Magnet off data analysis status

A. Zoccoli
University and INFN, Bologna

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DESY-HH

Outline

- Events processed and trigger conditions
- MonteCarlo simulations and evaluations
- ECAL setup and calibration
- SVD setup
- J/ψ search
- Conclusions and perspectives

Trigger and statistics

Detectors used in the analysis: SVD, RICH, ECAL

ECAL Pretrigger: 11 boards instrumented on the Inner section (10 running)

Trigger conditions:
- Pretrigger: 1 cell with $P_T \geq 1\,GeV/c$
- SLT: 2 clusters with $P_T \geq 1.1\,GeV/c$ and $M_{INV} \geq 2.2\,GeV/c^2$

Target rate: ranging from $2.5\,MHz$ to $10\,MHz$

After data quality checks on the detectors behaviour and beam quality we have analysed up to now:

$$N_{ev} \sim 1.25 \cdot 10^6\ events$$

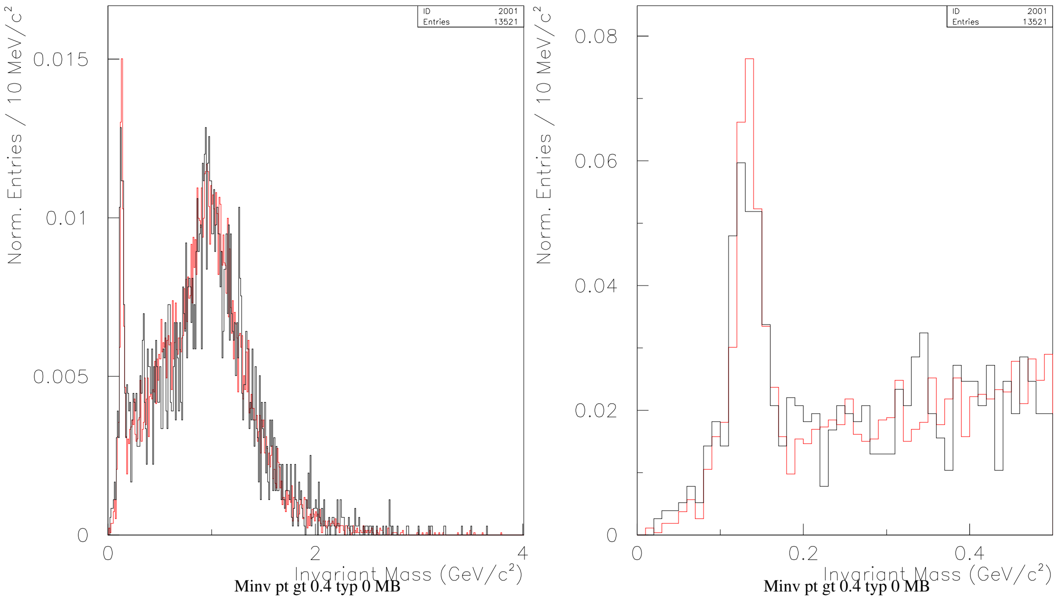
MonteCarlo simulations

- Many improvements implemented in the MC code:
  - Generator: P_T of J/ψ weighted on real data
  - ECAL Readout: maps of the channels taken from real data, pedestal sumlation, dead channels handling
  - ECAL Pretrigger simulation

- Comparison of inelastics MC with Minimum Bias data. π^0 width as a function of ECAL calibration precision:
  Miscalibration: 10 % $\Rightarrow$ $\sigma(\pi^0) \sim 17\, MeV/c^2$
  Miscalibration: 5 % $\Rightarrow$ $\sigma(\pi^0) \sim 13\, MeV/c^2$

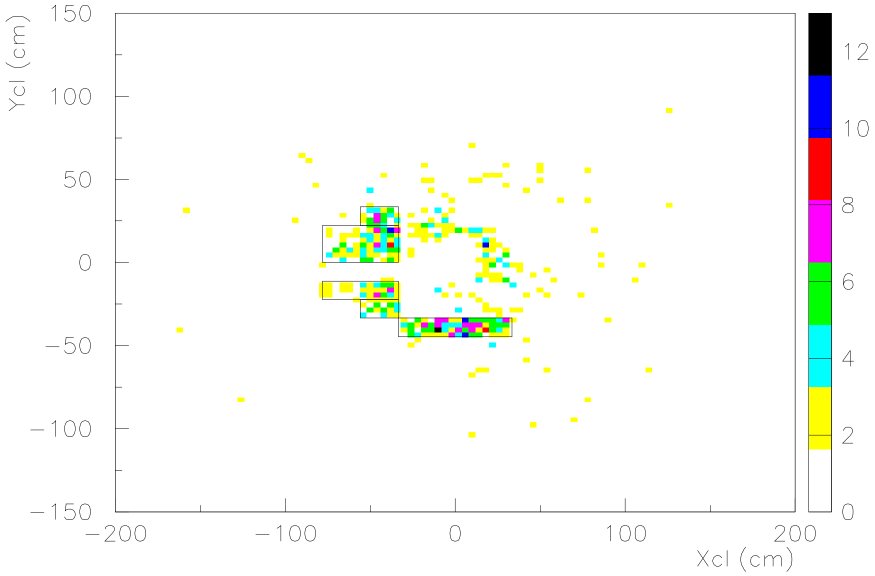
- Evaluation of J/ψ trigger and reconstruction efficiency ($\epsilon_{J/\psi}$). This is dependent on SVD hit efficiency and is ranging in the interval:
  $\epsilon_{J/\psi} \in [0.08 \div 0.48]\,\%$

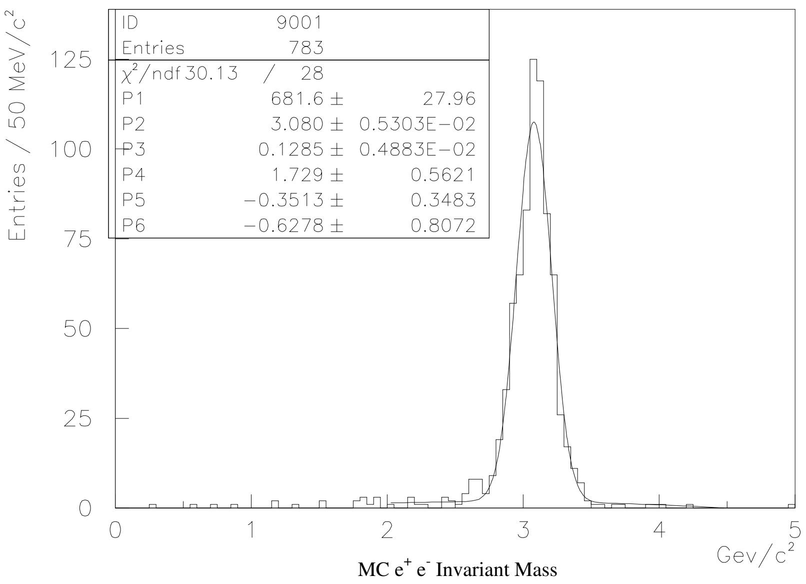
J/ψ Minimum Bias events



Comparison between Real Data (black) and MC events (red) with 5 % ECAL Miscalibration

J/ψ MonteCarlo simulation
(99 configuration





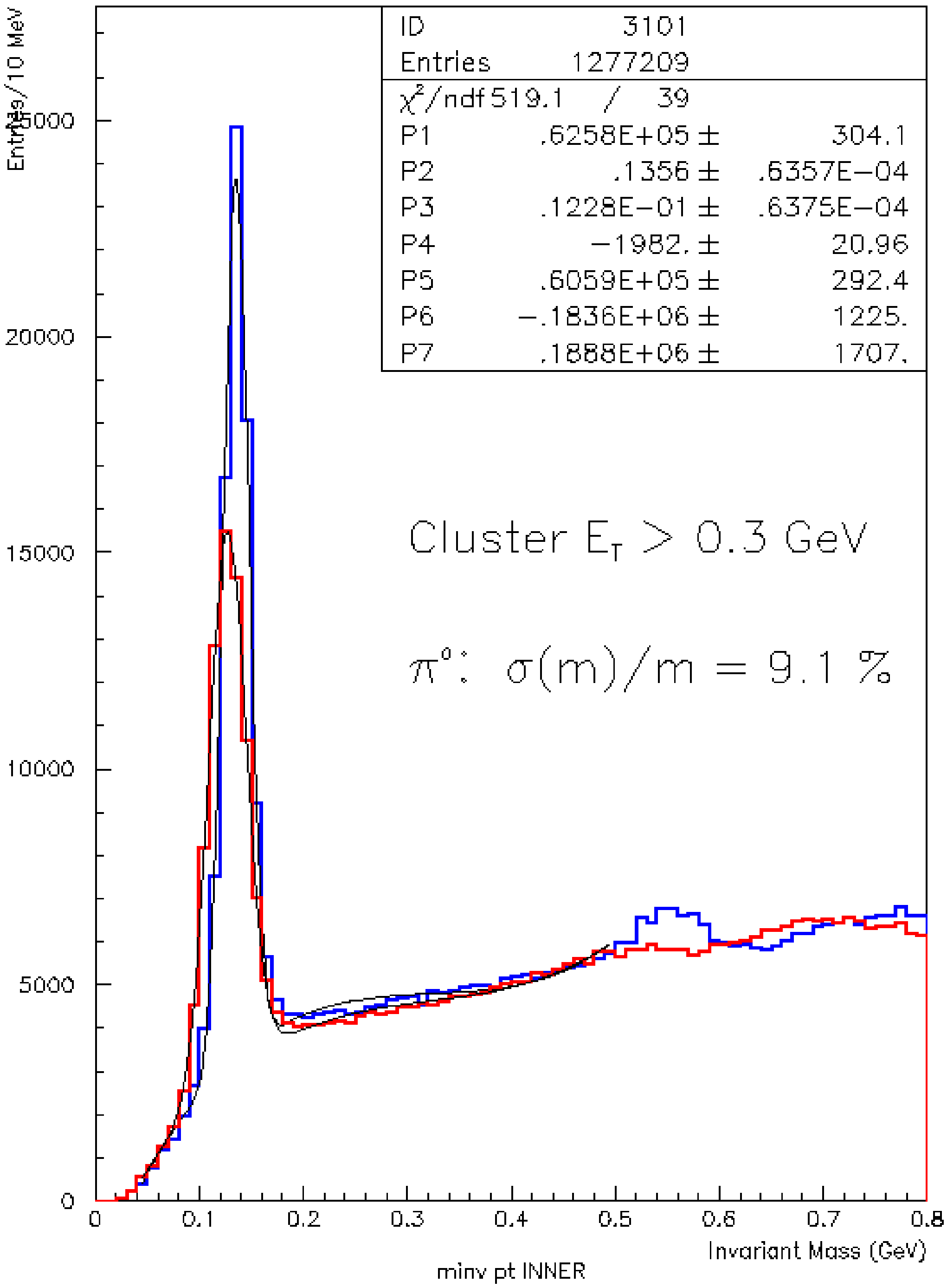
5 % ECAL Miscalibration

ECAL detector

- Readout boards equipped most ($\sim$ 80 %)of the Inner/Middle sections of ECAL
- Calibration from equalization and π^0 method was supplied for the Pretrigger LUT and the SLT code
- Fine π^0 calibration on single cells performed on the sample analyzed (two iterations), obtaining the right π^0 mass value and achieving uniformity between Inner and middle sections and good precision for π^0 and η:
  π^0 : $\sigma(\pi^0) \sim 12 - 13\, MeV/c^2$
  η : $M_\eta \sim 545 - 550\, MeV/c^2$; $\sigma(\eta) \sim 35\, MeV/c^2$

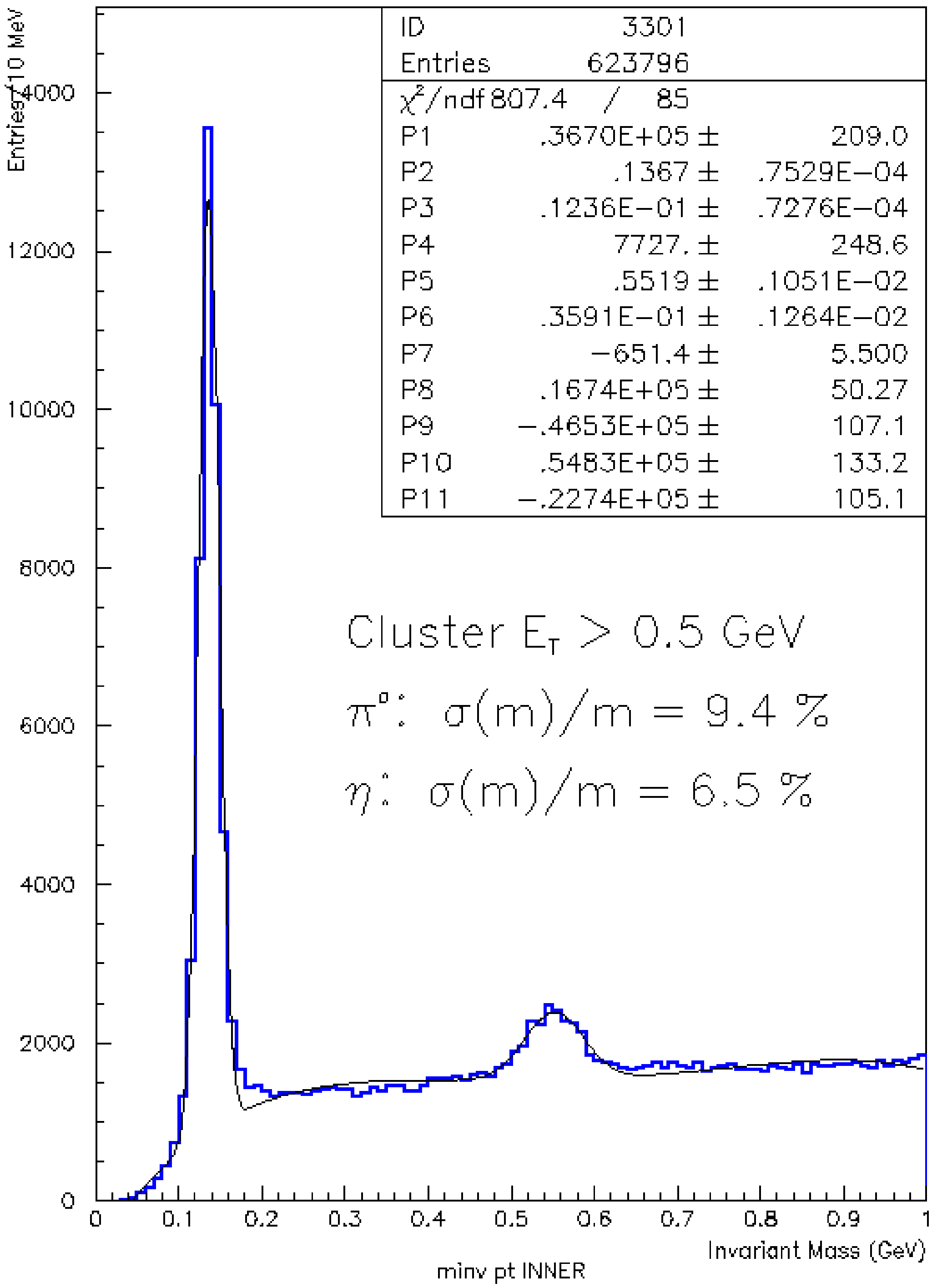
  Calibration precision: $\sim$ 5%. Another iteration ?

Inner ECAL

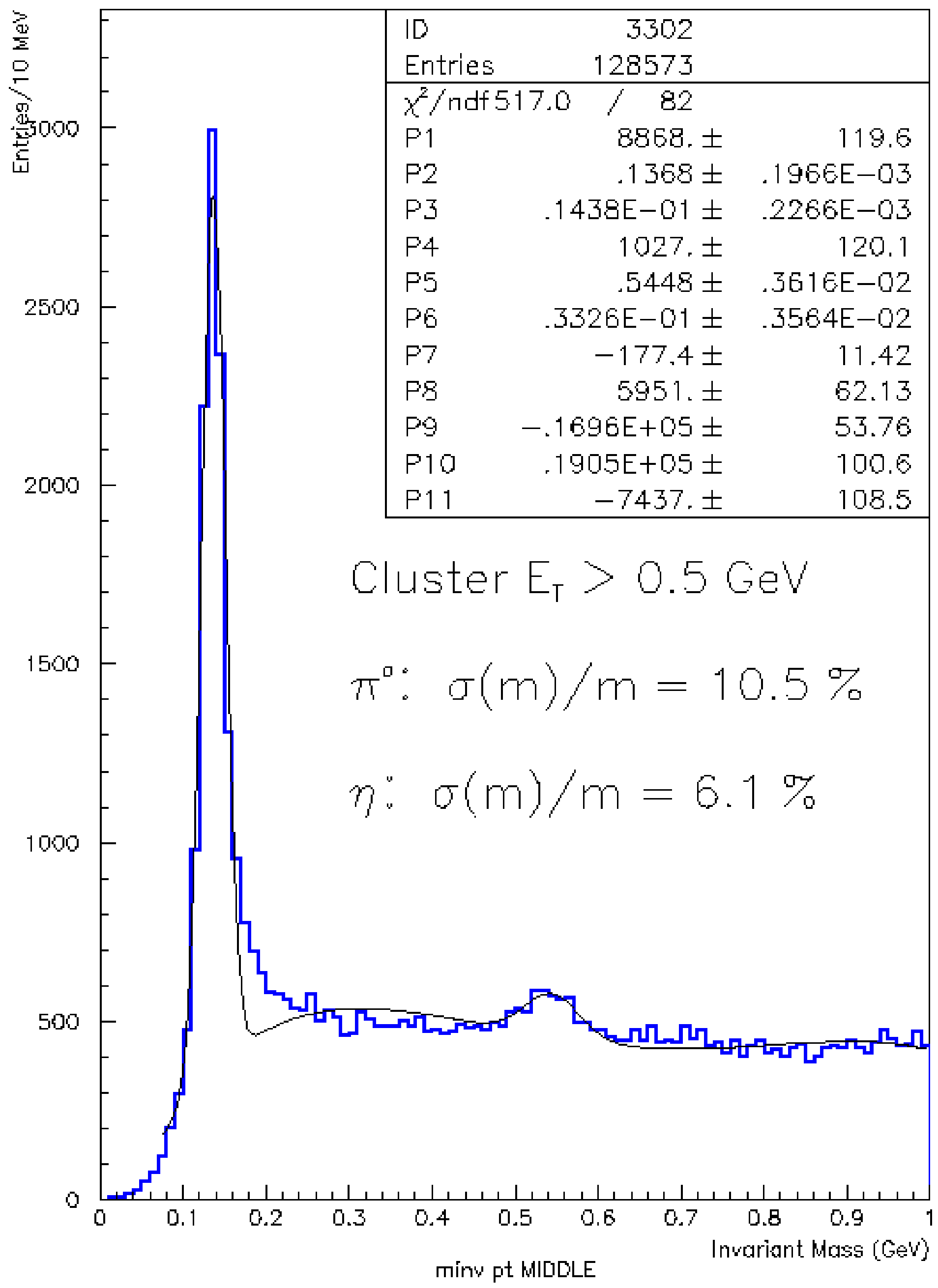


ID 3101
Entries 1277209
χ^2/ndf 519.1 / 39
P1 .6258E+05 ± 304.1
P2 .1356 ± .6357E−04
P3 .1228E−01 ± .6375E−04
P4 −1982. ± 20.96
P5 .6059E+05 ± 292.4
P6 −.1836E+06 ± 1225.
P7 .1888E+06 ± 1707.
Cluster E_T > 0.3 GeV
π^0: $\sigma(m)/m$ = 9.1 %
Entries/10 MeV
0
5000
10000
15000
20000
25000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Invariant Mass (GeV)
minv pt INNER

Inner ECAL


ID 3301
Entries 623796
χ^2/ndf 807.4 / 85
P1 .3670E+05 ± 209.0
P2 .1367 ± .7529E−04
P3 .1236E−01 ± .7276E−04
P4 7727. ± 248.6
P5 .5519 ± .1051E−02
P6 .3591E−01 ± .1264E−02
P7 −651.4 ± 5.500
P8 .1674E+05 ± 50.27
P9 −.4653E+05 ± 107.1
P10 .5483E+05 ± 133.2
P11 −.2274E+05 ± 105.1
Cluster E_T > 0.5 GeV
π^0: $\sigma(m)/m$ = 9.4 %
η: $\sigma(m)/m$ = 6.5 %
Entries/10 MeV
Invariant Mass (GeV)
minv pt INNER

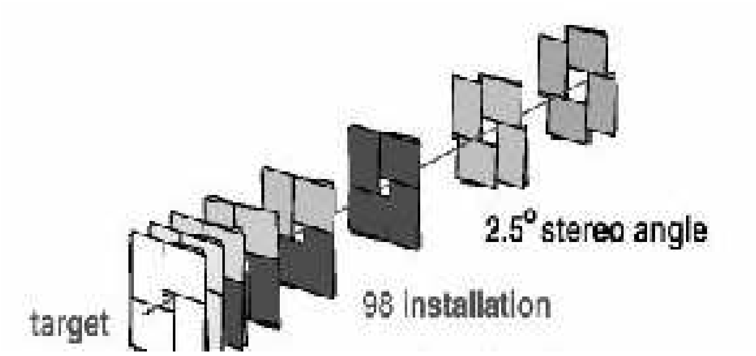
Middle ECAL



ID 3302
Entries 128573
χ²/ndf 517.0 / 82
P1 8868. ± 119.6
P2 .1368 ± .1966E−03
P3 .1438E−01 ± .2266E−03
P4 1027. ± 120.1
P5 .5448 ± .3616E−02
P6 .3326E−01 ± .3564E−02
P7 −177.4 ± 11.42
P8 5951. ± 62.13
P9 −.1696E+05 ± 53.76
P10 .1905E+05 ± 100.6
P11 −7437. ± 108.5
Cluster E_T > 0.5 GeV
π°: σ(m)/m = 10.5 %
η: σ(m)/m = 6.1 %
Entries/10 MeV
Invariant Mass (GeV)
minv pt MIDDLE

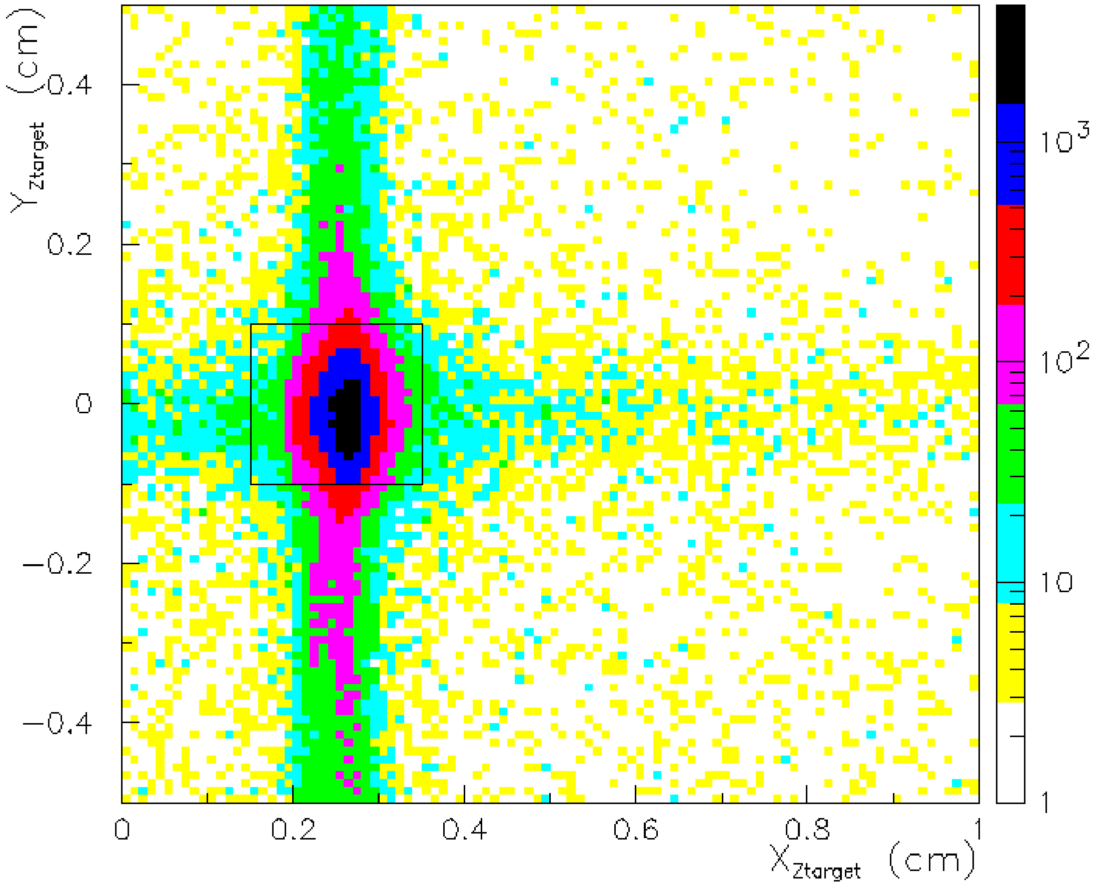
SVD detector

- L-shape configuration detector



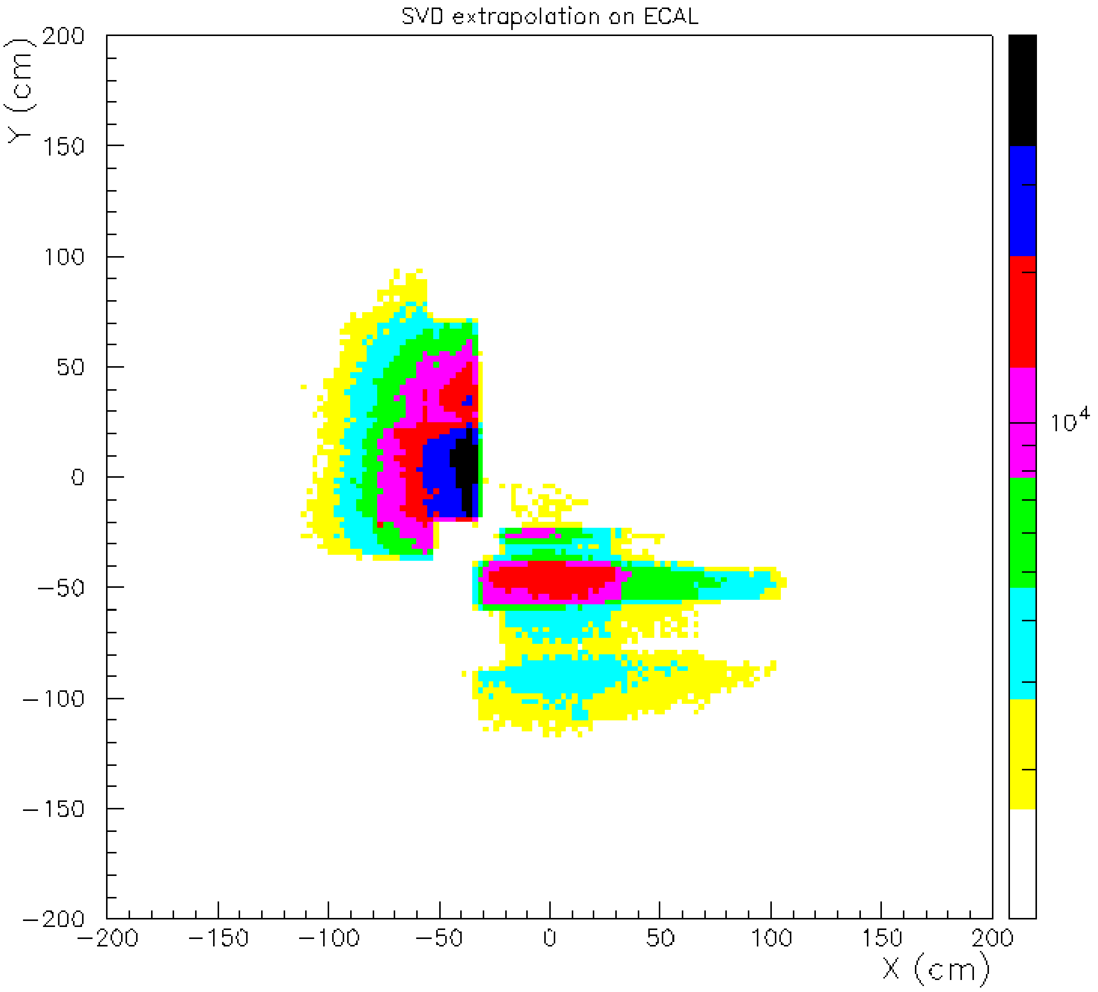
- Five hits at least required in each reconstructed track (2 stations)
- 3 o'clock quadrant has a good coverage on most of ECAL pretrigger boards
- target spot seen (from different wires)
- ECAL-SVD alignment studied and optimized (see residuals)

Reconstructed Target Spot with Holmes



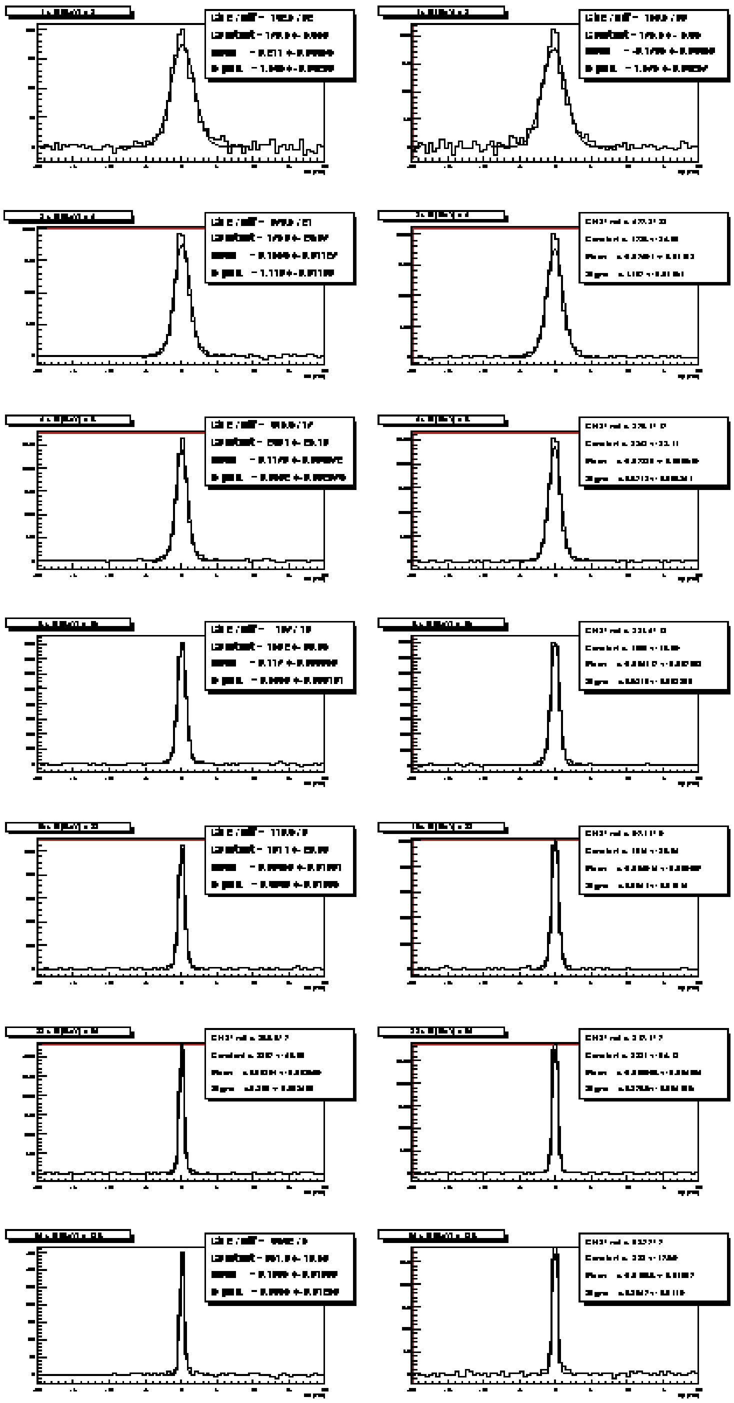
(Rectangle = Target constraint for analysis)

SVD projection on ECAL



The SVD segments are required to come from the primary vertex region.

SVD - ECAL residuals



J/ψ search

Requirements:

- Two high-P_T clusters in ECAL
- ECAL-SVD match (typically $\leq 1\,cm$)
- SVD tracks coming from the target spot

The number of expected J/ψ can be written as:

$$N_{J/\psi} = N_{ev} \cdot R_{TRIG} \cdot \frac{\sigma^{DIR}_{J/\psi}}{\sigma_{IN}} \cdot BR(J/\psi \rightarrow e^+e^-) \cdot \epsilon_{REC}$$

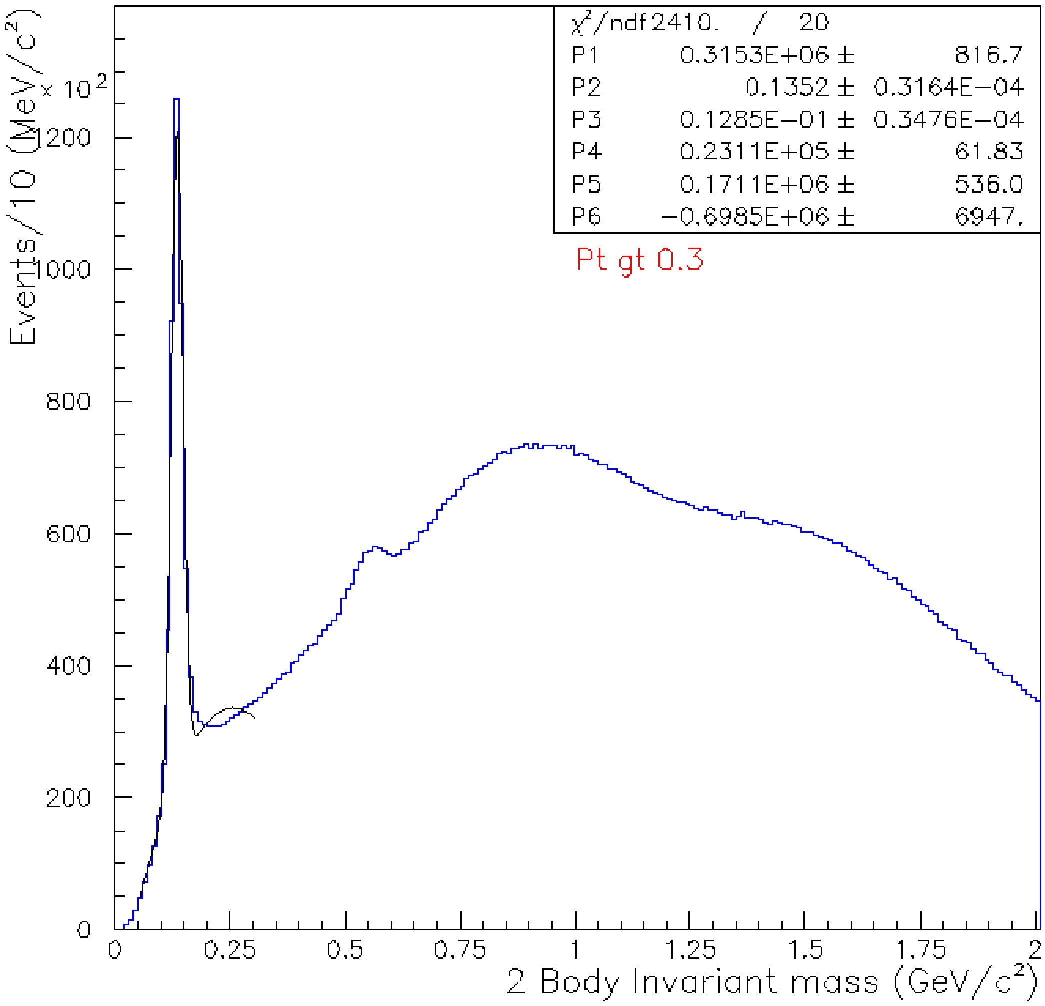
Where:
N_{ev} is the number of analysed events
$R_{TRIG} = 20000$ is the trigger rejection factor
$\sigma^{DIR}_{J/\psi}/\sigma_{IN} = 2 \cdot 10^{-5}$
$BR(J/\psi \rightarrow e^+e^-) = 6 \cdot 10^{-2}$
$\epsilon_{REC} = 0.14\%$ for SVD hit efficiency of 60%

In this way we get:

$$N_{ev} \sim 50\ J/\psi\ /\ 10^6\ events$$

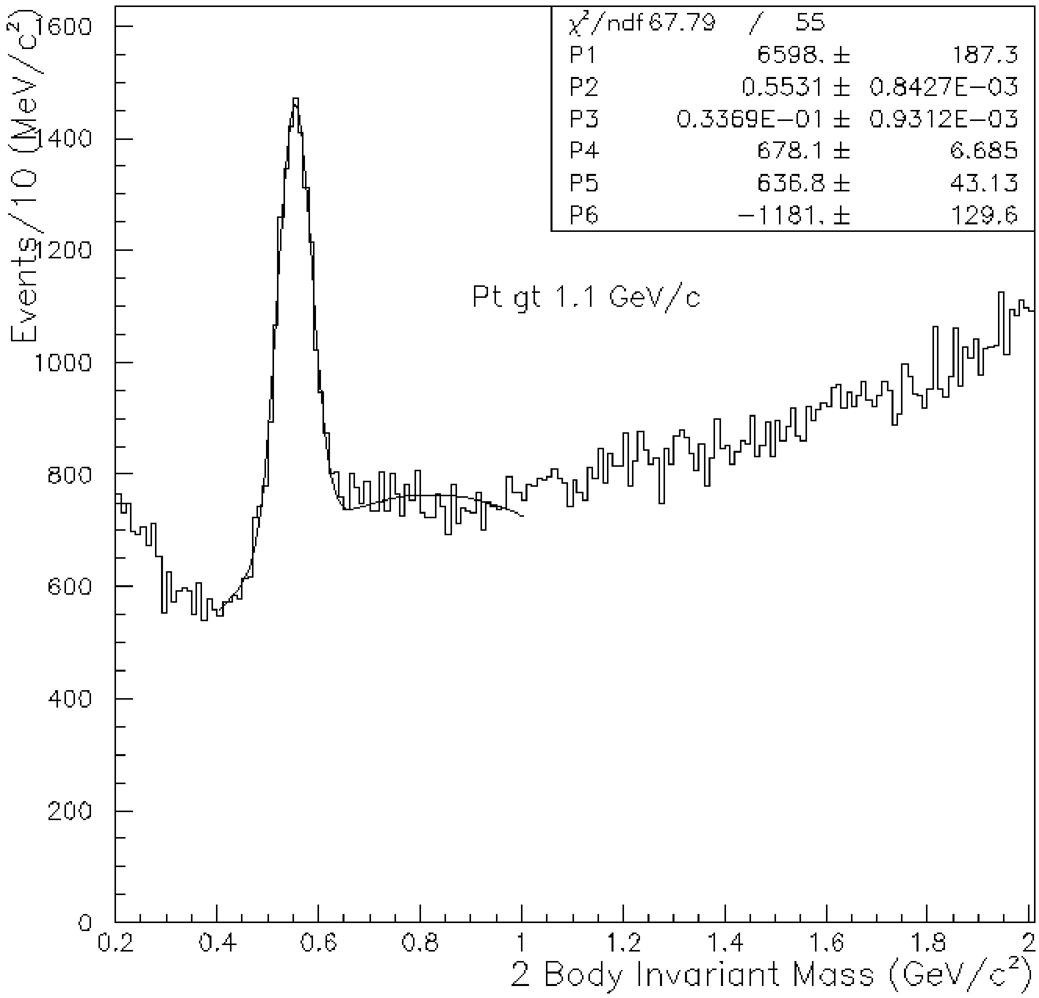
Compatible with the luminosity evaluation (see R. Mankel presentation).

π^0 Detection

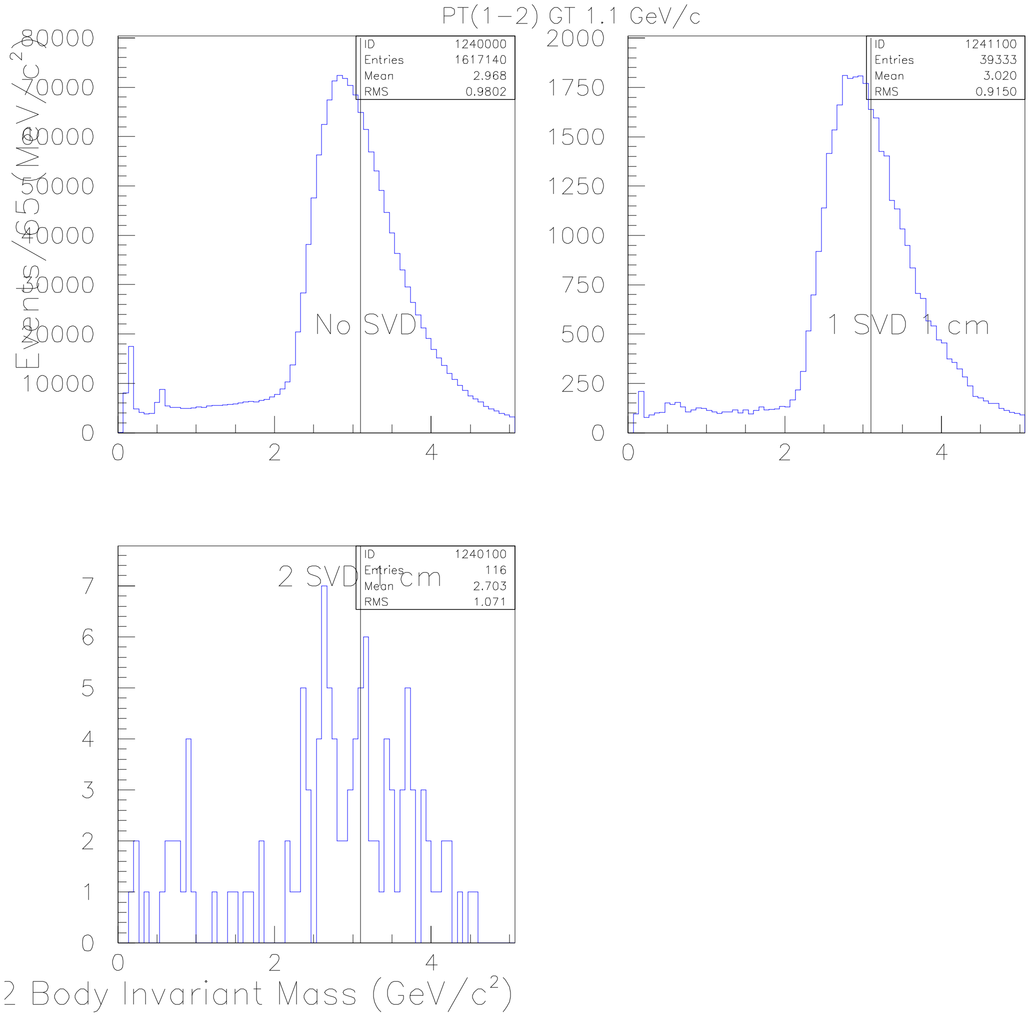


More than 300000 π^0s are present in the peak and have been used for the ECAL calibration

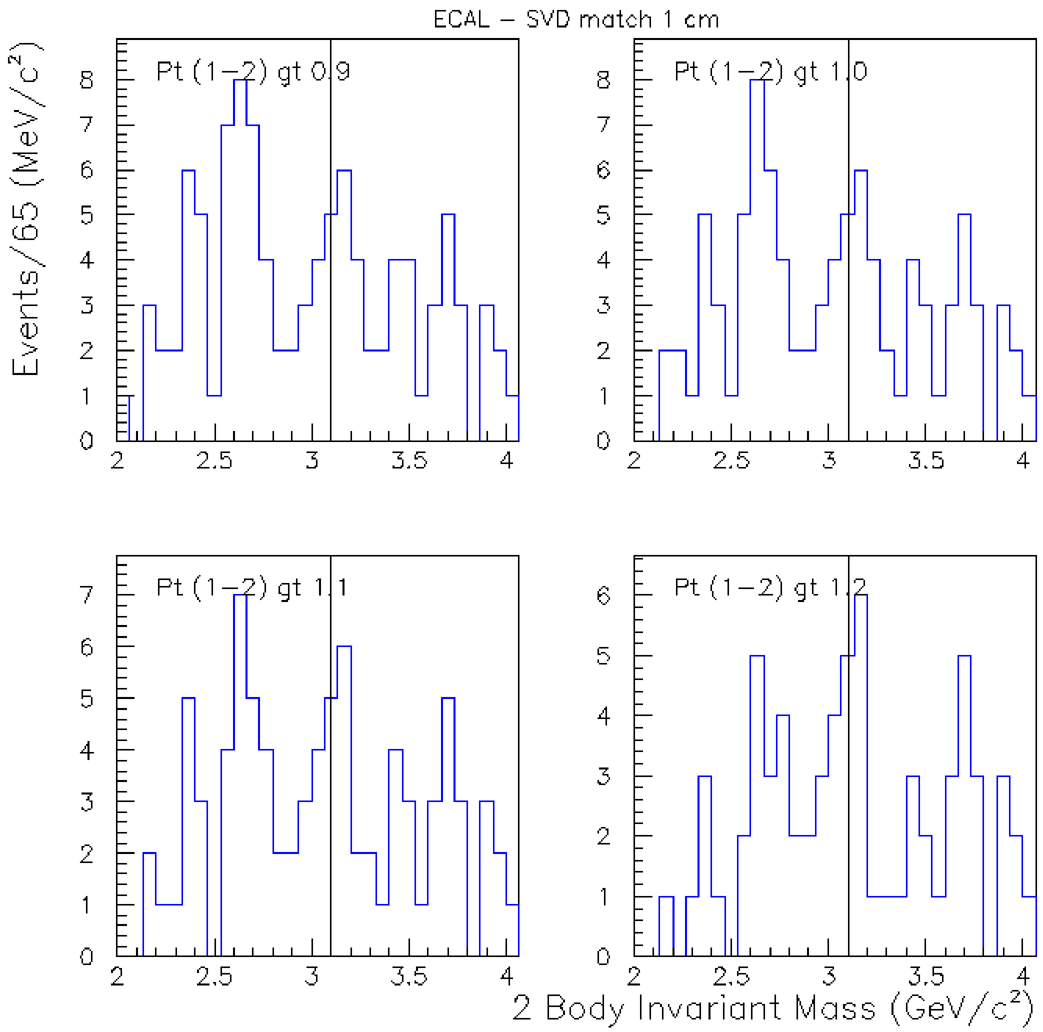
η Detection



J/ψ Search



0, 1, 2 ECAL-SVD coincidences: relative distance less than 1 cm.



ECAL – SVD match 1 cm
Pt (1–2) gt 0.9
Pt (1–2) gt 1.0
Pt (1–2) gt 1.1
Pt (1–2) gt 1.2
Events/65 (MeV/c²)
2 Body Invariant Mass (GeV/c²)

Conclusions

- Full analysis chain is running
- ECAL calibration and SVD alignment have been improved
- Given still large uncertainties in SVD track efficiency, dead time effects, luminosity evaluation, the expected J/ψ Yield may not be in contradiction with the real data
- Appreciable suppression of background
- Statistics can be improved by adding more runs and data taken in different trigger conditions (combination of the samples may be difficult)

Comparison with 98 Study

Number of expected J/ψ in 98 and 99 configurations produced in single interactions

	98 Study	99 exp.	Factor
J/ψ Events	40000	$\sim$ 50	
Trigger/reco ϵ	$\sim$ 1.5%	$\sim$ 0.14%	$\sim$ 10
DAQ Time	10^6 s	$\sim 4 \cdot 10^4$ s	$\sim$ 25
Dead Time	1	$\sim$ 0.3	$\sim$ 3.3
Total			$\sim$ 825

From the ratio of the expected J/ψ we get:

$\frac{N^{98}_{J/\psi}}{N^{99}_{J/\psi}} = \frac{40000}{50} = 800$

In good agreement.