Monte Carlo Simulation of $p\overline{p} \rightarrow \gamma\gamma$ and $p\overline{p} \rightarrow \gamma\pi^0$ for Panda
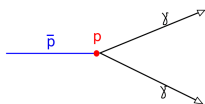
Michael Düren, Irina Brodski, Zoltan Gagyi-Pàlffy
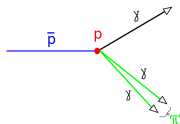
March 26, 2009

JUSTUS-LIEBIG-
UNIVERSITÄT
GIESSEN

panda

12th HANUC Lecture Week Torino 23rd-27th March 2009

Monte Carlo Simulation of $p\overline{p} \rightarrow \gamma\gamma$ and $p\overline{p} \rightarrow \gamma\pi^0$ for Panda
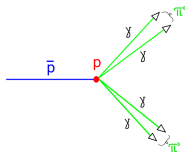
└─ Processes

Interesting Uncharged Processes and Background

$p\overline{p} \rightarrow \gamma\gamma$

$p\overline{p} \rightarrow \gamma\pi^0$

background process: $p\overline{p} \rightarrow \pi^0\pi^0$
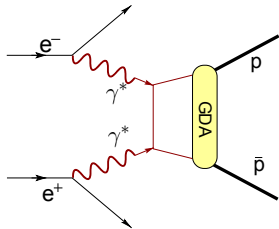
$p\overline{p} \to \gamma\gamma$
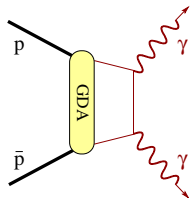
$p\overline{p} \to \gamma\gamma$
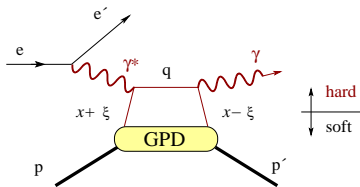
crossed-channel: DVCS
$\gamma^* p \to \gamma p$

time reversed of $\gamma\gamma \to p\overline{p}$
[BELLE]

$p\bar{p} \rightarrow \gamma\pi^0$
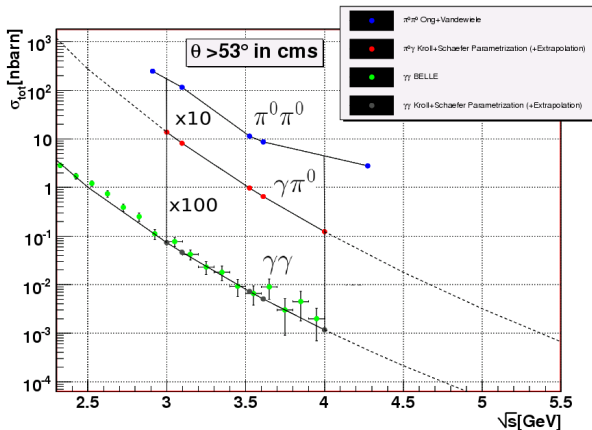

$$p\bar{p} \rightarrow \gamma\pi^0$$

crossed-channel: $\gamma^* p \rightarrow \pi^0 p$
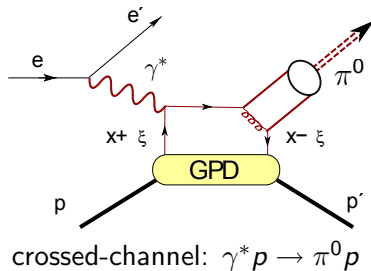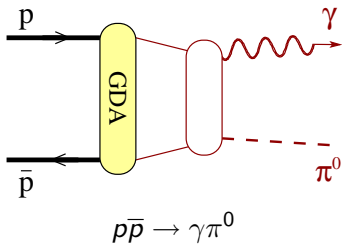
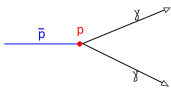# Cross Sections of the Processes

Preparing the Separation

1. Sorting the bumps by Energy in CMS.
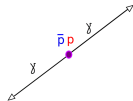   Each bump stands in best case for exactly one photon:
   Bump1→energy() > Bump2→energy() > Bump3→energy()
   > Bump4→energy()...

2. Kinematical cuts.

Monte Carlo Simulation of $p\overline{p} \rightarrow \gamma\gamma$ and $p\overline{p} \rightarrow \gamma\pi^0$ for Panda
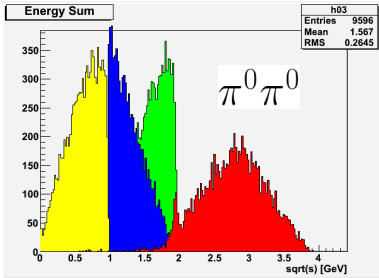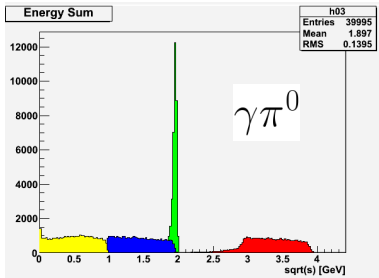
└─ Processes

   └─ Separation

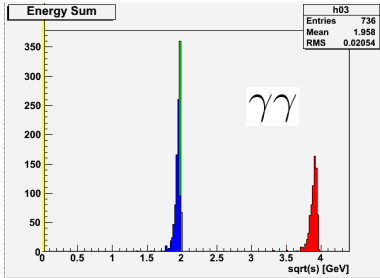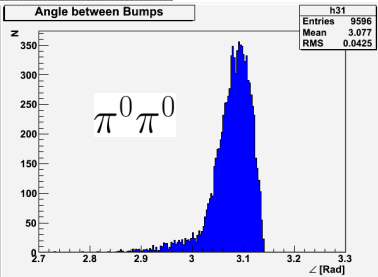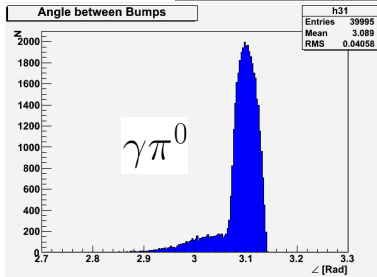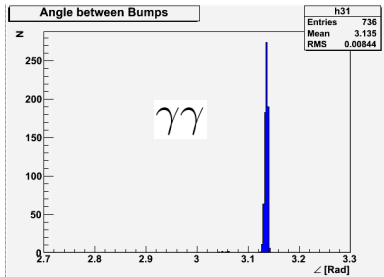# Criteria for $p\overline{p} \rightarrow \gamma\gamma$

lab system

cms of $p\overline{p}$

- ► Only 2 valid Bumps! (ca. 75% of $\gamma\gamma$ and ca. 2% of $\gamma\pi^0$ events.)
- ► Bump1→energy()+Bump2→energy()$\simeq E_{max} > 0.96 * \sqrt{s}$
- ► $\angle(Bump1, Bump2) - \pi < 0.008$.
- ► |Bump1→energy()-Bump2 →energy()| <0.04.
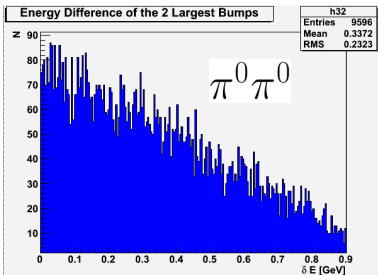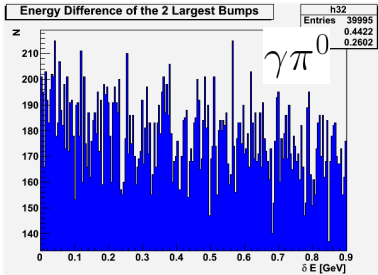- ► (No reconstructable π^0 mass from Bump2 and Bump3)
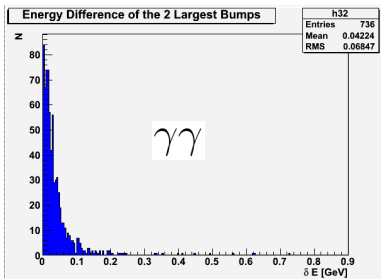
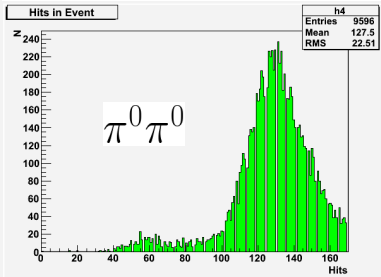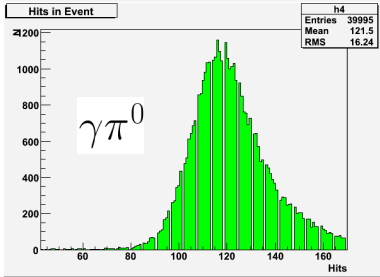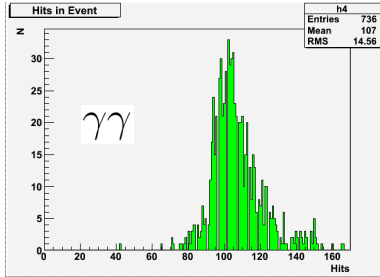# Energy Recontruction ($\sqrt{s} = 4 GeV$)

3 largest bumps and their sum (red)
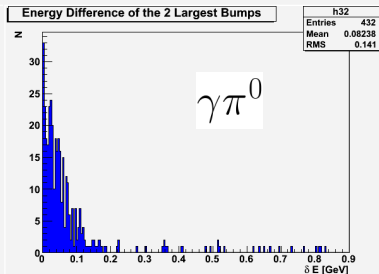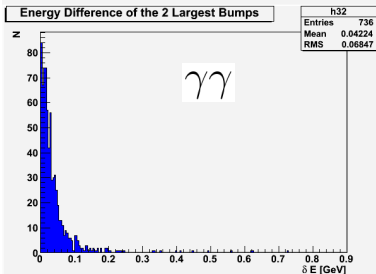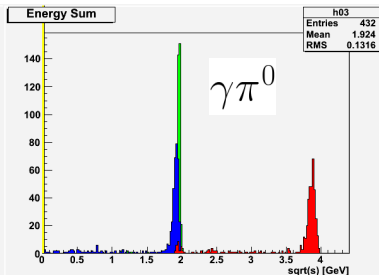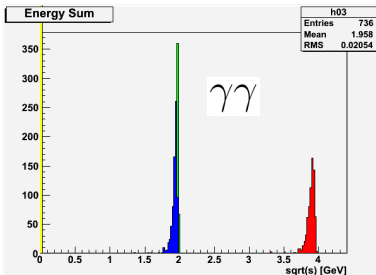
∡(Bump1,Bump2)

Energy difference of Bump1 and Bump2

Hitsum in Event

Hitsum in the event

Only 2 Bumps (ca. 75% of $\gamma\gamma$ and ca. 2% of $\gamma\pi^0$ events.)

Only 2 Bumps (ca. 75% of $\gamma\gamma$ and ca. 2% of $\gamma\pi^0$ events.)
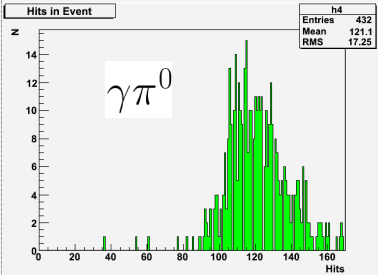
Criteria for $p\bar{p} \rightarrow \gamma\pi^0$
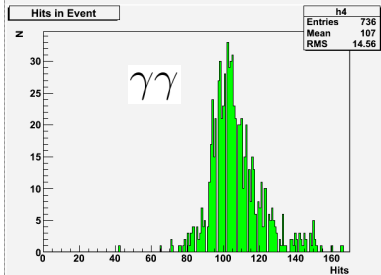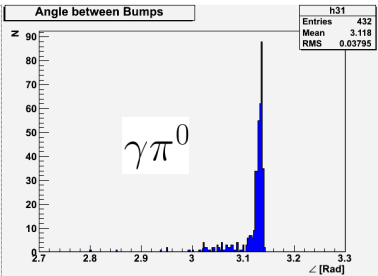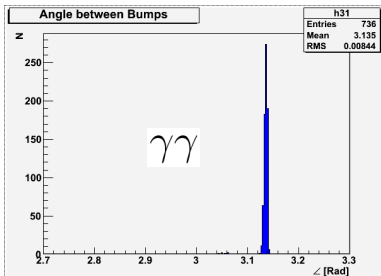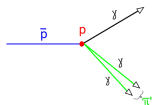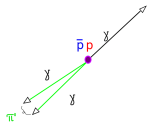

lab system

cms of $p\bar{p}$
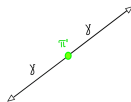
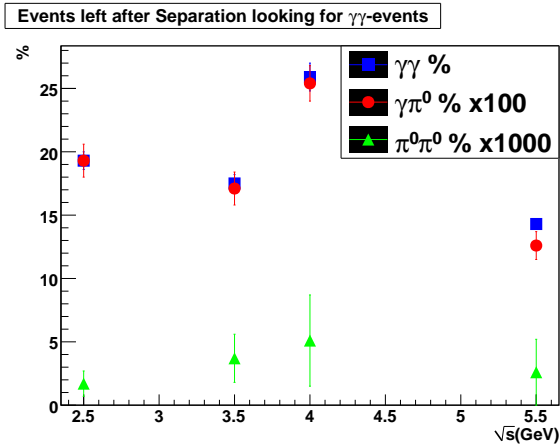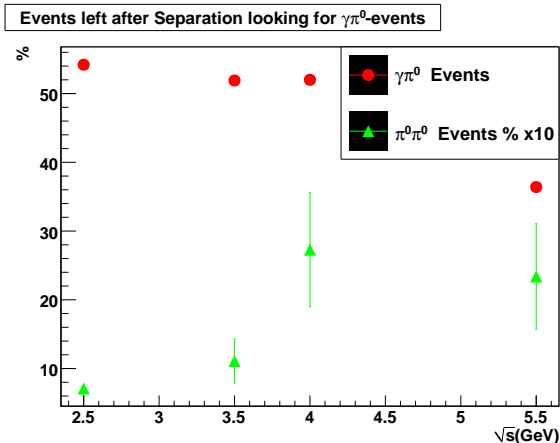cms of π^0

- Bump1→energy()+Bump2→energy()+Bump3→energy()> $0.96\sqrt{s}$
- Reconstructable π^0 mass for exactly one pair of bumps.

Efficiency $p\overline{p} \to \gamma\gamma$

Events left after Separation looking for $\gamma\gamma$-events

Monte Carlo Simulation of $p\overline{p} \rightarrow \gamma\gamma$ and $p\overline{p} \rightarrow \gamma\pi^0$ for Panda

└─ Processes

   └─ Efficiency

Efficiency $p\overline{p} \rightarrow \gamma\pi^0$

Events left after Separation looking for $\gamma\pi^0$-events

Outlook

- ▶ Look at shower shapes
- ▶ Use hits in bump and not in event
- ▶ Analyse other uncharged channels e.g. $p\bar{p} \to \eta_c\pi^0 \to \gamma\gamma\gamma\gamma$
  with backgroung: $p\bar{p} \to \pi^0\pi^0 \to \gamma\gamma\gamma\gamma$
- ▶ ...