

*Summary of the pre-selection studies for  
 $\eta \rightarrow \pi^+ \pi^- \gamma$  and  $\eta \rightarrow e^+ e^- \gamma$  analysis*

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# Questions from previous meeting

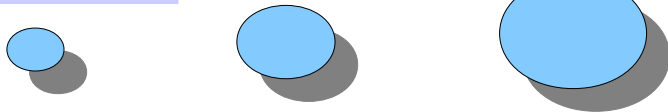
- Should we use vertex bank or not? (at the pre-selection level)
  - in 20% of selected vertexes at least for one track pion hypothesis is wrong (muon)
  - lower efficiency
  - are the track parameters better? For pions / electrons ?
- Is KPM stream worth the effort?
  - worse track reconstruction in KPM and hence rejection of signal events (left with  $< 1\%$  of total BR)

# Next steps

- Investigate different track selection and resulting efficiency and purity
- add  $\eta \rightarrow e^+ e^- \gamma$  to pre-selection
- repeat analysis of Ilaria

- ▶ Pre-selection:
  - ▶  $\geq 2$  prompt photons  $|t_{cl} - l_{cl}/c| < 5\sigma_t$
  - ▶ most energetic photon with  $E_\gamma \geq 250$  MeV assumed recoil
- ▶ Track selection
- ▶ Kinematical constraints
  - ▶ Calculate  $E_\gamma^{recoil}$  from 2 body  $\Phi$  decay kinematics
  - ▶ Calculate  $\gamma_{eta}$  from  $\eta$  decay kinematics
  - ▶  $\gamma_{eta} : |E_t - P_t| < 10$  MeV
  - ▶ We should find cluster with OpAn  $< 0.2$  rad to the calculated  $\gamma_{eta}$

$$\phi \rightarrow \eta \gamma$$



$$\eta \rightarrow \pi^+ \pi^- \gamma$$

$$\eta \rightarrow \pi^+ \pi^- \pi^0$$

$$\eta \rightarrow e^+ e^- \gamma$$

# Track selection

Tested selection based on the position of the first point of the track and based on the distance to IP using track parameters from PCA (better!)

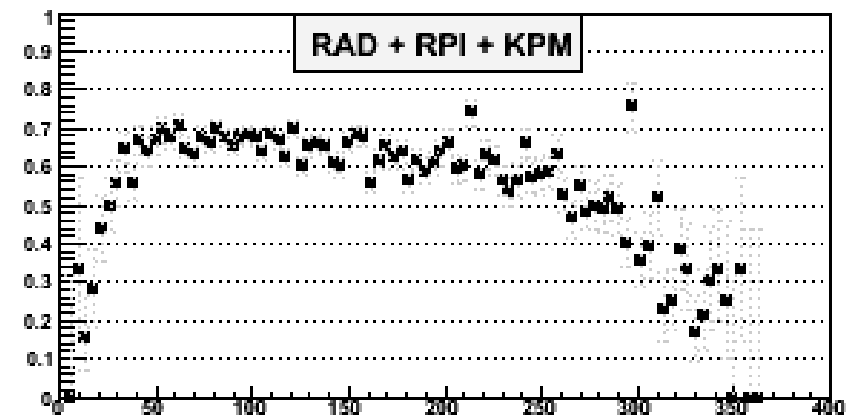
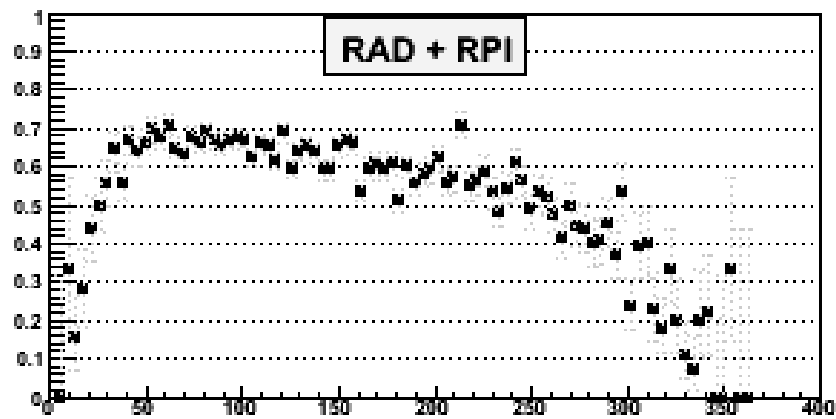
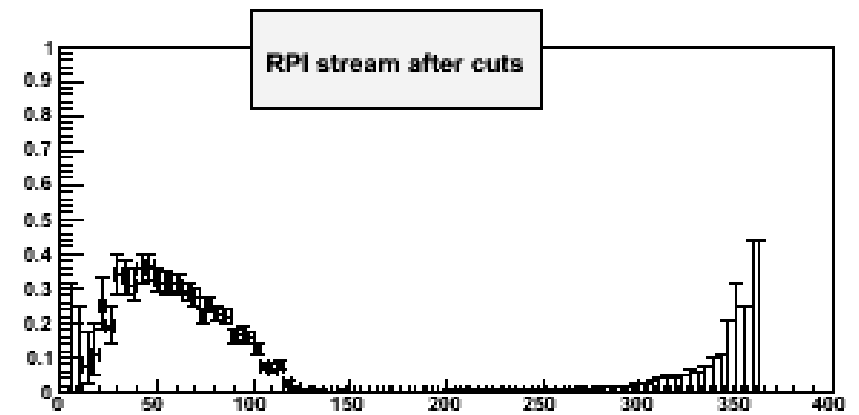
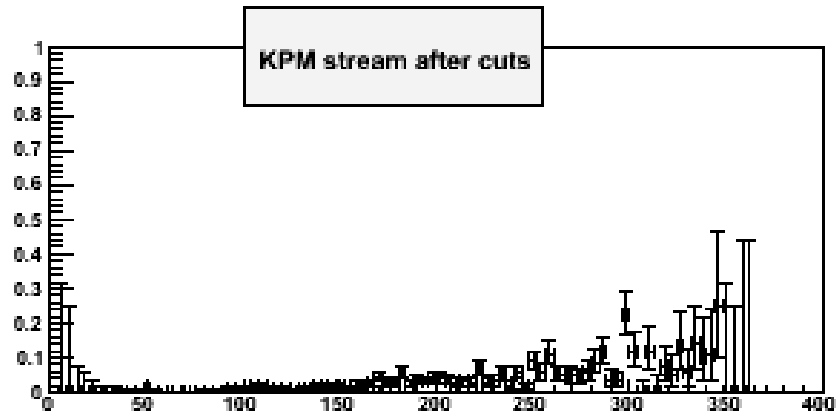
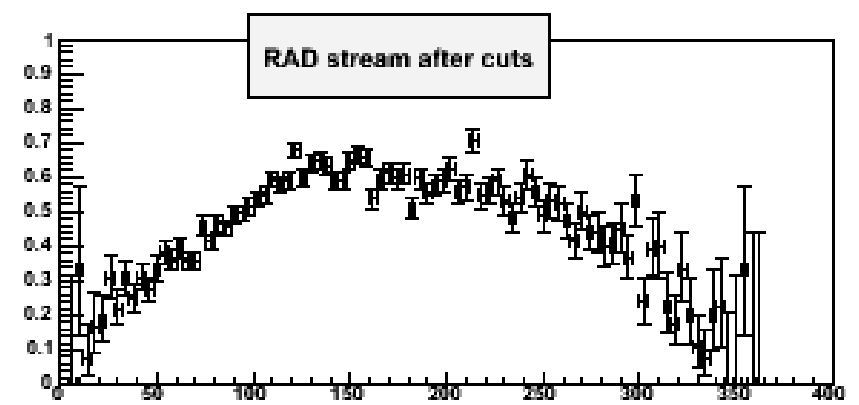
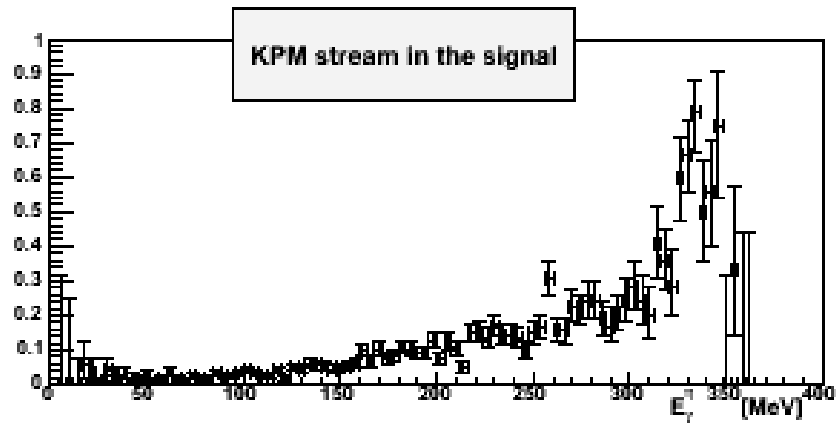
	All events	RAD	RPI	KPM
<b>Total</b>	17619	10916	1665	1210
$\pi^- \pi^+$	11759 (67%)	9112 (83%)	1544 (93%)	393 (32%)
$\pi^+ \mu^-$	1056 (6%)	586 (5%)	33 (2%)	145 (12%)
$\pi^- \mu^+$	972 (5%)	540 (5%)	36 (2%)	150 (12%)

# Total number of signal events at generation level 22131

<b>Signal processing with track selection from vertex bank:</b>	Preselection	Event signature	$ \text{Et-Pt}  < 10\text{MeV}$	$\text{OpAn} < 0.2$
ALL	17619 (80%)	12553 (57%)	10321 (47%)	9629 (43%)
RAD	10916 (49%)	9430 (43%)	8284 (37%)	7877 (36%)
KPM	1210 (5.5%)	595 (2.7%)	255 (1.1%)	186 (0.8%)
RPI	1665 (7.5%)	1524 (6.8%)	1415 (6.4%)	1336 (6.0%)

<b>Signal processing with track selection from track bank based on PCA of the track:</b>	Preselection	Event signature	$ \text{Et-Pt}  < 10\text{MeV}$	$\text{OpAn} < 0.2$
ALL	17619 (80%)	15335 (69%)	12499 (56%)	11550 (52%)
RAD	10916 (49%)	10904 (49%)	9771 (44%)	9271 (42%)
KPM	1210 (5.5%)	998 (4.5%)	475 (2.1%)	359 (1.6%)
RPI	1665 (7.5%)	1665 (7.5%)	1575 (7.1%)	1493 (6.7%)

# Efficiency with new track selection

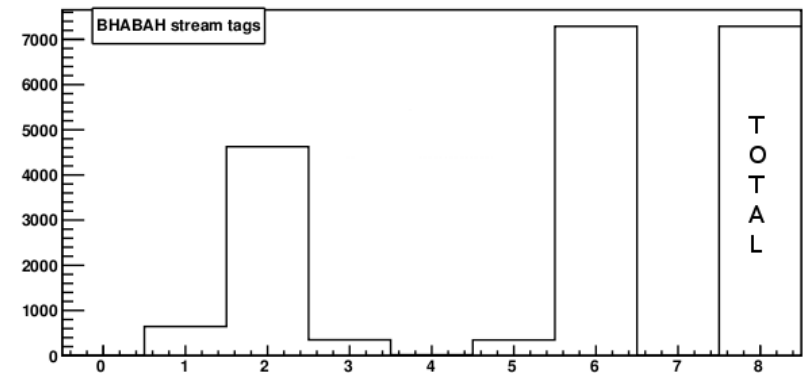
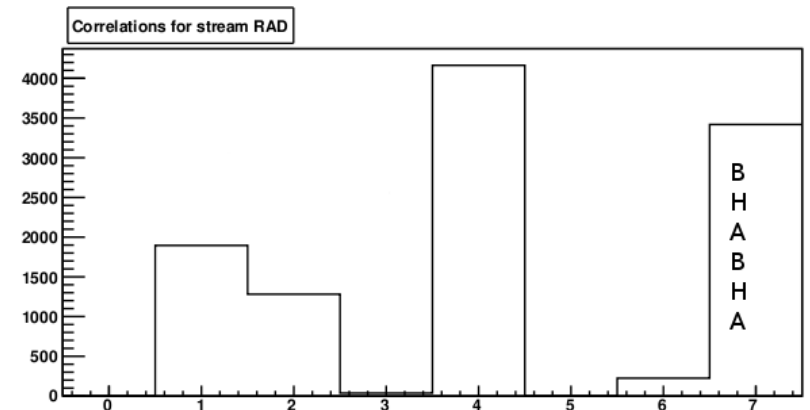
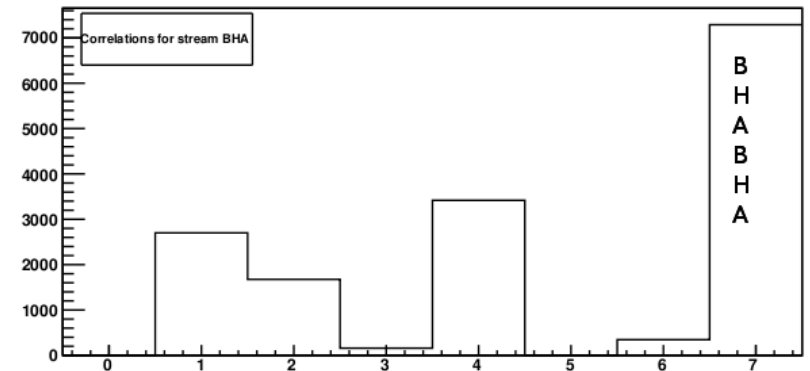


*What about  $\eta \rightarrow e^+ e^- \gamma$  ?*

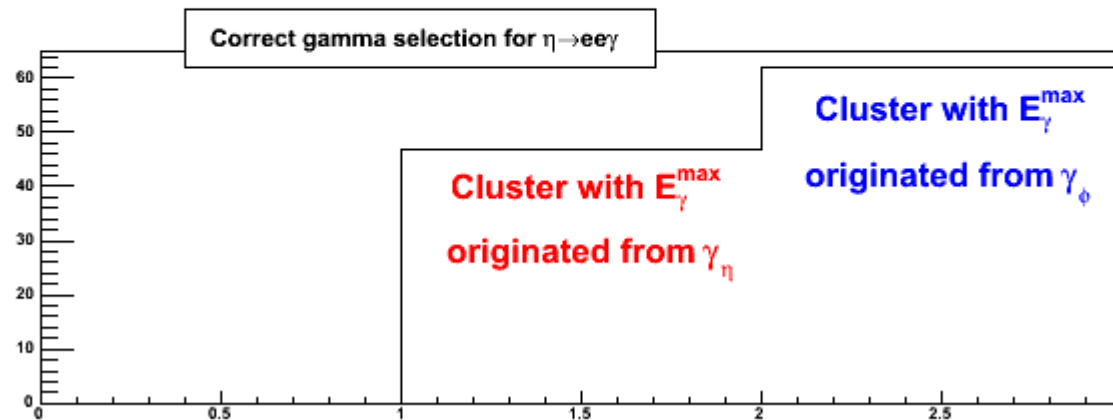
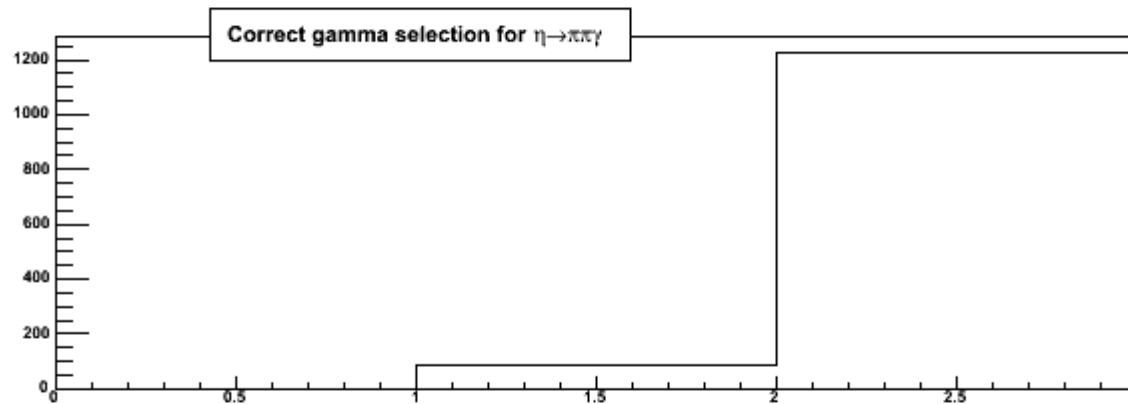
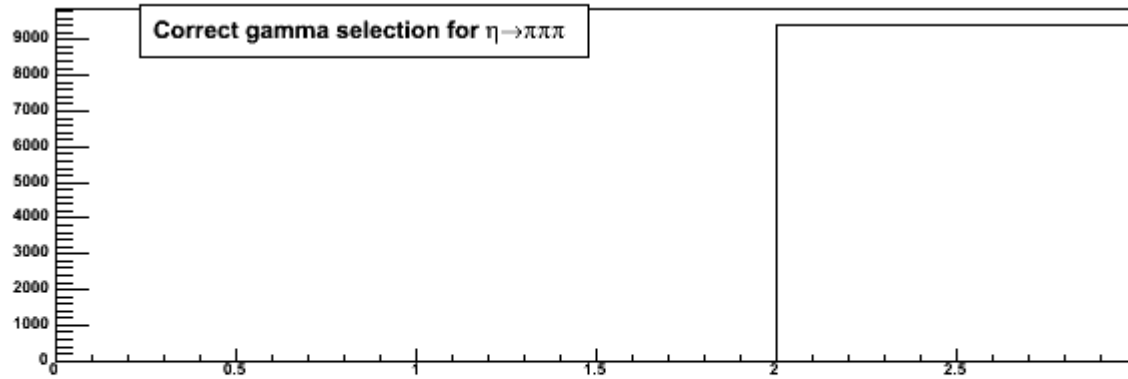


# $\eta \rightarrow e^+ e^- \gamma$ events classification

- Stream occupancy:
  - #7: BHA = 80%
  - #4: RAD = 44%
  - #1: KPM = 35%
  - #2: KLS = 21%
  - #6: UFO = 5%
  - #3: RPI = 2% } combined 87%
- BHABHA tags fired:
  - #6: Radiative Bhabhas = 100%
  - #2: Golden Bhabhas = 65%



# Selecting most energetic cluster as originated from $\Phi$ decay

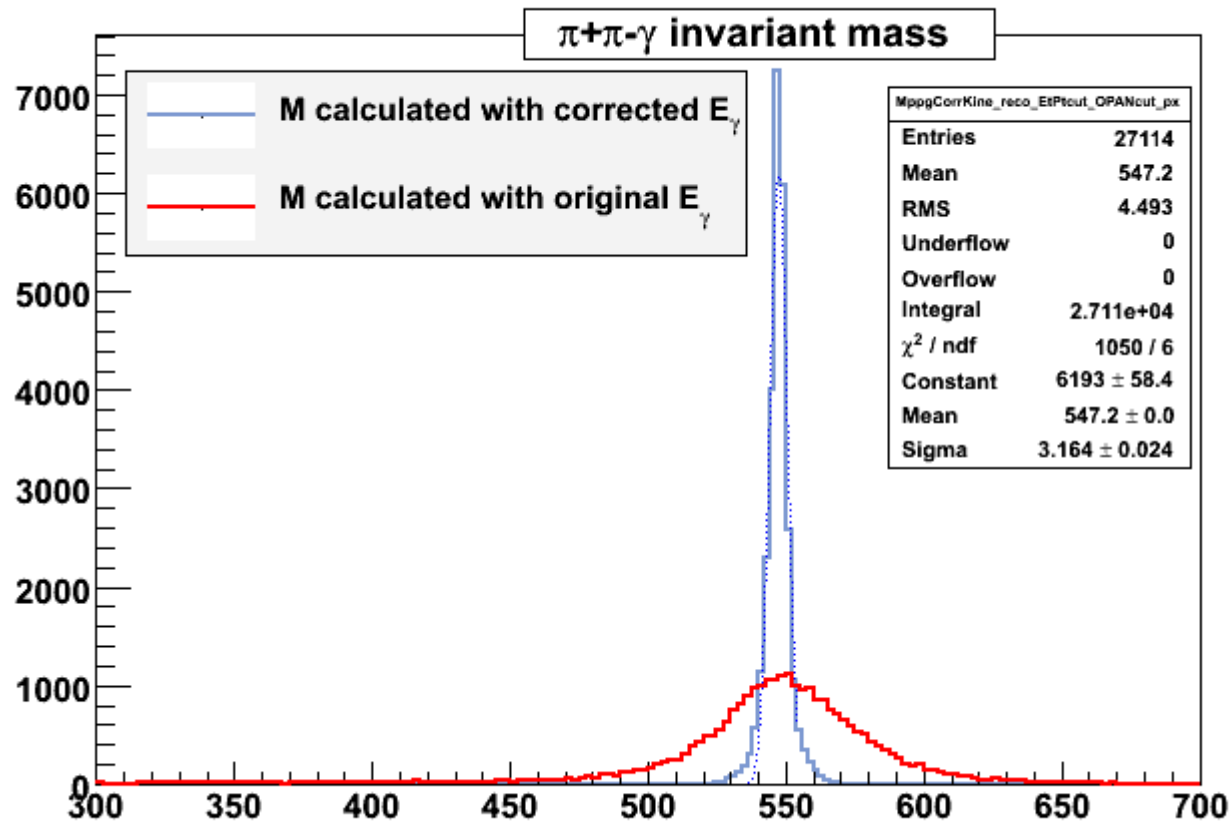


# Quick look into experimental data

Data 2005 rad stream, runs: 34406 ÷ 34499,  $L_{\text{int}} = 13.6 \text{ pb}^{-1}$

Expected number of  $\eta \rightarrow \pi^+ \pi^- \gamma$  in data  $\sim 28.000$

(From MC studies signal-to-background ratio after the cuts  $\sim 1:1$ )



# Conclusions

- Clear improvement in acceptance without vertex requirement
- Track information is sufficient for good selection
- Proposed event selection does not suit  $\eta \rightarrow e^+ e^- \gamma$ 
  - *Different event classification*
  - *No obvious way to select recoil  $\gamma$  from  $\Phi$  decay*
- Next steps:
  - *RAD (S/B ~ 1:1) and RPI (S/B ~ 1:60) streams analysis*
  - *Compare normalization with luminosity and  $\eta \rightarrow \pi^+ \pi^- \pi^0$*

spares

