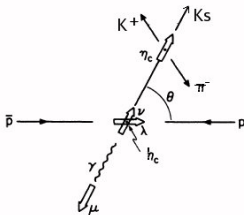


Status of $\bar{p}p \rightarrow h_c \rightarrow \eta_c + \gamma$ analysis

D. Melnychuk, SINS Warsaw

PANDA collaboration meeting, 11.12.2007

Description of the studied channel



$$p\bar{p} \rightarrow h_c \rightarrow \eta_c + \gamma \rightarrow K_S K^\pm \pi^\mp \gamma,$$

$$E_\gamma = 503 \text{ MeV}$$

$$\eta_c \rightarrow K_S^0 K^\pm \pi^\mp, \text{ BR} = 1.9 \cdot 10^{-2}$$

$$E_{CM} = 3526 \text{ MeV}, p_z = 5609 \text{ MeV}$$

$$\sigma_{p\bar{p} \rightarrow h_c \rightarrow \eta_c + \gamma} = 40 \text{ nb} \text{ (E835)}$$

Background

$$p\bar{p} \rightarrow K_S K^\pm \pi^\mp \pi^0, \quad \sigma = 100 \mu\text{b}$$

$$p\bar{p} \rightarrow K^\pm K^\mp \pi^\pm \pi^\mp \pi^0, \quad \sigma = 30 \mu\text{b}$$

$$p\bar{p} \rightarrow \pi^\pm \pi^\mp \pi^\pm \pi^\mp \pi^0, \quad \sigma = 750 \mu\text{b}$$

Signal/background ratio

$$0.76 \cdot 10^{-5}, 3.3 \cdot 10^{-5}, 1.4 \cdot 10^{-6}$$

Event selection

- 20 k events

$$p\bar{p} \rightarrow h_c \rightarrow \eta_c + \gamma, \eta_c \rightarrow K_s K^\pm \pi^\mp \quad (E_{CM} = 3526 \text{ MeV})$$

- background

- 100 k events $p\bar{p} \rightarrow K_s K^\pm \pi^\mp \pi^0$
- 100 k events $p\bar{p} \rightarrow K^\pm K^\mp \pi^\pm \pi^\mp \pi^0$
- 100 k events $p\bar{p} \rightarrow \pi^\pm \pi^\mp \pi^\mp \pi^\mp \pi^0$

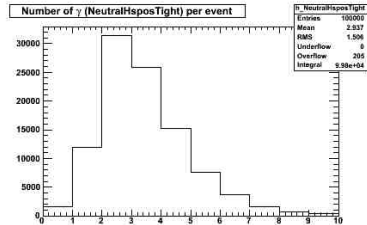
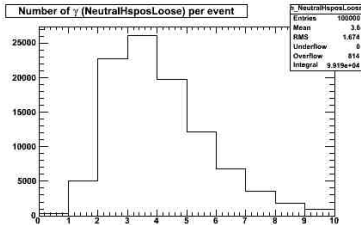
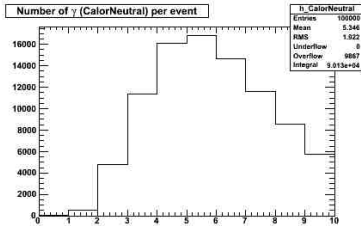
Selection cuts:

- 4C-fit to beam energy and momentum + additional constraint on K_s mass, $CL > 1\%$
- η_c pre-fit selection [2.6:3.2] GeV
- η_c post-fit selection [2.9:3.06] GeV
- K_s common vertex constraint, with pre-fit mass selection [0.3:0.8] GeV
- E_γ within [0.4:0.6] GeV
- no π^0 candidates in event

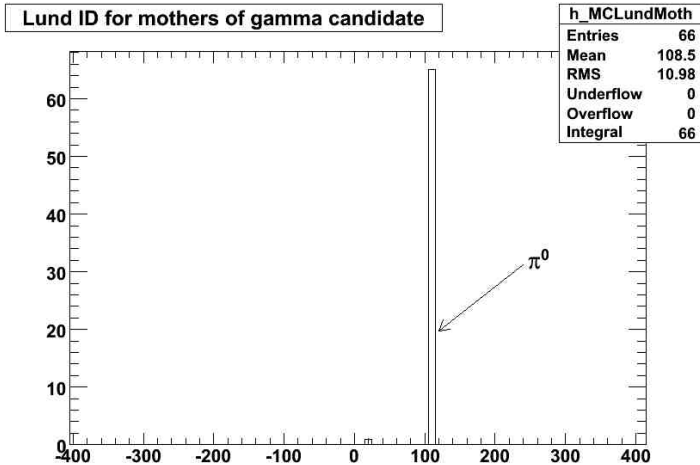
Selection efficiency

	signal	background	ratio
η_c mass pre-fit, K_S mass prefit, PID	9269	4078	11578
4C-fit CL>1 %	6977	799	3014
η_c mass, E_γ	6556	209	839

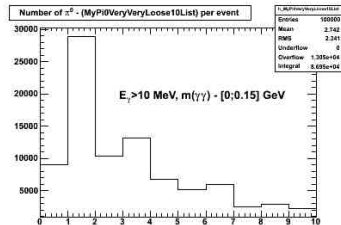
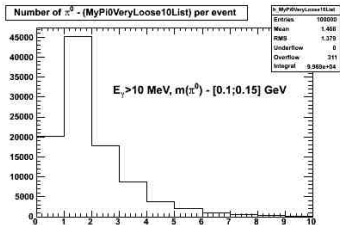
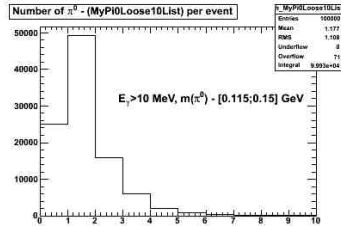
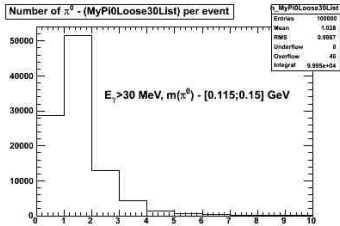
Multiplicity of γ . Effect of hadronic split-off suppression.



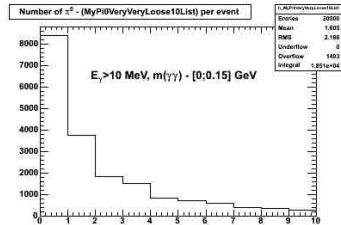
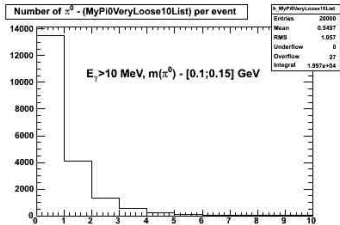
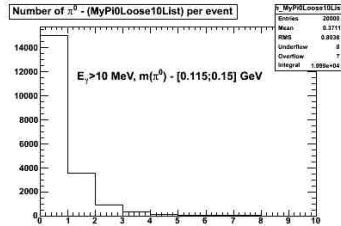
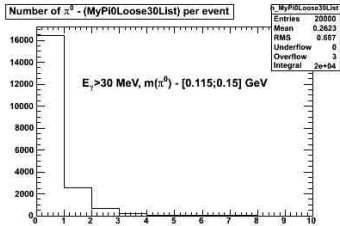
MC truth source of γ .



Number of π^0 (background)



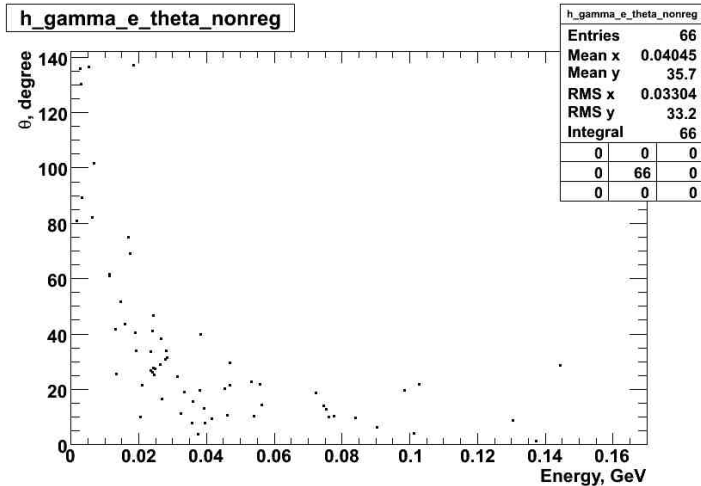
Number of π^0 (signal)



Efficiency of π^0 cuts

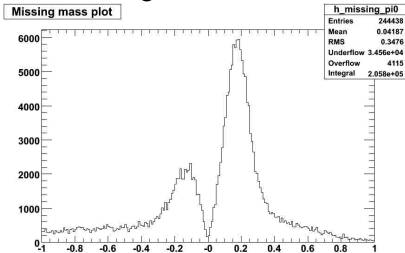
	signal	background	ratio
$E_\gamma > 30\text{MeV}, m(\pi^0) - [0.115; 0.15]\text{GeV}$	5505	126	602
$E_\gamma > 10\text{MeV}, m(\pi^0) - [0.115; 0.15]\text{GeV}$	4957	79	419
$E_\gamma > 10\text{MeV}, m(\pi^0) - [0.1; 0.15]\text{GeV}$	4482	66	388
$E_\gamma > 10\text{MeV}, m(\gamma\gamma) - [0; 0.15]\text{GeV}$	3023	45	392

Energy and angular distribution of non-registered γ

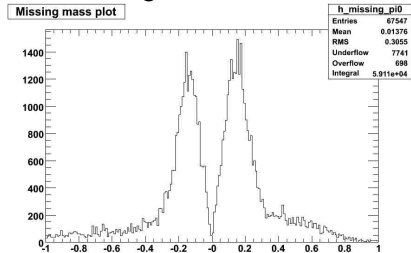


Missing mass distribution

Background



Signal



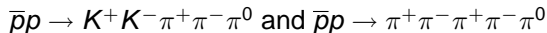
Summary

- Achieved signal/background ratio = 1 : 388.
- Defining signal significance

$$n = \frac{S}{\sqrt{(S + B)}}$$

$n=5$ will be achieved after 3 days of measurements.

- Importance for low energy gamma detection to reject background from π^0 has been shown. Decreasing γ low energy threshold from 30 to 10 MeV gives 44 % improvement to signal/background ratio.
- Other possible background channels



do not contribute to the signal with studied statistics. The signal to background ratio is below 1:1 and 1:20 correspondingly.