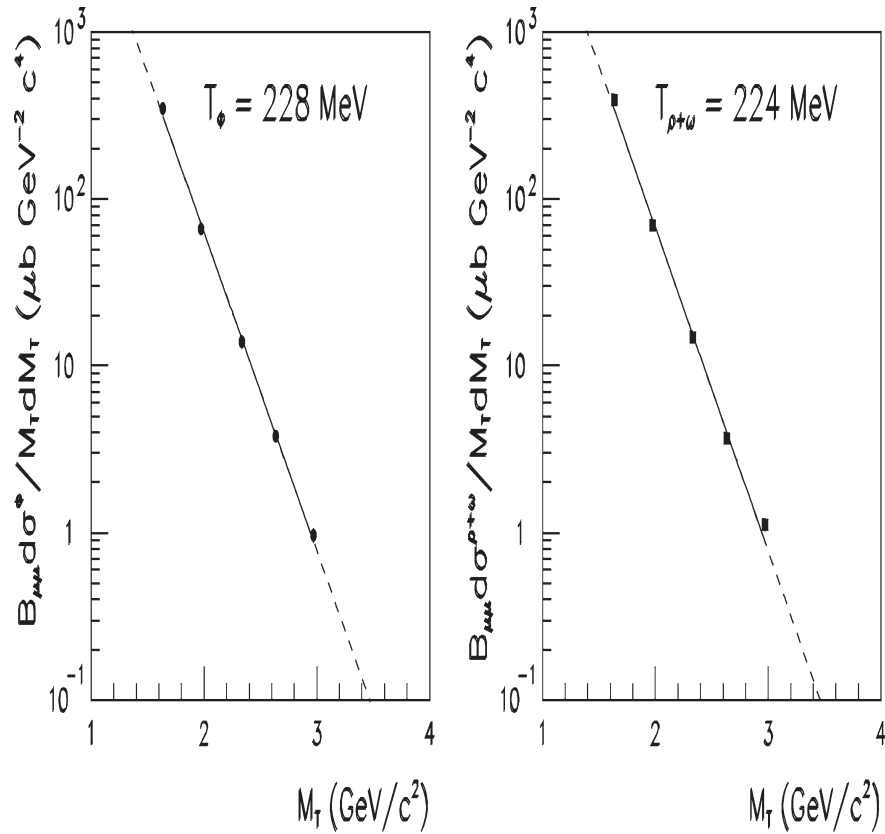


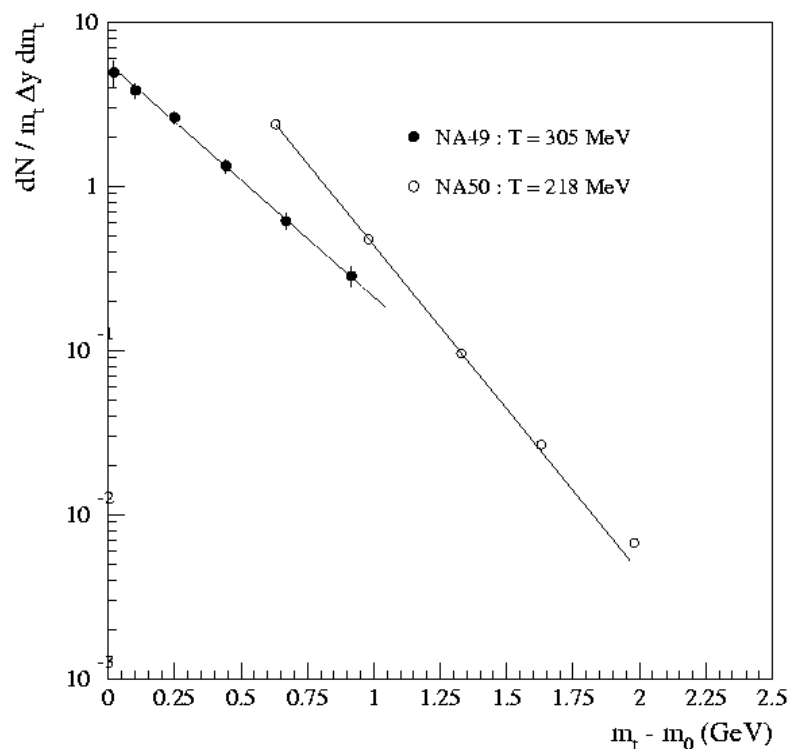
+

## Multiplicities:

- Ratio  $\phi$  to  $\rho + \omega$  close to 1 (central coll.)
- After correction for branching ratio:  $\Delta N_{\phi} = 0.54$  (in their acceptance)
- This confirms their first result







Updated plot needed with estimate on **systematic errors!**

- Overlapping region:

- 3 times more  $\phi$
- Slopes differ by 40%

- Possible experimental problems
- **New properties** of vector mesons in **hot hadronic matter** ?
- **Rescattering** of decay products ?

- Theoretical thoughts:

- p.e. R.A. Schneider, W. Weise  
 hep-ph/0102189  
 and references herein

### Assumptions:

- Straight line **extrapolation** of logarithmic  $m_T$ -Spectra to  $m_T = 0$
- **Same rapidity distribution** as measured in NA49

### Theoretical predictions:

- Due to rescattering of kaons rapidity distribution should be narrower in muon channel

### Result:

- Total yield **> 40**
- This is more than **5 times higher** than NA49 yield  $7.6 \pm 1.1$



RQMD calculations:

- 26% of all  $\Phi \rightarrow K^+ K^-$  have rescattered or absorbed daughter
- **Hardening** of observed  $m_t$  spectrum:
  - $T = 242 \pm 4$  MeV (NA50: 227 MeV, NA49: 305 MeV)
- **Broadening** of rapidity distribution
- Observed change in absolute multiplicity not explained by rescattering
- Ref.: S.C. Johnson, B.V. Jacak, A. Drees  
Eur. Phys. J. C. DOI 10.1007/s100520100569 (2001)

- Two contradicting measurements of total yield

No theoretical explanation

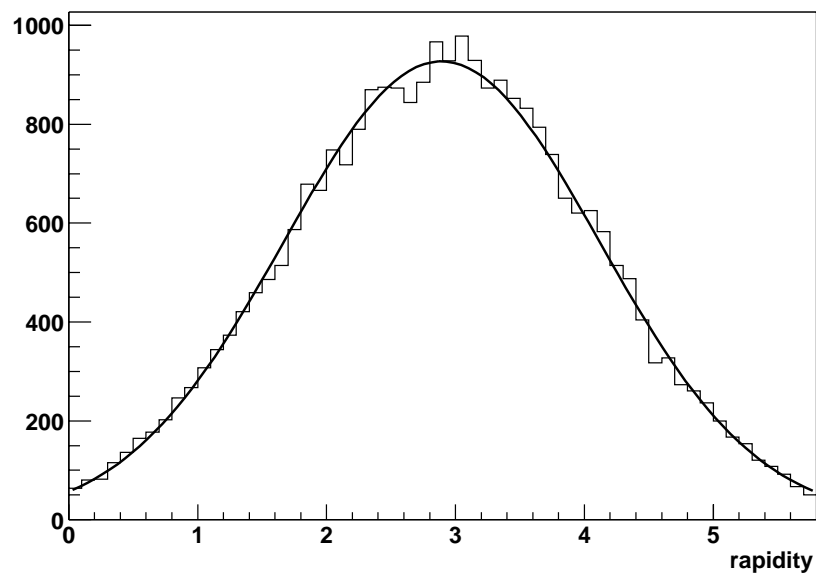
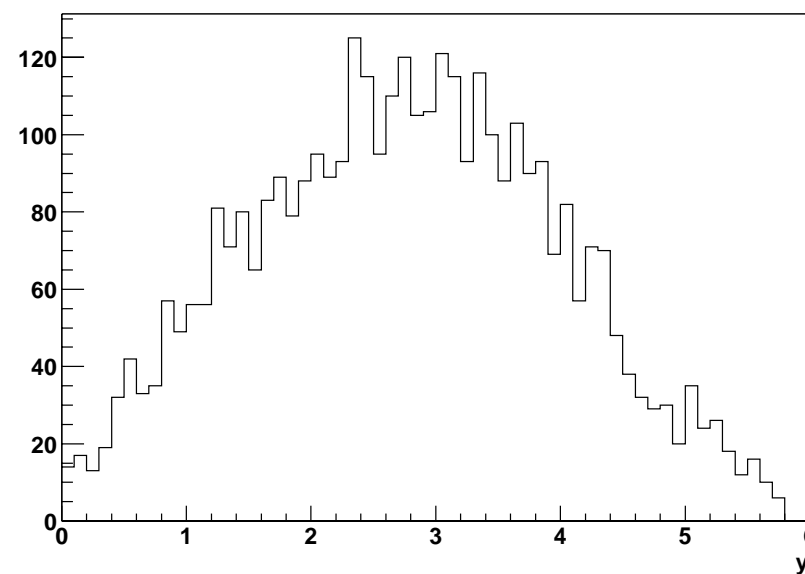
→ New experimental program  $\Phi \rightarrow e^+ e^-$

### General Method:

- Take known experimental data as input for simulation
- Simulation for detector acceptance and efficiency
- Optimization of cut variables
- Analysis of data

## Embedding:

- Status of reconstruction chain July 2002: 52,000  $\phi$ 's embedded  
i.e. Simulation includes 256tbins and corresponding changes but not latest fixes
- NA49  $K^+K^-$  rapidity width 1.22, pt slope parameter 305 MeV

generated  $\Phi$  rapidity

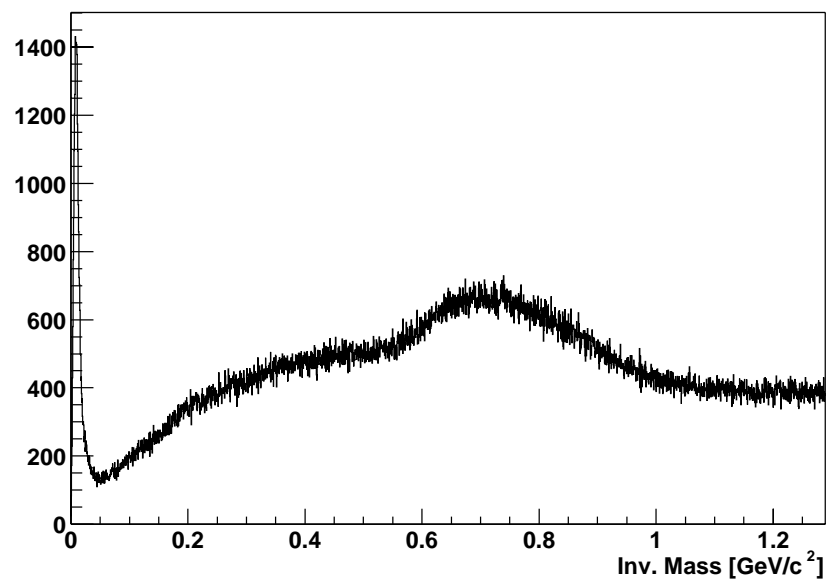
<u>Cuts</u>	<u>old</u>	
bx	< 1.9	cm
by	< 1.0	cm
Number of points (VT1 or MTPCs)	> 50	(PID)
Sum of points VT1 + VT2	> 30	(no MTPC only)
Mass window around $\phi$ mass	$\pm 7$	MeV
p	1-20	GeV
pt	> 0.29	GeV

Corrections:

Efficiency * acceptance	1%	98
Particle identification	56%	1.78
Branching ratio	$2.91 \times 10^{-4}$	3436

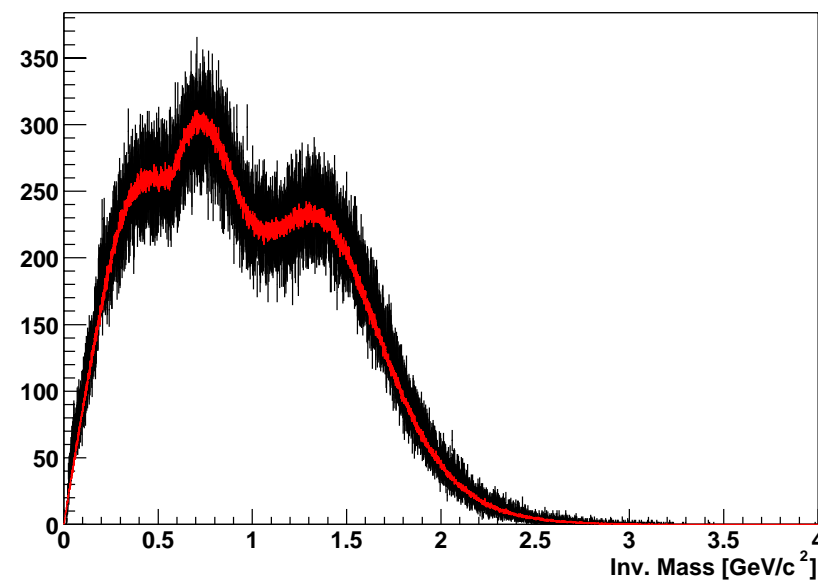
Expected significance:

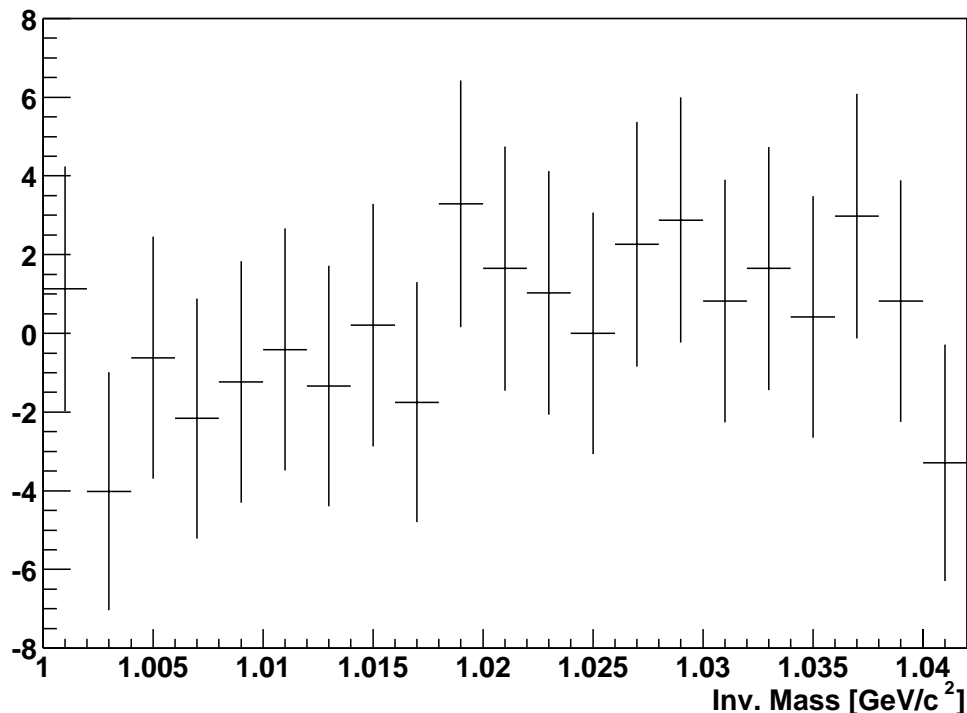
Signal to sqrt (background)      0.47



2,912,966 events  
818,822 e<sup>+</sup>e<sup>-</sup> pairs

Removal of electrons from conversions  
by lab. frame opening angle cut



$\phi$  yield per event:

- $\phi \rightarrow e^+ e^-$ :  
 $6 \pm 16.5 \pm \text{syst.}$
- Upper limit (95% C.L.):  
39
- NA49  $\phi \rightarrow K^+ K^-$ :  $7.6 \pm 1.1$
- NA50  $\phi \rightarrow \mu^+ \mu^-$ :  $> 40$

Background determined by polynomial fit outside  $\phi$  mass region:  
Fit from 960 to 1010 MeV and from 1030 to 1080 MeV,  
extrapolation through  $\phi$  mass region

- **Upper limit** below extrapolation of NA50 yield  
BUT: systematic error quite high
- Meeting with NA50 April, 2<sup>nd</sup>
- Last checks:  
Momentum resolution: simulation  $\gamma \rightarrow e^+ e^-$
- Write note