

# Direct measurement of the total width of the $\eta'$ meson

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on behalf of the COSY-11 collaboration

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Mesons	Properties		
	$m$ [ $MeV/c^2$ ]	$\Gamma$ [ $MeV/c^2$ ]	$\tau$ [s]
$\pi^\pm$	$139.5702 \pm 0.0004$	$(2.528 \pm 0.001) \times 10^{-14}$	$(2.603 \pm 0.001) \times 10^{-8}$
$\pi^0$	$134.977 \pm 0.001$	$(0.8 \pm 0.1) \times 10^{-5}$	$(8.4 \pm 0.6) \times 10^{-17}$
$\eta$	$547.51 \pm 0.18$	$(1.30 \pm 0.07) \times 10^{-3}$	$(5.10 \pm 0.29) \times 10^{-19}$
$\eta'$	<b><math>957.78 \pm 0.14</math></b>	<b><math>0.202 \pm 0.016</math> fit</b>	<b><math>(3.26 \pm 0.29) \times 10^{-21}</math></b>
		<b><math>0.30 \pm 0.09</math> mean</b>	<b><math>(2.19 \pm 0.94) \times 10^{-21}</math></b>
		<b><math>0.33</math> theory</b>	<b><math>2.00 \times 10^{-21}</math></b>
$K^\pm$	$493.68 \pm 0.02$	$(5.32 \pm 0.01) \times 10^{-14}$	$(1.238 \pm 0.002) \times 10^{-8}$
$K_S^0$	$497.68 \pm 0.02$	$(7.35 \pm 0.01) \times 10^{-12}$	$(0.895 \pm 0.001) \times 10^{-10}$
$K_L^0$	$497.68 \pm 0.02$	$(1.27 \pm 0.01) \times 10^{-14}$	$(5.18 \pm 0.04) \times 10^{-8}$



$$\text{Br}(X) \sim \Gamma(X)$$

e. g.

$$X = (\eta' \rightarrow \gamma\gamma)$$

$$\text{Br}(X) = \Gamma(X) / \Gamma_{\text{total}}$$

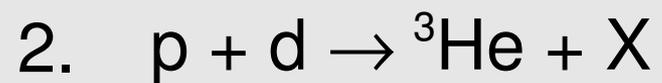
COSY (WASA-at-COSY), DAΦNE (KLOE 2), MAMI-C....





NIMROD

$$0.28 \pm 0.10 \text{ MeV}/c^2$$



SATURNE

$$0.40 \pm 0.22 \text{ MeV}/c^2$$



- |    |                                       |         |                                       |
|----|---------------------------------------|---------|---------------------------------------|
| 1. | $\pi^- + p \rightarrow n + X$         | NIMROD  | $0.28 \pm 0.10 \text{ MeV}/c^2$       |
| 2. | $p + d \rightarrow {}^3\text{He} + X$ | SATURNE | $0.40 \pm 0.22 \text{ MeV}/c^2$       |
| 3. | $p + p \rightarrow p + p + X$         | COSY    | $? \pm \mathbf{0.02} \text{ MeV}/c^2$ |



$\pi^- + p \rightarrow n + X$ 

NIMROD

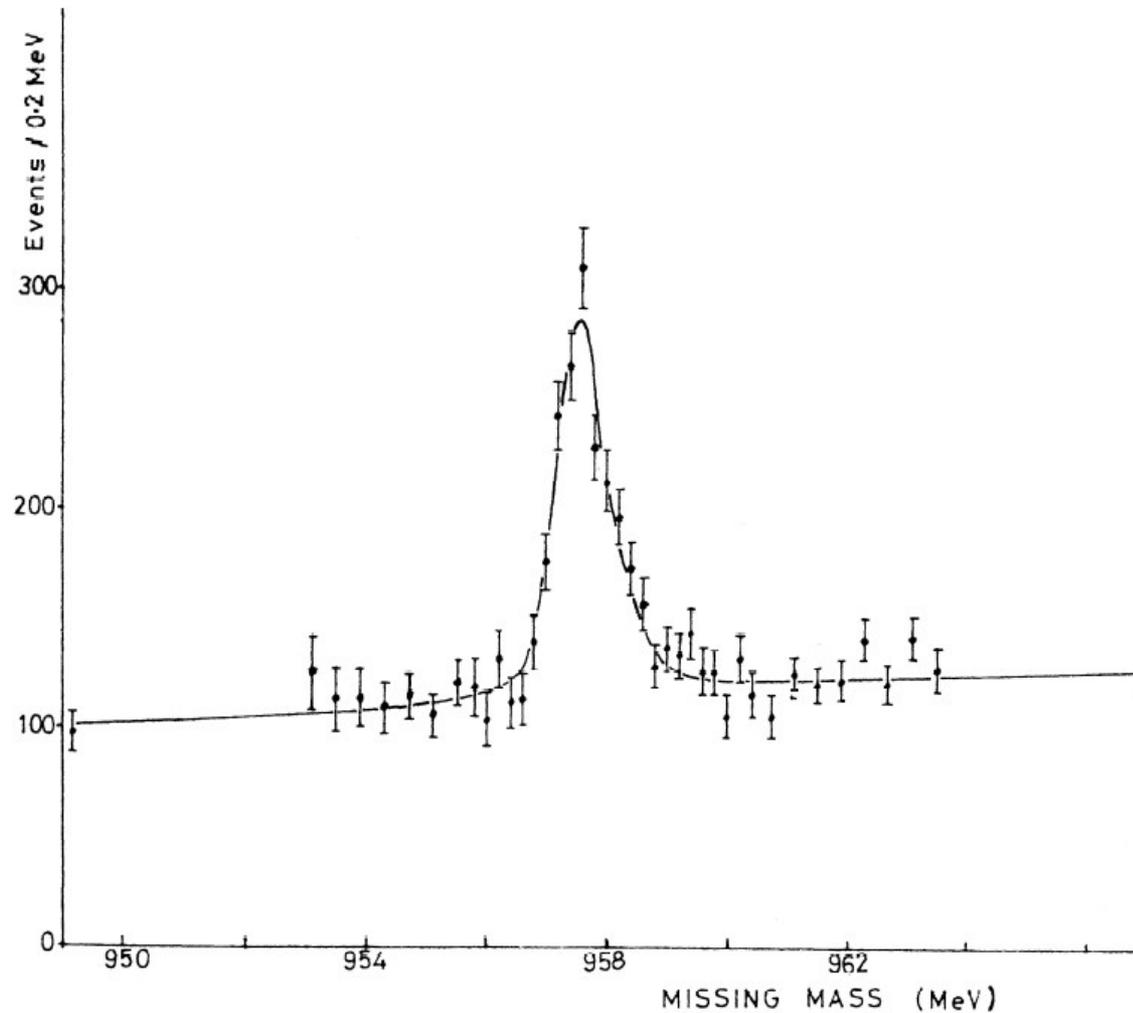
 $0.28 \pm 0.10 \text{ MeV}/c^2$ 

Fig. 3. Missing mass spectrum for reaction (1) close to the  $\eta'$  threshold ( $\approx 1.44 \text{ GeV}/c$ ). The final state c.m. momentum  $p^*$  is restricted to the range  $p^* < 28 \text{ MeV}/c$ . The bin size is  $0.2 \text{ MeV}/c^2$  in the central region and the smooth curve is the fit to the convolution of the resolution function with a Breit-Wigner of width  $\Gamma = 0.28 \text{ MeV}$  plus a quadratic background.

D. M. Binnie et al., Phys. Lett. B 83 (1979) 141



$$p p \rightarrow p p X$$

$$\mathbb{P} = ( E, \mathbf{p} )$$

$$\mathbb{P}_{\text{beam}} + \mathbb{P}_{\text{target}} = \mathbb{P}_1 + \mathbb{P}_2 + \mathbb{P}_X$$

$$m_X^2 = | \mathbb{P}_X |^2 = | \mathbb{P}_{\text{beam}} + \mathbb{P}_{\text{target}} - \mathbb{P}_1 - \mathbb{P}_2 |^2$$

$$m_X^2 = ( E_{\text{beam}} + E_{\text{target}} - E_1 - E_2 )^2 - ( \mathbf{p}_{\text{beam}} + \mathbf{p}_{\text{target}} - \mathbf{p}_1 - \mathbf{p}_2 )^2$$

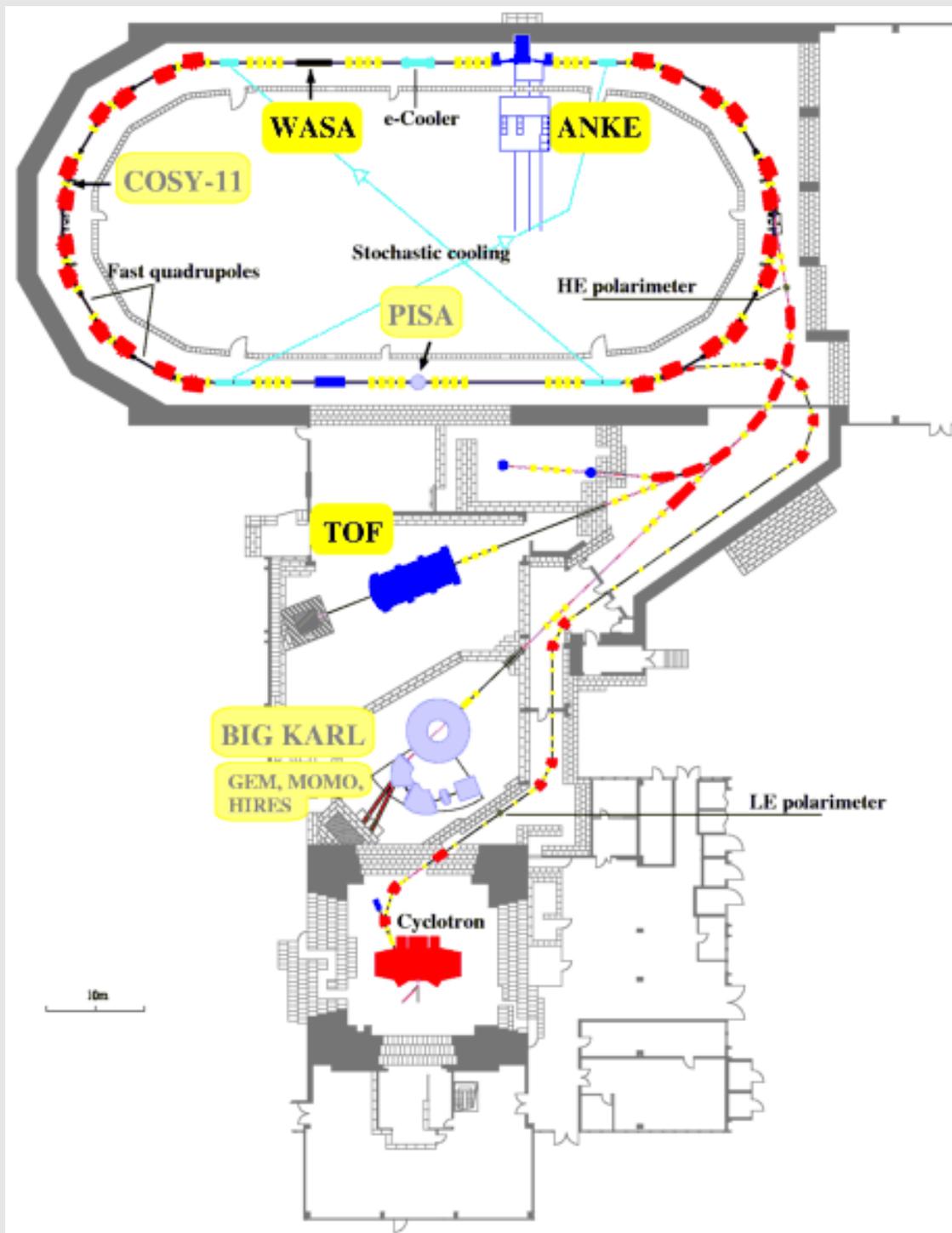
$$E^2 = m^2 + p^2$$

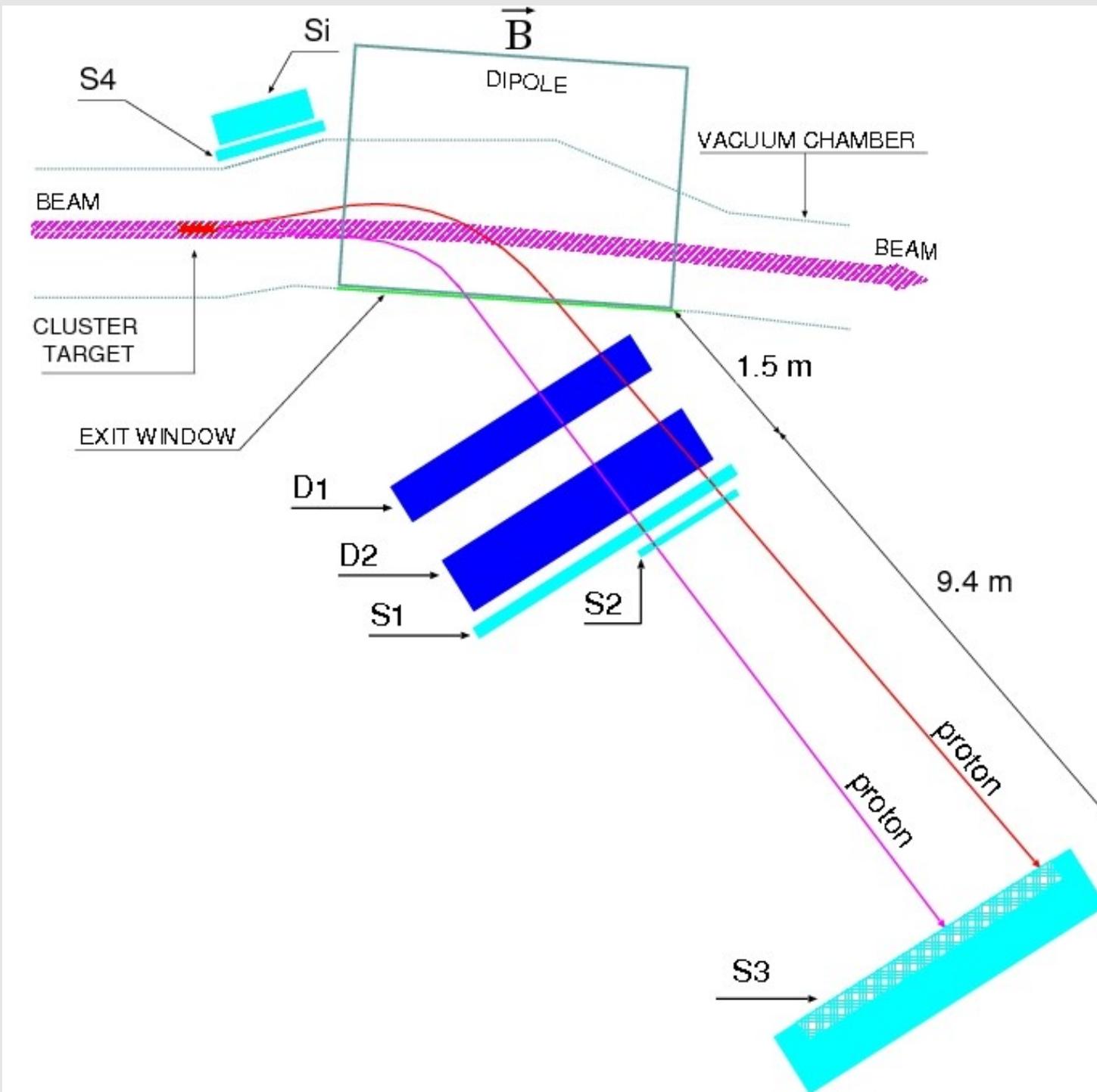
$$c = 1$$



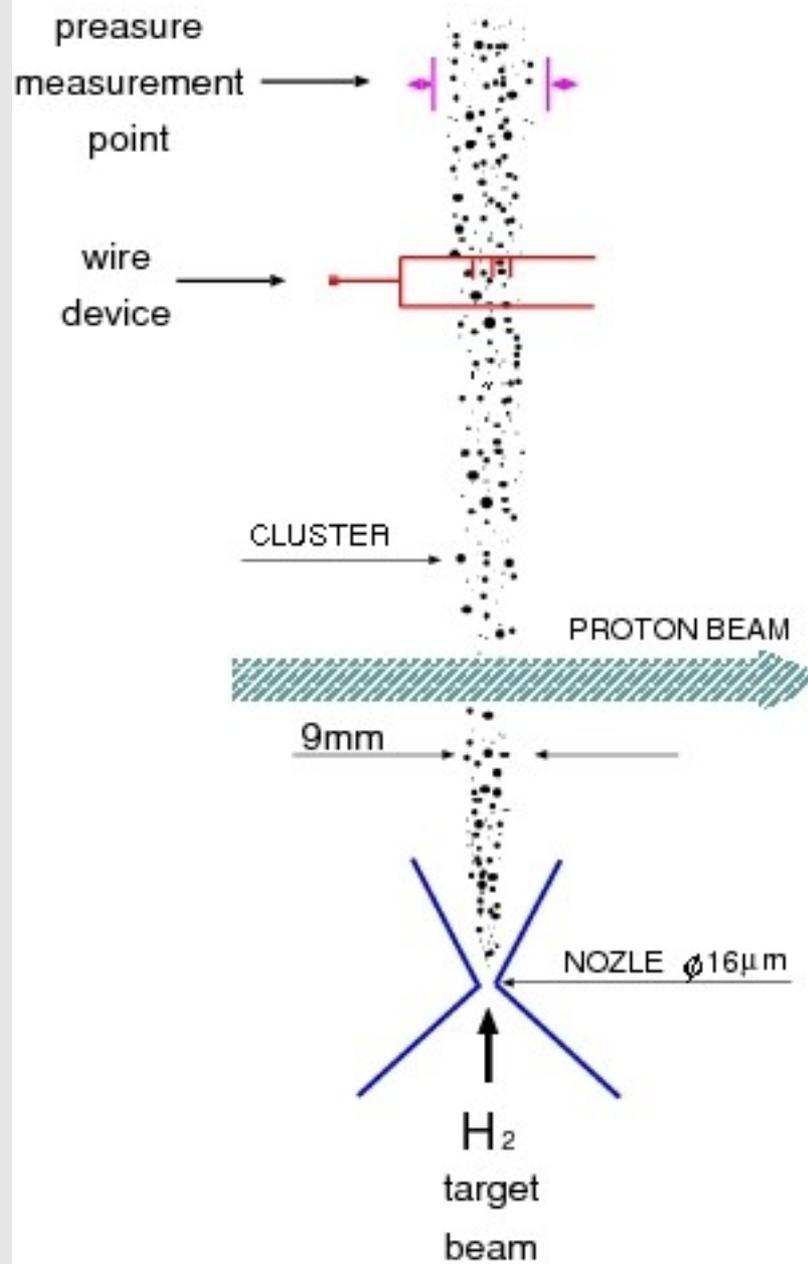


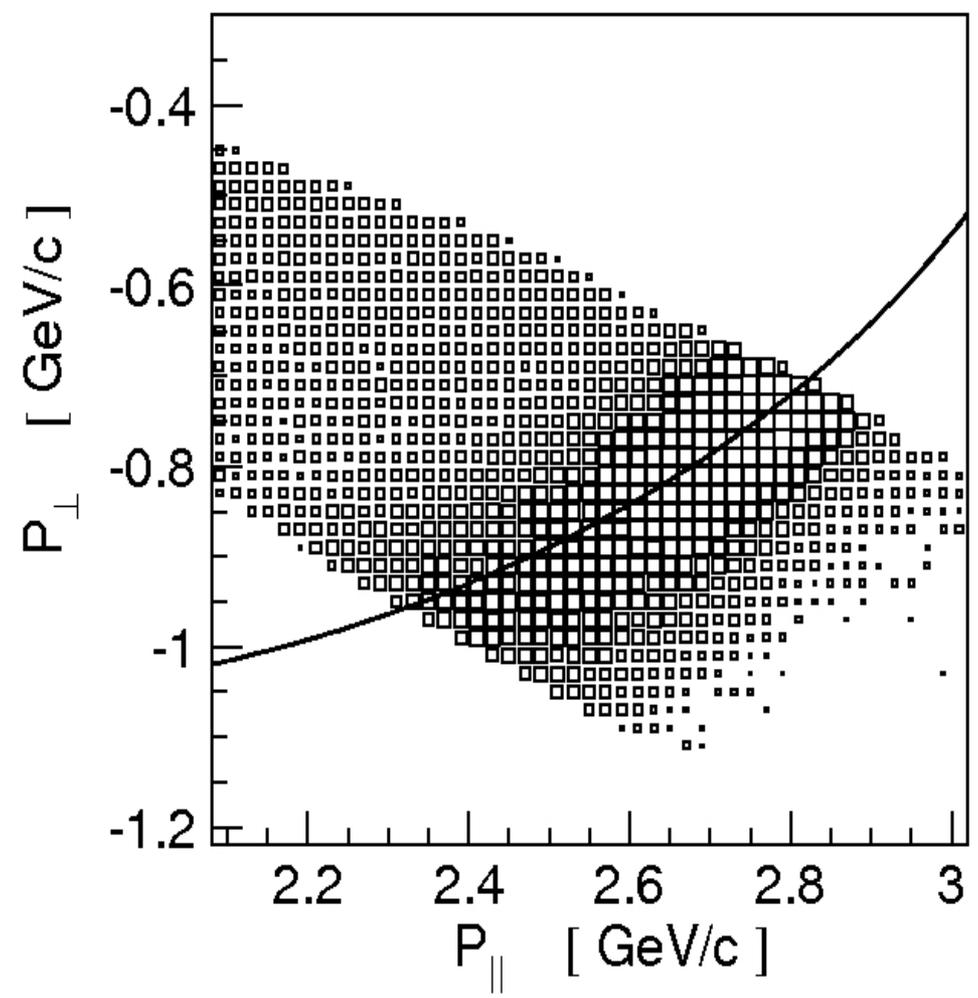
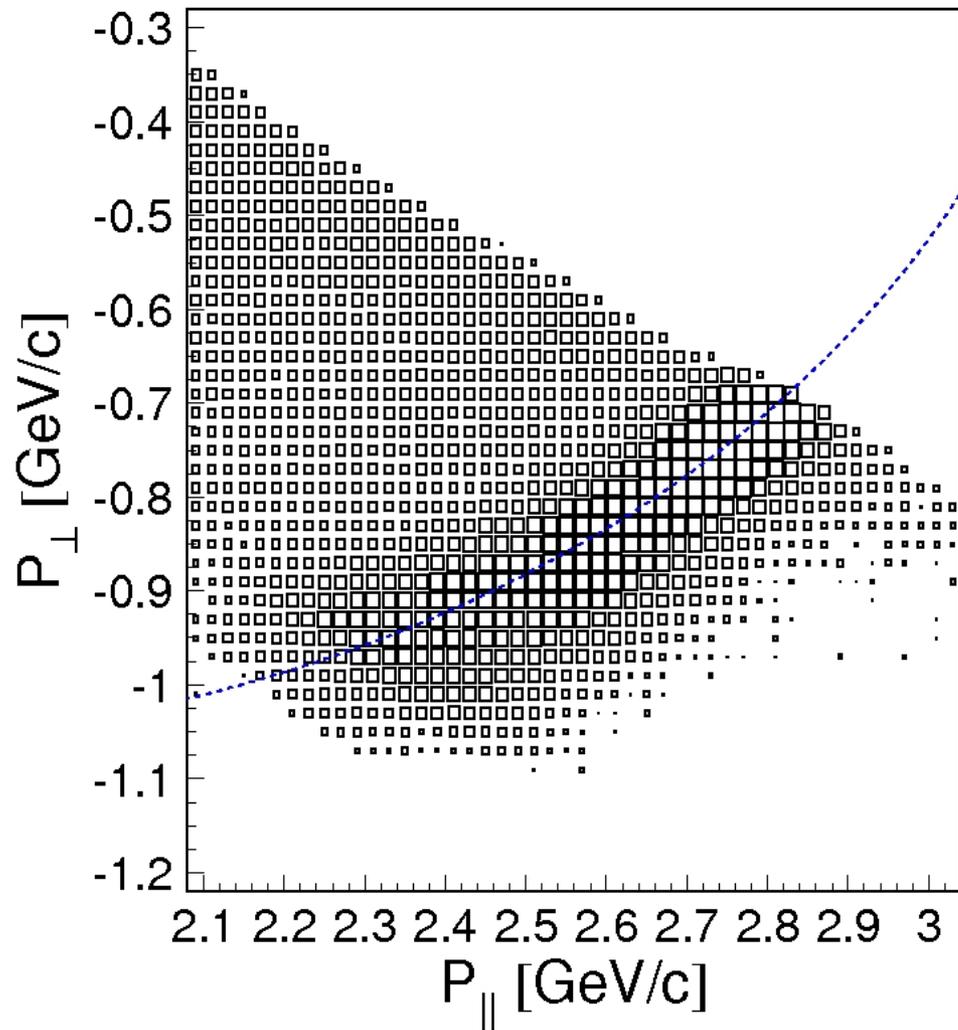




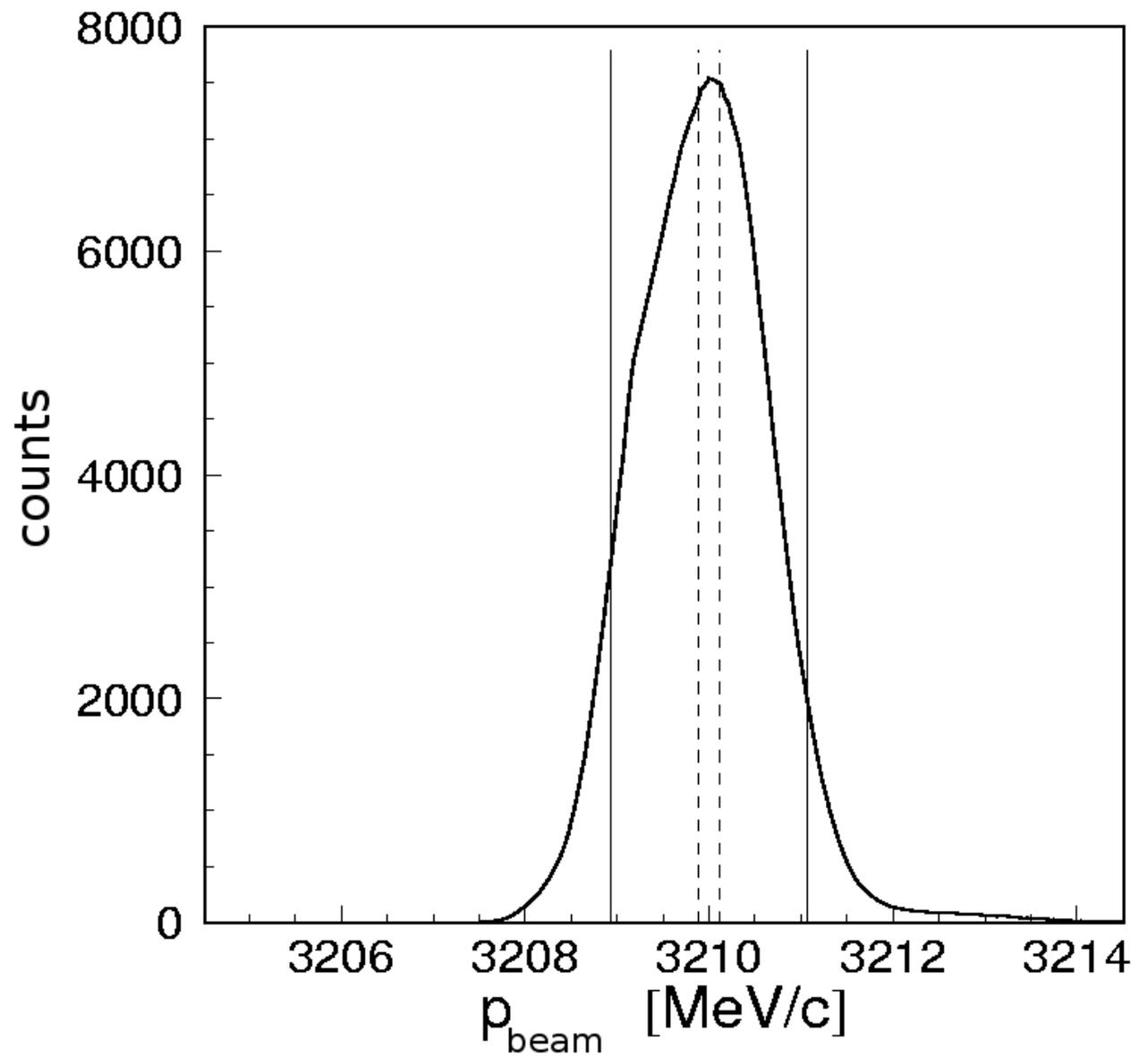


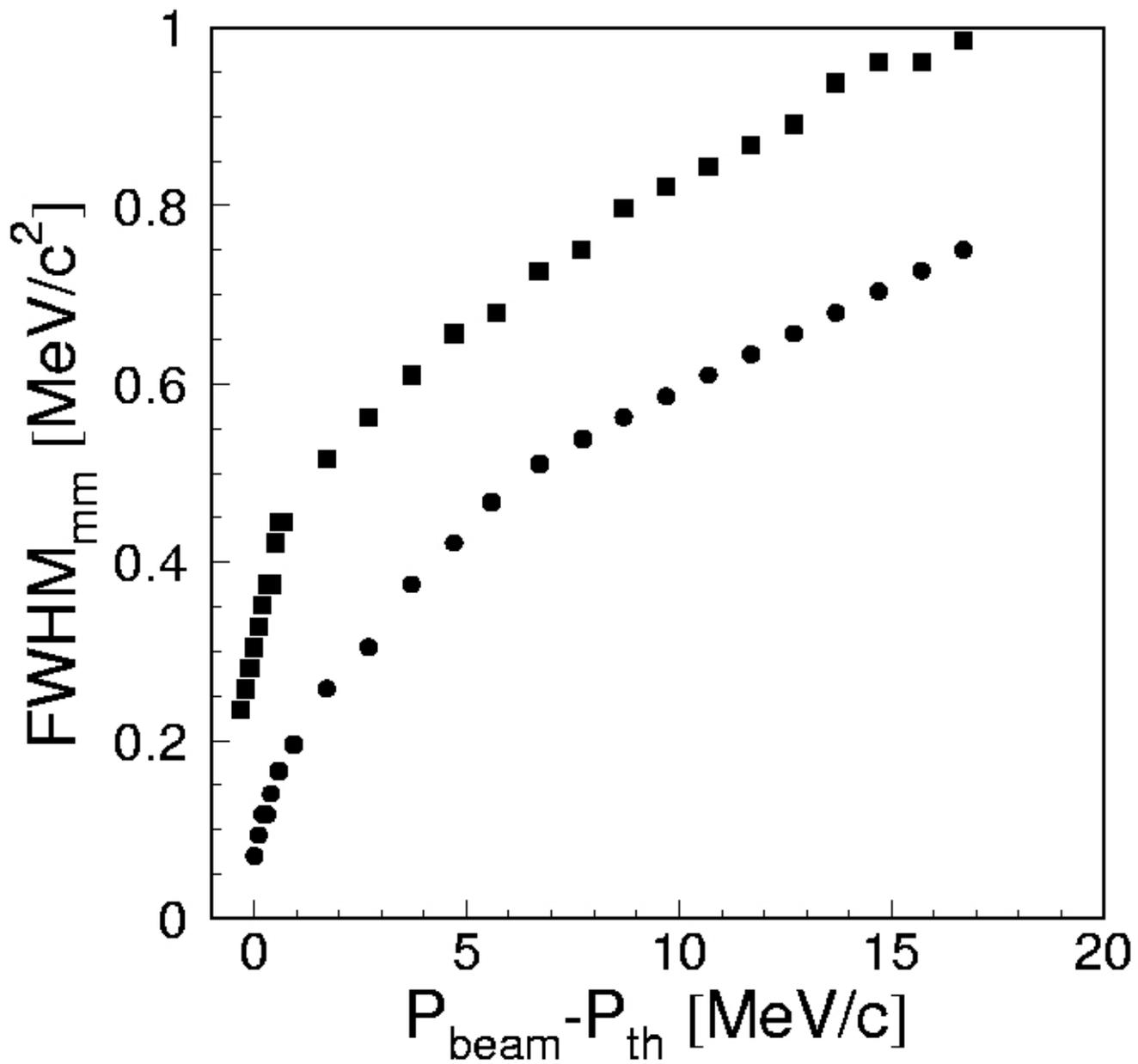
# CLUSTER BEAM DUMP





$$\Delta x = D \Delta p / p_0$$

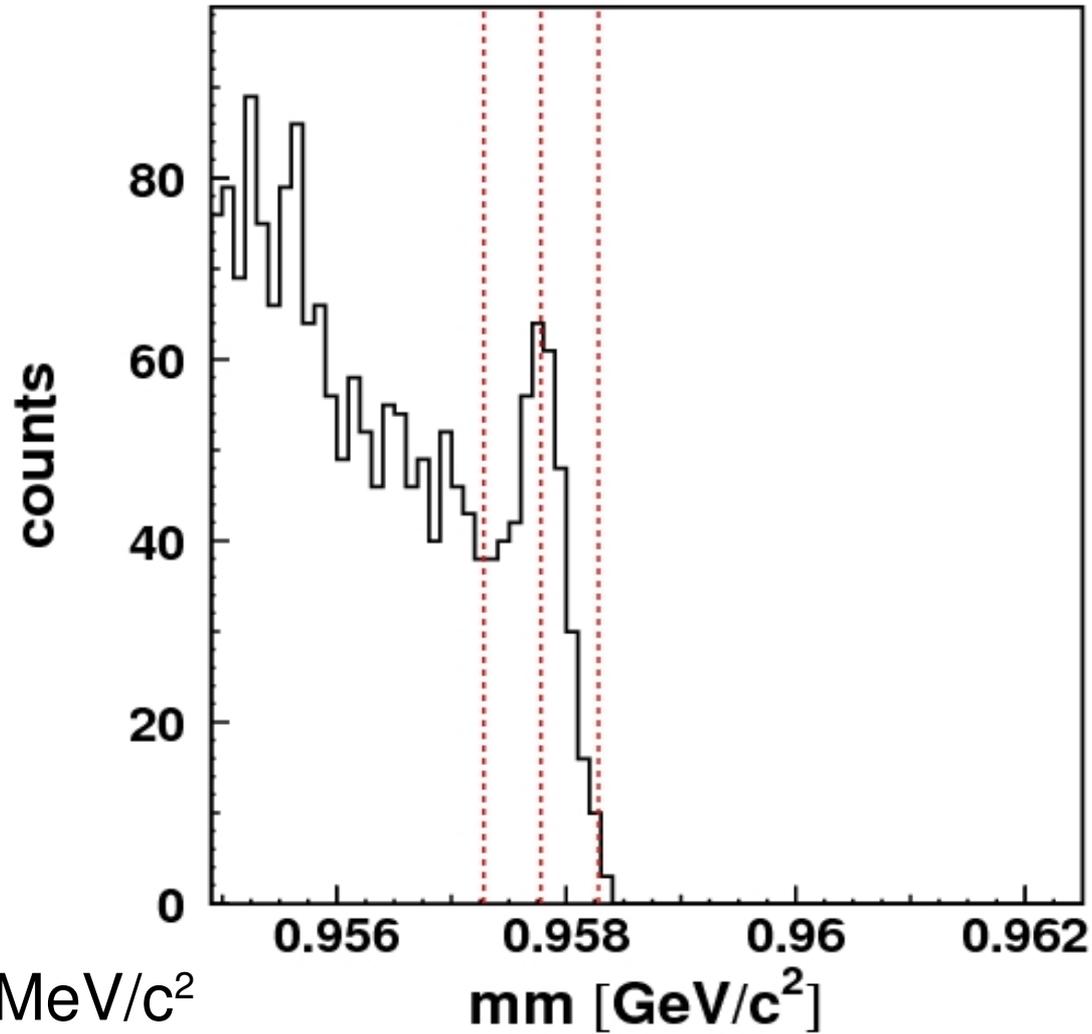




Q=0.9 MeV

PRELIMINARY

p p  $\rightarrow$  p p X



NIMROD 1.5 MeV/c<sup>2</sup>

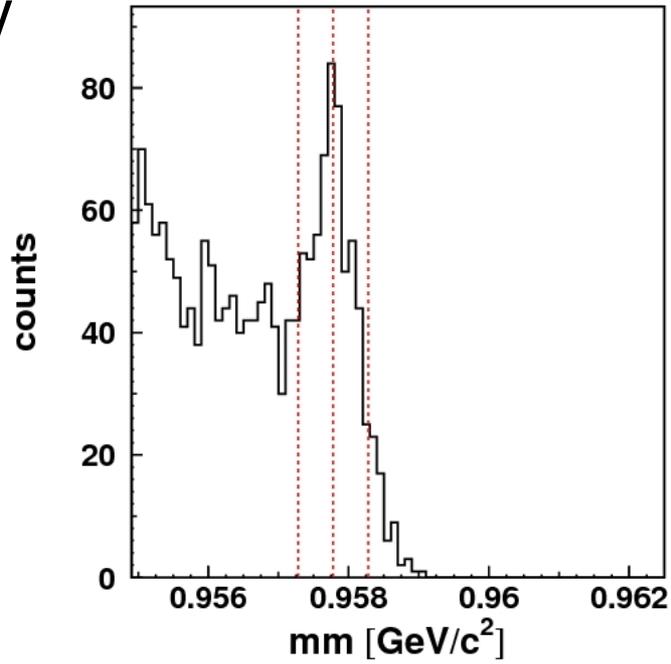
COSY  $\sim 0.4$  MeV/c<sup>2</sup>  
(preliminary)

$$\sigma_{mm}^2 = \sigma_{exp}^2 + \sigma_{\eta'}^2$$

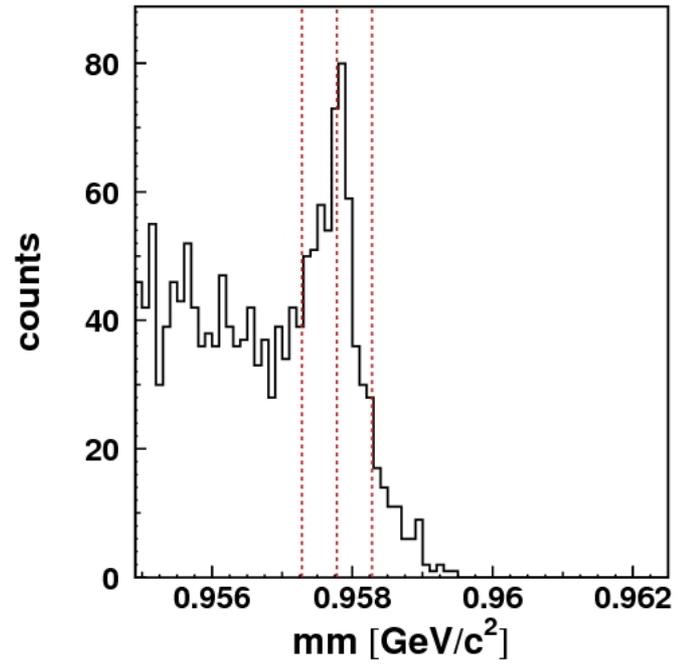


$pp \rightarrow ppX$

Q=1.5 MeV

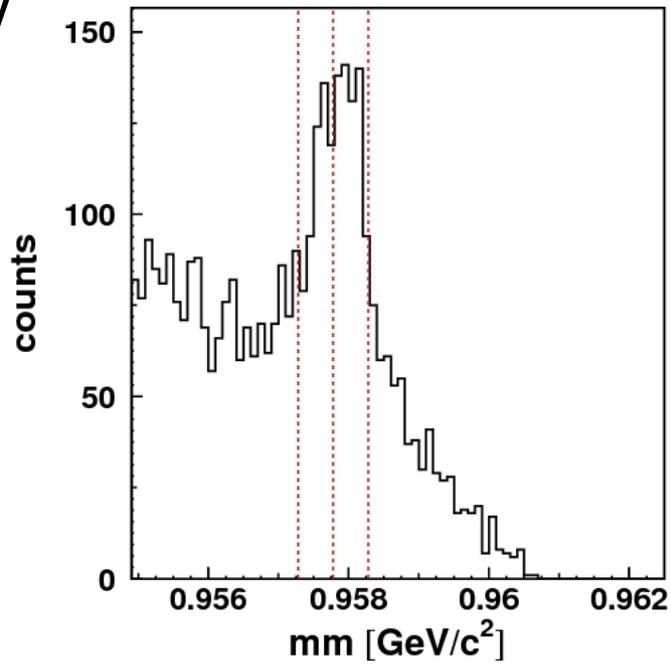


Q=1.8 MeV

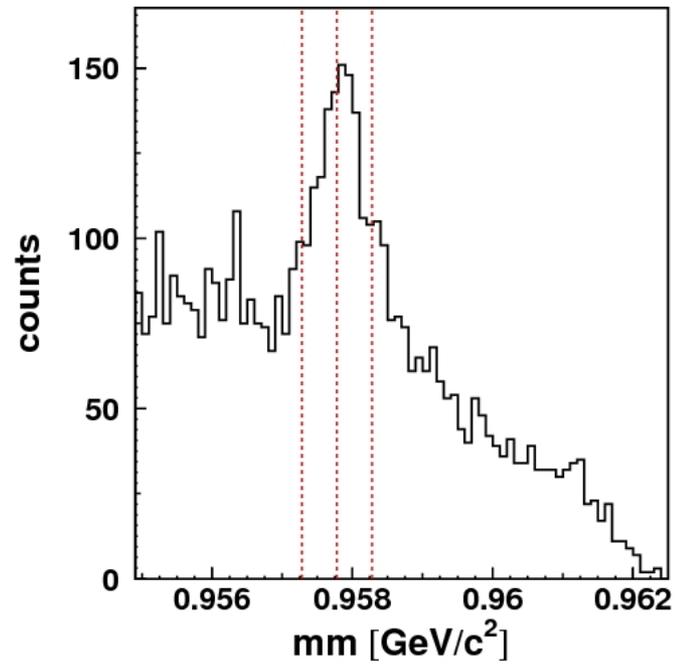


PRELIMINARY

Q=3.1 MeV



Q=5.0 MeV



*The End*

