η mass measurement with the 3γ final state

Phi radiative Working Group Meeting

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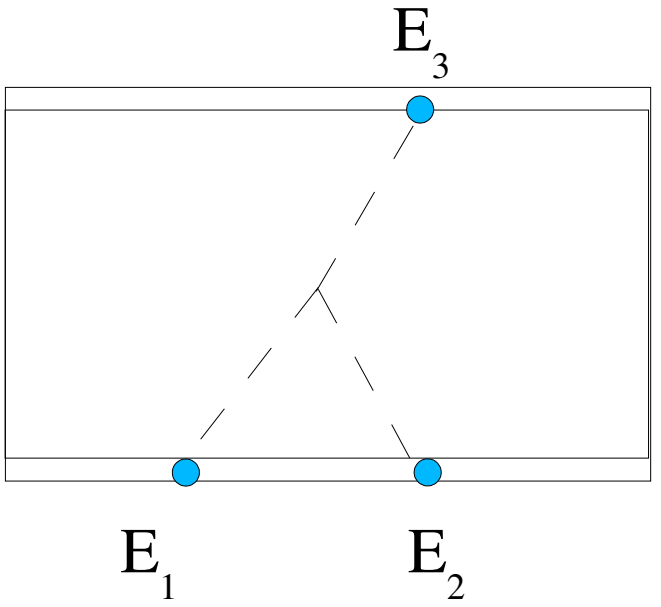
The method

$\phi \rightarrow \eta\gamma$ $\quad$ $\phi \rightarrow \pi^0\gamma$

$\eta \rightarrow \gamma\gamma$ $\quad$ $\pi^0 \rightarrow \gamma\gamma$

Using kinematic fit we can constraint the photon energies.



Kinematic fit constraints:

Pxtot, Pytot, Pztot, Etot → do the job

t-r/c of clusters → improve z resolution

We have 3 energies, 6 angles and 4 constraints. The energies are over determined by the cluster angles, no matter what is the cluster energy, no matter what is the energy scale of the calorimeter.

The knowledge of the total momentum is the crucial point.

Very simple selection

At least 3 prompt clusters on barrel

$$50° < \theta_\gamma < 130° \quad |t - r/c| < \min(5\sigma_t, 2ns)$$

Kinematic fit on the $\binom{n}{3}$ photon combinations;

Inputs to the kinematic fit.

3 x clusters information x,y,z,t

ϕ momentum from BMOM

I.P. position from BPOS

the combination with the smallest χ^2 is taken.

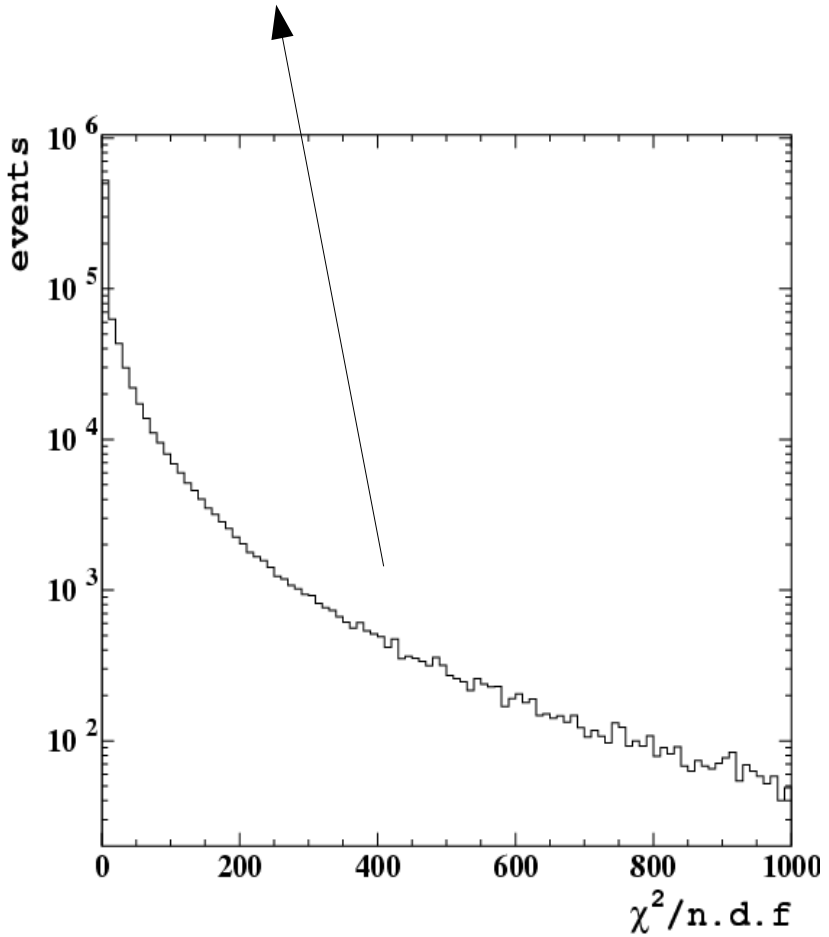
Kinematic fit output.

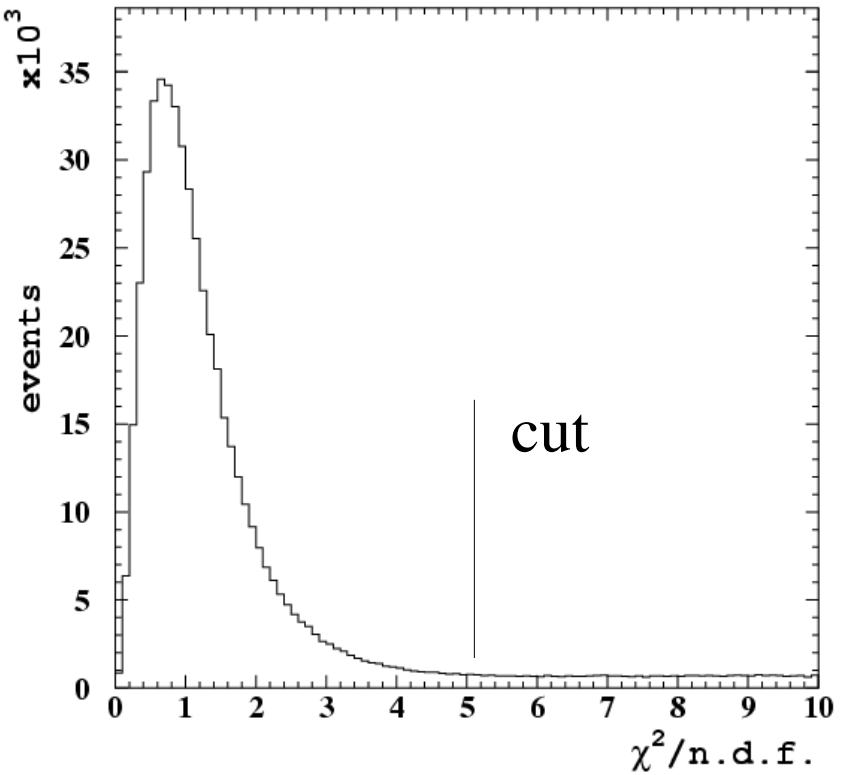
All the inputs.

χ^2 distribution

Huge background

2001 DATA





Dalitz plot

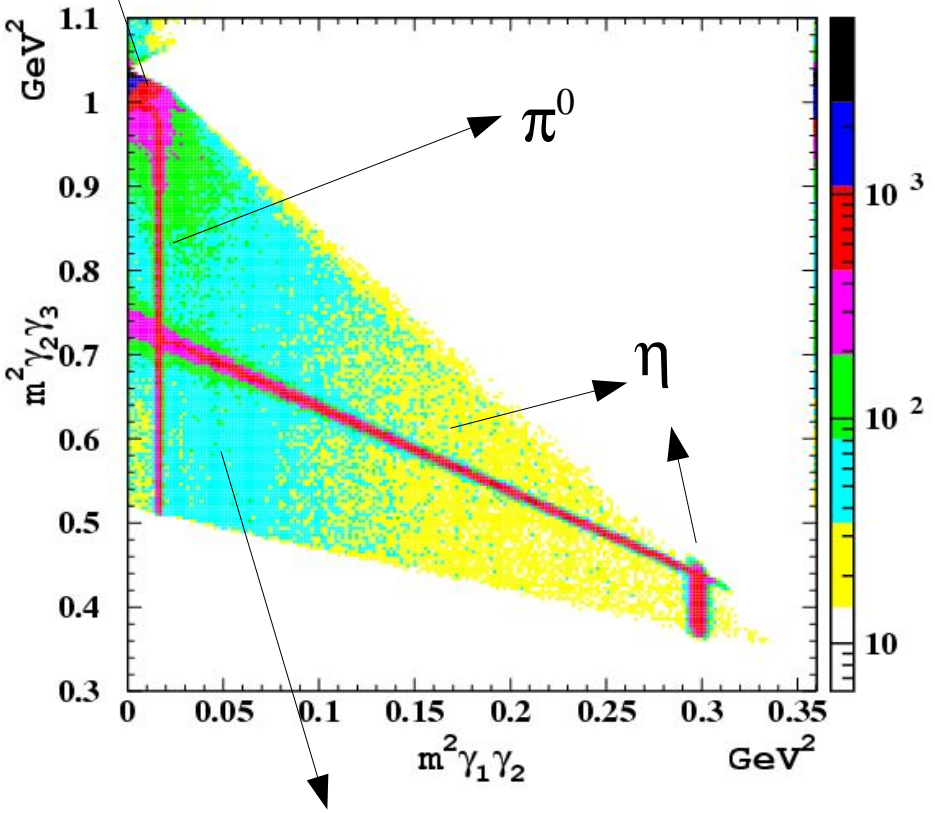
Dalitz plot

The photons are sorted according the energy. $E_1 < E_2 < E_3$

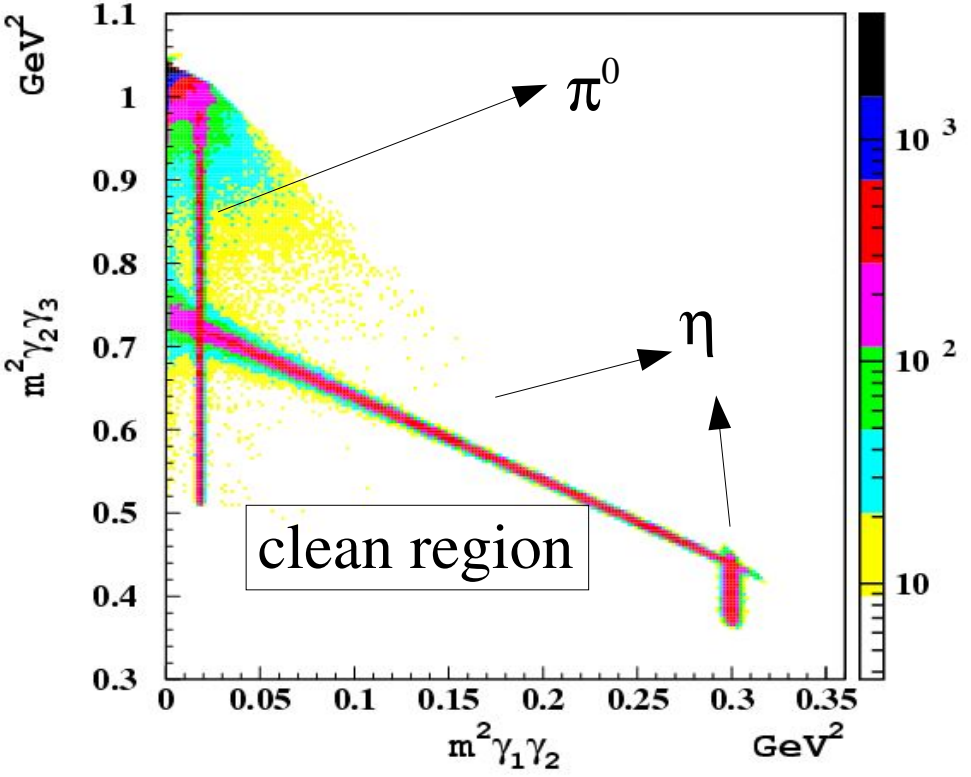
$\gamma\gamma(\gamma)$

$e^+ e^- (\gamma)$

no χ^2 cut

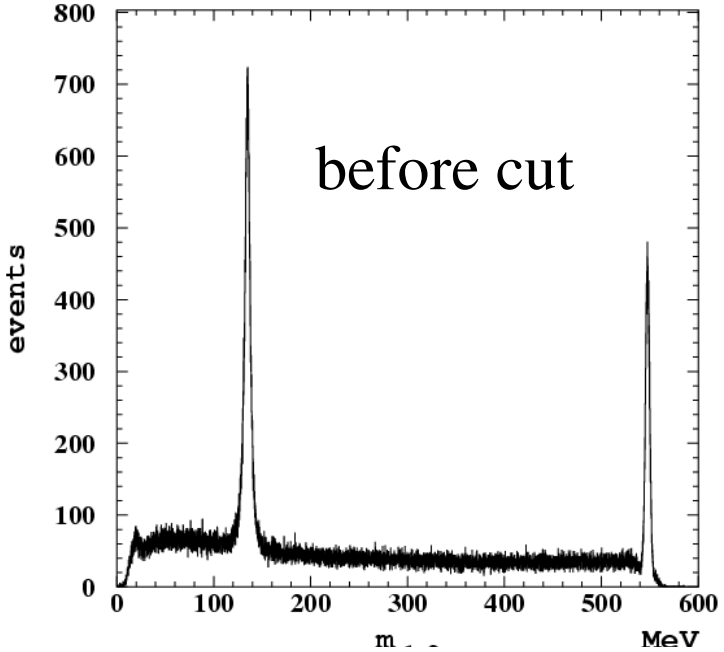


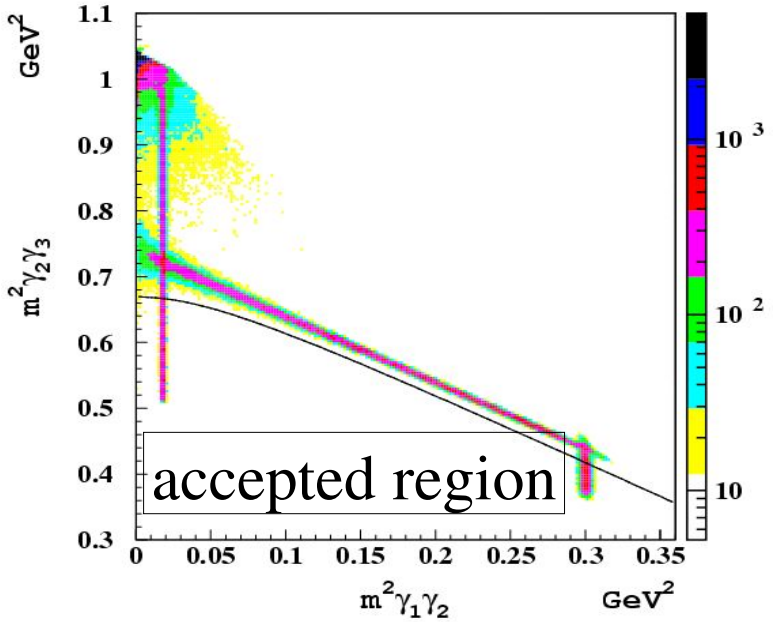
$\chi^2/n.d.f < 5$

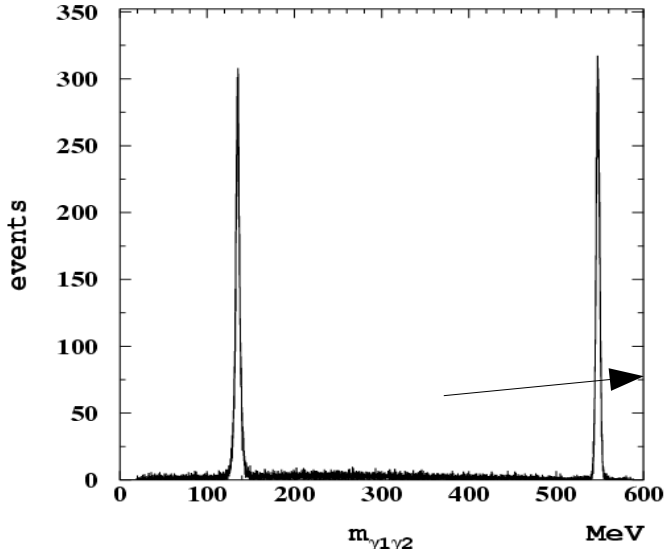


Background that doesn't close the kinematic.

Selection in the dalitz to reject background.

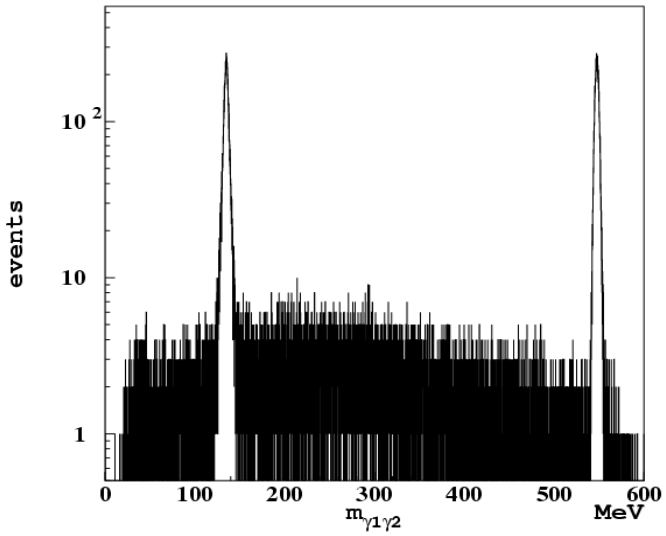






after cut

negligible background



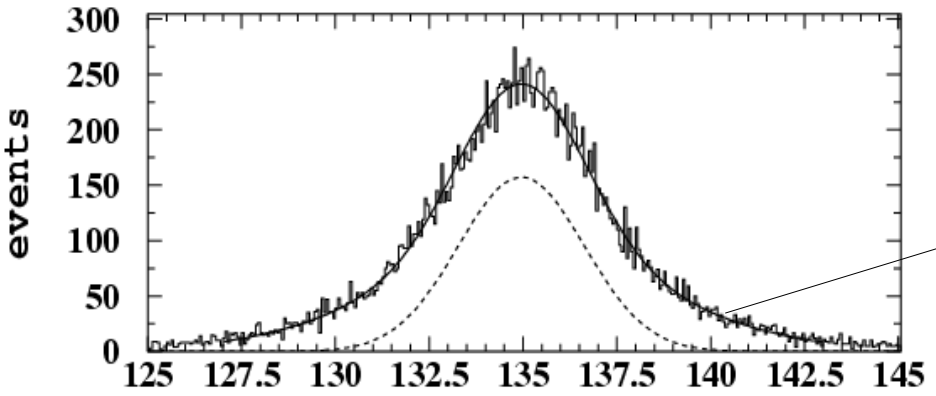
DATA analyzed

2001+2002 DATA are divided in 8 periods of 50 pb^{-1}.

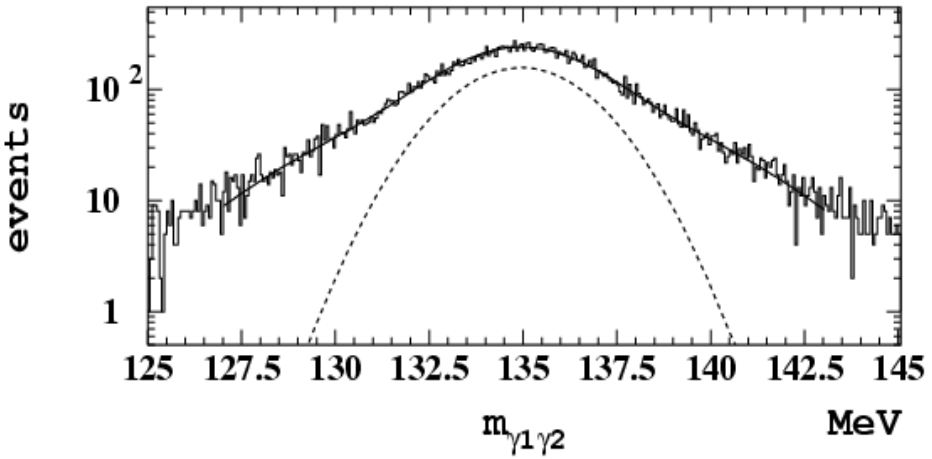
period	run-range	time-range	period	run-range	time-range
1	17874-20600	03/01 – 07/01	5	24451-25350	06/02-07/02
2	20601-22200	07/01-11/01	6	25351-26050	07/02-08/02
3	22201-23133	11/01-12/01	7	26051-26600	08/02-09/02
4	23201-24450	02/02-06/02	8	26601-27137	09/02

Absolute scale (π^0 mass)

Period 1



core gaussian



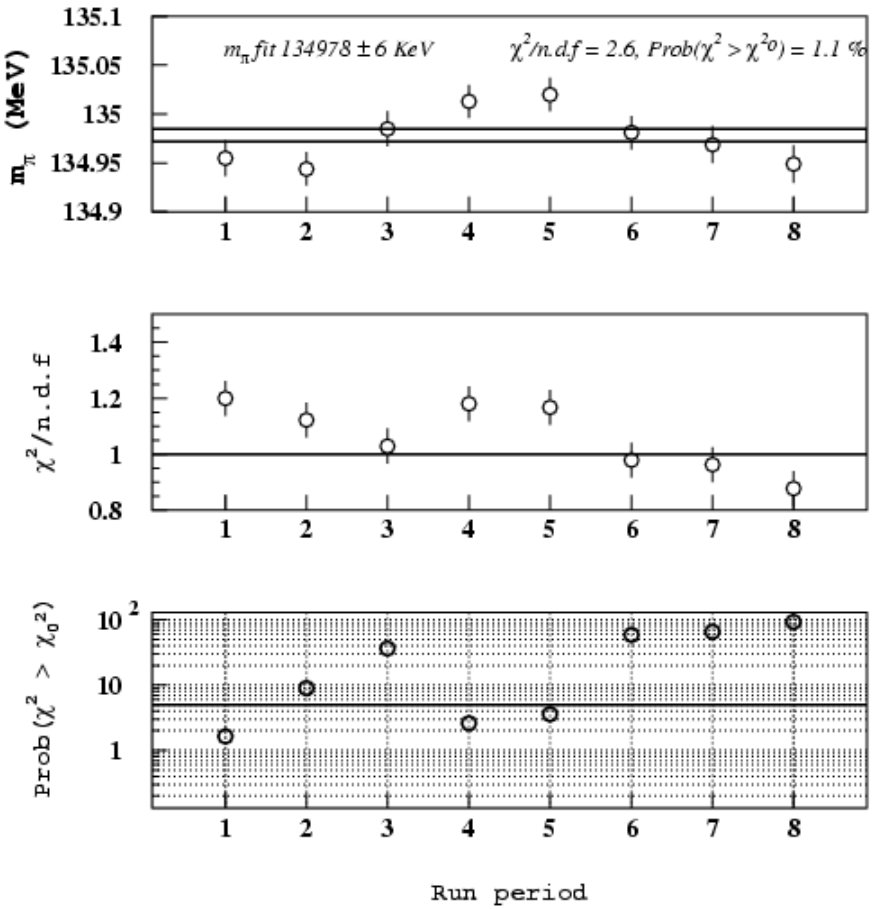
Double gaussian fit with the same mean

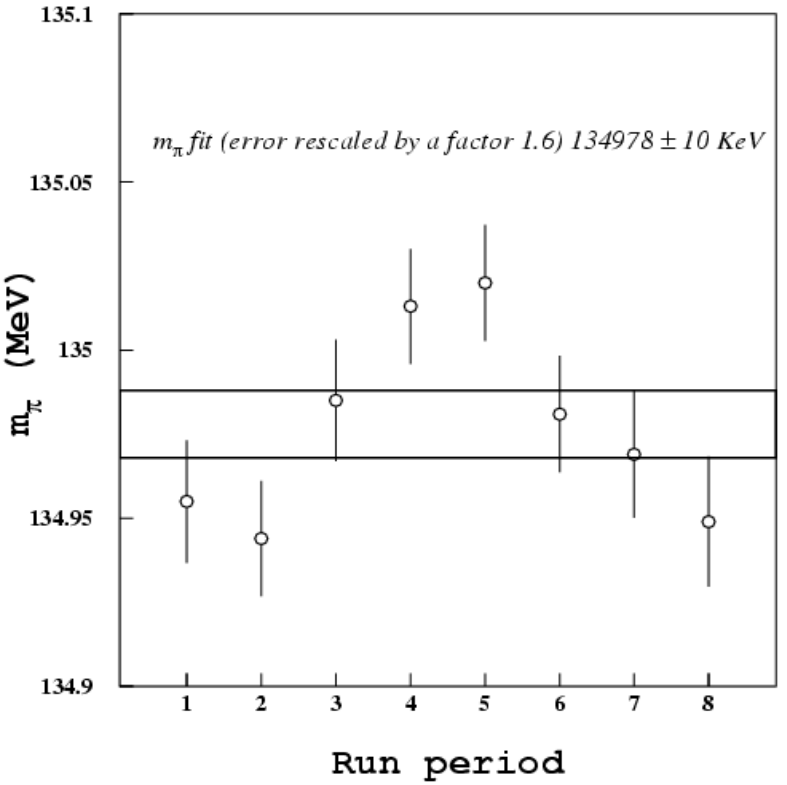
EXT NO.	PARAMETER NAME	VALUE	PARABOLIC ERROR	MINOS ERRORS NEGATIVE	MINOS ERRORS POSITIVE
1	P1	157.37	7.7690	-6.4913	6.5512
2	P2	134.95	0.18364E-01	-0.18209E-01	0.18307E-01
3	P3	1.6753	0.63836E-01	-0.54674E-01	0.55452E-01
4	P4	83.959	8.4273	-6.9819	6.8232
5	P5	3.7467	0.13312	-0.10129	0.11676

CHISQUARE = 0.1200E+01 NPFIT = 257

π^0 mass

rescaling the error by the factor sqrt(χ^2)





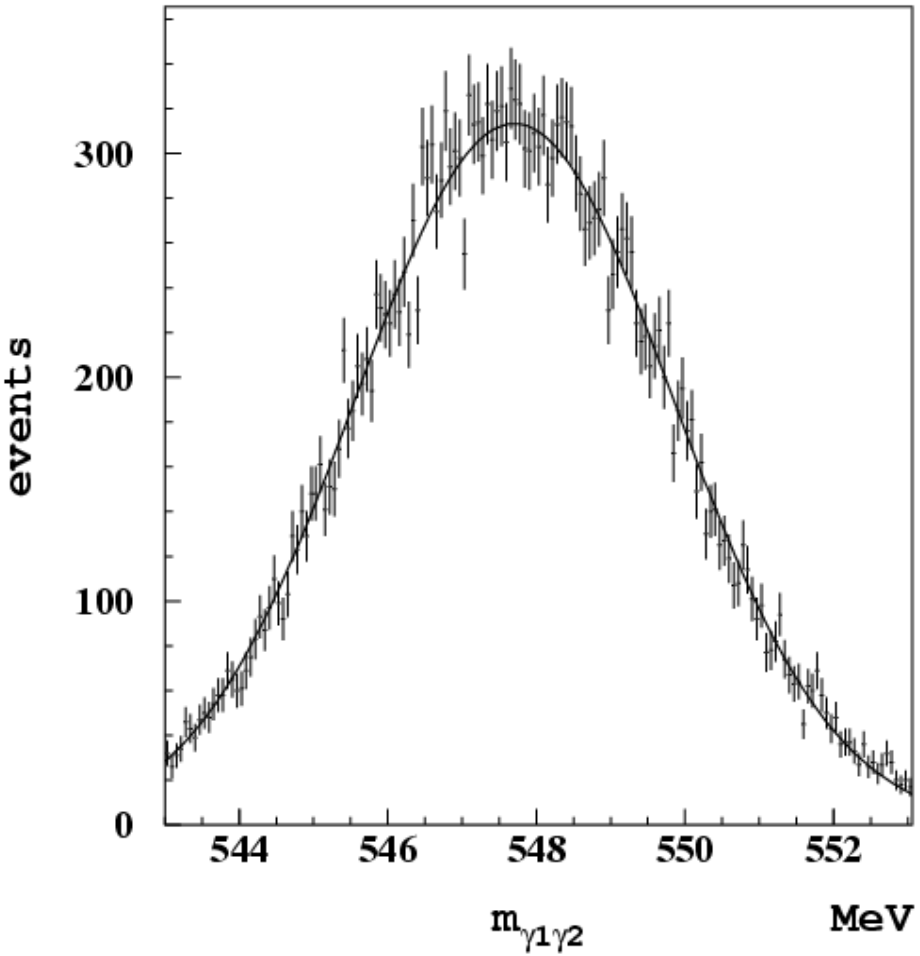
$m(\pi^0) = 134978 \pm 10$ KeV

$m(\pi^0)_{PDG} = 134976.6 \pm 0.6$ KeV

Absolute scale known @10 KeV

Fit to the η mass.

Single gaussian fit.



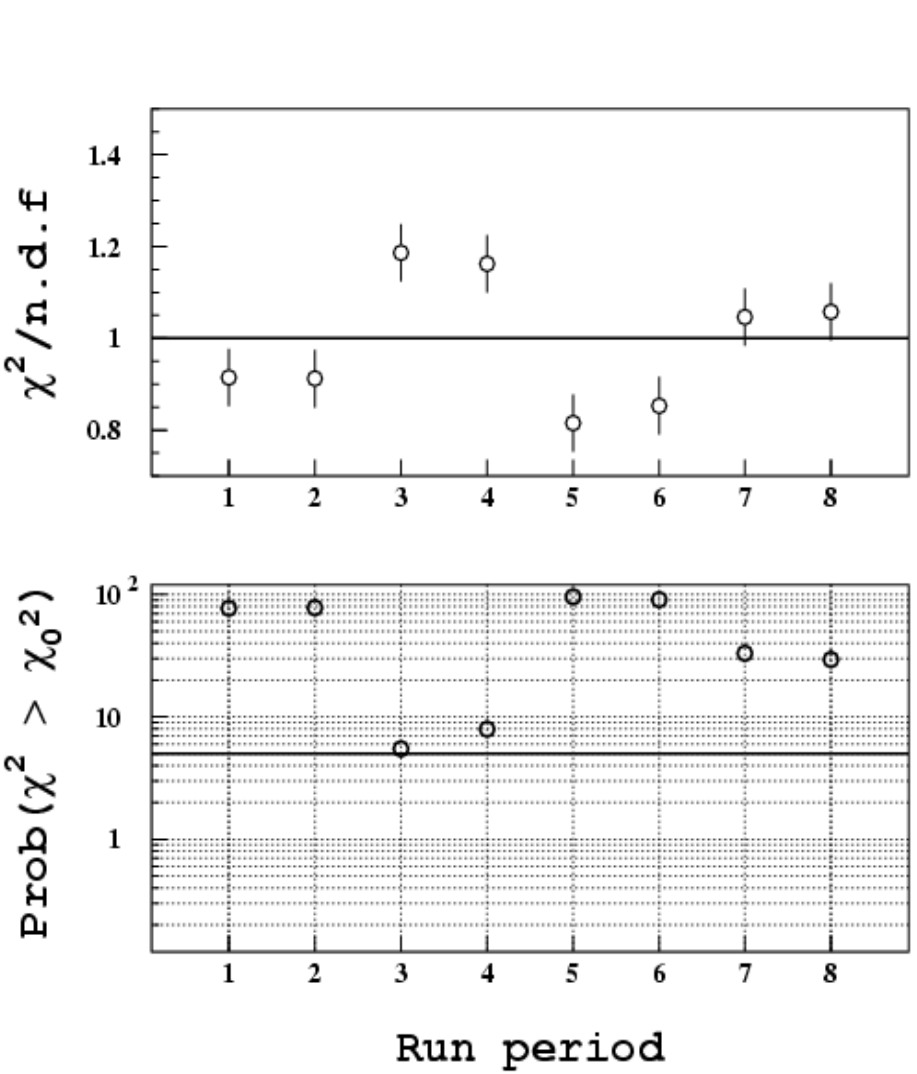
Fit result.

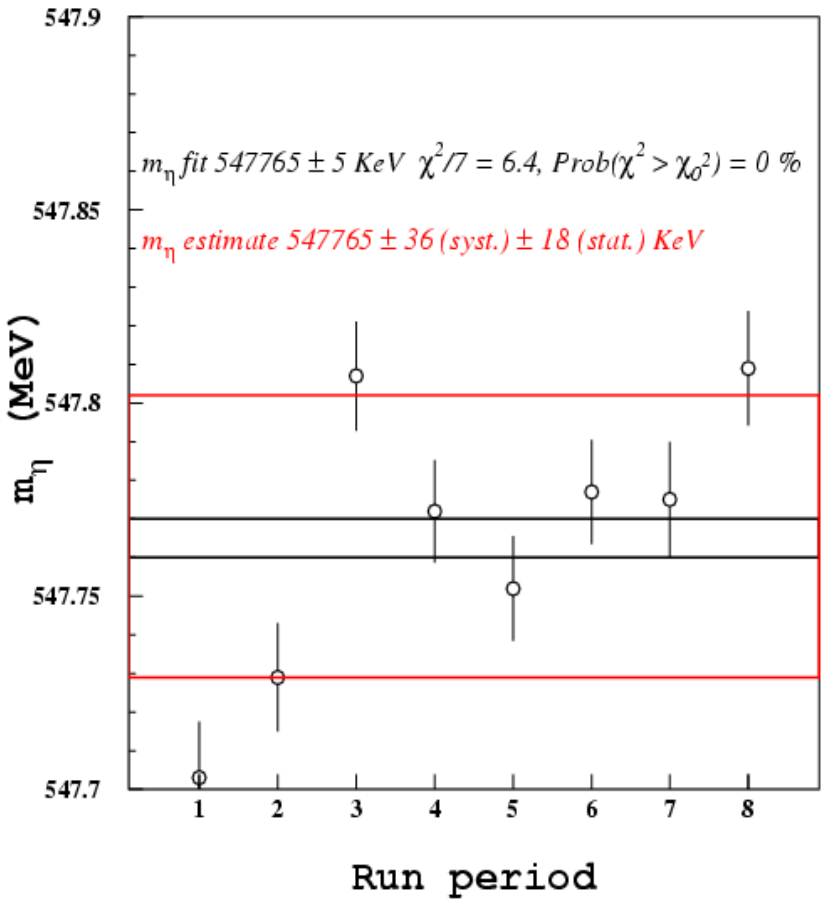
Mean 547.703 ± 0.018 MeV

Sigma 2.146 ± 0.012 MeV

χ^2/n.d.f = 0.91

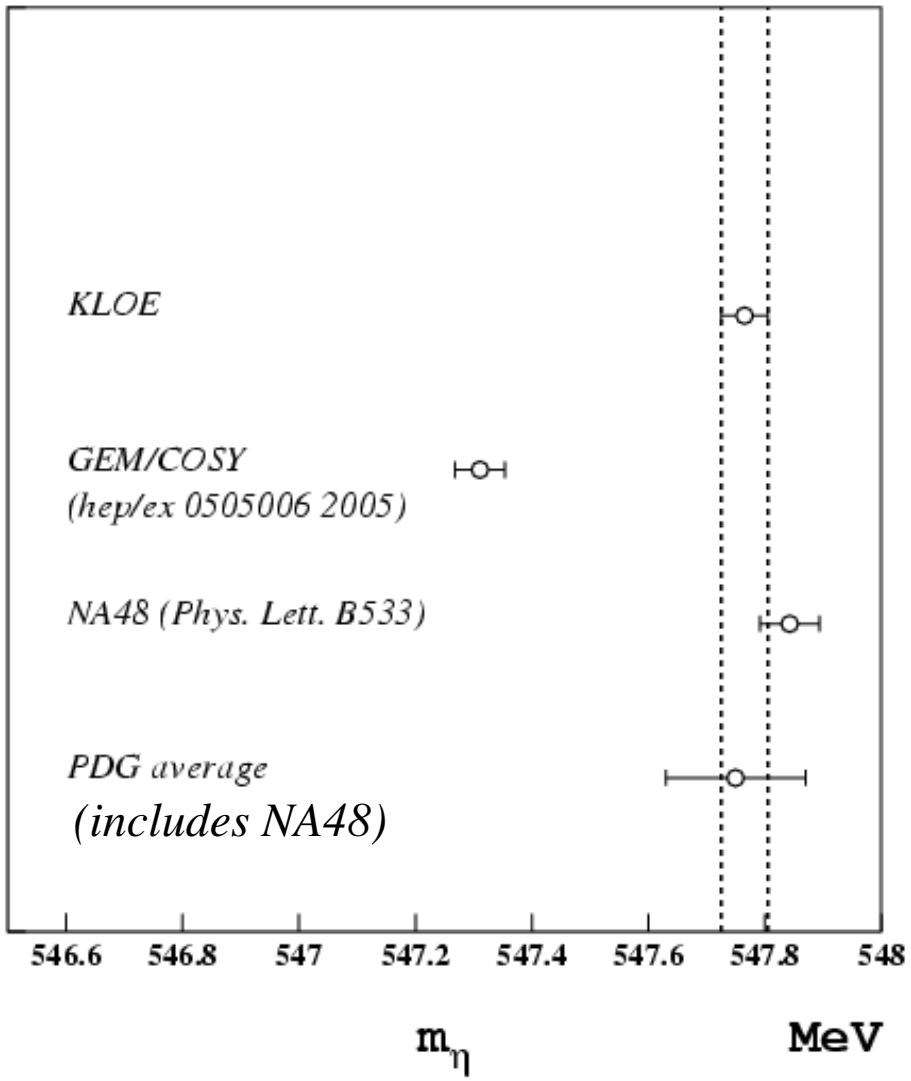
Results.





The systematic is taken into account by doing the rms of all measurements .

Comparison with previous measurement.



NA48 compatibility 1.2σ

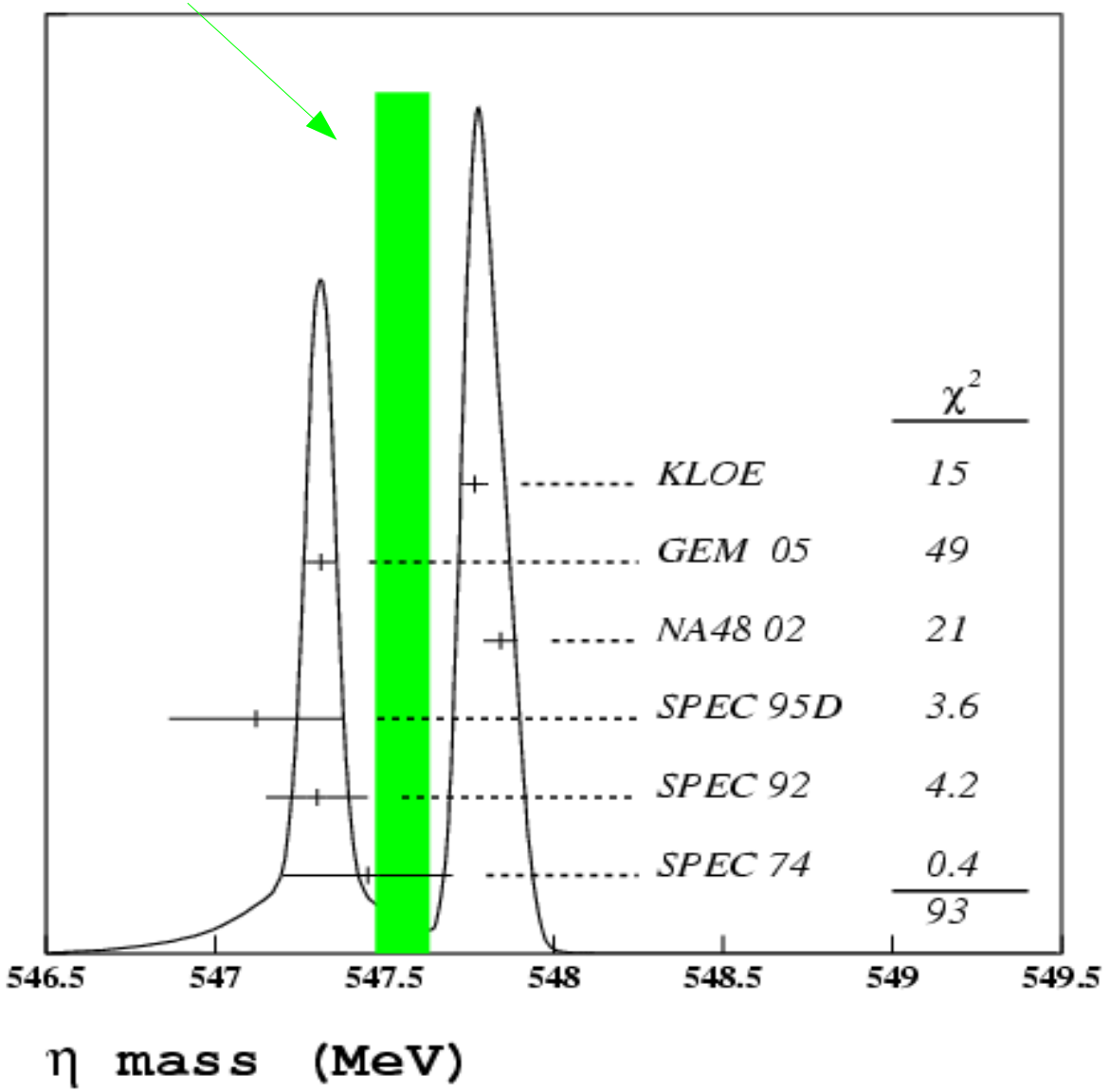
PDG recomputation

PDG 2004	547.75 ± 0.12 MeV
2004+GEM	547.51 ± 0.18 MeV
2004+GEM+KLOE	547.61 ± 0.13 MeV

New situation with KLOE.

average

scale factor 5.5



Conclusions

The KLOE calorimeter is able (alone) to do high precision measurements;

the absolute scale of the method is well checked using π^0 mass;

the main systematic come from the sqrt(s) knowledge.

For the prelimiary blessing (September)

Linearity response with MC toy.

Stability versus cuts choice.

For final blessing

Full simulation with 3 different values of η mass.