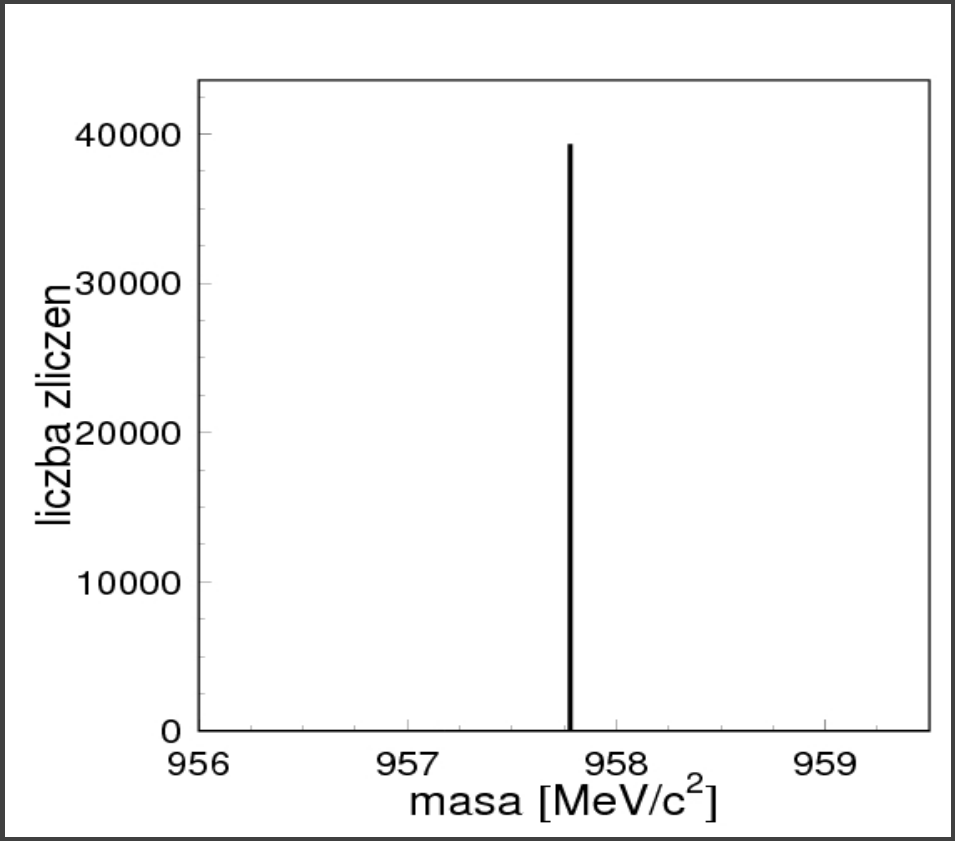
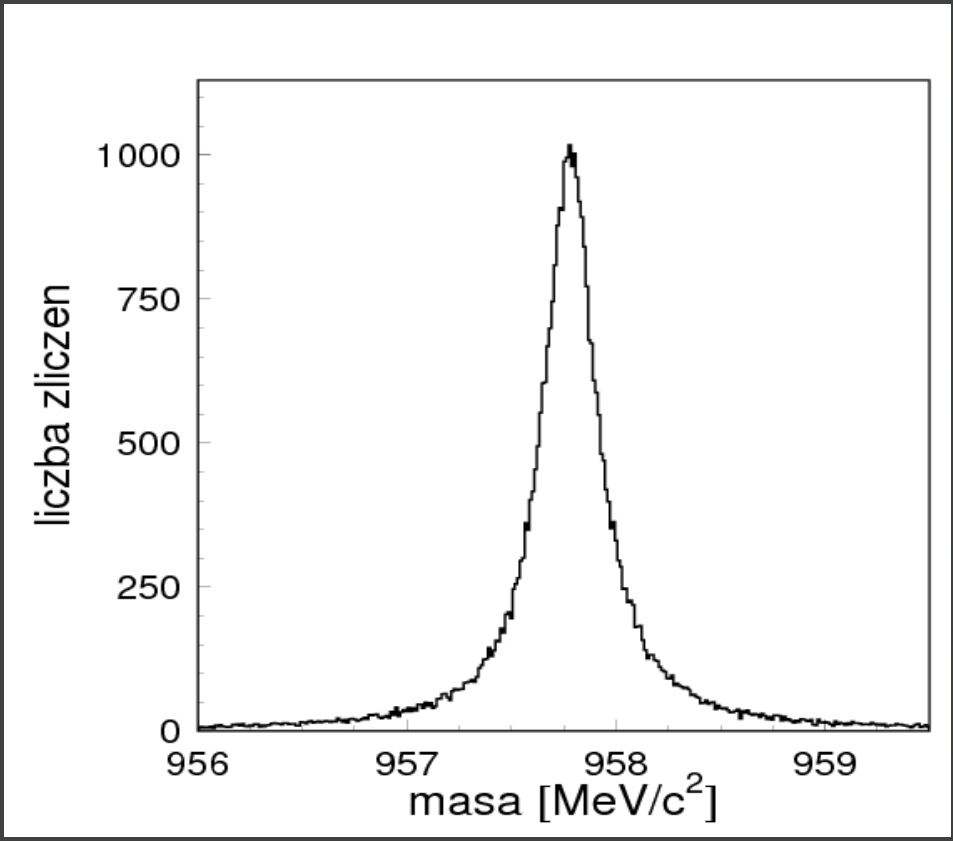
Pomiar szerokości naturalnej mezonu η'

Eryk Czerwiński


40000
30000
20000
10000
0
liczba zliczen
956
957
958
959
masa [MeV/c^2]


1000
750
500
250
0
liczba zliczen
956
957
958
959
masa [MeV/c^2]

$$p\,p \rightarrow p\,p\,X$$

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

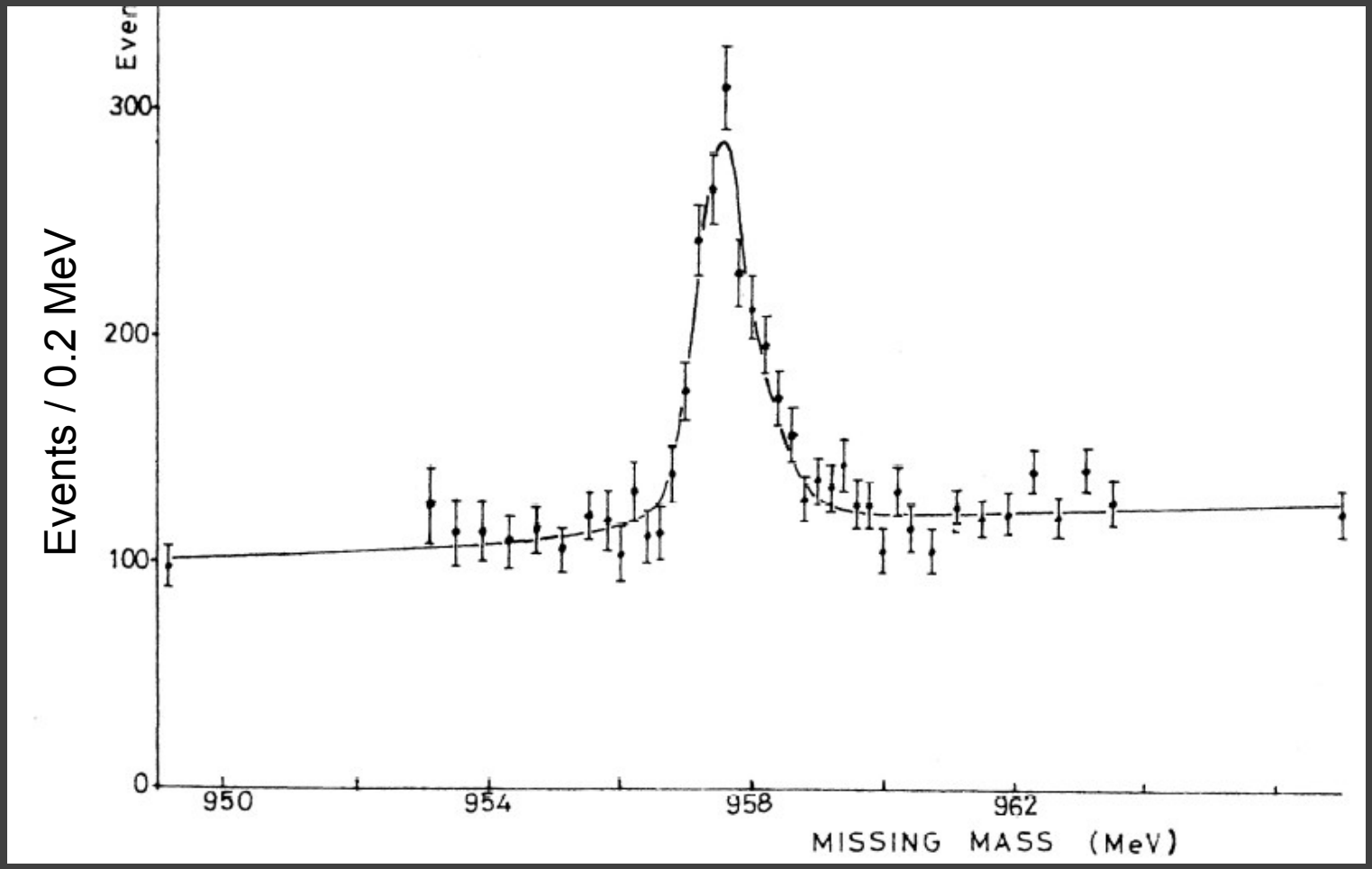
$$\mathbb{P}_{\text{beam}} + \mathbb{P}_{\text{target}} = \mathbb{P}_1 + \mathbb{P}_2 + \mathbb{P}_X$$

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

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

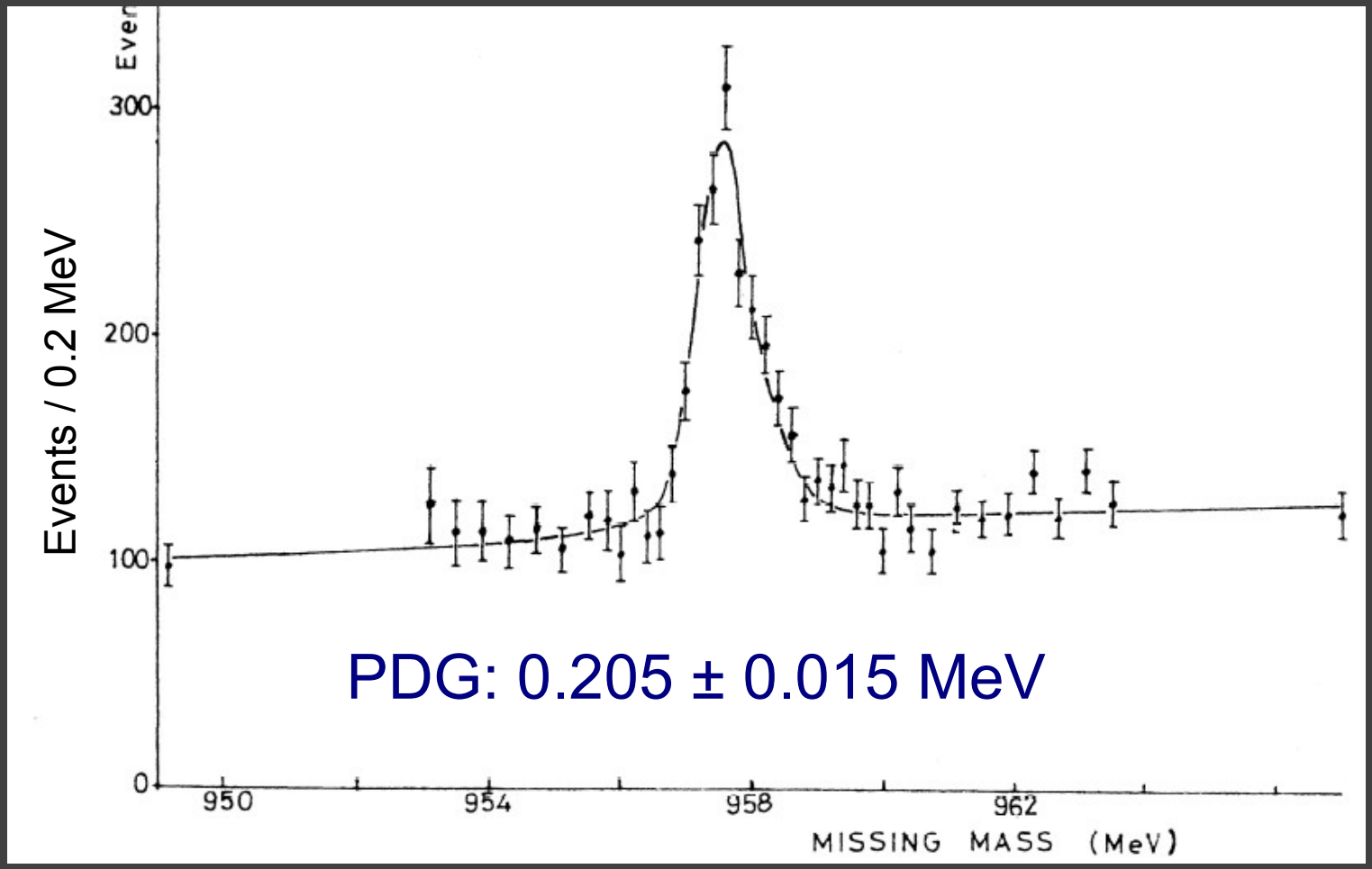
$$E^2 = m^2 + p^2 \qquad\qquad c = 1$$

$\pi^- + p \rightarrow n + X$ NIMROD 0.28 ± 0.10 MeV/c^2

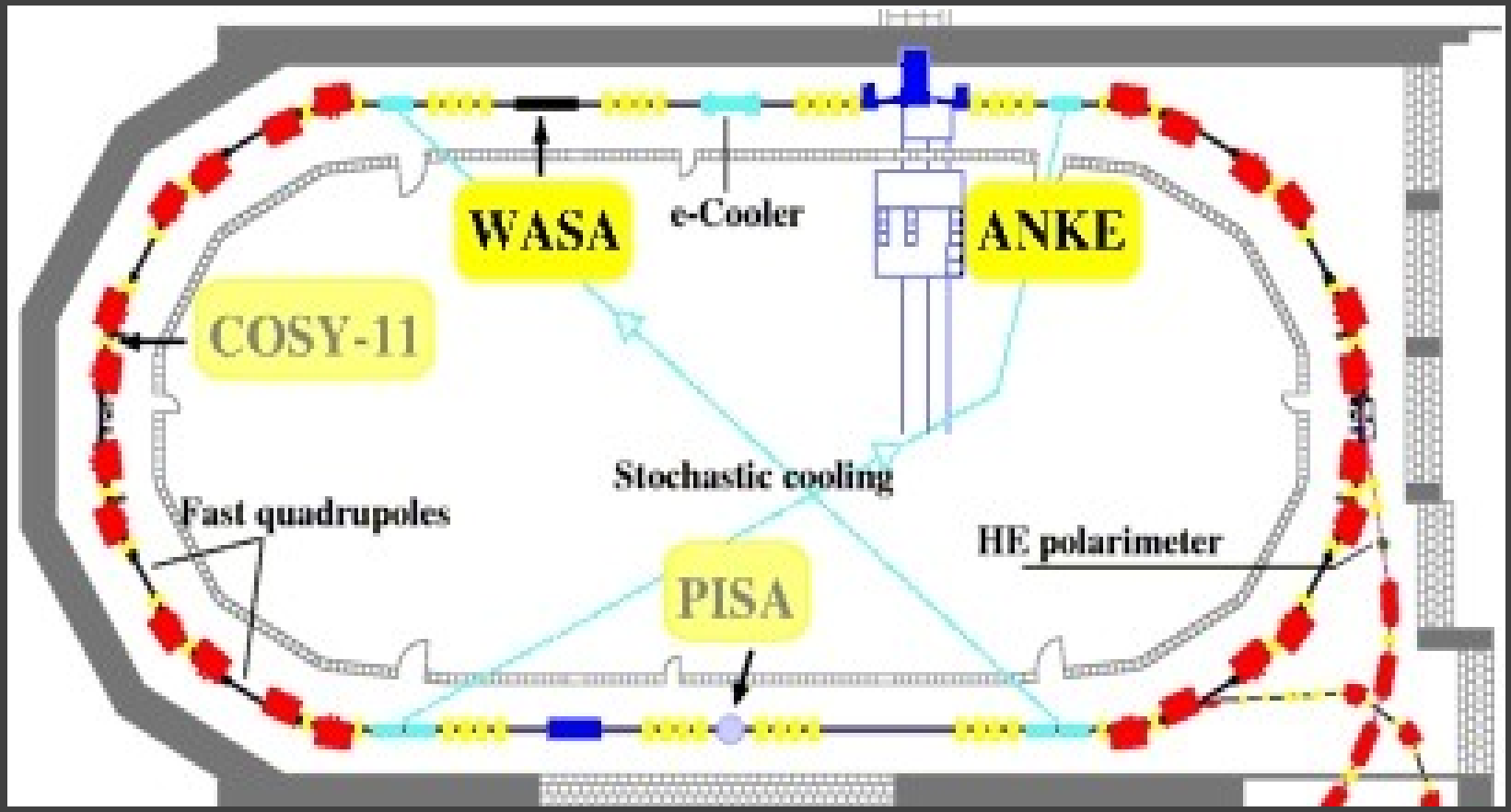


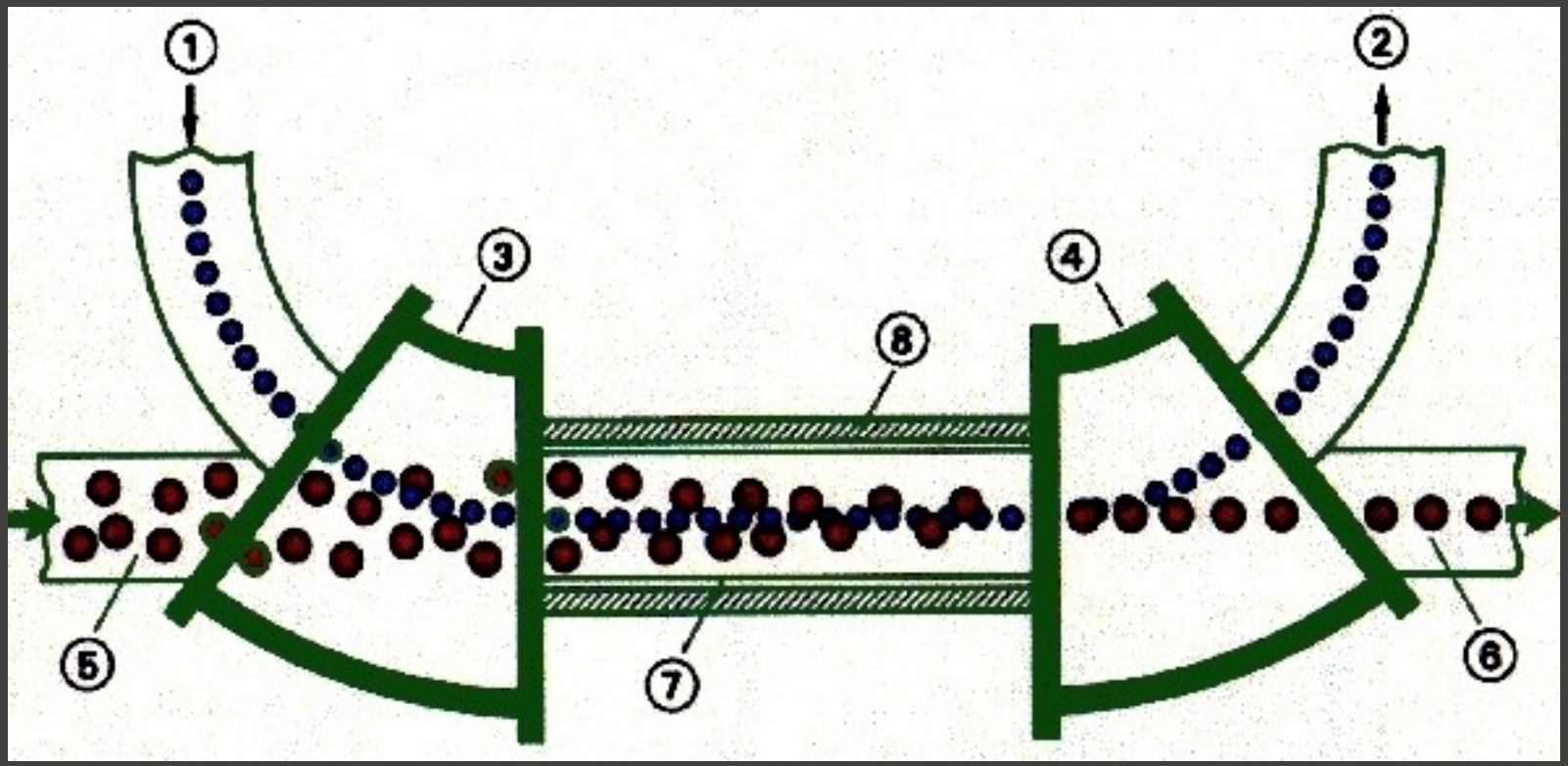
D. M. Binnie et al., Phys. Lett. B 83 (1979) 141

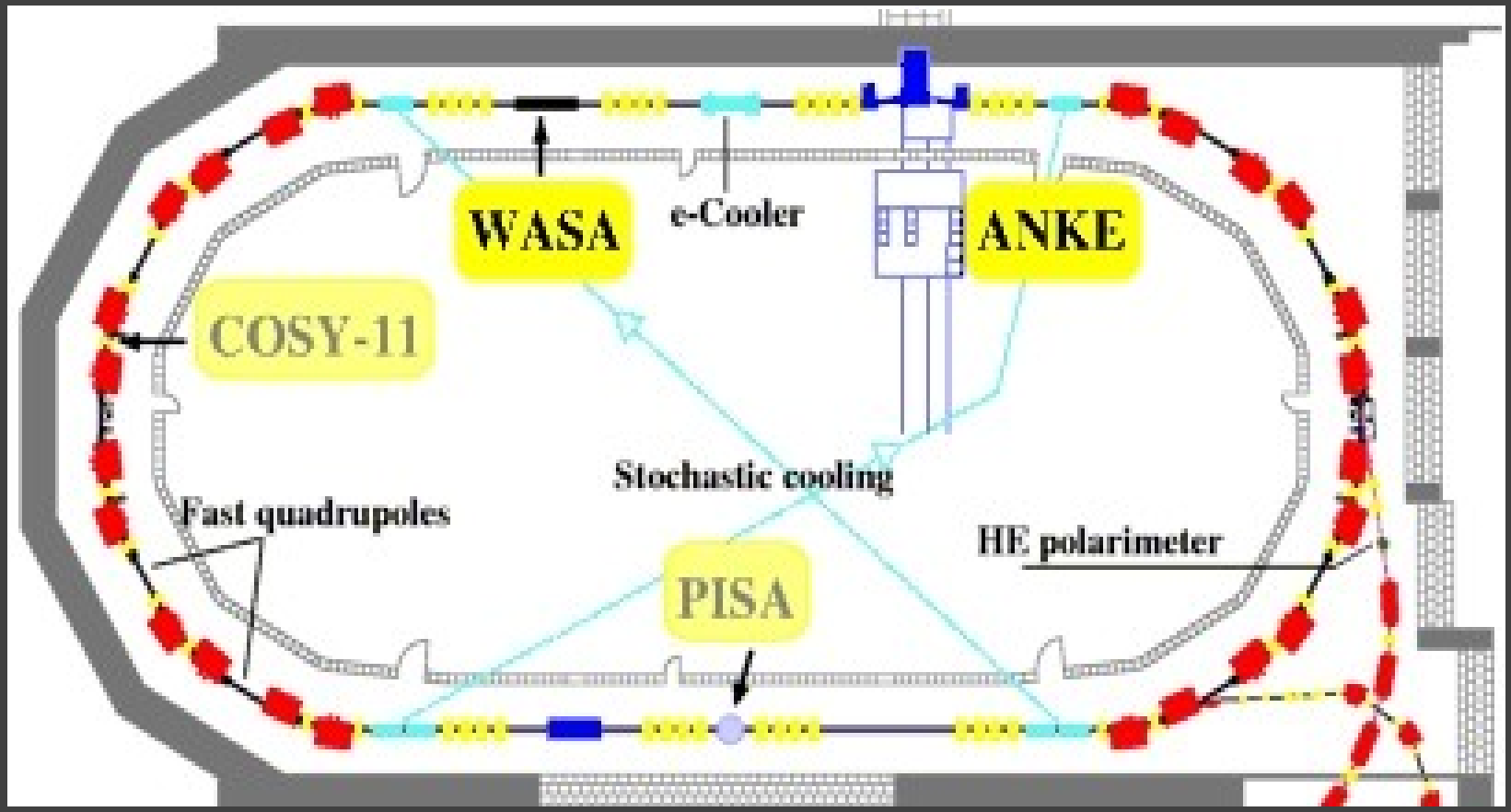
$\pi^- + p \rightarrow n + X$ NIMROD 0.28 ± 0.10 MeV

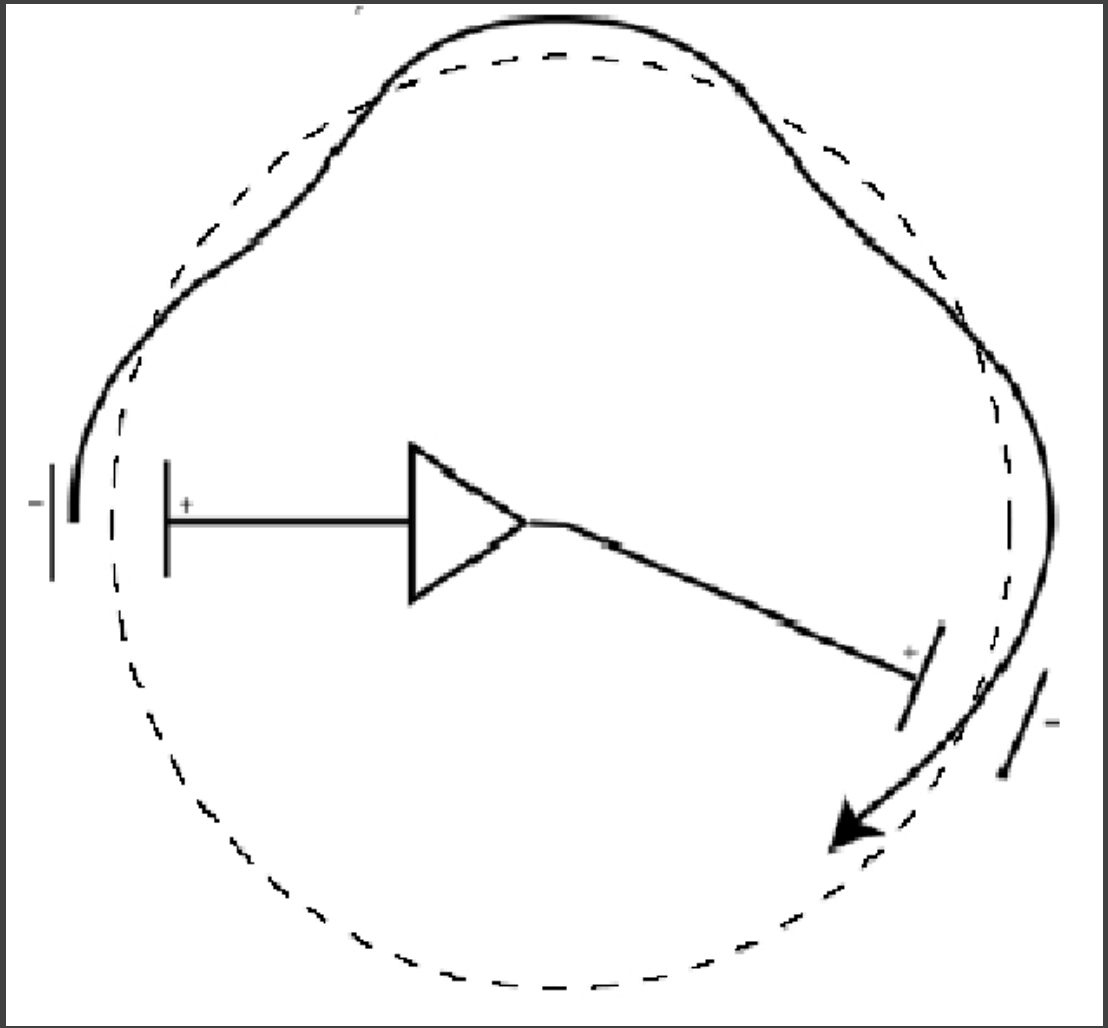


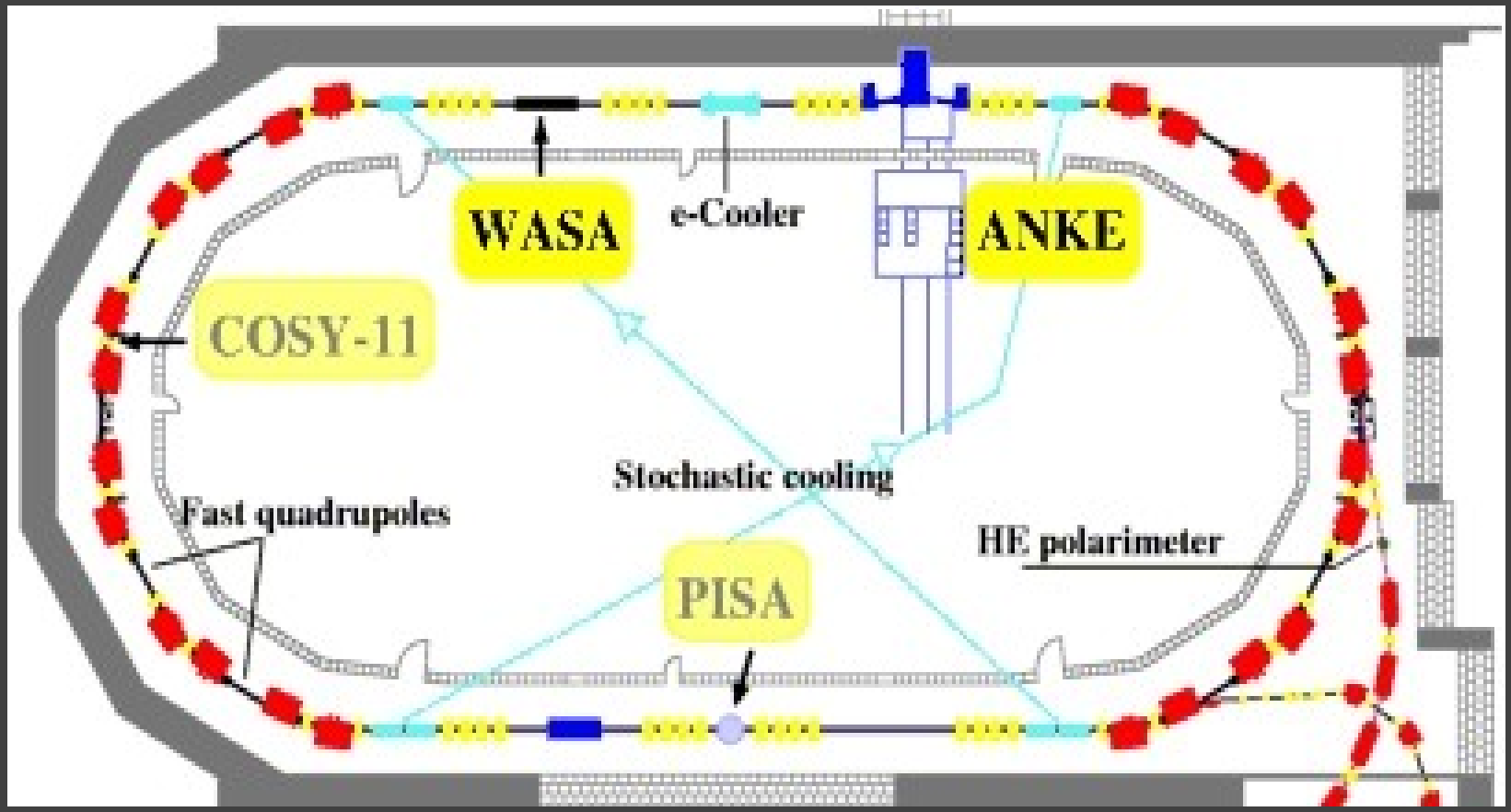
D. M. Binnie et al., Phys. Lett. B 83 (1979) 141

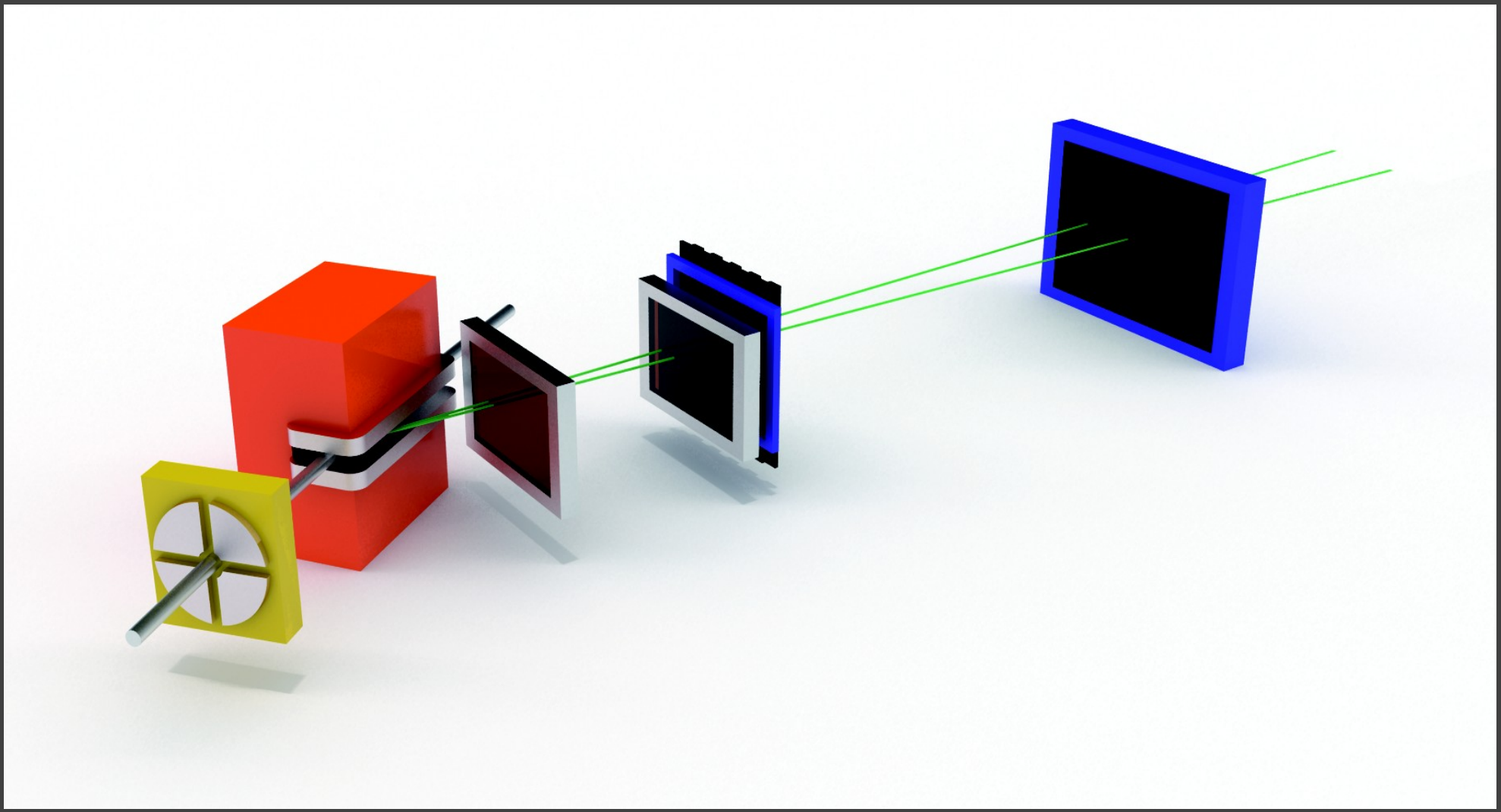

WASA
e-Cooler
ANKE
COSY-11
Stochastic cooling
Fast quadrupoles
HE polarimeter
PISA

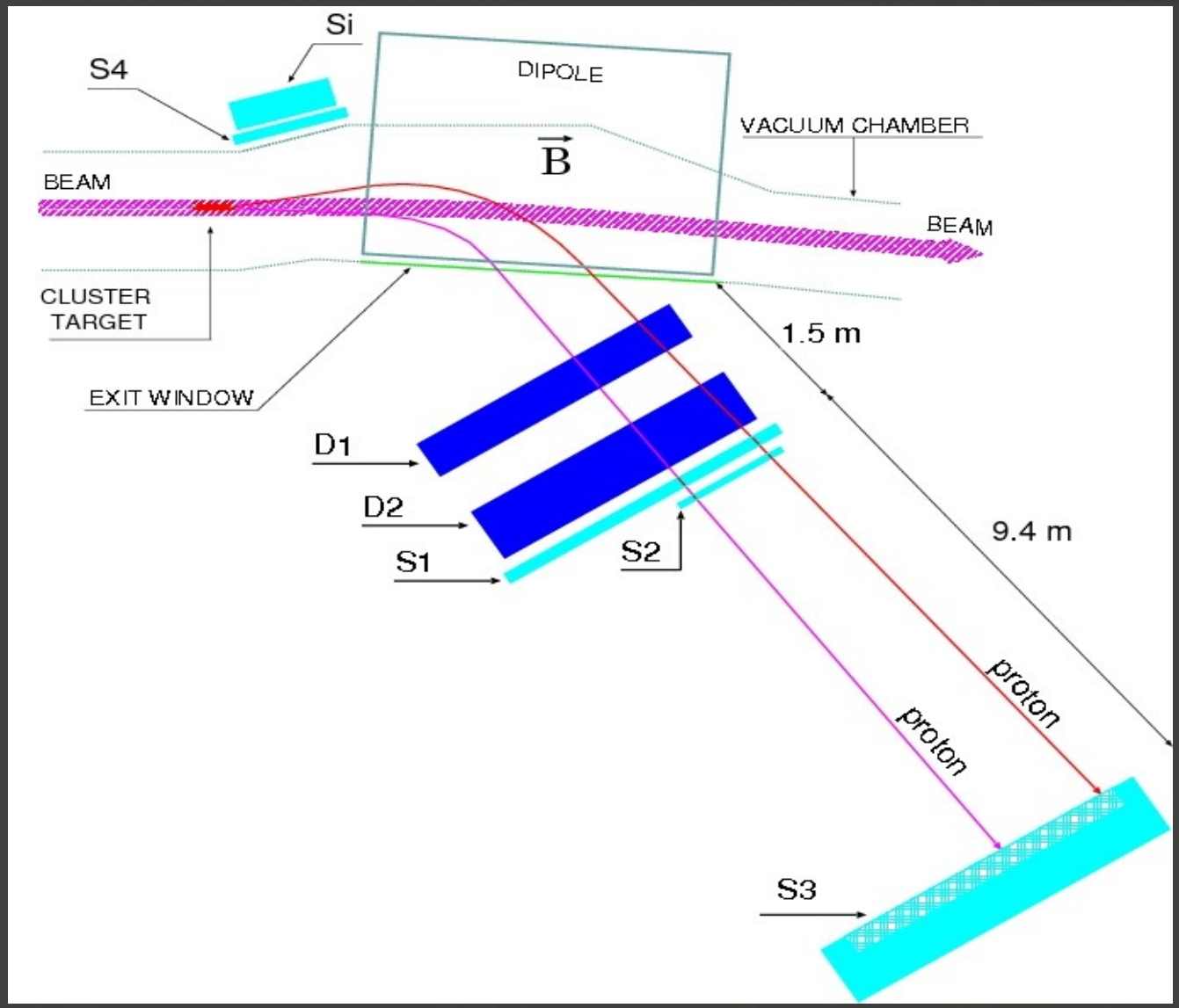

1
2
3
4
8
5
7
6

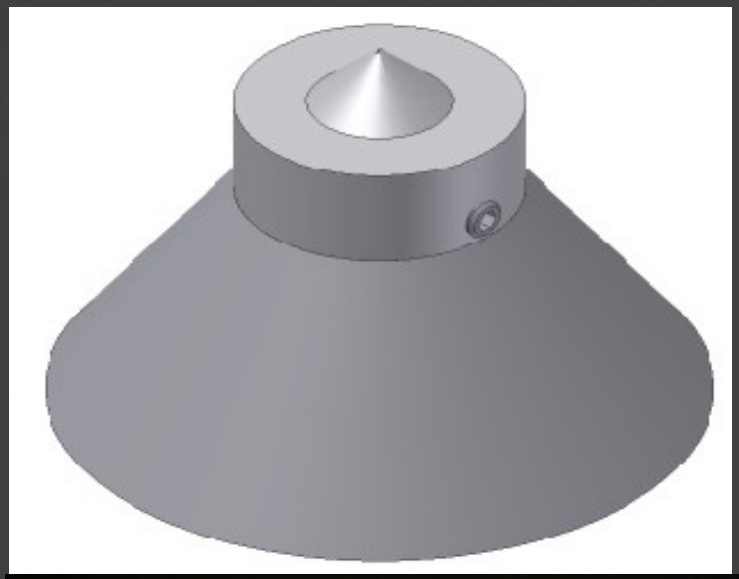

WASA
e-Cooler
ANKE
COSY-11
Stochastic cooling
Fast quadrupoles
HE polarimeter
PISA

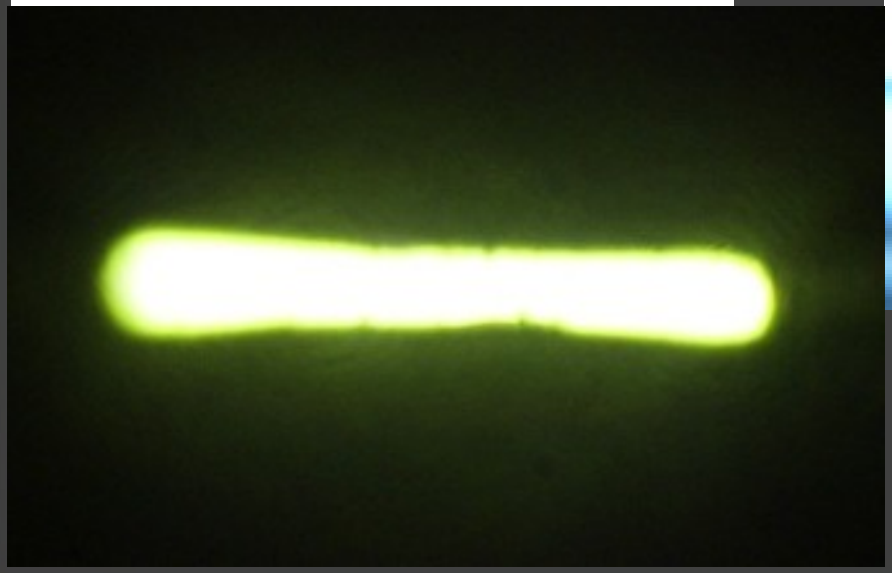


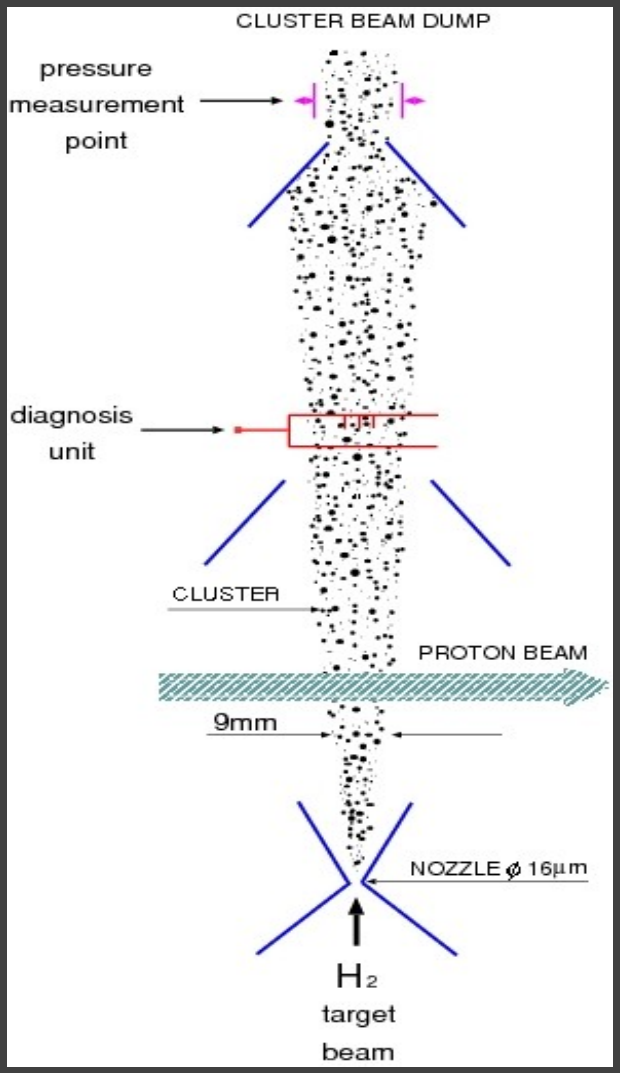

WASA
e-Cooler
ANKE
COSY-11
Stochastic cooling
Fast quadrupoles
HE polarimeter
PISA

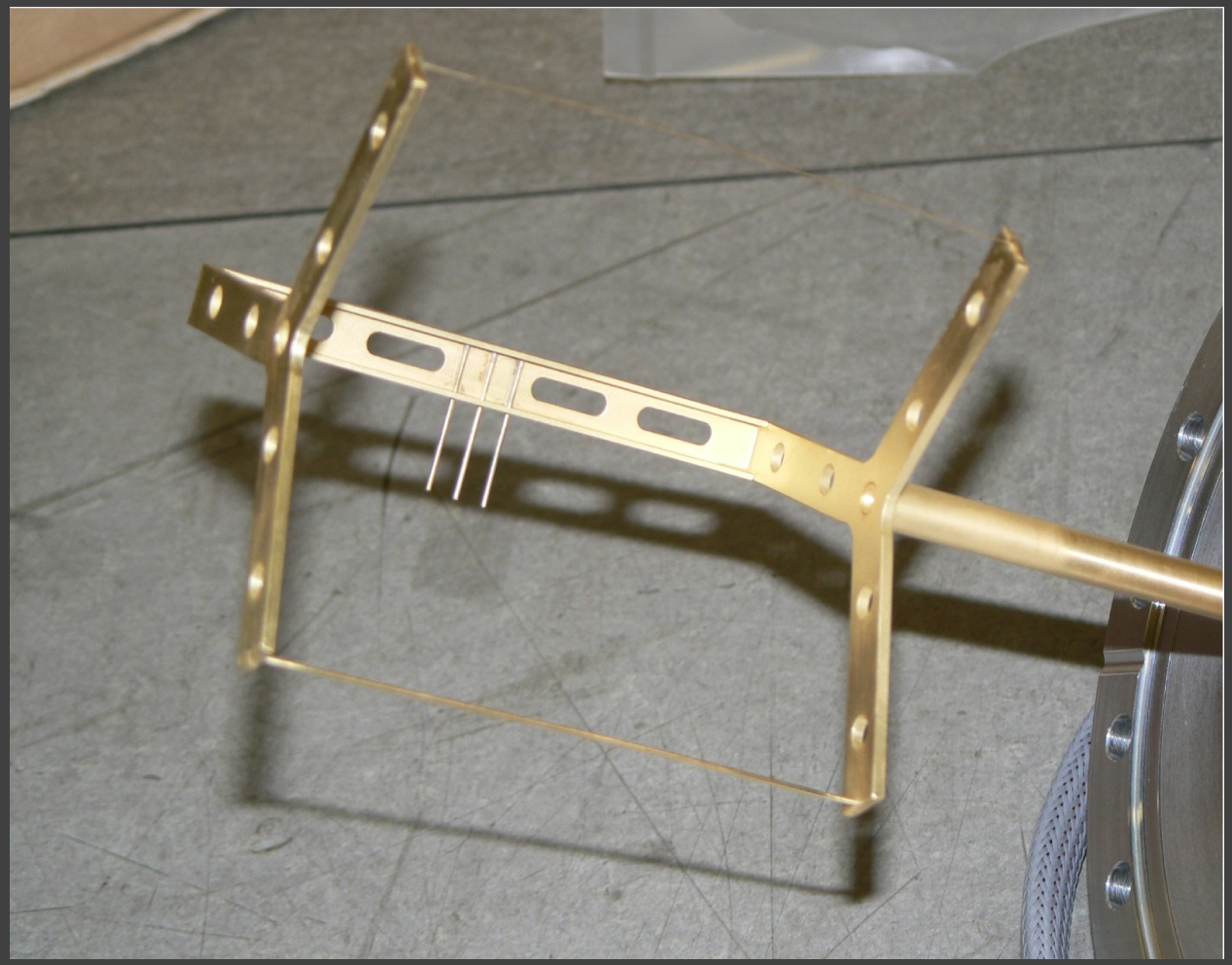


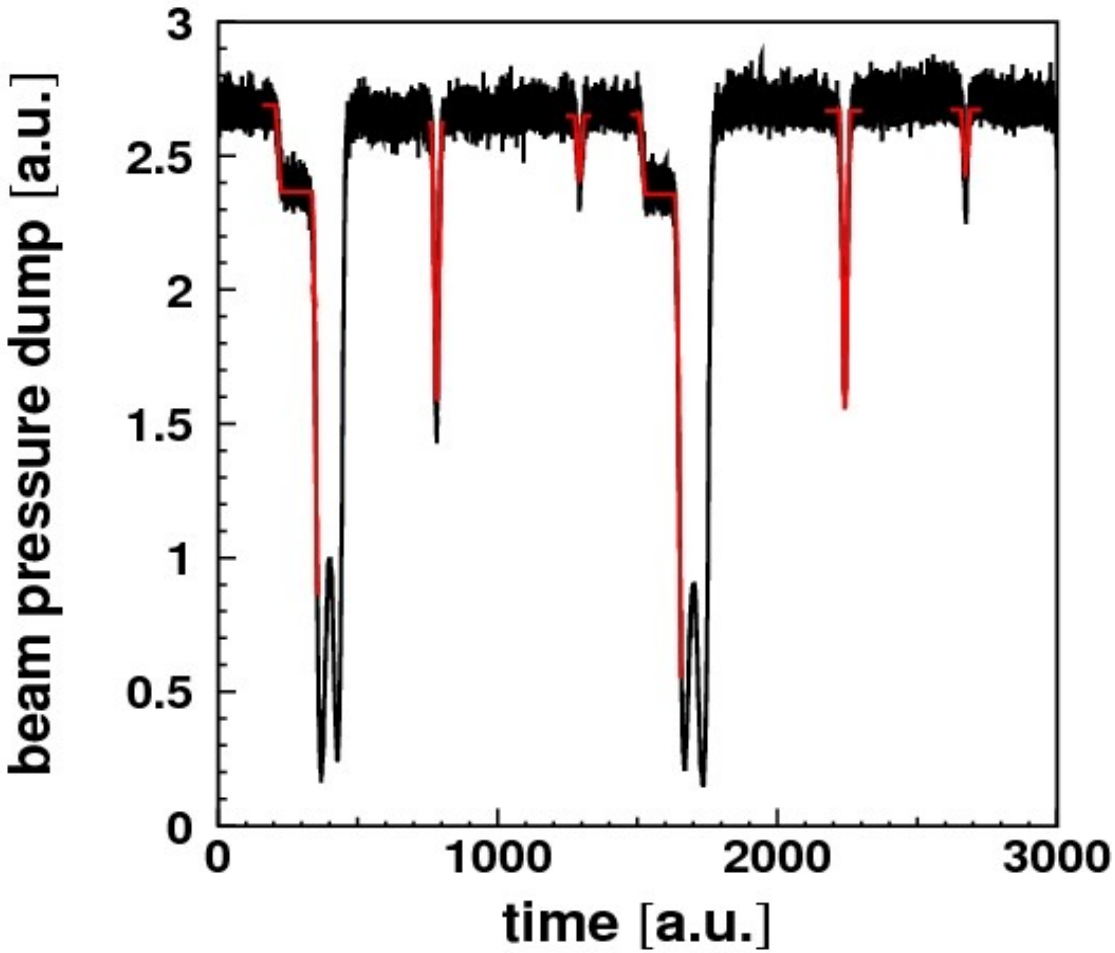

Si
S4
DIPOLE
VACUUM CHAMBER
B
BEAM
BEAM
CLUSTER
TARGET
1.5 m
EXIT WINDOW
D1
D2
S1
S2
9.4 m
proton
proton
S3

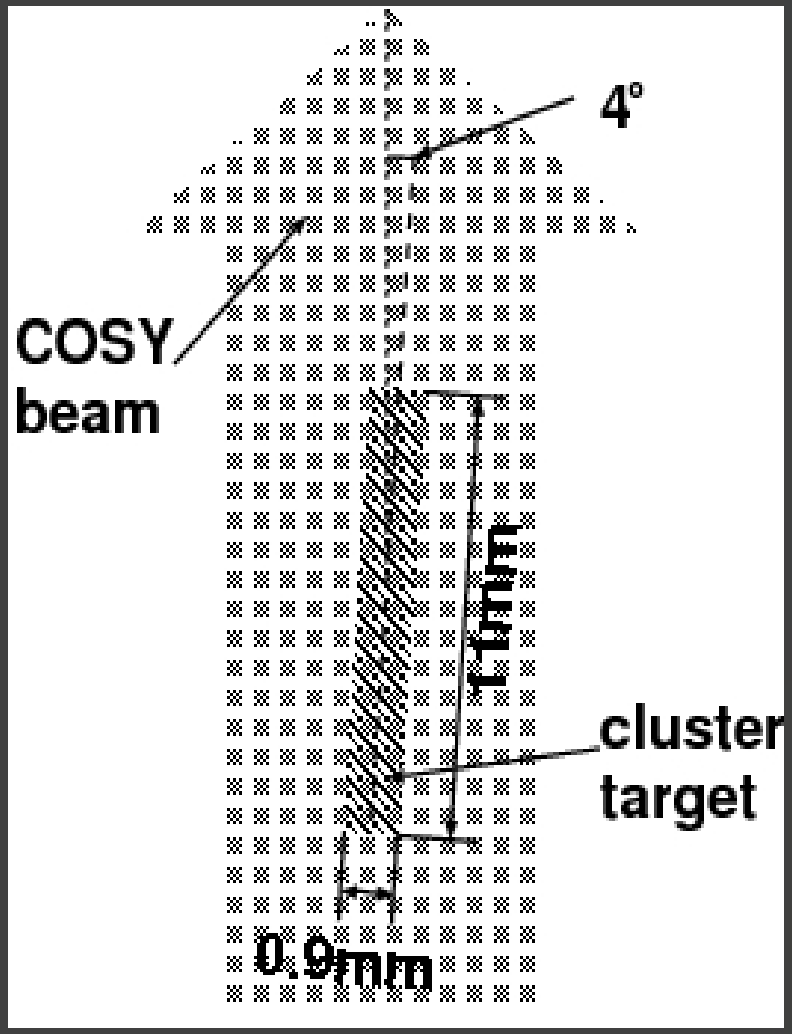


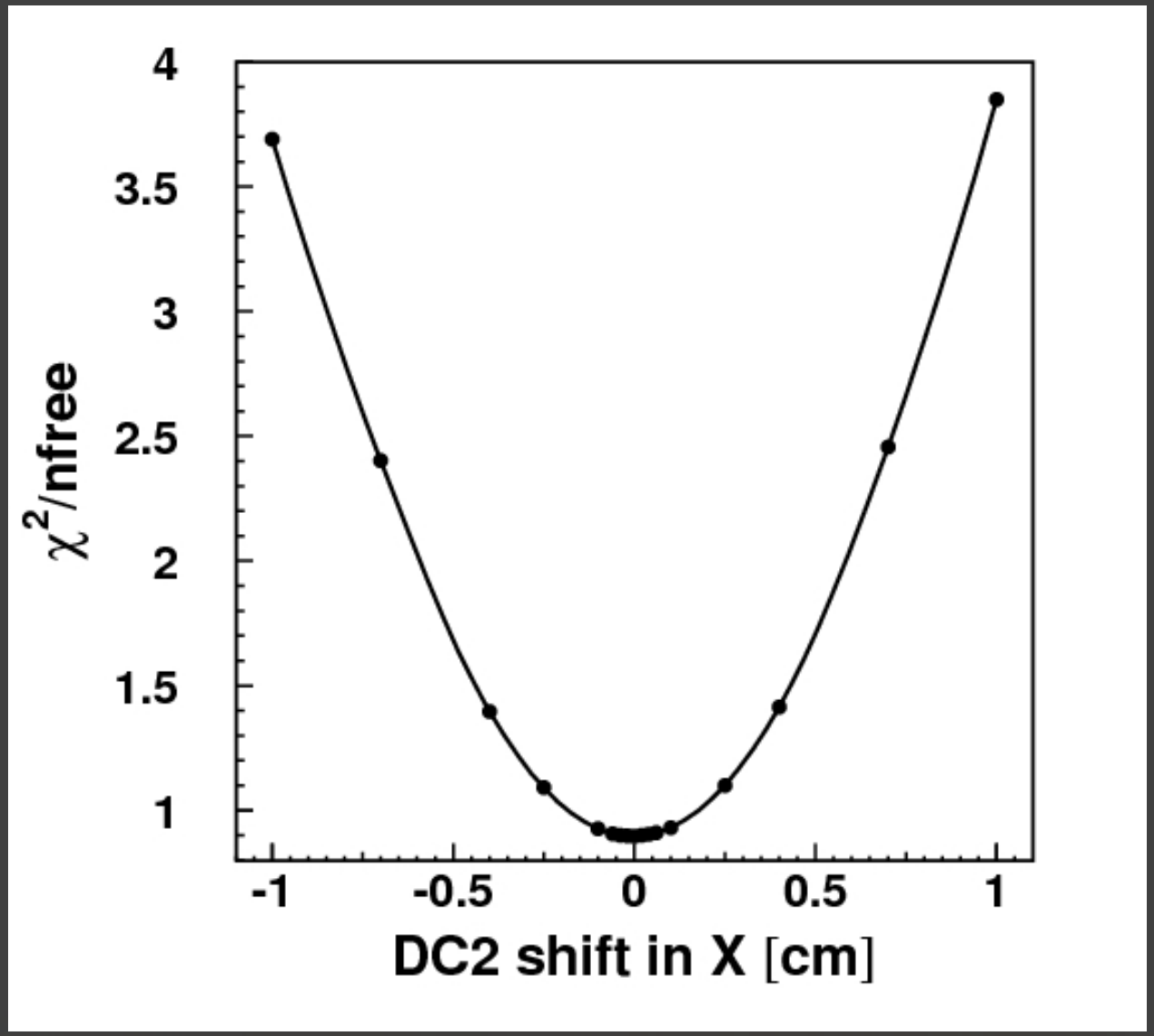


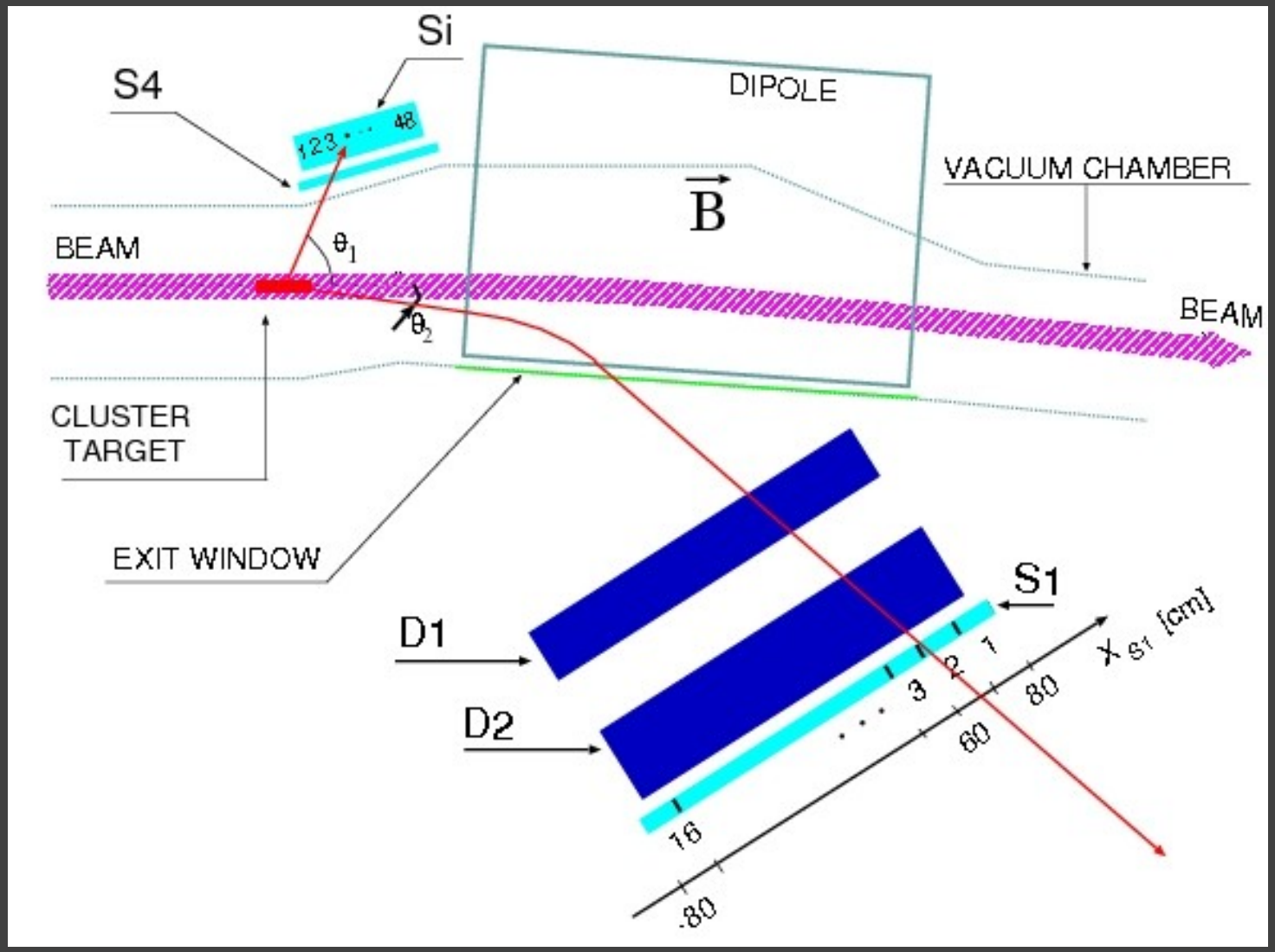

CLUSTER BEAM DUMP
pressure measurement point
diagnosis unit
CLUSTER
PROTON BEAM
9mm
NOZZLE ⌀ 16μm
H2
target beam

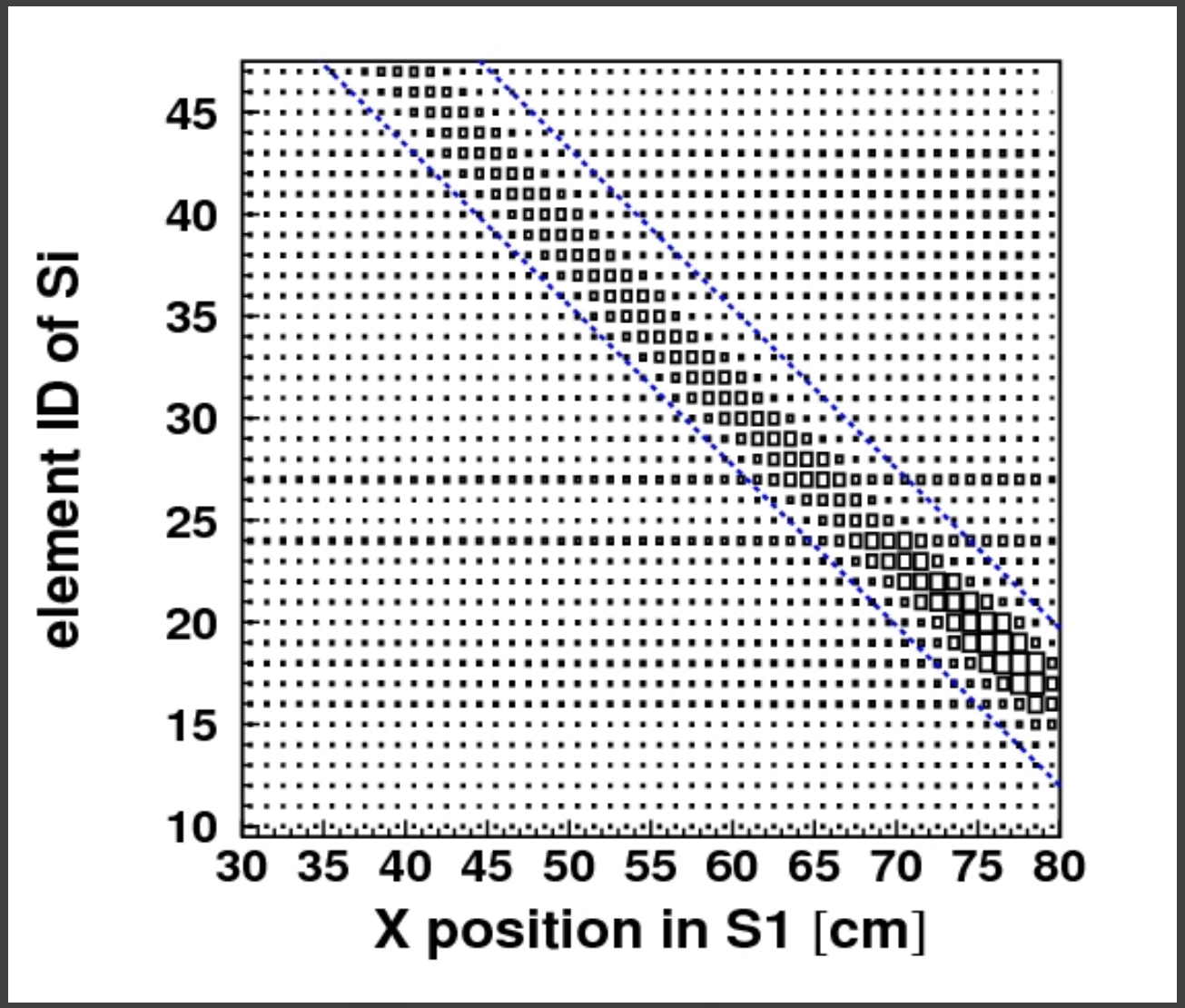


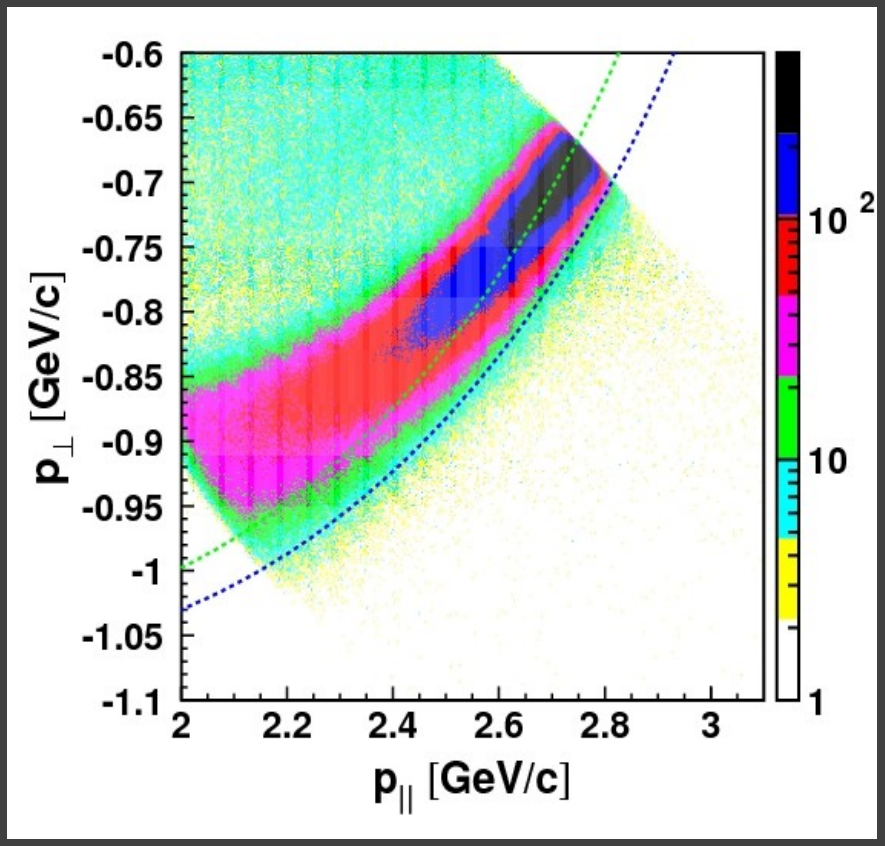

beam pressure dump [a.u.]
3
2.5
2
1.5
1
0.5
0
0
1000
2000
3000
time [a.u.]

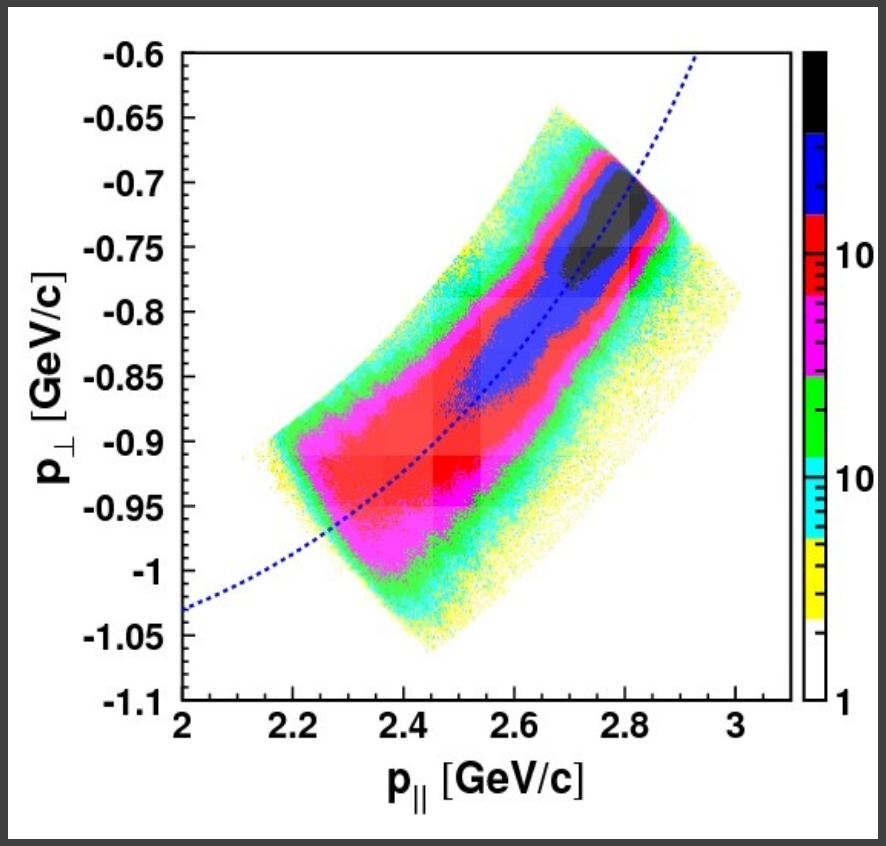

4°
COSY
beam
1 mm
cluster
target
0.9mm

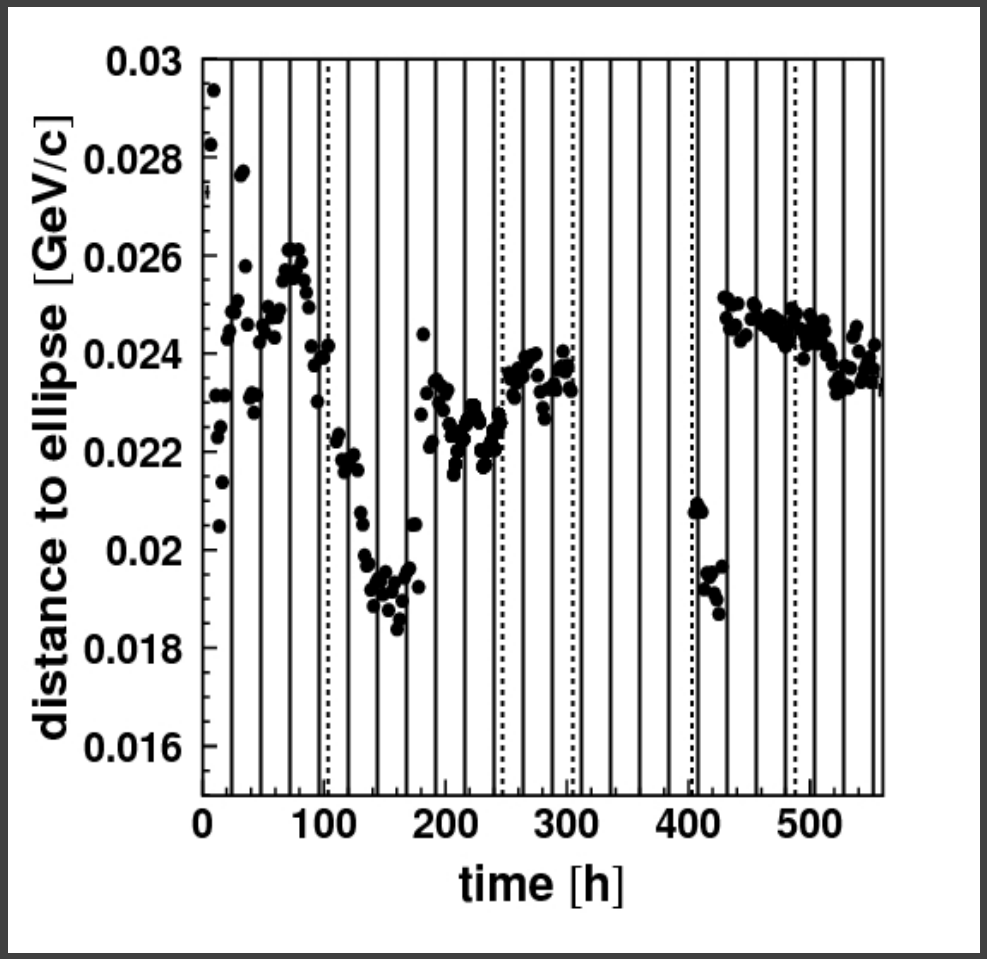

4
3.5
3
2.5
2
1.5
1
χ^2/nfree
-1
-0.5
0
0.5
1
DC2 shift in X [cm]

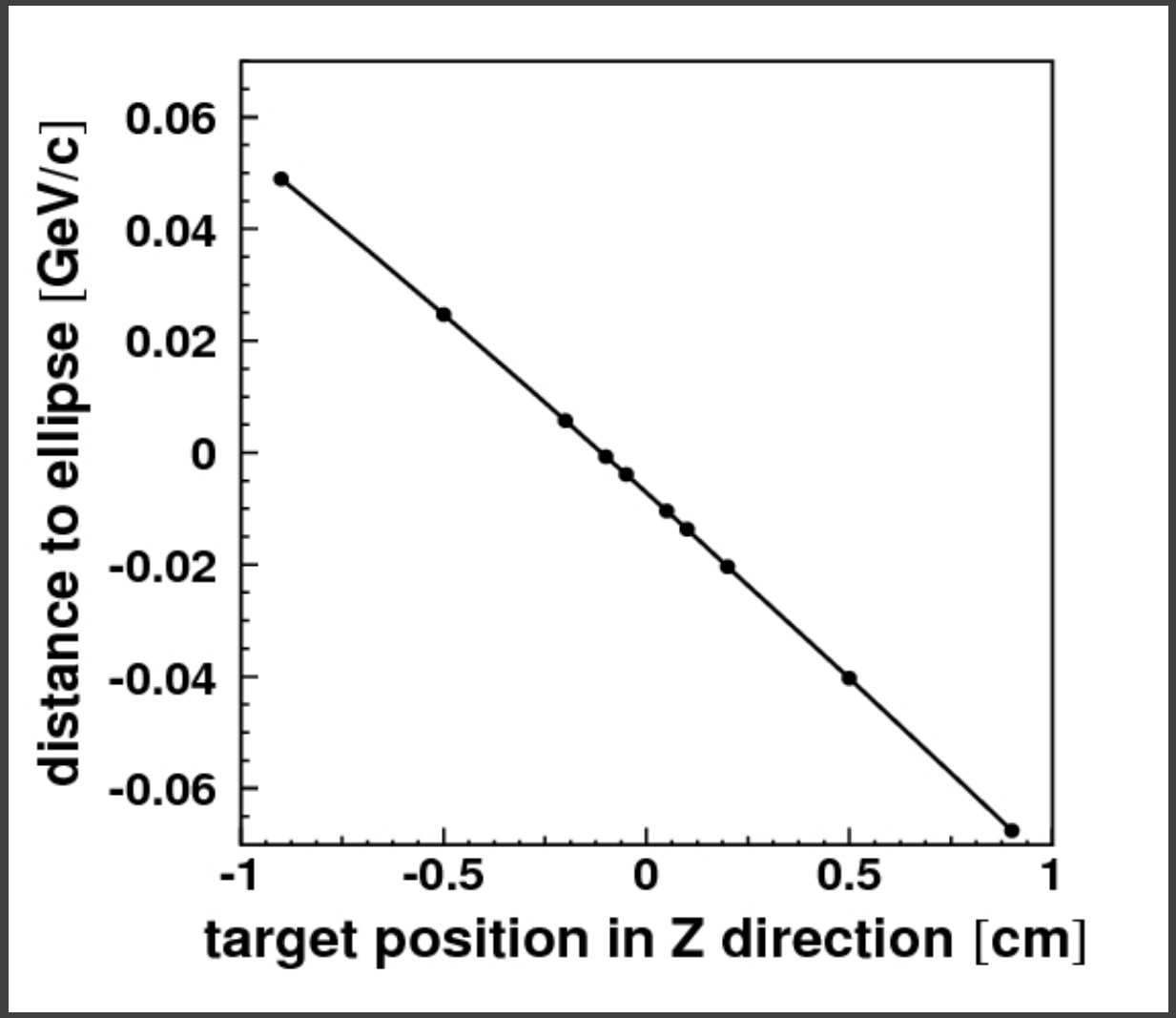

Si
S4
DIPOLE
VACUUM CHAMBER
B
BEAM
θ1
θ2
BEAM
CLUSTER
TARGET
EXIT WINDOW
S1
D1
D2
X S1 [cm]
1
2
3
16
80
60
-80

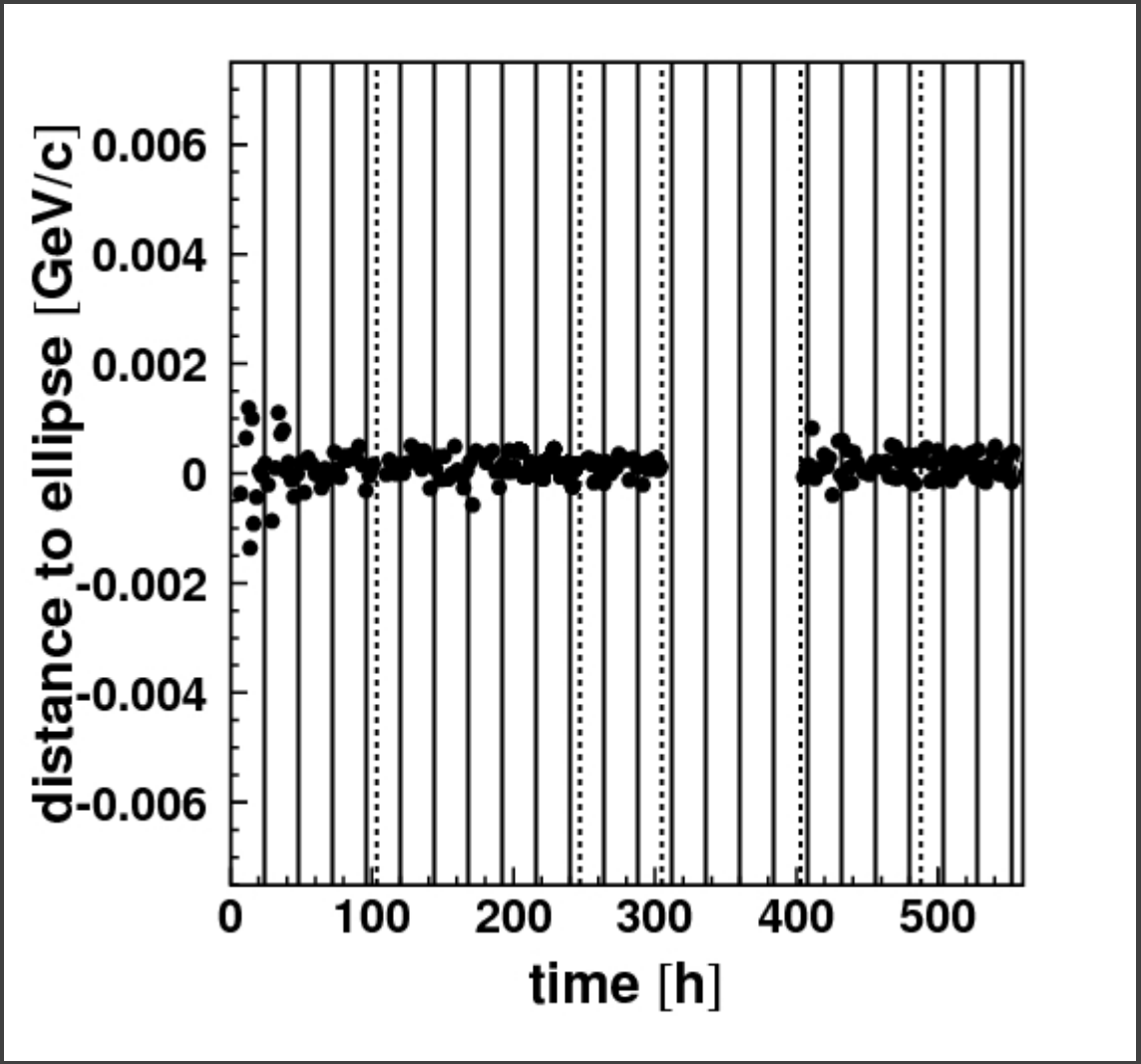

element ID of Si
45
40
35
30
25
20
15
10
30 35 40 45 50 55 60 65 70 75 80
X position in S1 [cm]

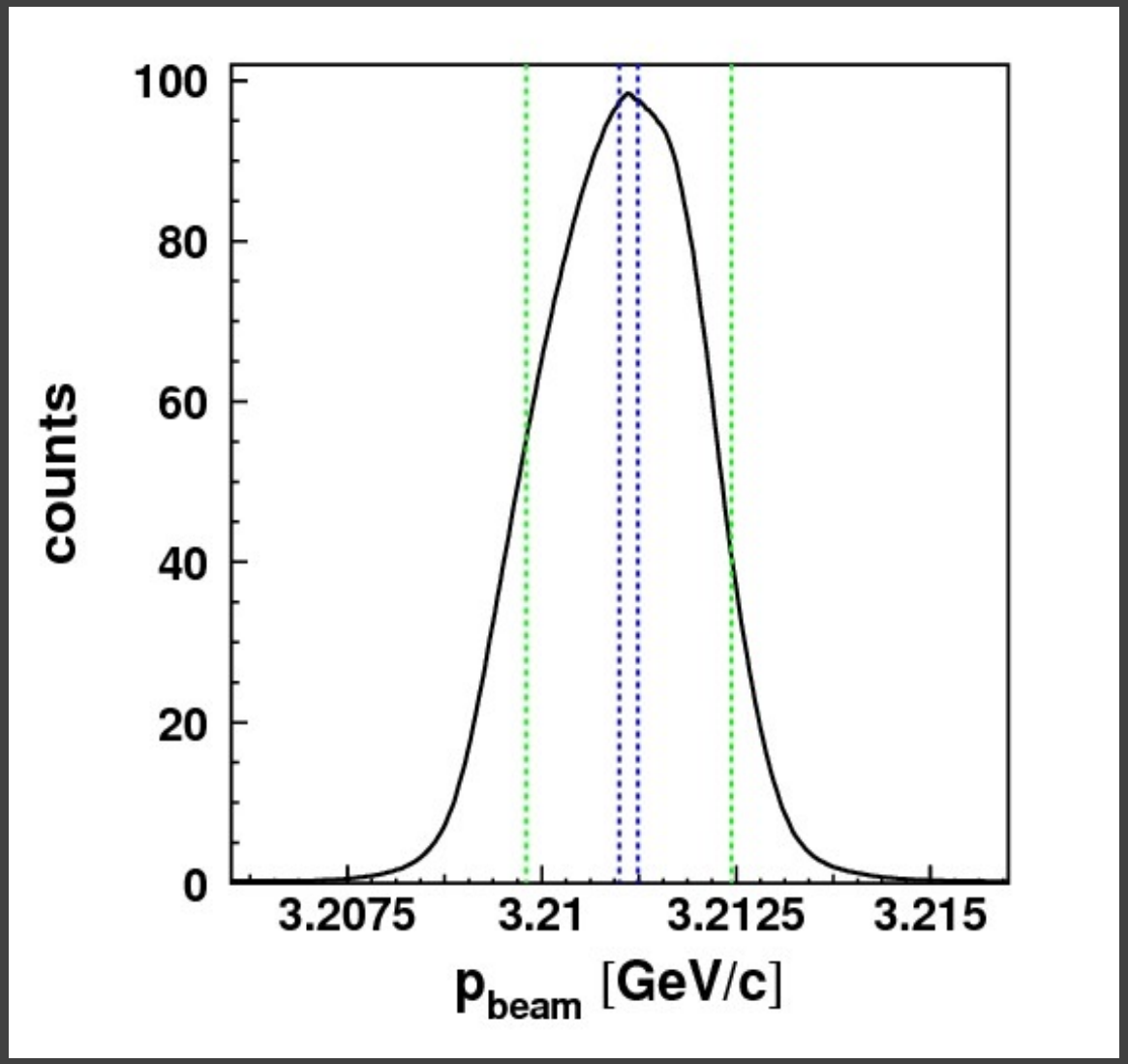

-0.6
-0.65
-0.7
-0.75
-0.8
-0.85
-0.9
-0.95
-1
-1.05
-1.1
2
2.2
2.4
2.6
2.8
3
$p_\perp$ [GeV/c]
$p_{||}$ [GeV/c]
10^2
10
1

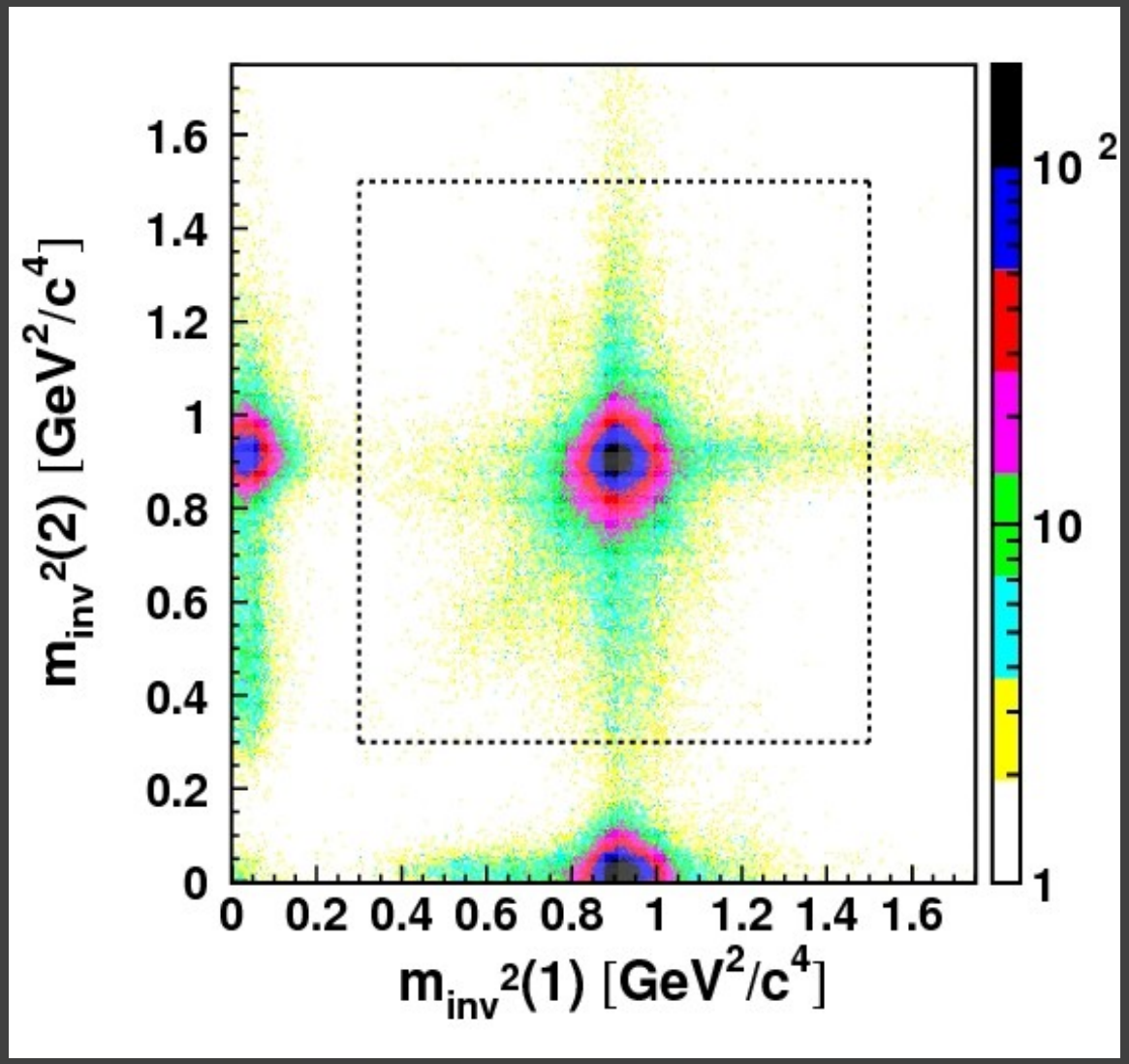

-0.6
-0.65
-0.7
-0.75
-0.8
-0.85
-0.9
-0.95
-1
-1.05
-1.1
2
2.2
2.4
2.6
2.8
3
$p_\perp$ [GeV/c]
$p_{||}$ [GeV/c]
10
10
1

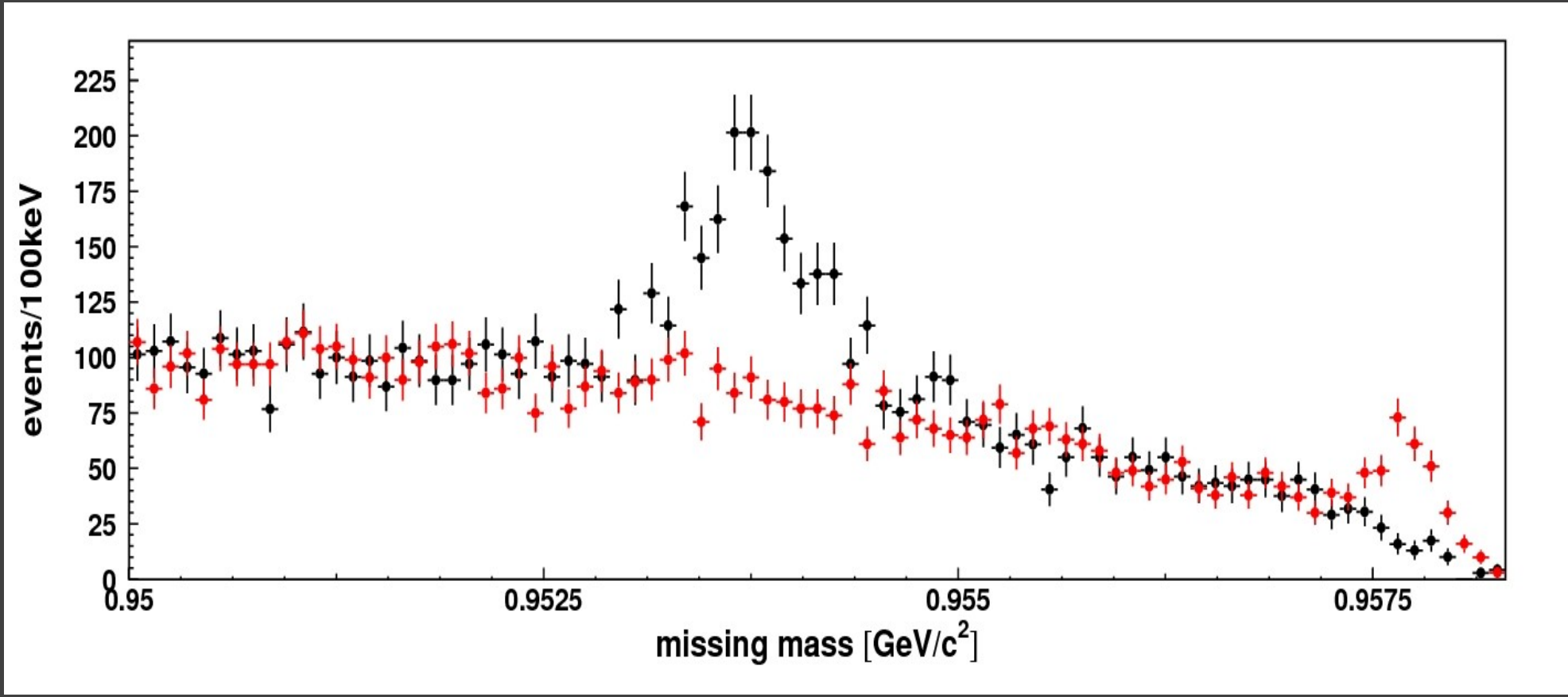

0.03
0.028
0.026
0.024
0.022
0.02
0.018
0.016
distance to ellipse [GeV/c]
0
100
200
300
400
500
time [h]

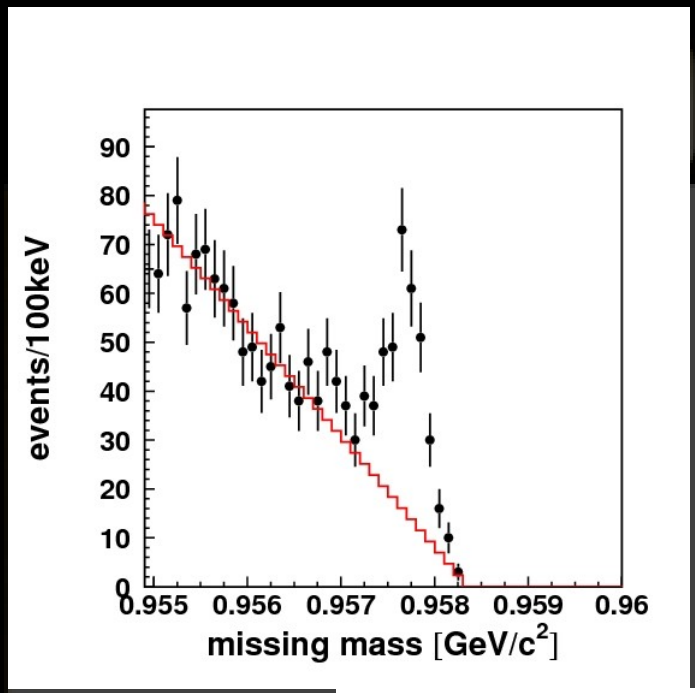

distance to ellipse [GeV/c]
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-1
-0.5
0
0.5
1
target position in Z direction [cm]

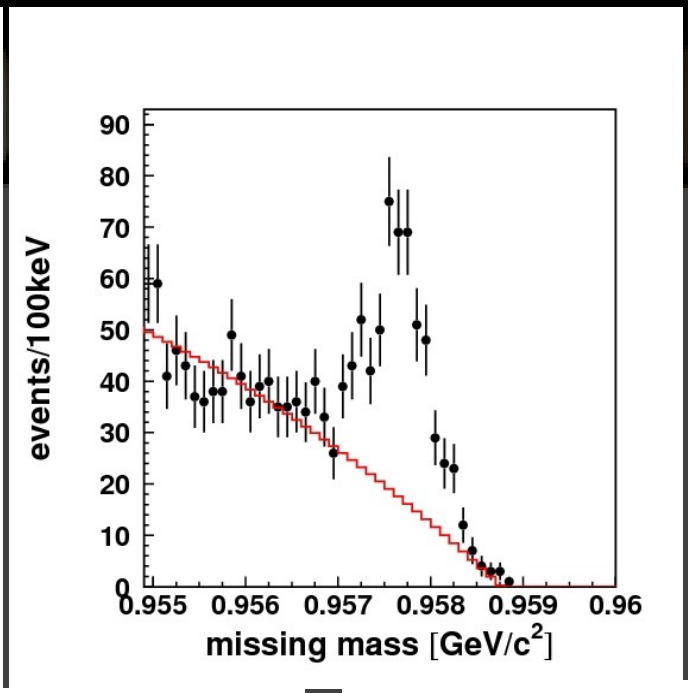

distance to ellipse [GeV/c]
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
0
100
200
300
400
500
time [h]

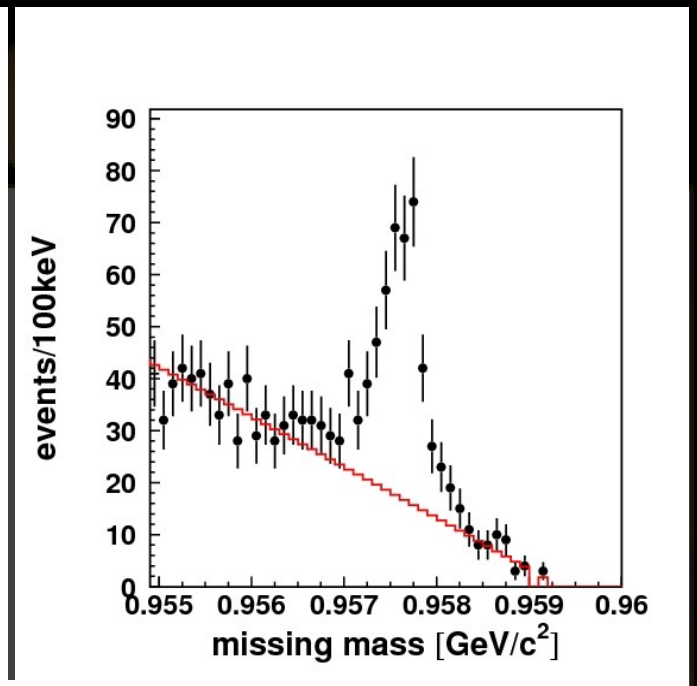

100
80
60
40
20
0
counts
3.2075
3.21
3.2125
3.215
p_{beam} [GeV/c]

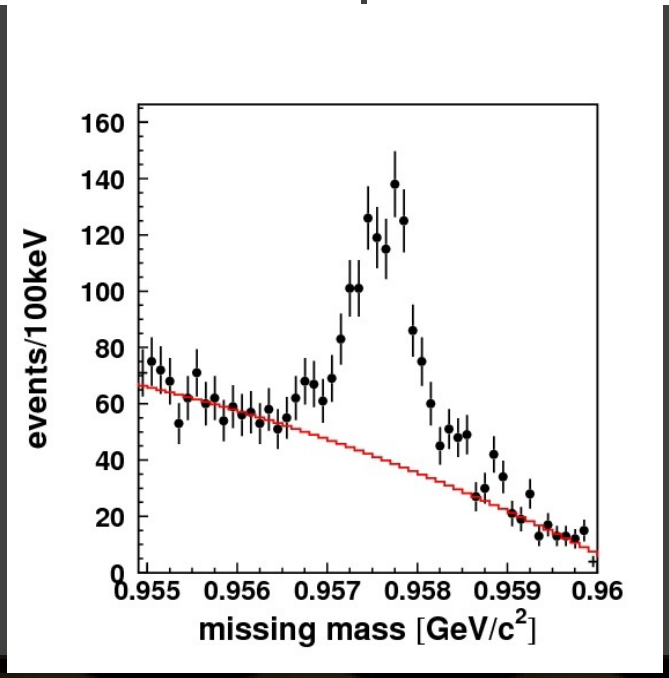

1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0 0.2 0.4 0.6 0.8 1 1.2 1.4 1.6
$m_{inv}^2(2)$ [GeV^2/c^4]
$m_{inv}^2(1)$ [GeV^2/c^4]
10^2
10
1

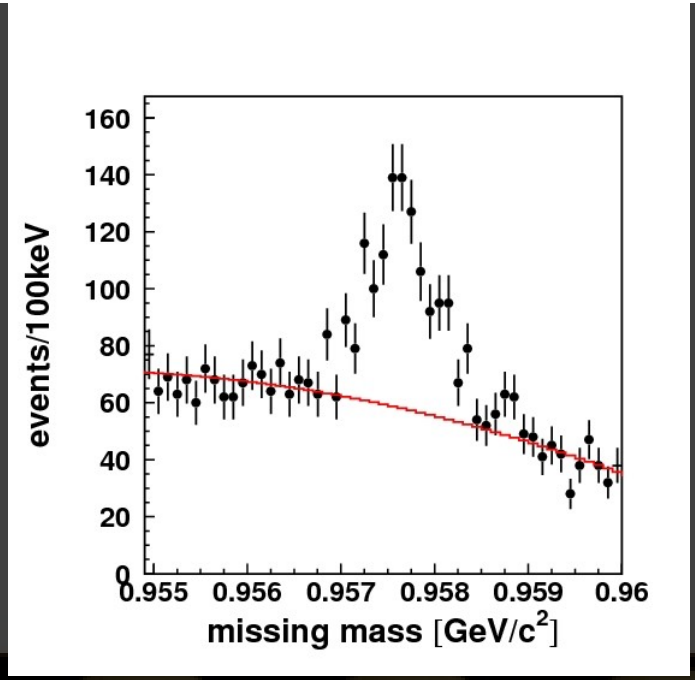

events/100keV
225
200
175
150
125
100
75
50
25
0
0.95
0.9525
0.955
0.9575
missing mass [GeV/c^2]

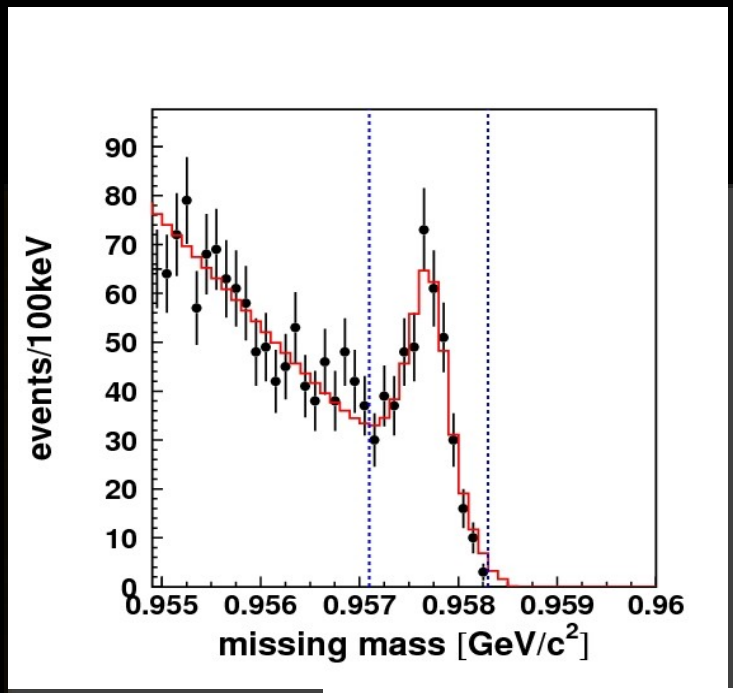

events/100keV
missing mass [GeV/c^2]

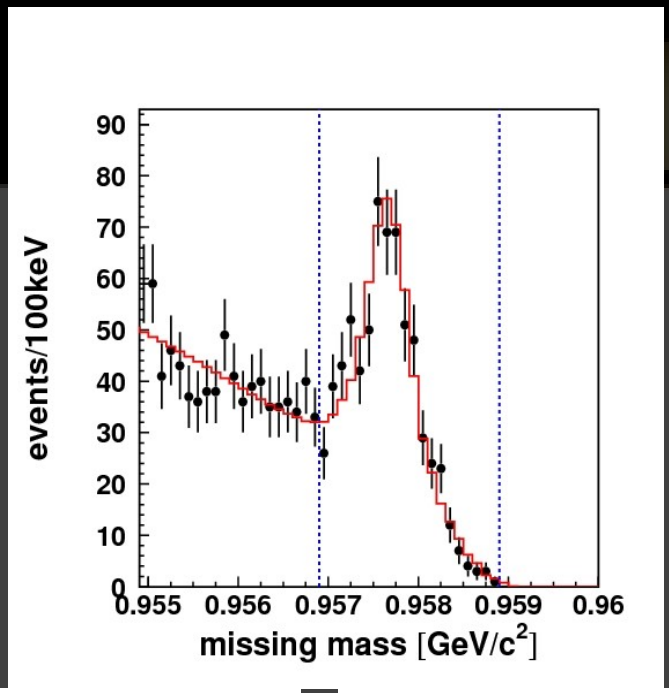

events/100keV
missing mass [GeV/c^2]

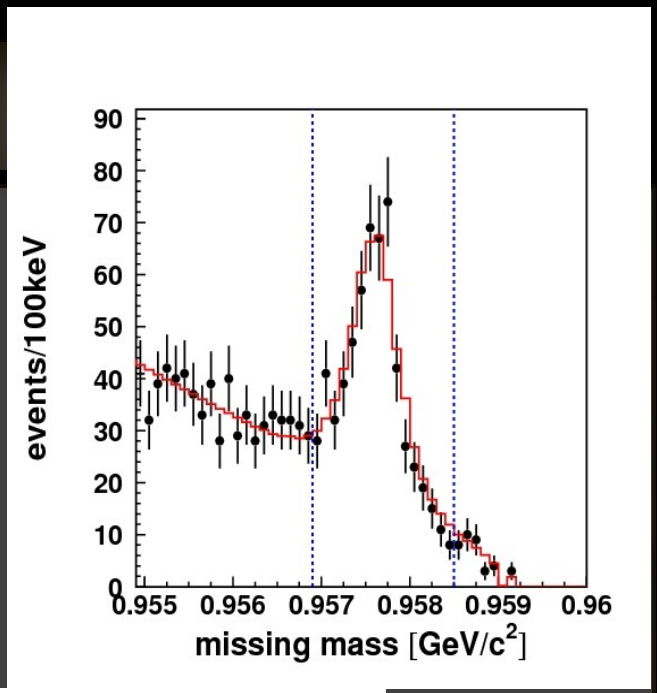

events/100keV
missing mass [GeV/c^2]

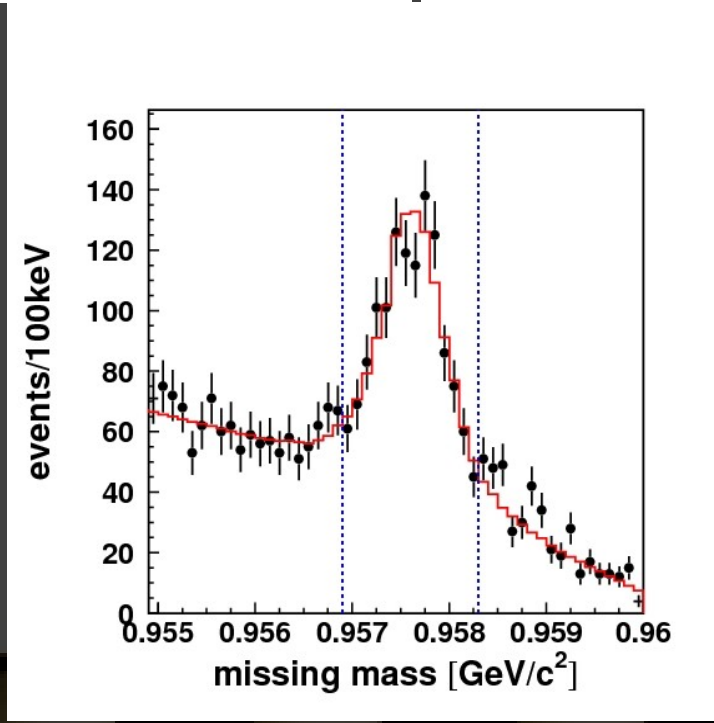

events/100keV
missing mass [GeV/c^2]

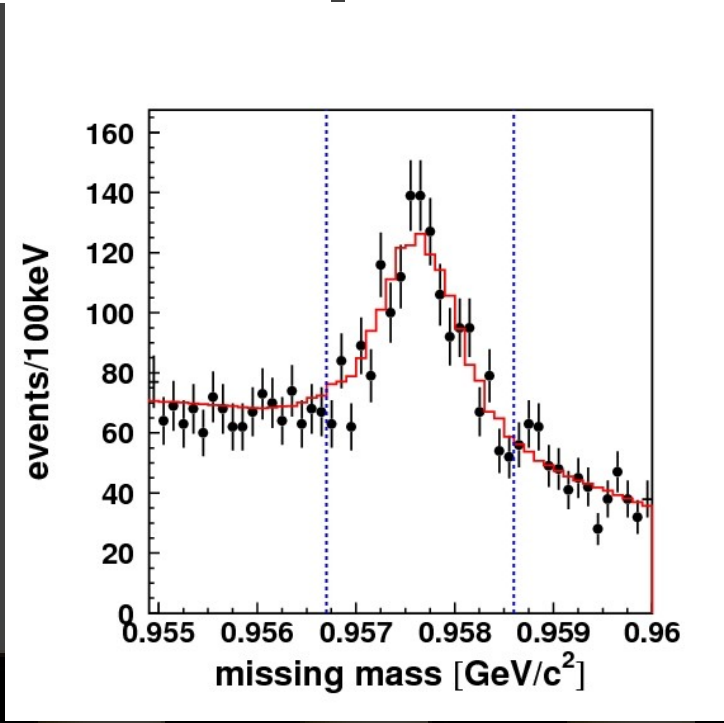

events/100keV
missing mass [GeV/c^2]

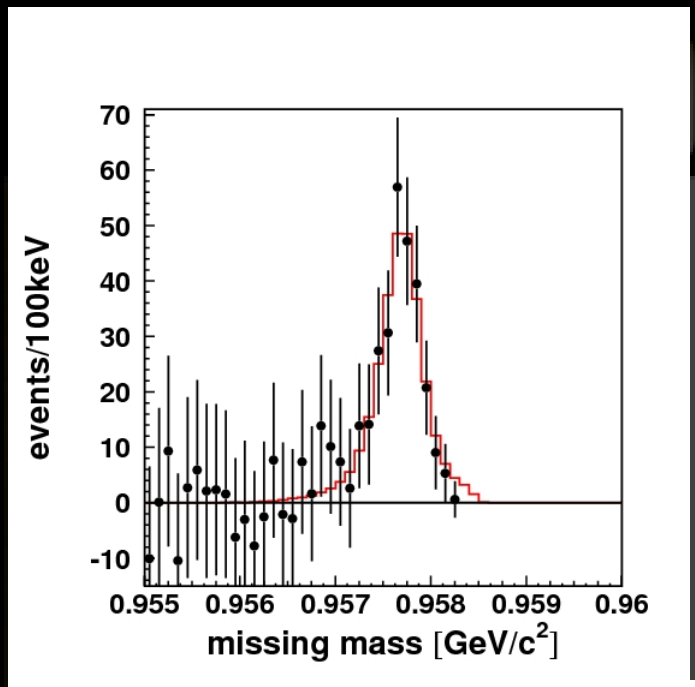

events/100keV
missing mass [GeV/c^2]

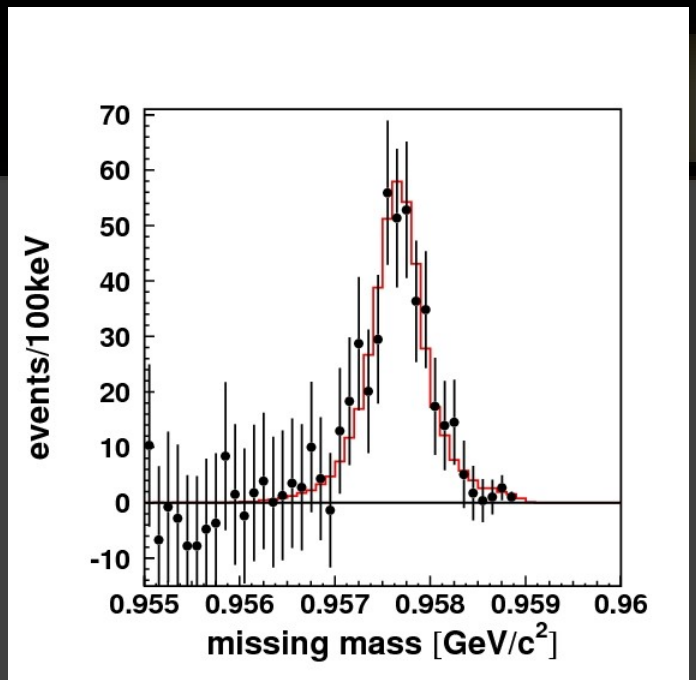

events/100keV
missing mass [GeV/c^2]

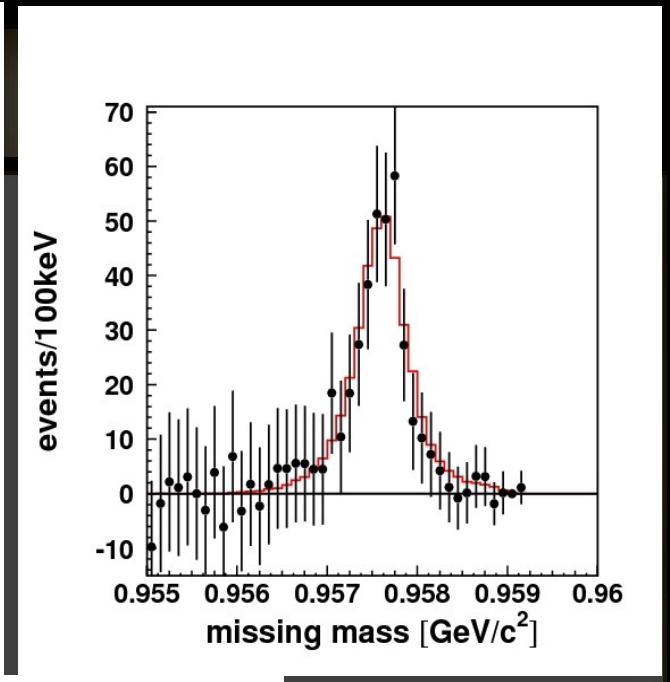

events/100keV
missing mass [GeV/c^2]

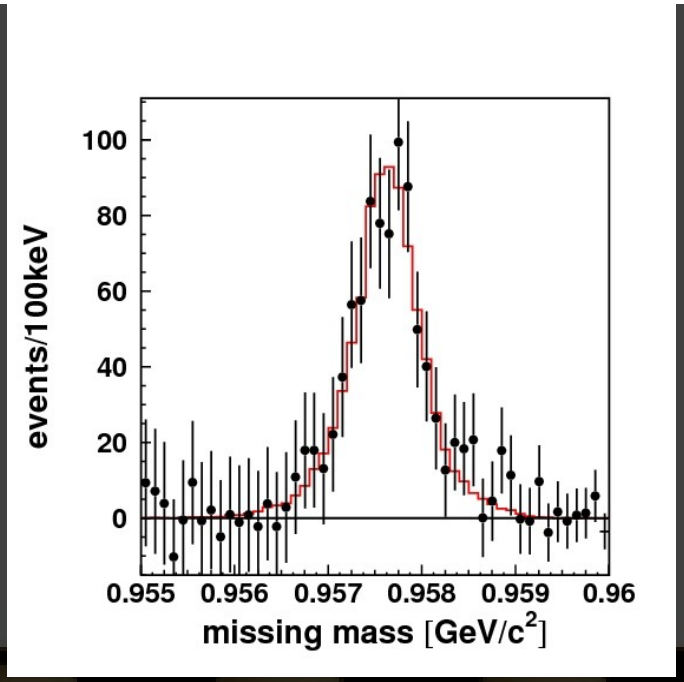

events/100keV
missing mass [GeV/c^2]

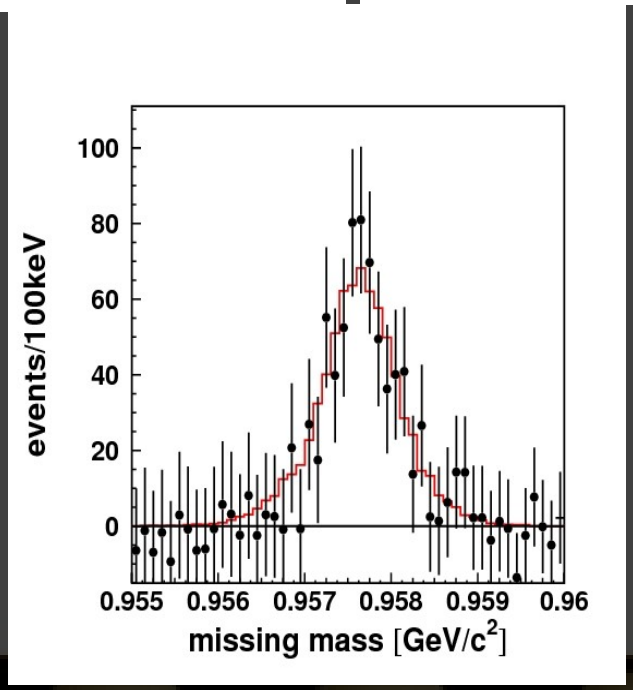

events/100keV
missing mass [GeV/c^2]

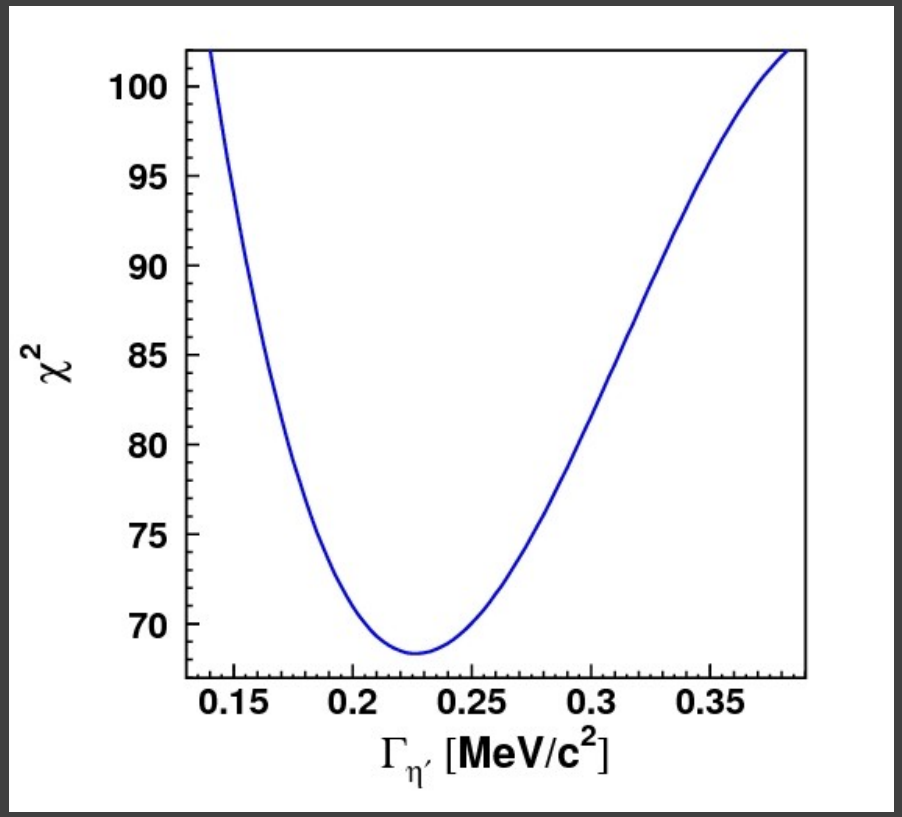

events/100keV
missing mass [GeV/c^2]

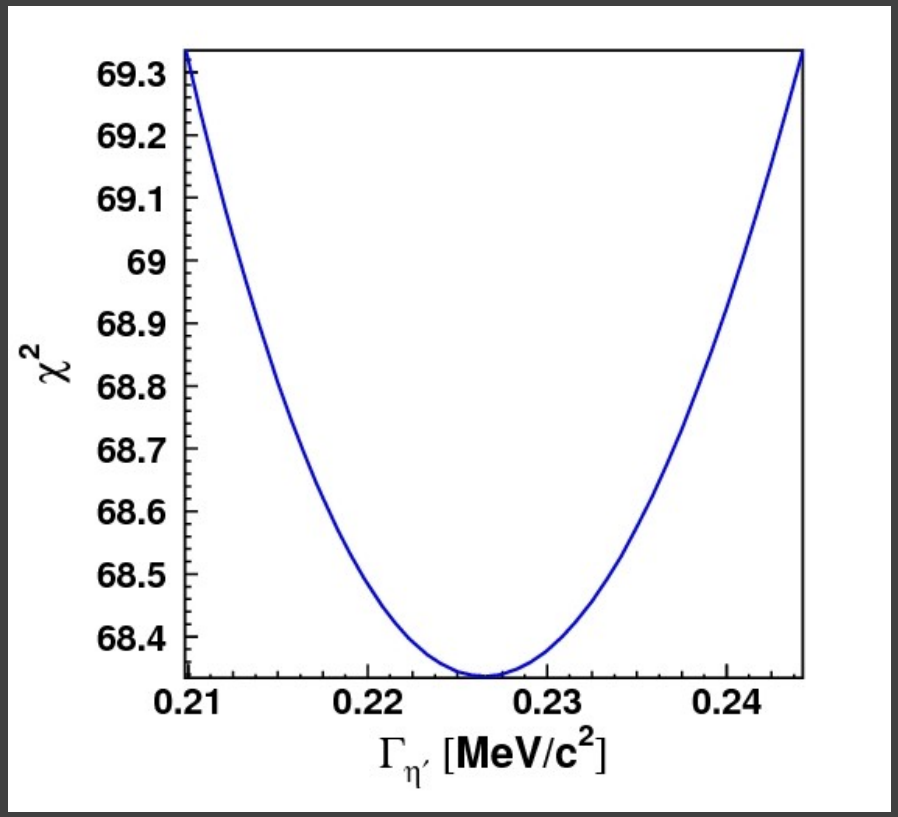

events/100keV
missing mass [GeV/c^2]


events/100keV
missing mass [GeV/c^2]


events/100keV
missing mass [GeV/c^2]


events/100keV
missing mass [GeV/c^2]


100
95
90
85
80
75
70
χ^2
0.15
0.2
0.25
0.3
0.35
$\Gamma_{\eta'}$ [MeV/c^2]


69.3
69.2
69.1
69
68.9
68.8
68.7
68.6
68.5
68.4
χ^2
0.21
0.22
0.23
0.24
$\Gamma_{\eta'}$ [MeV/c^2]

parameter contribution to the systematic error MeV

map of the magnetic field	0.007
target position	0.006
background subtraction method	0.006
ranges of missing mass, where χ^2 was calculated	0.005
bins width	0.004
absolute beam momentum	0.003
final state interaction (FSI) between protons	0.003
effective target width	0.002
position and orientation of the drift chambers	0.001
TOTAL	0.014

$\Gamma_{\eta'} = 0.205 \pm 0.015$ MeV	PDG
$\Gamma_{\eta'} = 0.28 \pm 0.10$ MeV	NIMROD
$\Gamma_{\eta'} = 0.226 \pm 0.017(\text{stat.}) \pm 0.014(\text{syst.})$ MeV	COSY-11

The End