Status of the η mass measurement

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Progress from the last presentation.

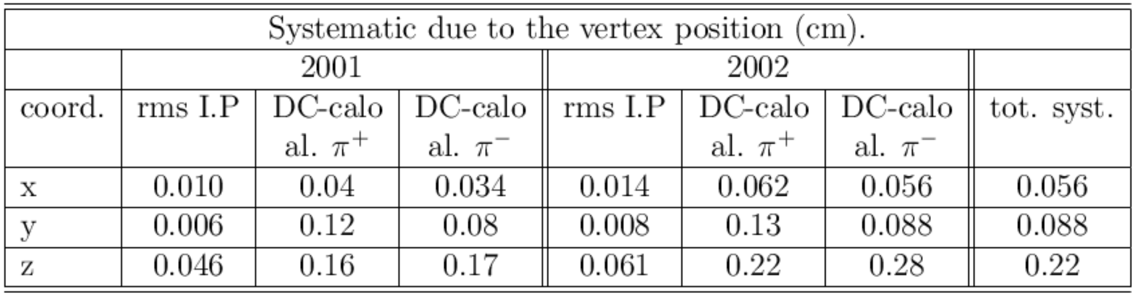
- Evaluation of the systematic error for the π^0 mass and the ratio of the two η/π^0 masses;

- Selection of a sample with a stable value of the sqrt(s);

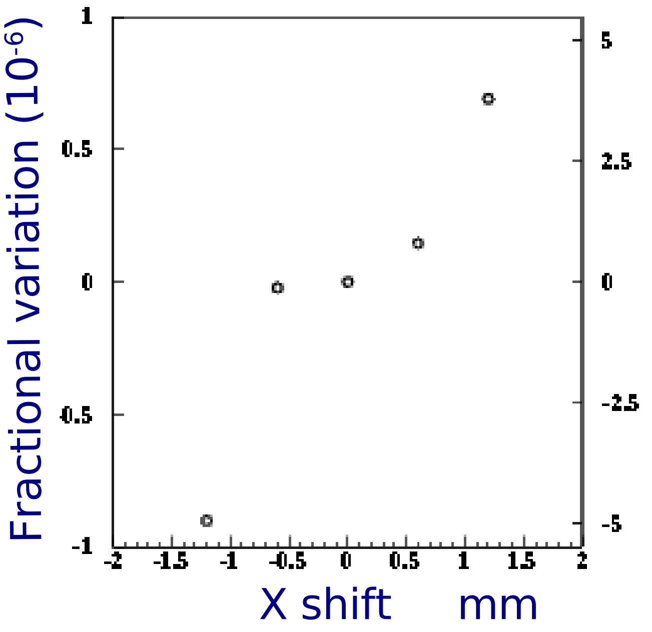
- Computation of the final result.

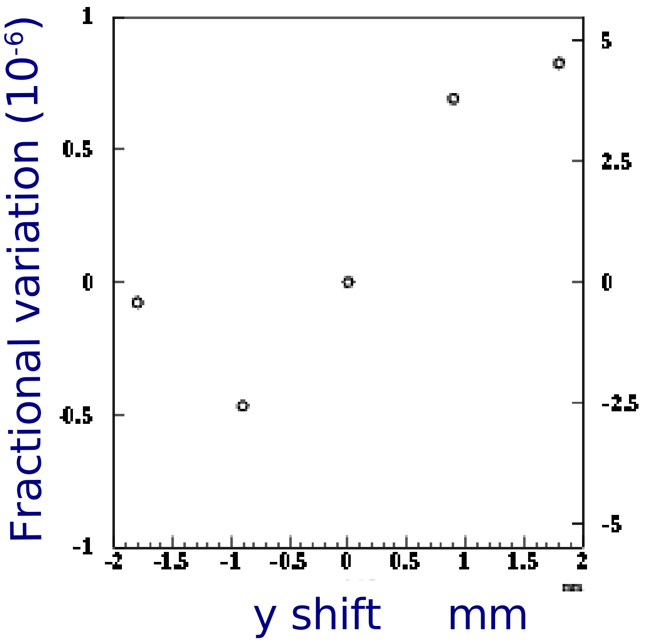
Vertex position systematic η

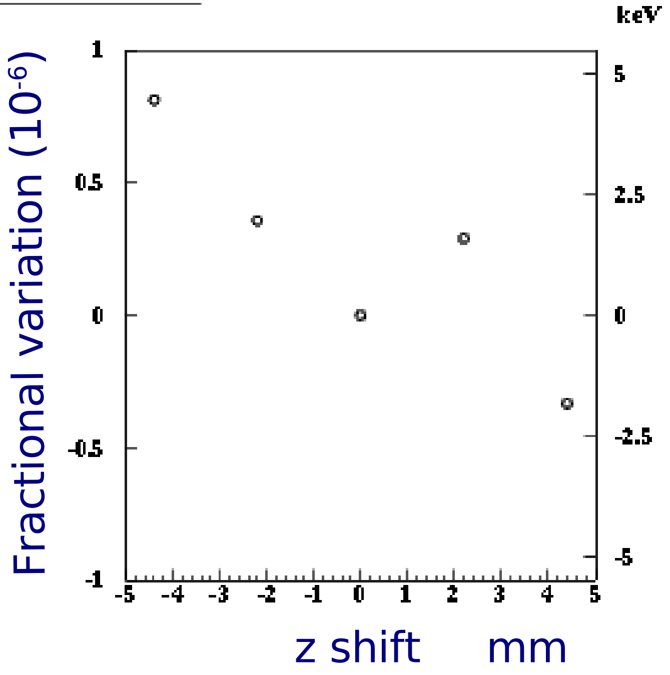
The uncertainty on the vertex is determined by using the $\pi\pi\gamma$ sample at the end the systematic uncertainty is given by:



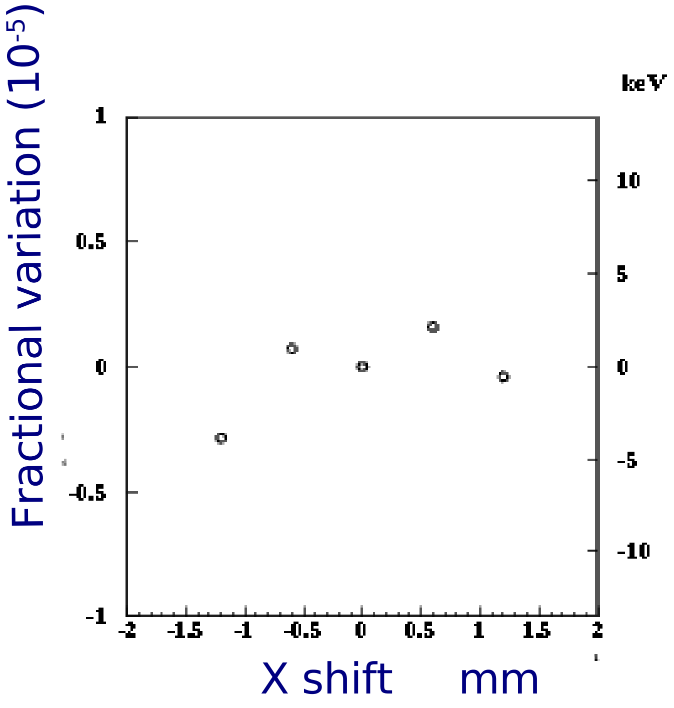
Systematic due to the vertex position (cm).							
	2001			2002			
coord.	rms I.P	DC-calo al. π^+	DC-calo al. π^-	rms I.P	DC-calo al. π^+	DC-calo al. π^-	tot. syst.
x	0.010	0.04	0.034	0.014	0.062	0.056	0.056
y	0.006	0.12	0.08	0.008	0.13	0.088	0.088
z	0.046	0.16	0.17	0.061	0.22	0.28	0.22

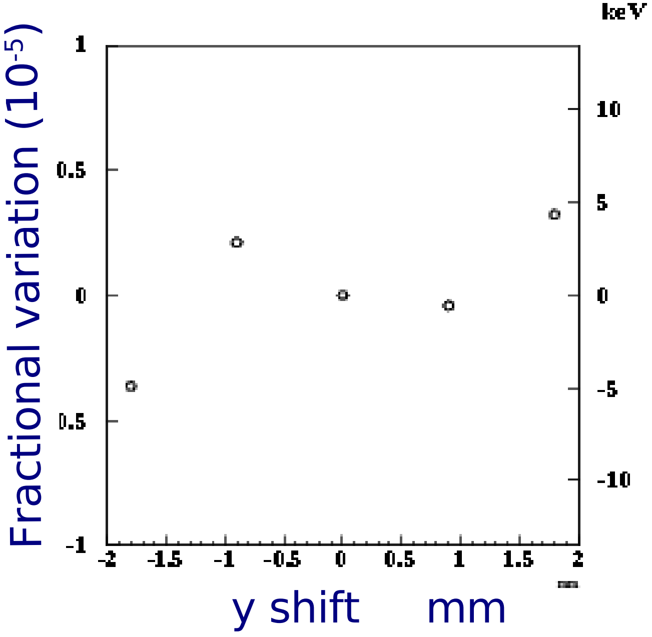


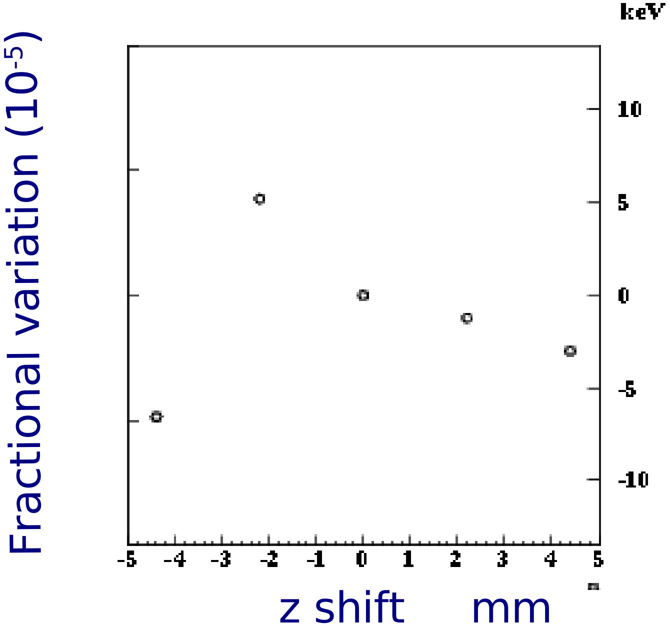




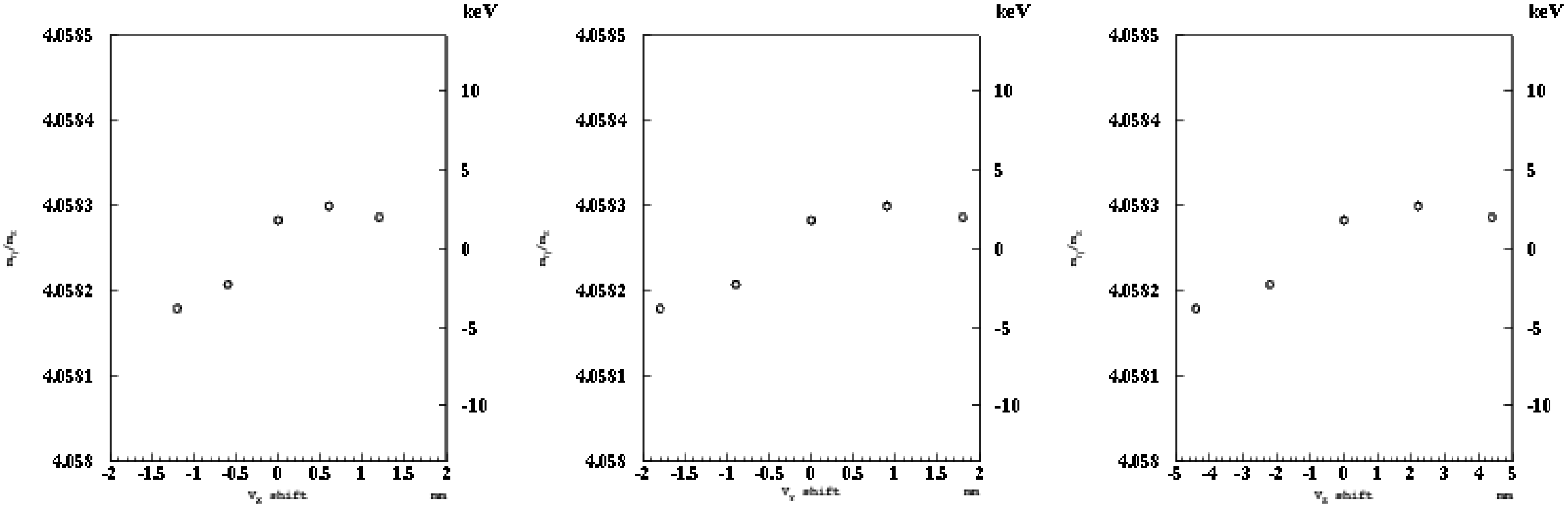
Vertex position systematic π^0





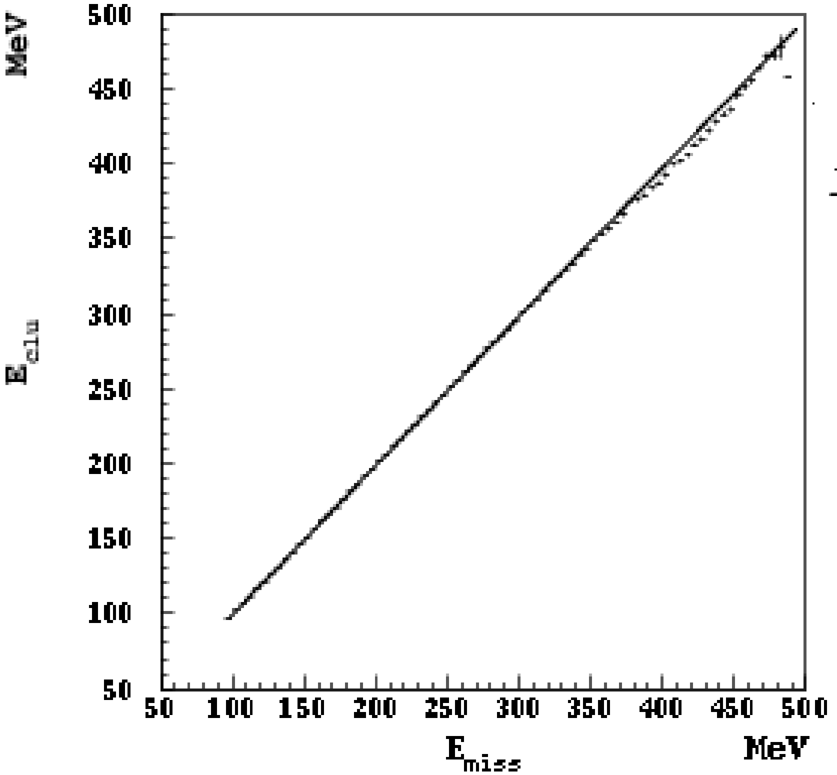


Vertex position systematic η/π^0



	m_η $(\times 10^{-6})$	m_π $(\times 10^{-6})$	m_η/m_π $(\times 10^{-6})$
V_X	1.8	15	15
V_Y	7	22	27
V_Z	4	37	35
overall	8	45	47

Energy calibration and linearity

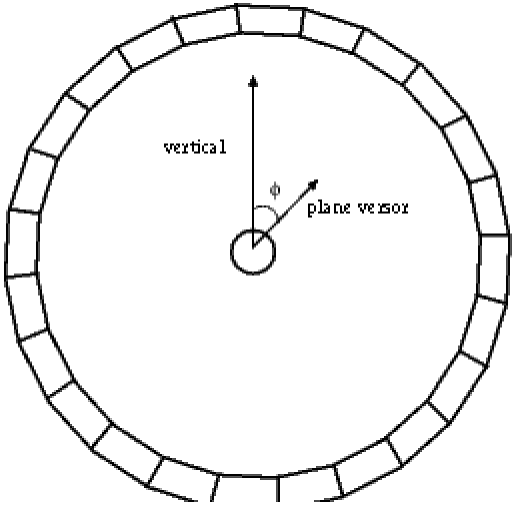


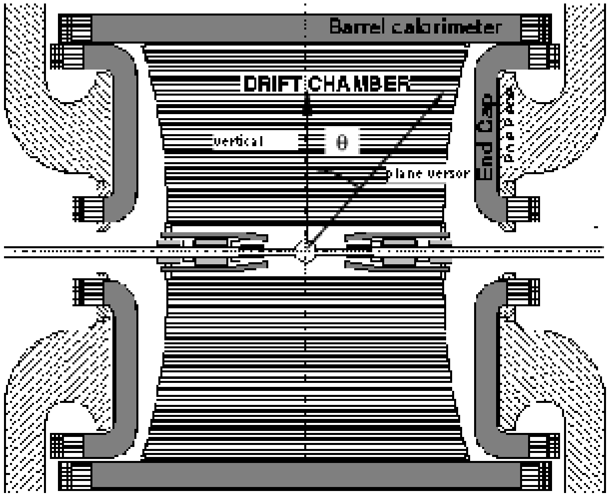
$$\frac{E_{clu} - (a + b * E_{miss})}{E_{miss}} = c + d * E_{miss} + e * E_{miss}^2$$

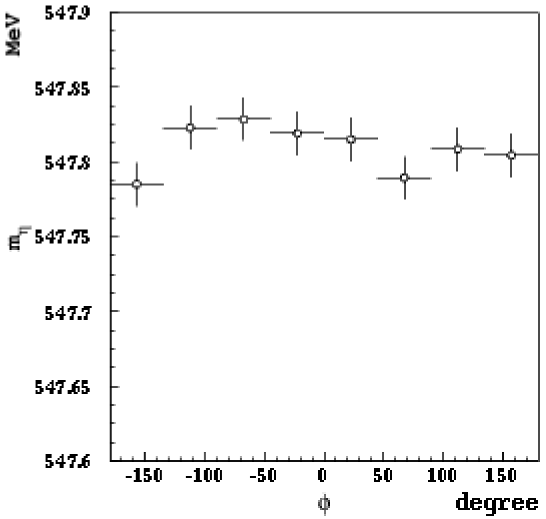
Linearity response parameters				
a (MeV)	b	c	d (MeV^{-1})	e (MeV^{-2})
-0.2	0.994	-2.1	0.019	-4.2×10^{-5}

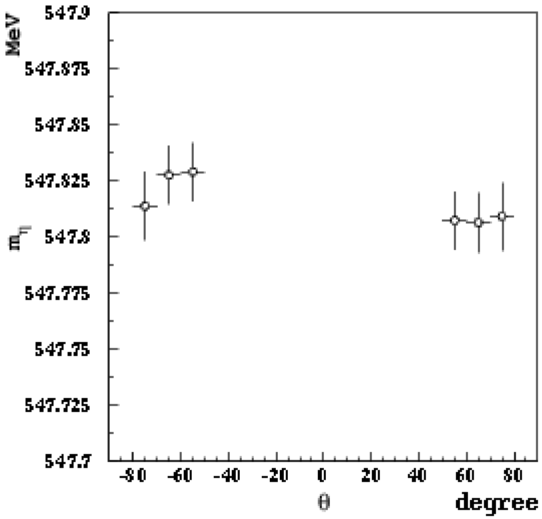
	m_η ($\times 10^{-6}$)	m_π ($\times 10^{-6}$)	m_η/m_π ($\times 10^{-6}$)
calibration constants (a,b)	7	7	14
linearity deviation (c,d,e)	7	81	76

Angular uniformity



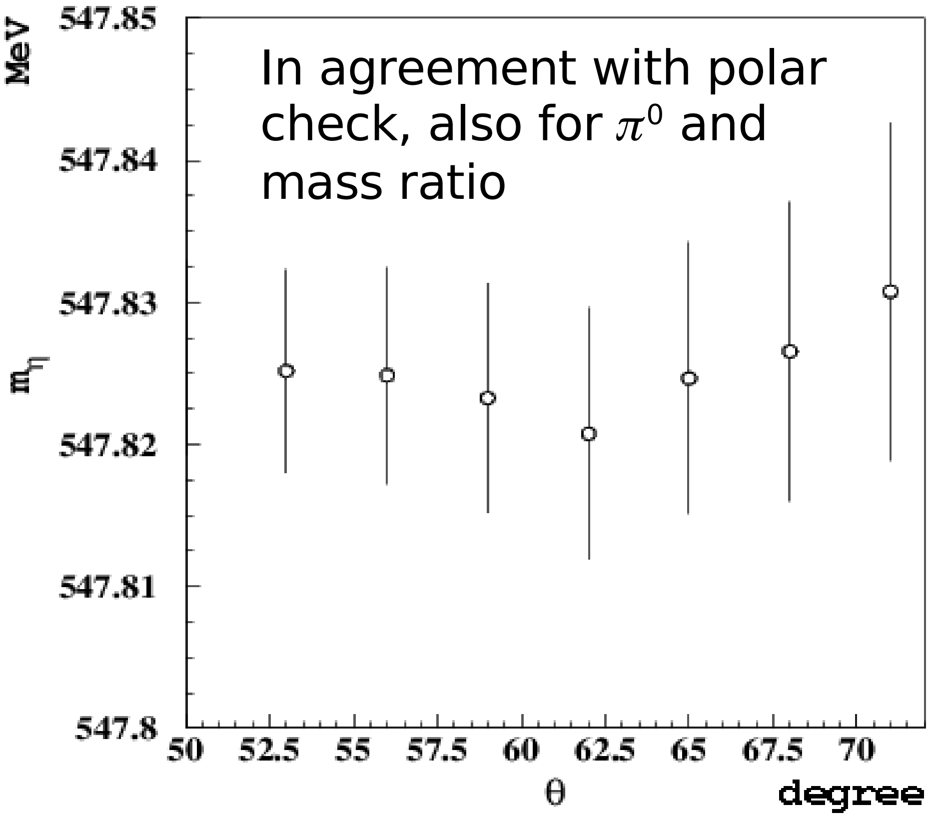




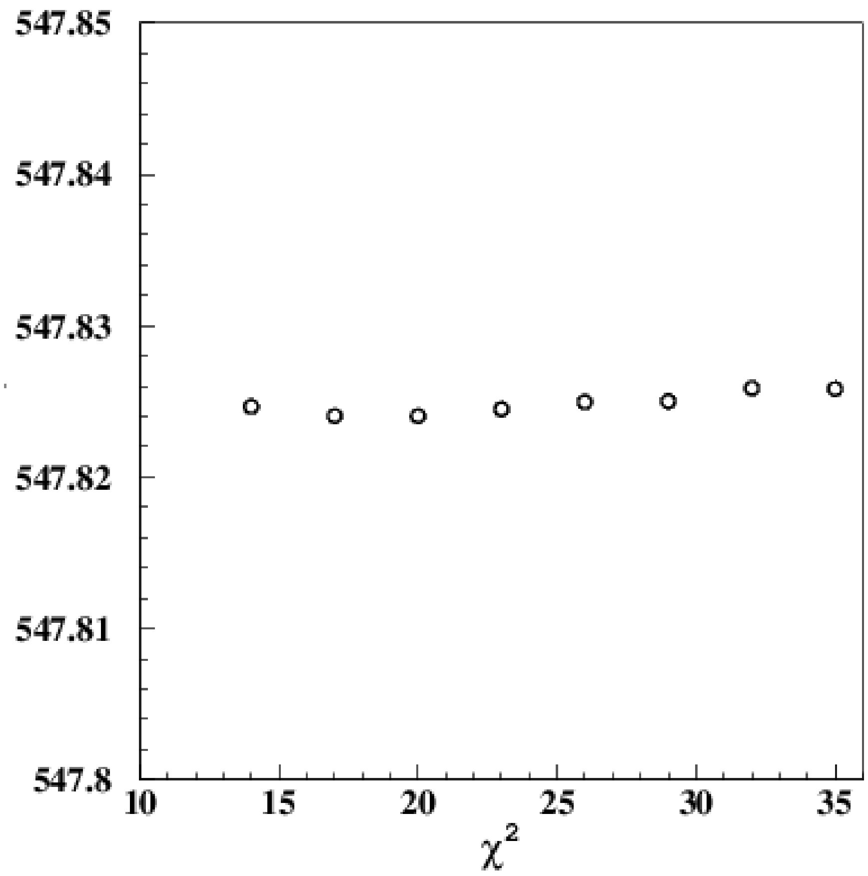


	m_η (keV)	m_π (keV)	m_η/m_π
azhimutal uniformity	15	12	3.7×10^{-4}
polar uniformity	10	44	1.2×10^{-3}

Polar angle and χ^2 cut

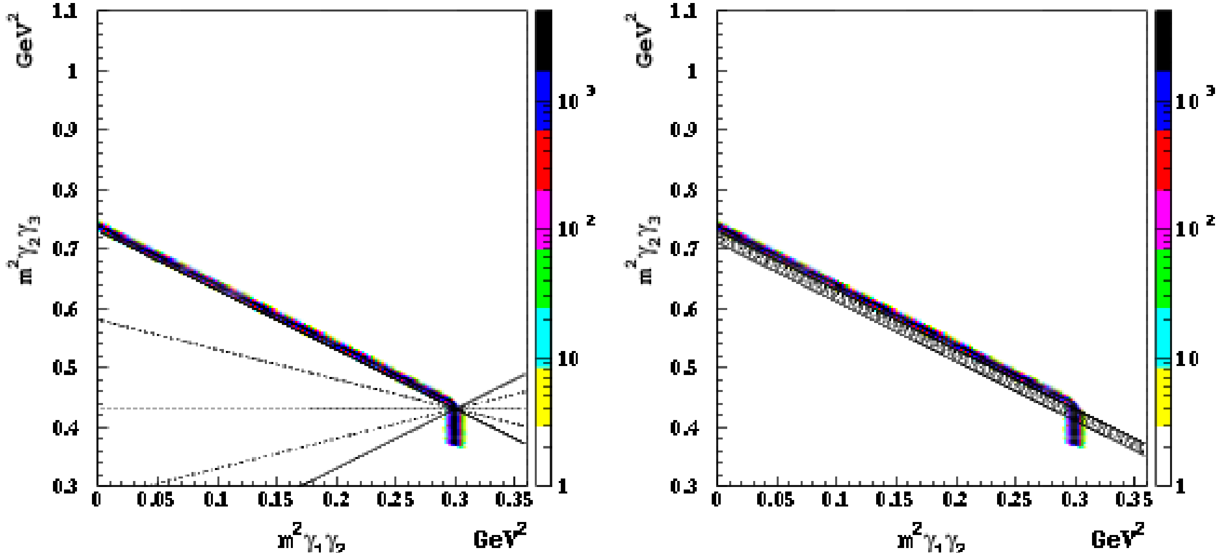


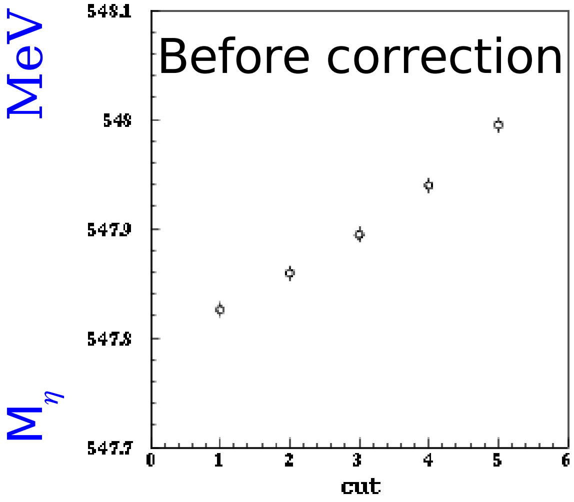
In agreement with polar check, also for π^0 and mass ratio



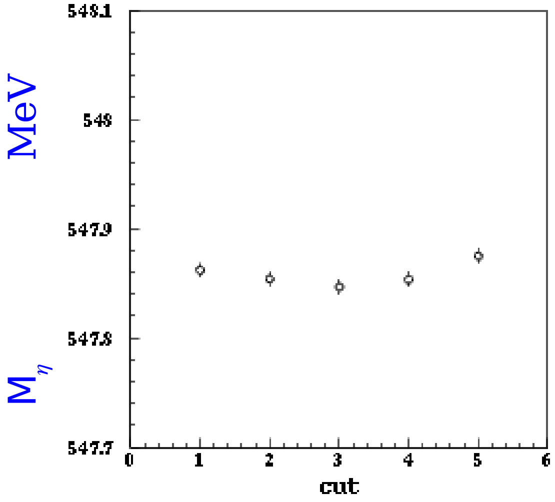
	m_η (keV)	m_π (keV)	m_η/m_π
χ^2 cut	0.7	4	1.3×10^{-4}

Dalitz cut



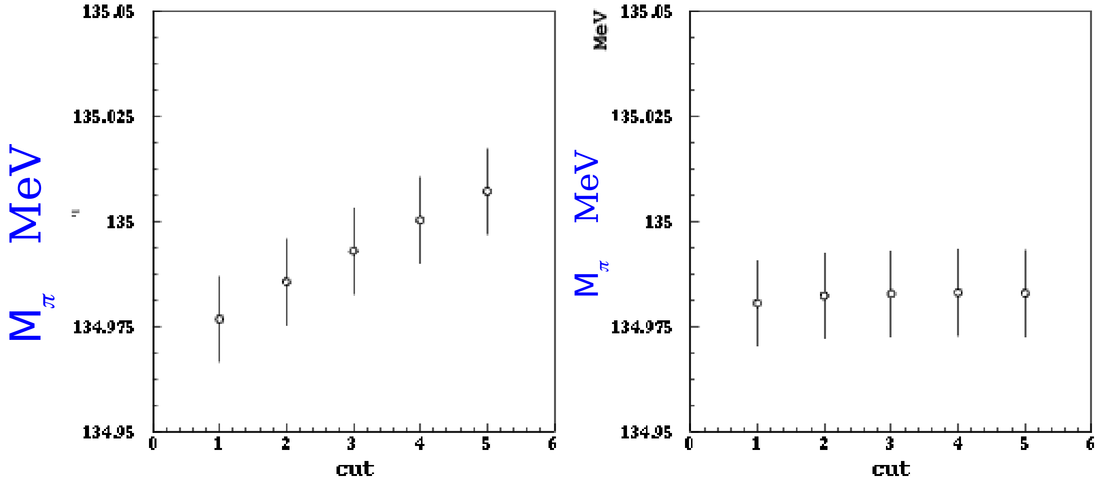


Before correction

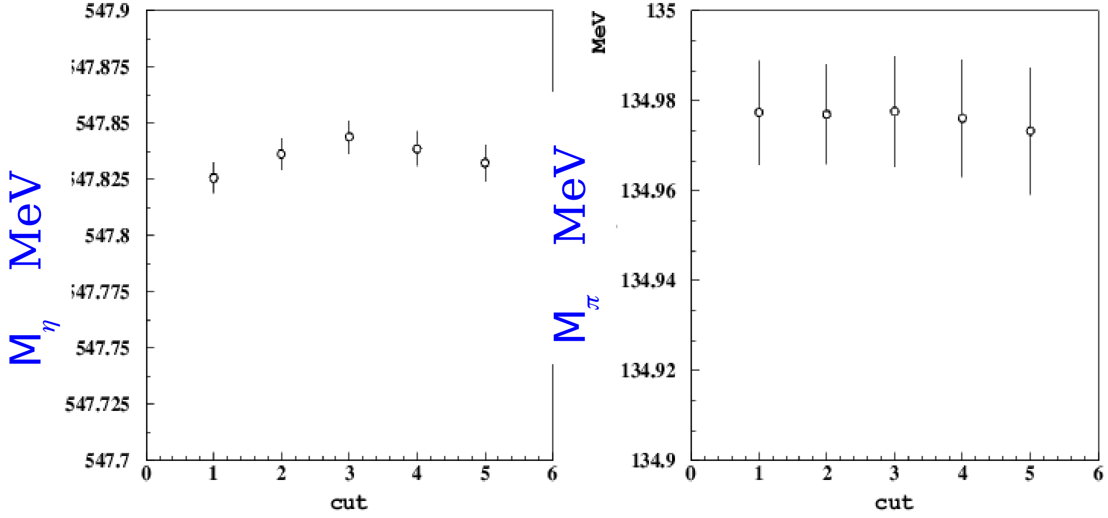


After correction

π^0 case and constant cut

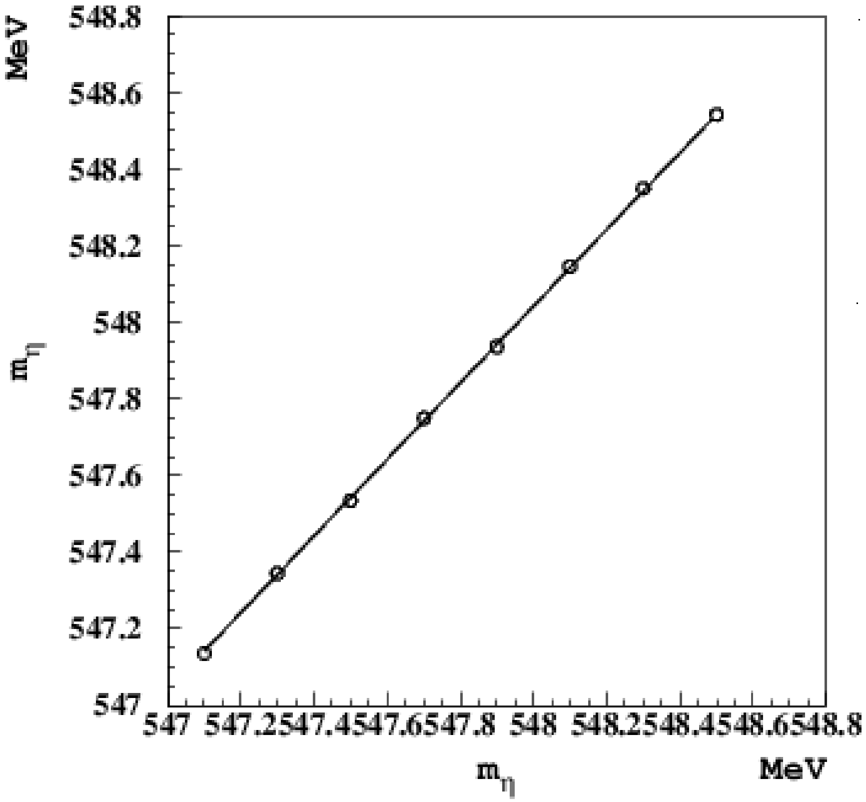


Slope cut for the π^0



constant cut

Global check of the fit



	$M_{rec} - M_{input}$		
	MC GEANFI (Δ_1)	TOY MC PAR (Δ_{dalmc})	TOY DATA PAR ($\Delta_{\mathrm{dalDATA}}$)
m_η	41 keV	-47 keV	-36.4 keV
m_{π^0}	65 keV	-6 keV	-3.8 keV

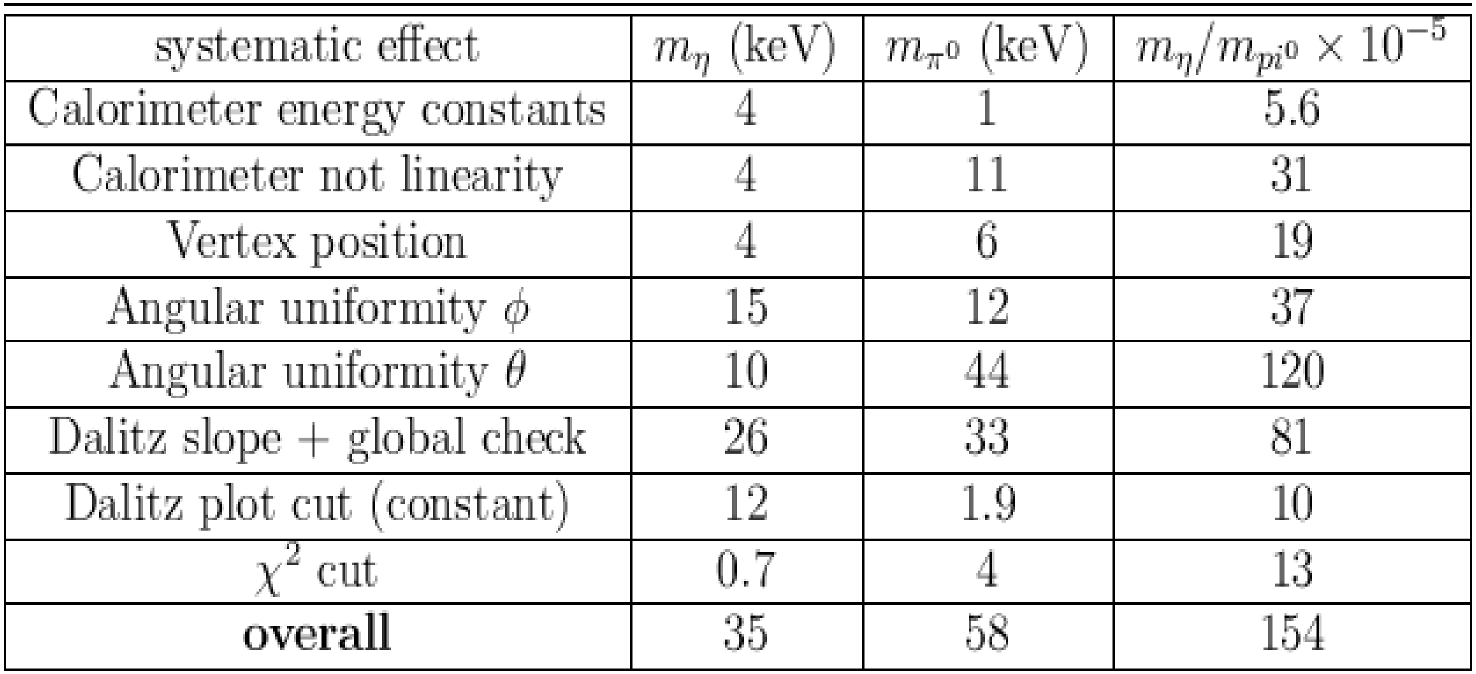
$$M_\eta = M_{\eta\mathrm{mes}} - (\Delta_1 - \Delta_{\mathrm{dalmc}} + \Delta_{\mathrm{dalDATA}}) =$$

$$M_{\eta\mathrm{mes}} - 41keV - 47keV + 36.4 = M_{\eta\mathrm{mes}} - 52keV$$

$$M_{\pi^0} = M_{\pi0\mathrm{mes}} - 65 - 6 + 3.8keV = M_{\pi^0} - 67keV$$

½ of the correction taken as systematic error.

Systematic table

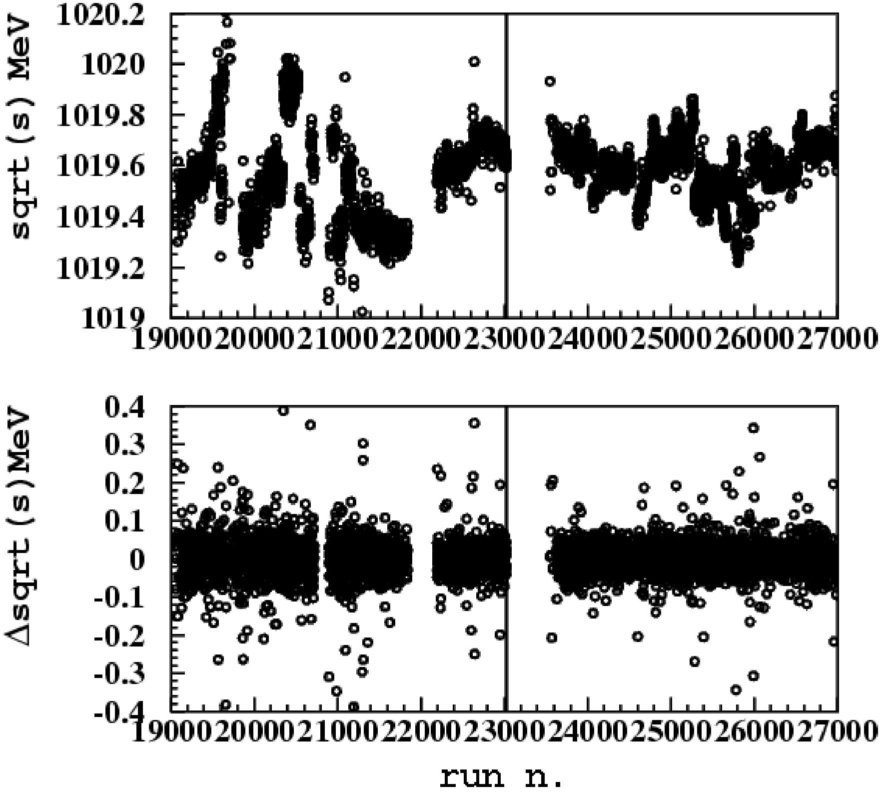


systematic effect	m_η (keV)	m_{π^0} (keV)	$m_\eta/m_{pi^0} \times 10^{-5}$
Calorimeter energy constants	4	1	5.6
Calorimeter not linearity	4	11	31
Vertex position	4	6	19
Angular uniformity ϕ	15	12	37
Angular uniformity θ	10	44	120
Dalitz slope + global check	26	33	81
Dalitz plot cut (constant)	12	1.9	10
χ^2 cut	0.7	4	13
overall	35	58	154

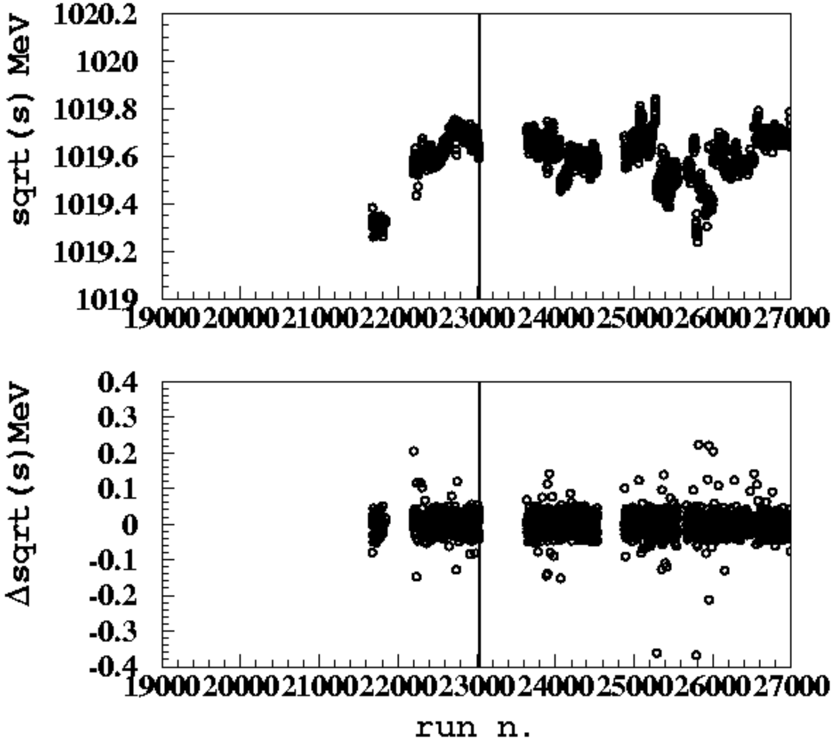
½ of the correction

DATA sample cleaning

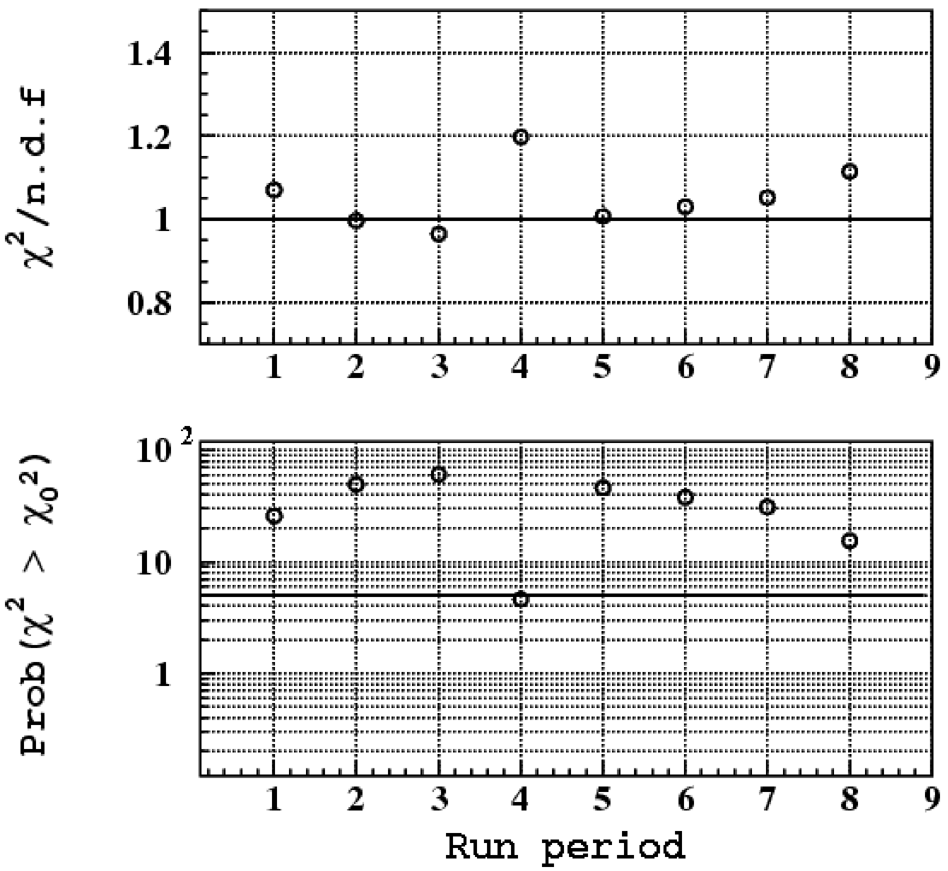
The measurement has an high sensitivity to the sqrt(s), to select high quality runs we require: $L_{int} > 100\ nb^{-1}$, $\Delta_{sqrt(s)} < 50$ keV (to protect against BMOM failures), elimination of the fast variation periods by hand, runs with bad trigger or bad time calibration dropped.)

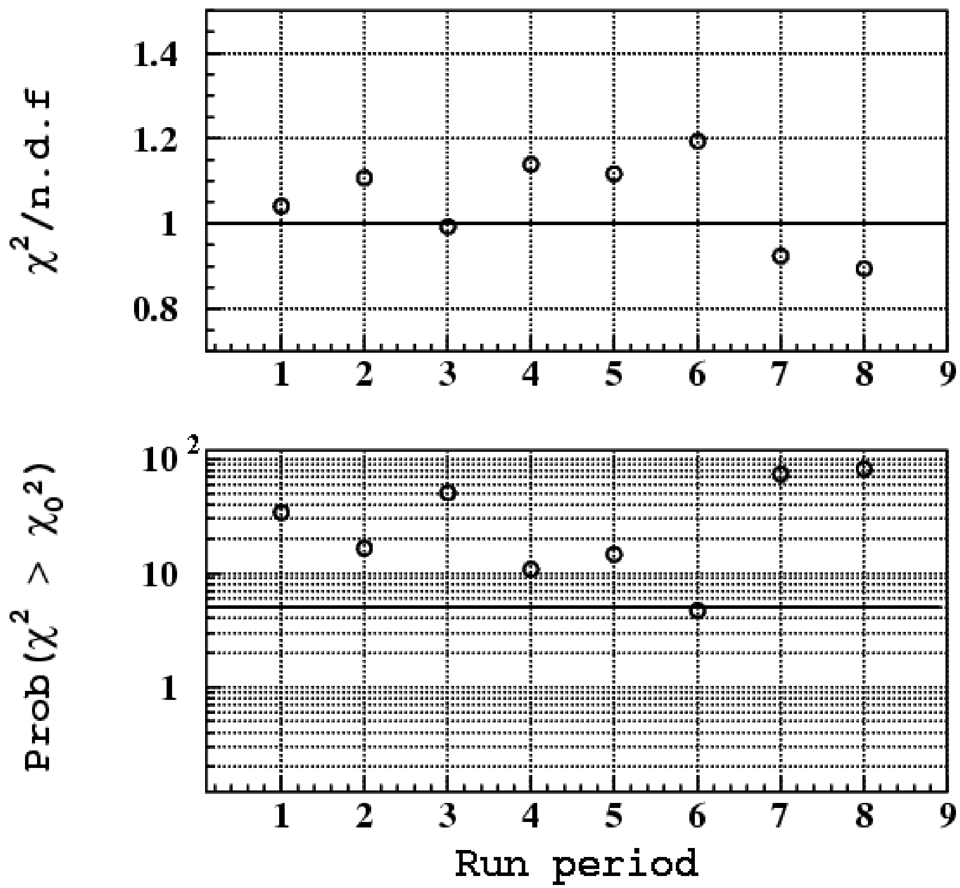


2001-2002 separation line

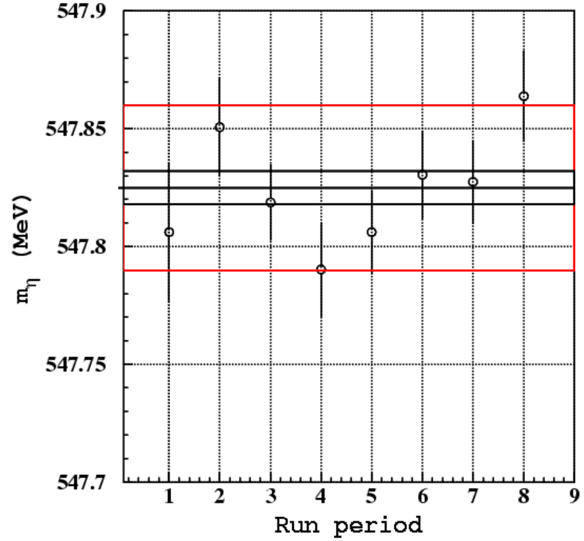


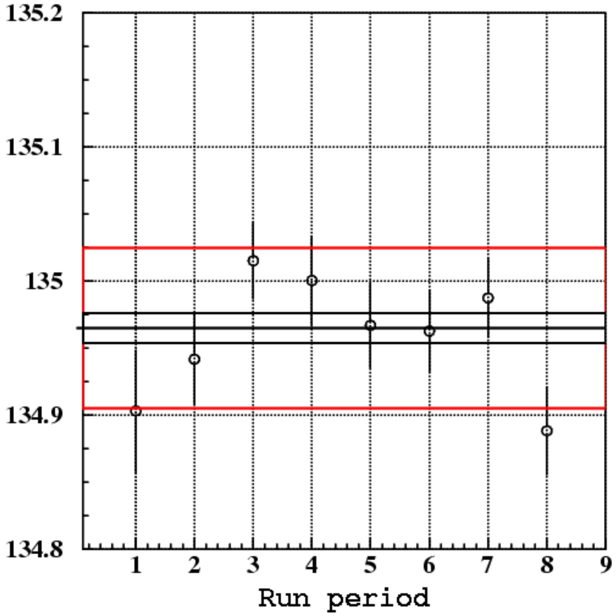
Fit quality (data sample divided into 8 periods)

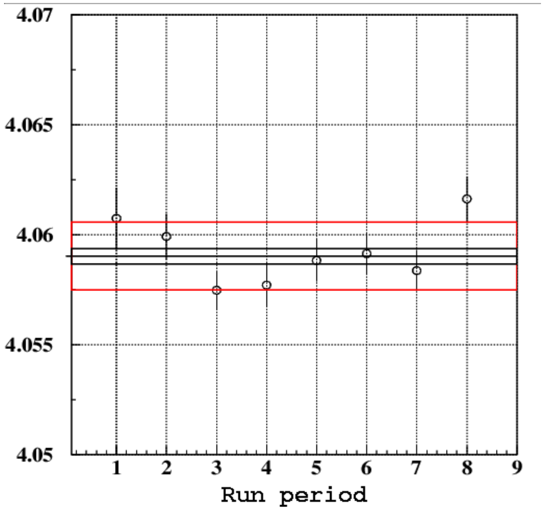




Fit results







Fit results

	Value	Error	$\chi^2_0/n.d.f$ (7 n.d.f)	Prob($\chi^2 > \chi^2_0$)
m_η	547825 keV	7 keV	1.5	17%
m_{π^0}	134965 keV	11 keV	1.8	9%
m_η/m_π	4.05901	0.00034	2.1	4.4%

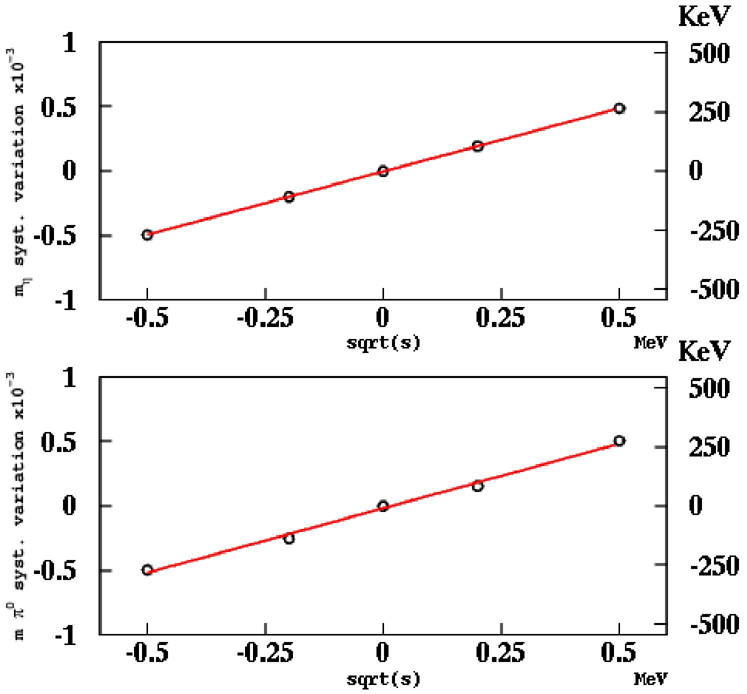
Corrections and final results

	value	correction	final value
m_η	547825	-52	547773
m_{π^0}	134965	-67	134898
m_η/m_{π^0}	4.05901	+0.00164	4.06065

$$\frac{m_\eta}{m_{\pi^0}} = 4.06065 \pm 0.00034(\text{stat.}) \pm 0.00154(\text{syst.})$$

$$(m_{\pi^0} = 1349766 \pm 0.6\ \text{keV})$$

$$m_\eta = 548093 \pm 46 \pm 207\ \text{keV}$$



$$m_\phi = 1019.329 \pm 0.011\ \text{MeV}$$

From scan

$$\frac{m_\eta}{m_\phi} = 0.537386 \pm 0.000007(\text{stat.}) \pm 0.000034(\text{syst.}) \pm 0.000006(m_\phi \quad \text{stat.})$$

$$\frac{m_{\pi^0}}{m_\phi} = 0.132340 \pm 0.000011(\text{stat.}) \pm 0.000057(\text{syst.}) \pm 0.000001(m_\phi \quad \text{stat.})$$

We can use the CMD-2 value for the mass, or the PDG average:

m_ϕ (CMD-2) = 1019.483 ± 0.011 ± 0.025
m_ϕ (PDG06) = 1019.460 ± 0.019

$$m_{\pi^0} = 134918 \pm 11 \pm 58 \pm 1 \pm 1.4(\text{CMD2} \quad \text{stat.}) \pm 3(\text{CMD2} \quad \text{syst.}) \quad \text{keV}$$

$\Delta_{\text{PDG}} = 1\sigma$

$$m_\eta = 547856 \pm 7 \pm 35 \pm 6 \pm 6(\text{CMD2} \quad \text{stat.}) \pm 14(\text{CMD2} \quad \text{syst.})$$

$$m_\eta = 547844 \pm 7 \pm 35 \pm 6 \pm 11(\text{PDG} \quad \text{syst.}) \quad \text{keV}$$

$$m_\eta = 547.843 \pm 0.030 \pm 0.041 \quad \text{MeV}$$ NA48

$$m_\eta = 547.311 \pm 0.028_{\text{stat}} \pm 0.032_{\text{syst}} \text{ MeV}$$ GEM