Measurement the η and η' mesons at the COSY-11

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COSY-11 experimental setup

- track detection
- TOF detection

Physics

- threshold experiment
- production mechanizm

Normalization (from $pp \to pp$)

Results for $pp \to pp\eta$

- missing mass spectra
- cross section
- angular distribution for η

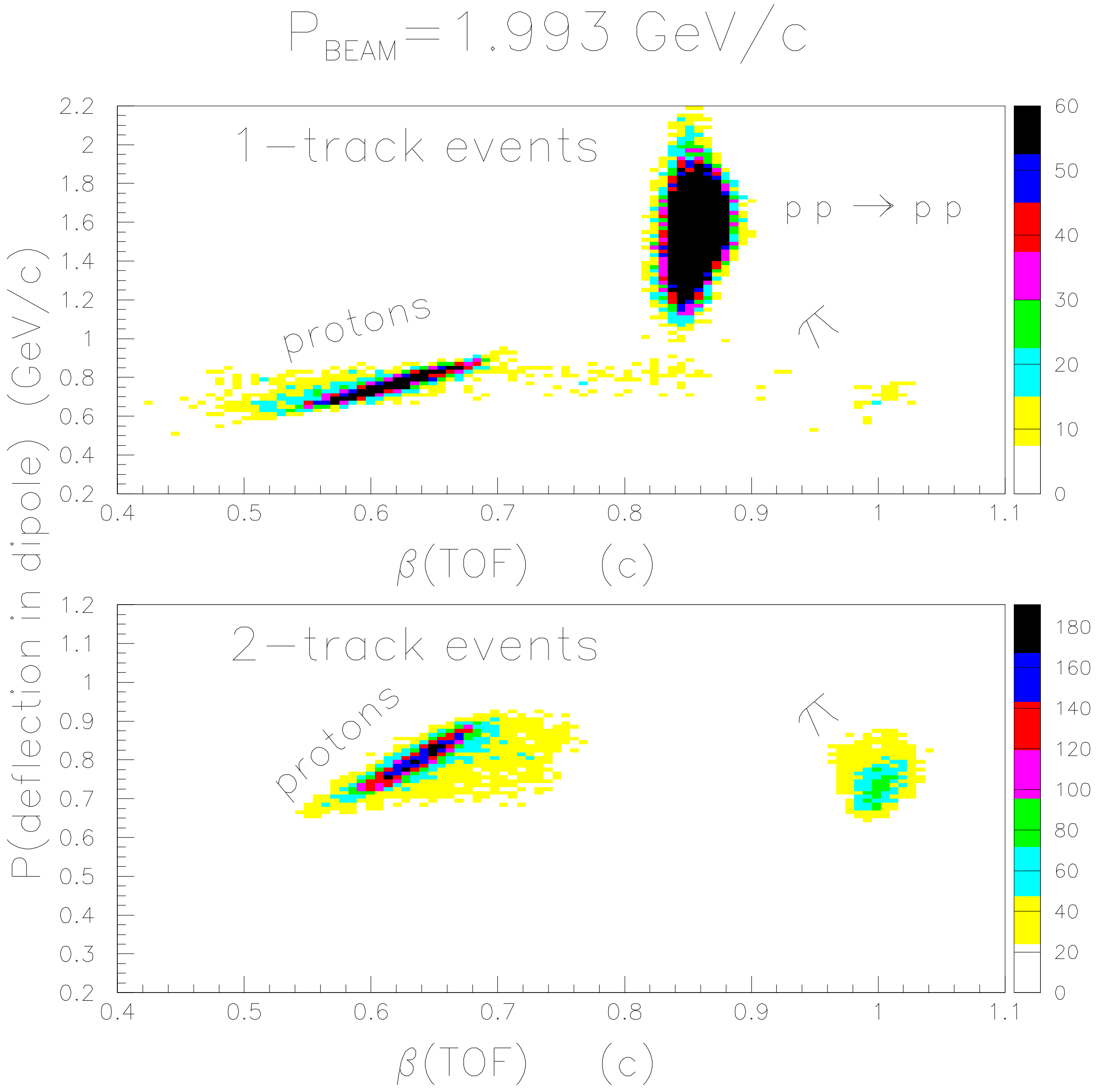
Results for $pp \to pp\eta'$

- missing mass spectra

Plans and beam request

Calibration

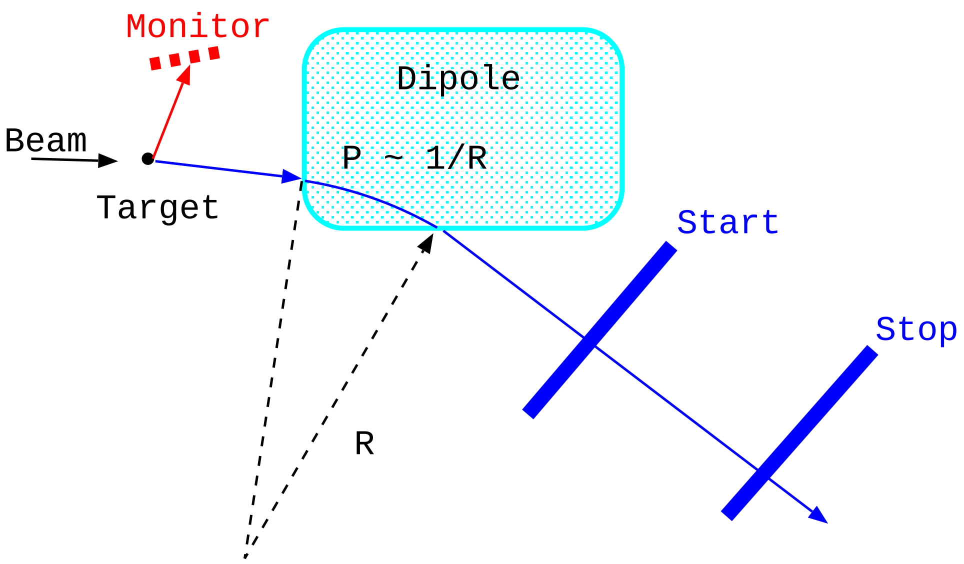
- Time of Flight between scintillators S1 and S3 ($pp \to pp$ reaction is used)
- proton/pion discrimination using relation: $p = m * \beta * \gamma$

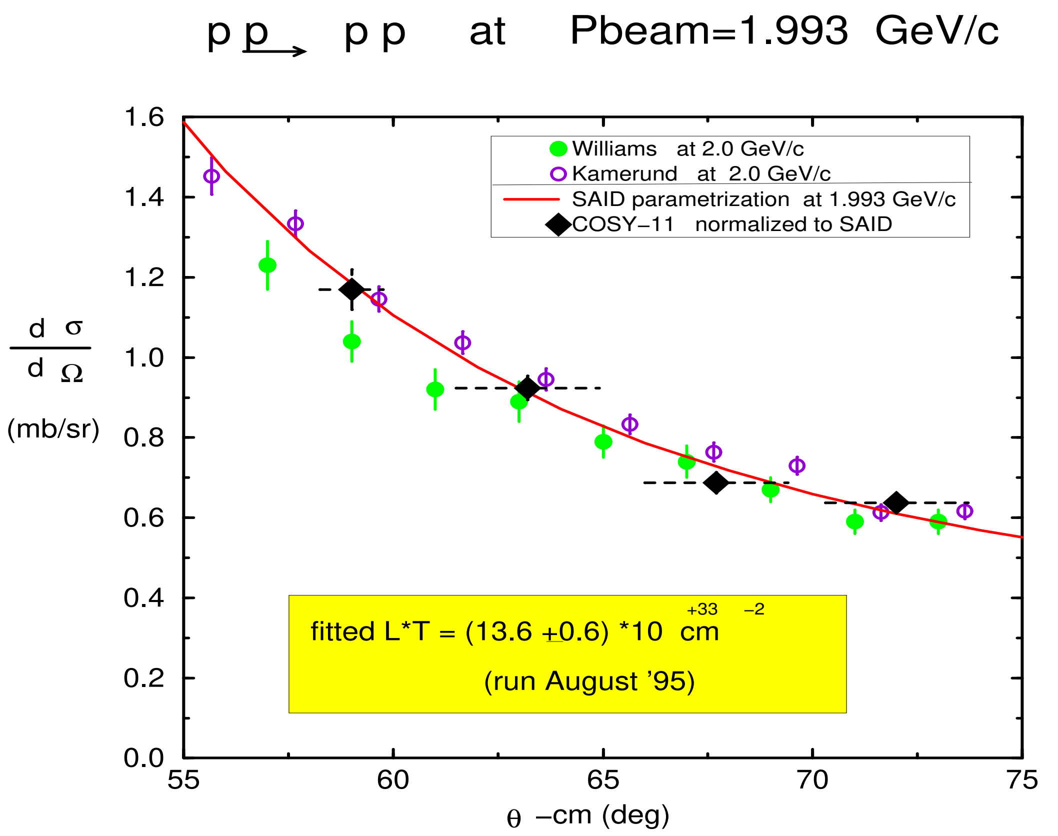


Integrated liminosity $L * T$

from normalization of the $pp \to pp$ to the SAID parametrization

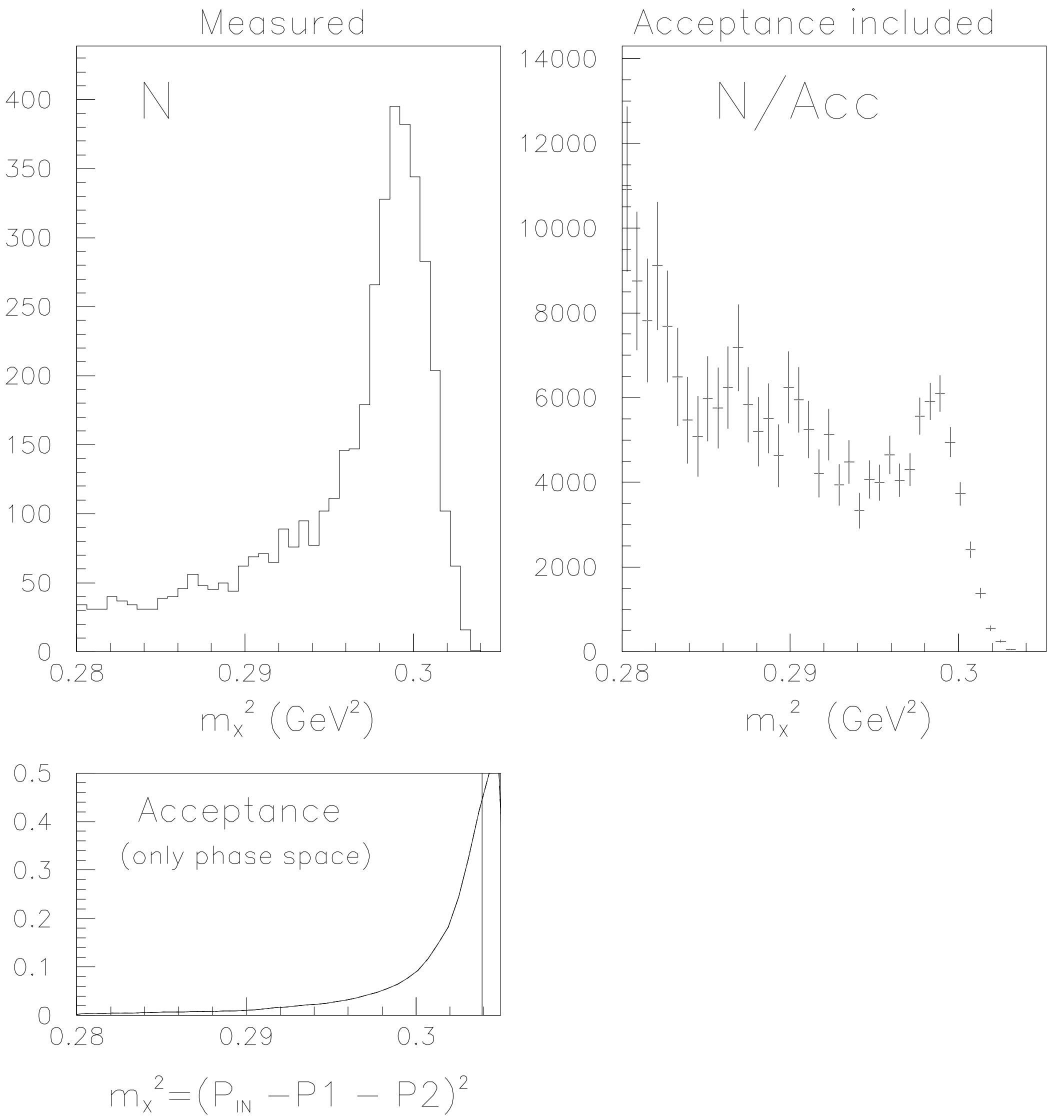
$$\frac{d\sigma}{d\Omega_{cm}} = \frac{N}{L{*}T * \Delta\Omega_{cm}}$$





X-mass spectrum

from $pp \to ppX$ reaction measured at $P_{BEAM} = 1.993$ GeV/c
(i.e. 10 MeV/c above η production threshold)



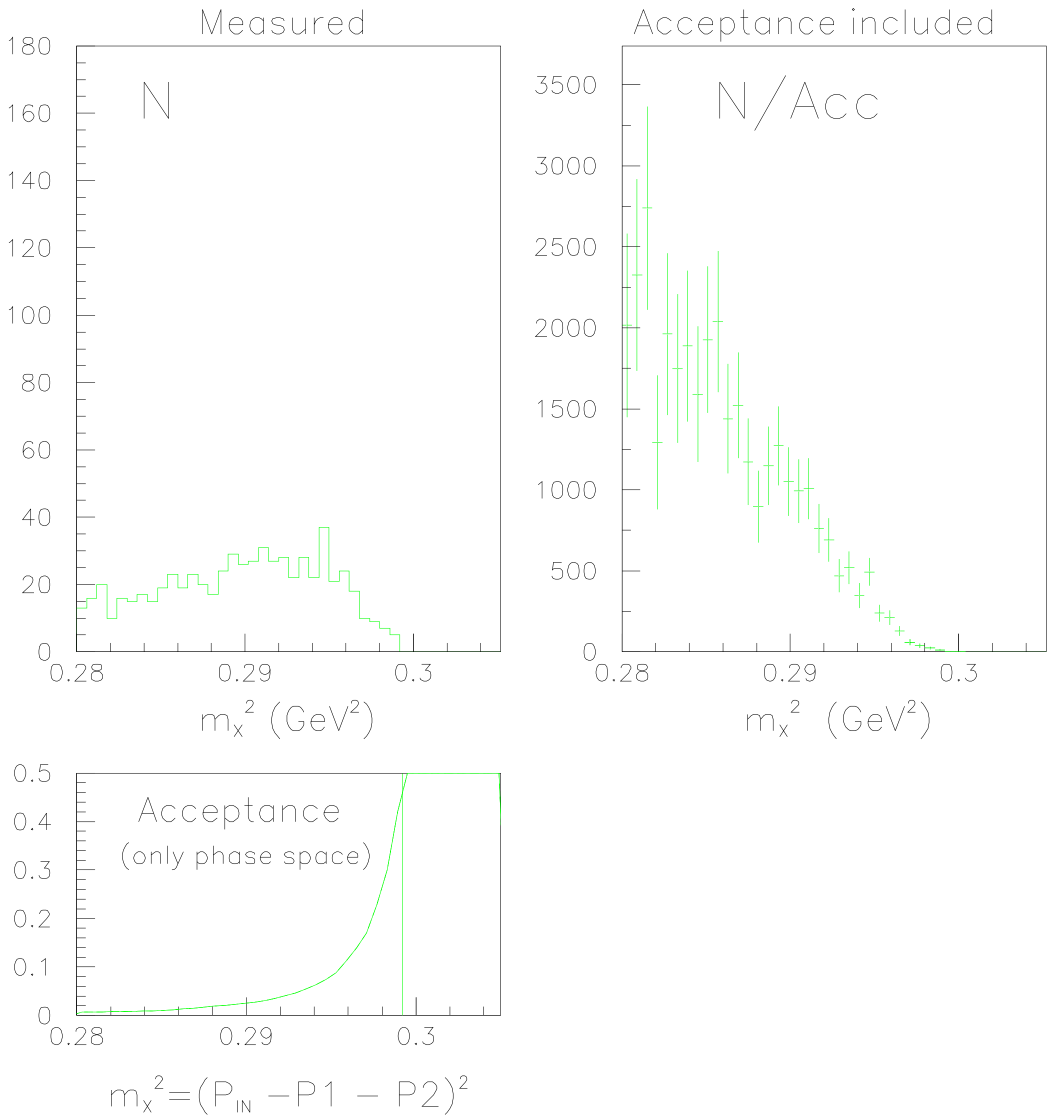
Acceptance for $pp \to ppX$

- Monte-Carlo event generator was used
- $\frac{d\sigma}{d\Omega_1\, d\Omega_2\, dp_1} \sim$ phase space (no FSI_{PP} included)
- drift chamber: smearing of drift time
- events reconstructed by means of the standard algorythm

X-mass spectrum

from $pp \to ppX$ reaction measured at $P_{BEAM} = 1.981$ GeV/c

(i.e. 1 MeV/c below η production threshold)

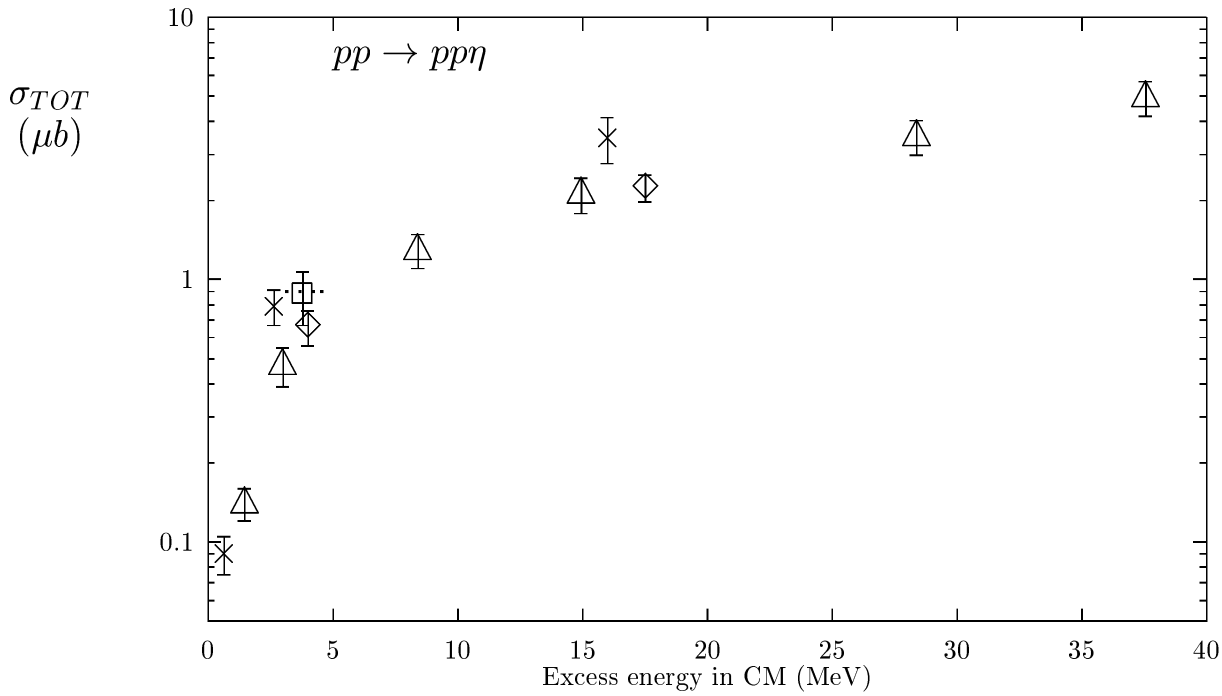


Cross section for $pp \to pp\eta$ at 1.993 GeV/c

$$\sigma = \frac{N}{Acc * L{*}T} = 0.9 \pm 0.2(\mu b)$$

errors	(%)
statistical	3
background	20
acceptance [a]	10
luminosity	4.5

[a] FSI-pp not included



The Cosy-11 point (□) is consistent with results of Calén (△) , Chiavassa (×) and Bergdolt (◇) .

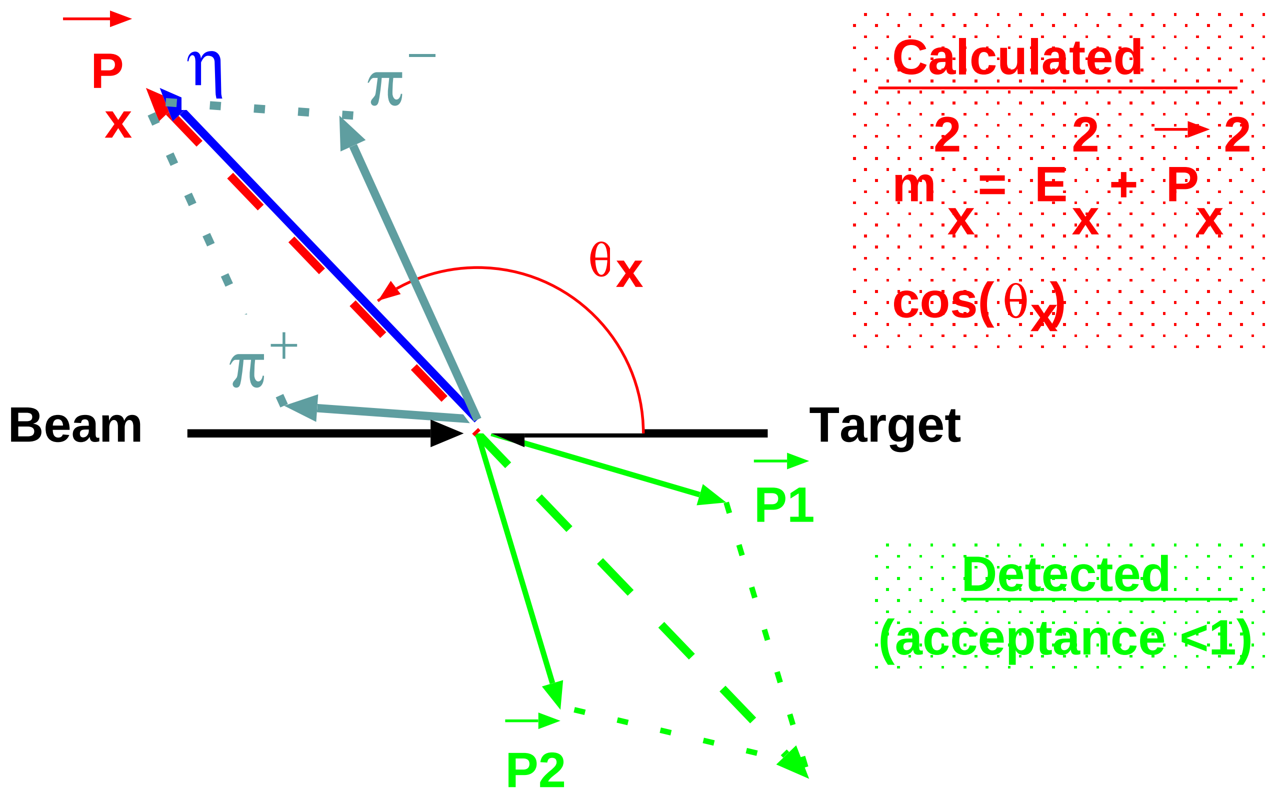
<u>Error of the energy execess Q=3.8 MeV/c</u>

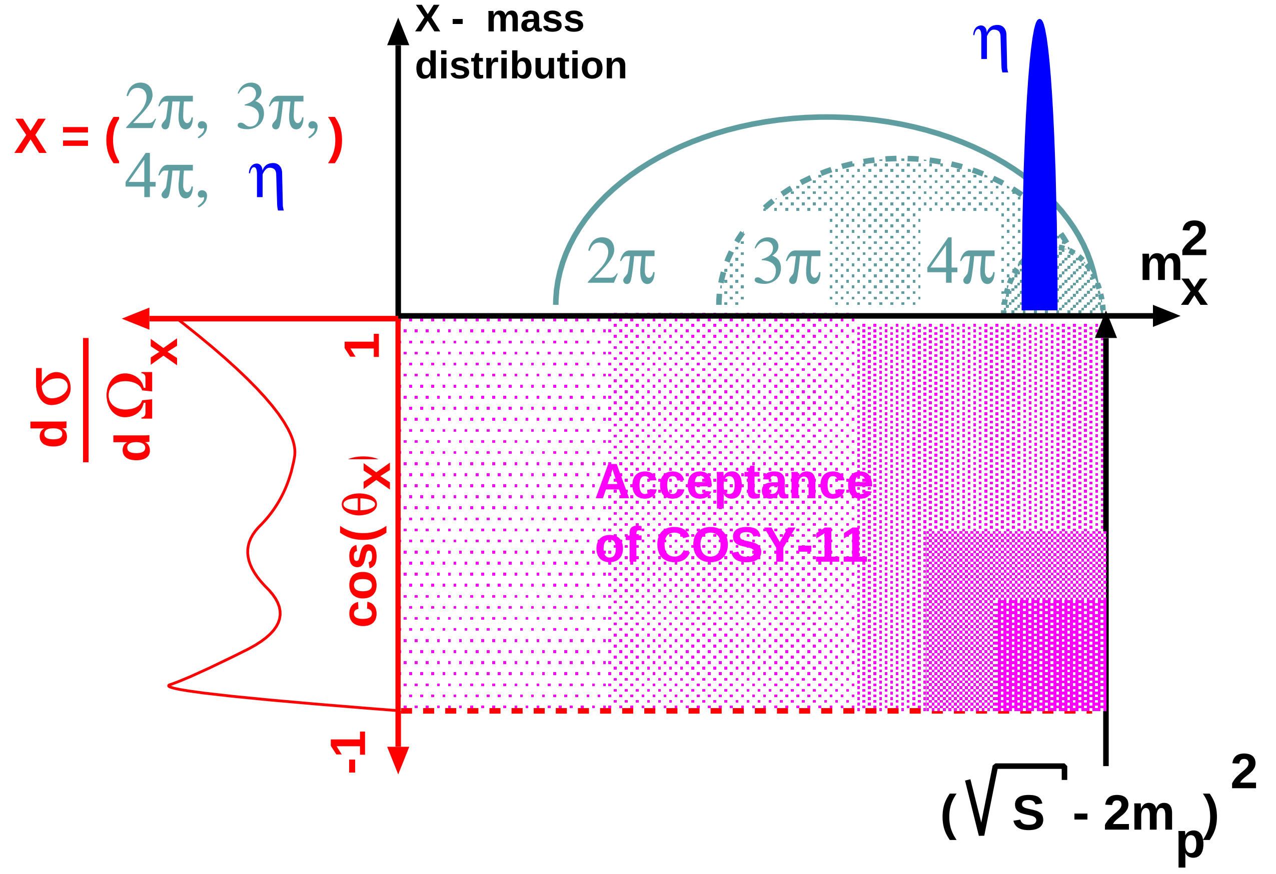
$Q = \sqrt{s(P_{BEAM})} - 2 * m_p - m_\eta$

$\Delta\ P_{BEAM} \simeq\ 2\ MeV/c \quad (e.g \quad 2\ GeV/c\ *\ 1^o/_{oo})$

$\Delta\ Q \simeq 0.7 MeV$

Kinematics of p+p → p p X in CMS

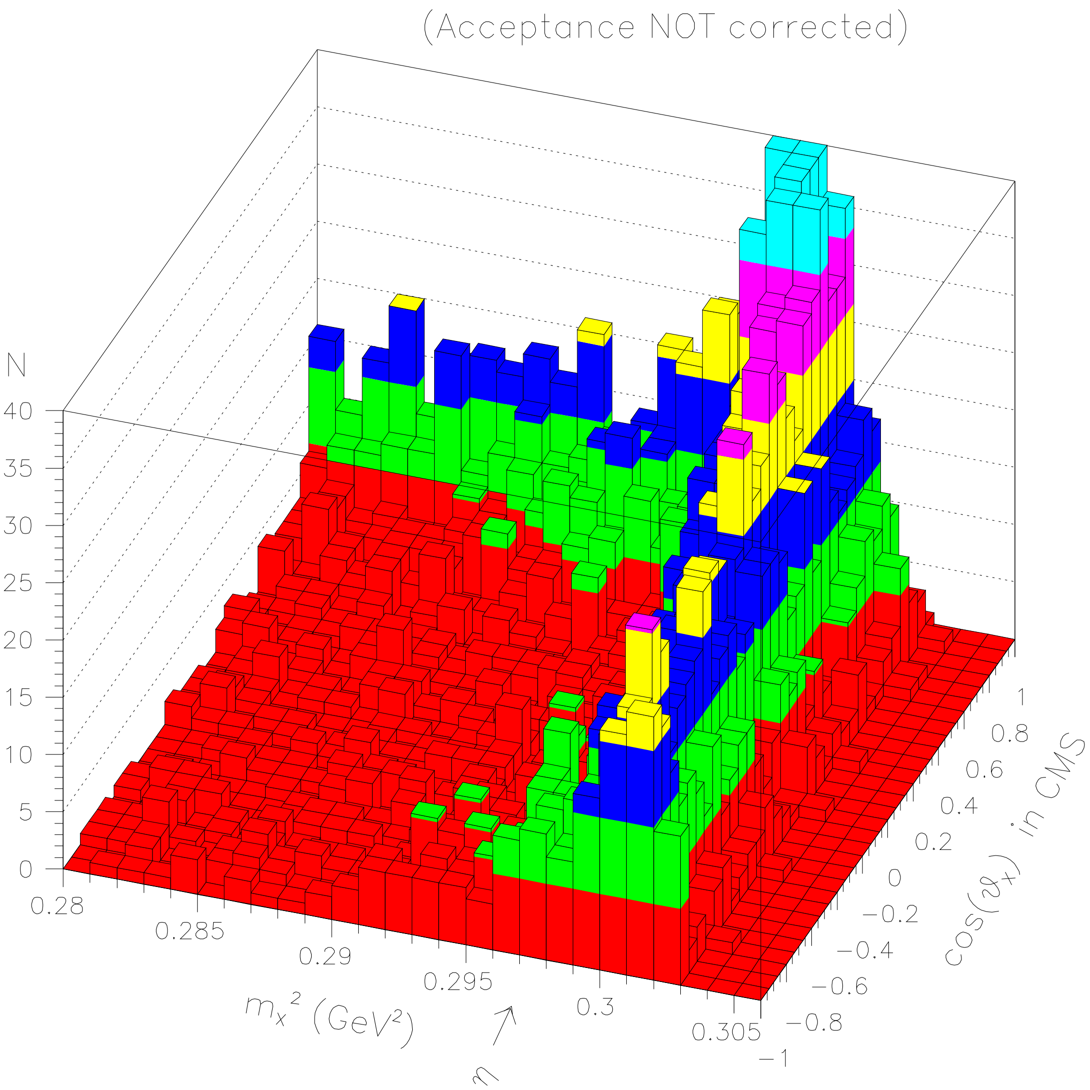




Measured angular distribution

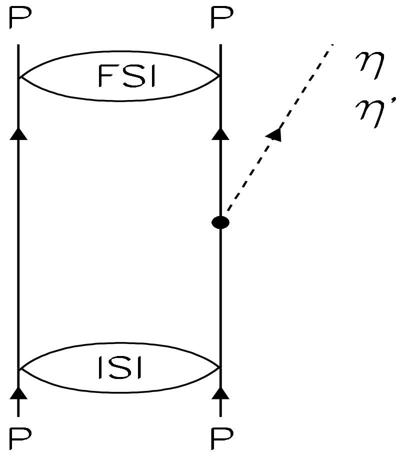
for η at $P_{BEAM} = 1.993$ GeV/c

(i.e. 10 MeV/c above η production threshold)

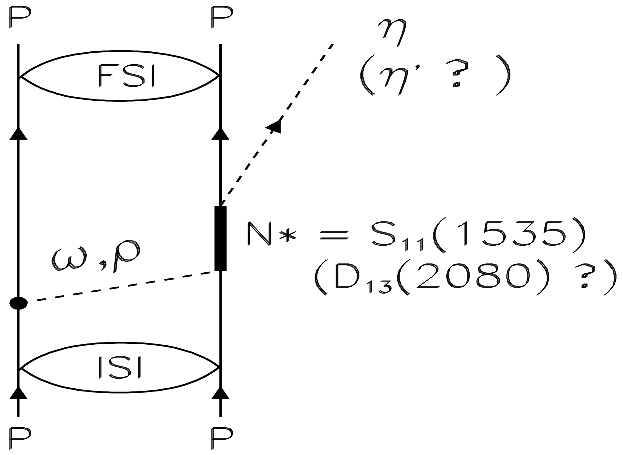


Examples for possibles reactions measured at the COSY-11 detector setup

Possible production mechanism for η and $\eta'(958)$



Direct production



via N* resonance

Beam request for $pp \to pp\eta$ reaction: 4 WEEKS

- total cross section dependece on energy close to threshold
- angular distribution for η
- proton-proton correlation

P beam (GeV/c)	T in CM (MeV)	σ_{TOT} (μb)	Acceptance	Counts (1/day)	Req uired	
					Counts [a]	Time (day)
1.980	-0.7	-	-	-	-	3
1.985	1.0	0.1	0.4	1.7k[b]	20k	12
1.990	2.8	0.4	0.2	3.5k	20k	6
1.995	4.5	2.0	0.1	8.6k	20k	3
2.000	6.3	2.5	0.05	5.4k	20k	4
						Σ 28 days

[a] ASSUMING INTEGRATED LUMINOCITY OF $5 * 10^{29} cm^{-2}s^{-1}$
[b] k = 1000 counts

Beam request for $pp \to pp\eta'$ reaction: 3 WEEKS

- total cross section dependece on energy close to threshold

beam momentum $[MeV]$	momentum above threshold $[MeV/c]$	counts [a] 1/day	required time [day]	expected number of events
3205	-3 (below)	~50	4	200
3210	2	~80	3	240
3212	4	~120	2	240
3214	6	~140	8	1120
			Σ 17 days	

[a] ASSUMING INTEGRATED LUMINOCITY OF $2 * 10^{30} cm^{-2}s^{-1}$

reaction	σ (μb)	Acc	$Acc * \sigma * 10^3$
$pp \to pp2\pi^0$	~ 500	$7 * 10^{-5}$	35
$pp \to pp3\pi^0$	~ 50	$9 * 10^{-4}$	45
$pp \to pp4\pi^0$	? (1)	0.14	? (140)
$pp \to pp\eta$	~ 1	0.13	130