Mesons in ep missing spectra

G. M. Urciuoli

- Meson photoproduction provide a good tool to study nucleon resonances. For example, a large number of resonances predicted by the constituent quark model still not discovered in πN scattering and π photoproduction, possibly because of the weak coupling to the pion, could be observed in meson photoproduction.
- With respect to experiments that measured meson production with real γ, APEX could provide a much higher intensity primary beam that could compensate for the much smaller acceptance. Besides, APEX could be able to produce missing mass spectra with a resolution improved of about two orders of magnutude.

Comparison APEX - SPring-8/LEPS (1)

Primary beam:

APEX: $6*10^{14}$ electrons,

Spring-8/LEPS: $5*10^{11}$ photons

Proton angular acceptance

APEX: ± 50 (vertical) x ± 20(horizontal) mrad

Spring-8/LEPS: ± 250 (vertical) x ± 120(horizontal) mrad

Proton momentum acceptance

APEX: 0.16 GeV/c

Spring-8/LEPS: 2.50 GeV/c

Comparison APEX - SPring-8/LEPS (2)

Proton
momentum resolution

APEX: $2\text{-}3*10^{-4}$

Spring-8/LEPS: 1%

Real or virtual photon
Energy resolution

APEX: $2\text{-}3*10^{-4}$

Spring-8/LEPS: 1%

An example: study of the reactions:

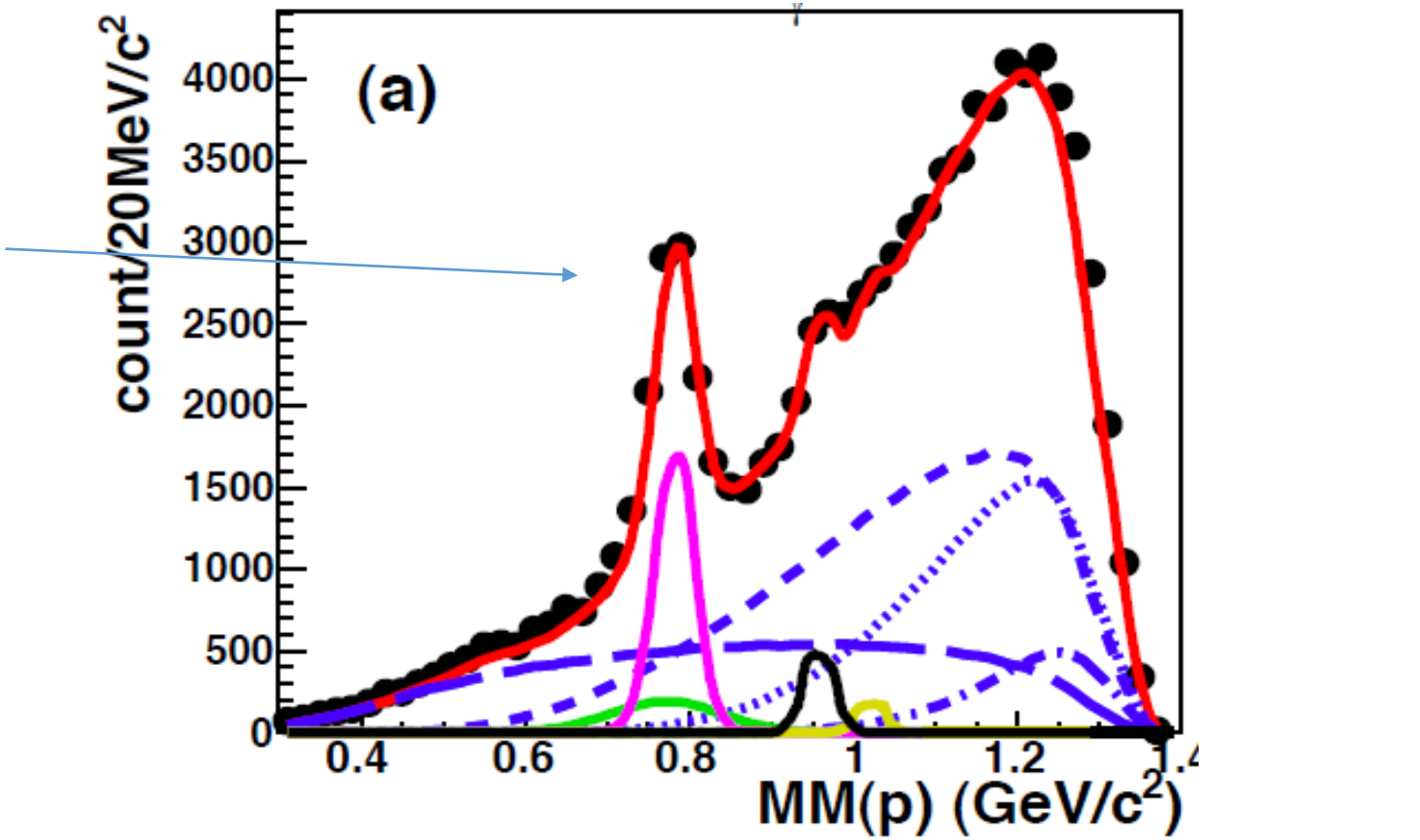
$$\gamma p \rightarrow p\omega \rightarrow p\pi^+\pi^-\pi^0$$
$$\gamma p \rightarrow p\eta' \rightarrow p\pi^+\pi^-\eta$$

- The following spectrum shows the missing mass spectrum obtained at Spring-8/LEPS with the following kinematic constriants:

$$2.125 < E_{\gamma} < 2.375 \text{ GeV} \quad 0.90 < \Theta^{P}_{C.M} < 1.0$$

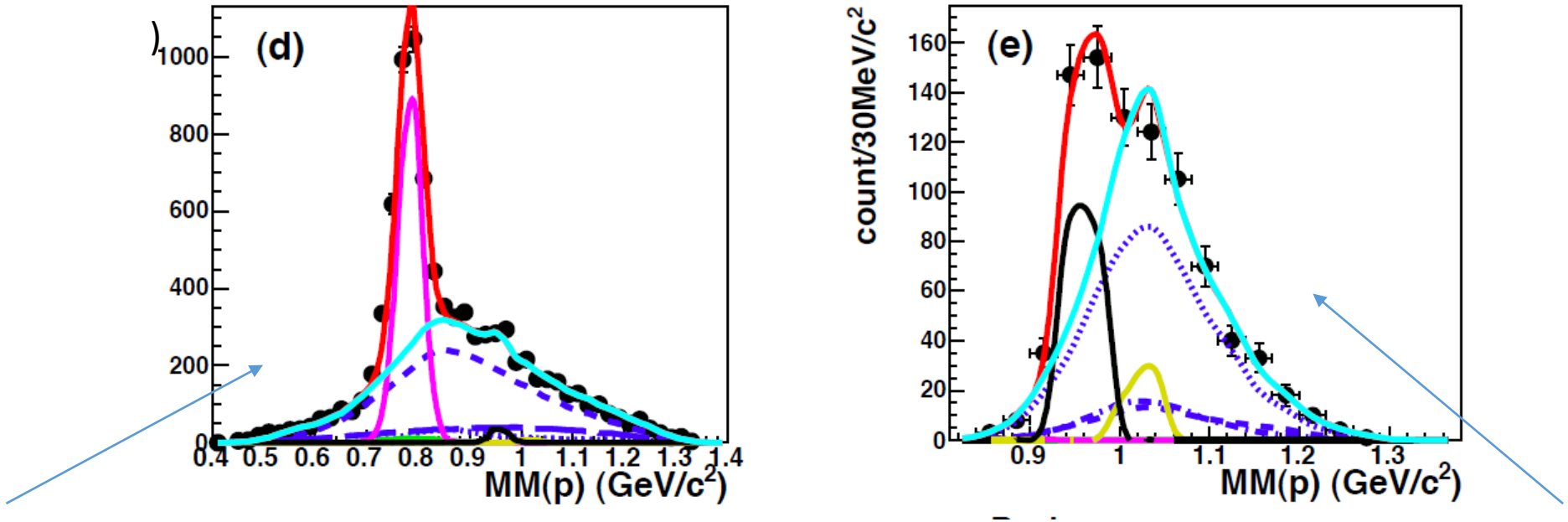
It should be noted, however, that the background was highly suppressed by the inclusion of the detections of πs in the trigger.

Much narrower in APEX



Serious possible setback to be checked:

- Without the possibility to detect the meson decay produtcs (πs and Ks), as with the present APEX apparatus, it would be impossible to apply cuts usually applied to reduce the huge background and to disentangle between diffrent contributions.
- For example it would be impossible to obtain the following spectra obtained at Spring-8/LEPS from the spectrum a) shown in the previous slide: (M $M^2(p, \pi^+, \pi^-)$ and M $M^2(p, \pi^{+/-})$ the missing mass squared for the $\gamma p \rightarrow p \pi^+\pi^- X$ and $\gamma p \rightarrow p \pi^{\pm} X$ respectively):



$0.15 < M\,M^2(p, \pi^+, \pi^-) < 0.19$ GeV²
$0.05 < M\,M^2(p, \pi^{+/-}) < 0.44$ GeV²
(to select ω)

$0.24 < M\,M^2(p, \pi^+, \pi^-) < 0.36$ GeV²
$0.40 < M\,M^2(p, \pi^{+/-}) < 0.72$ GeV²
(to select η')

To be performed

- A simulation through Monte Carlo that includes known and supposed resonances to check that APEX better resolution could compensate for the lack of meson decay product detections.

Conclusions

- APEX measurments employng mesons detected through e p mising mass spectra seem to be feasible. However aa serious check of a possible setbacks caused by the fscts that meson decay products cannot be detected should be perfrmed.