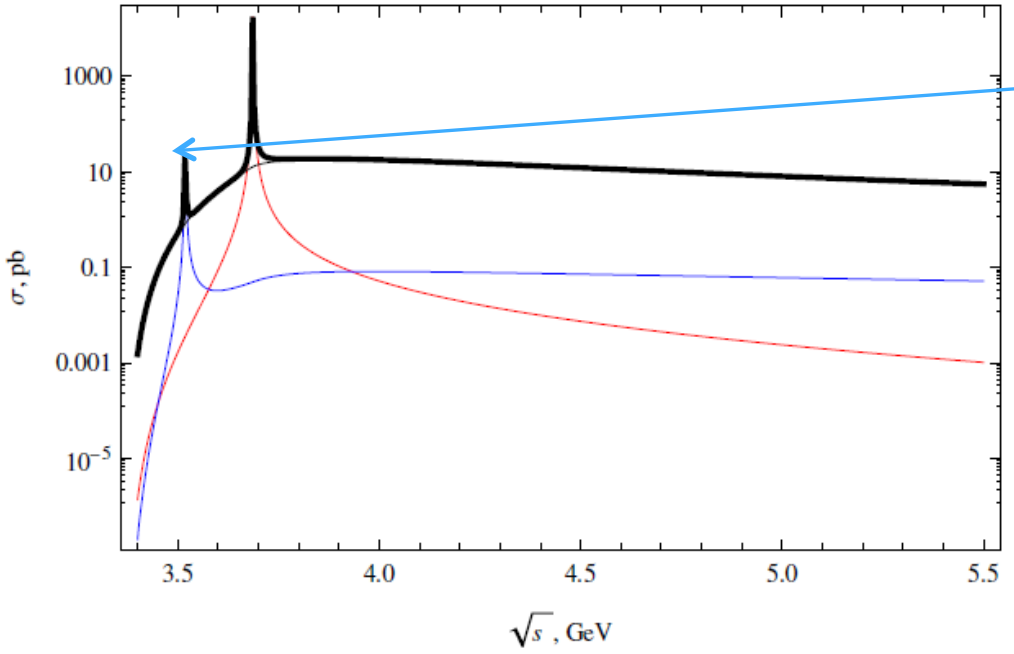
Status of $J/\psi\pi^o\pi^o$ analysis

Vasily Mochalov for Dmitry Morozov

Input from generators

- $p\bar{p} \rightarrow h_c \rightarrow J/\psi\pi^o\pi^o$ – theoretical model and EvtGen based generator



√s = 3.52 GeV

$\psi(2S)$	h_c	$p\bar{p}$
$0.004\,pb$	$93\,nb$	$0.8\,pb$

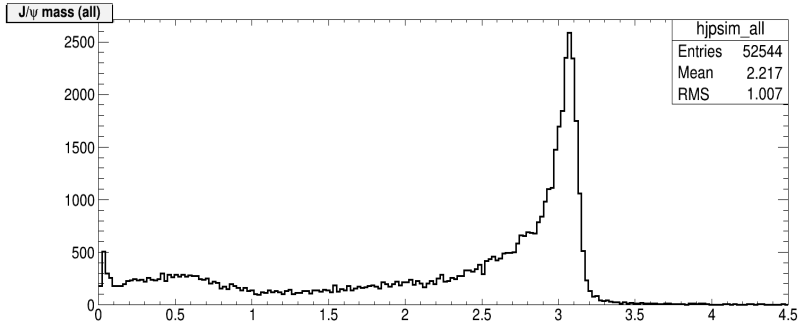
- $p\bar{p} \rightarrow \pi^+\pi^-\,\pi^0\pi^0$ – theoretical model and EvtGen based generator
  - σ = 10 μb
- $p\bar{p} \rightarrow J/\psi\eta\pi^0$ – theoretical model and EvtGen based generator
  - σ = 0 (for h_c and $\psi(2S)$ channels due to mass of constituents)

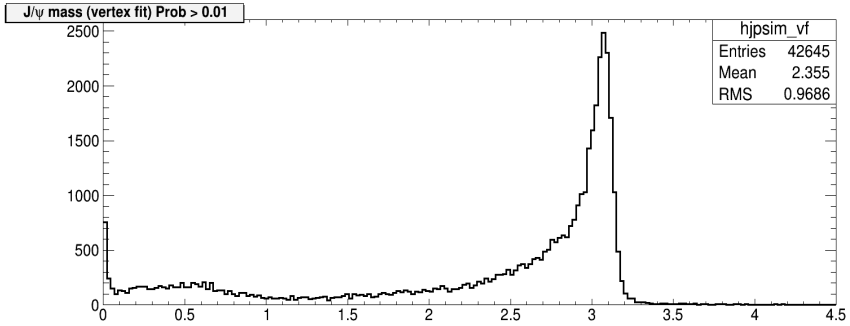
Simulation

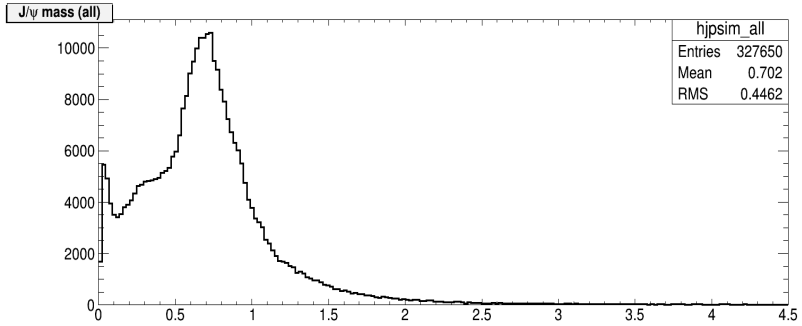
- Reason – to study h_c production in the mode when all particles detected by EMC (this not observed earlier, observed decay channels less than 60%, 40% are unknown)
- September 2014
- PandaRoot rev. 25909
- $N_{ev}\ (p\bar{p} \rightarrow h_c \rightarrow J/\psi\pi^0\pi^0 \rightarrow e^+e^-4\gamma\ (100\%)) = 20k$
- $\sigma_{bkg}/\sigma_{sgl} \approx 110 \Rightarrow N_{ev}\ (p\bar{p} \rightarrow \pi^+\pi^-\ \pi^0\pi^0)_{min} = 1.1 \cdot 10^4$
- $N_{ev}\ (p\bar{p} \rightarrow \pi^+\pi^-\ \pi^0\pi^0\ ) = 100k$
- Goals:
  - Obtain rejection factor < 10^{-4} (for the pollution by bkg <1%)
  - Reconstruction efficiency
  - Calculate N_{ev}/day
  - influence of FSC

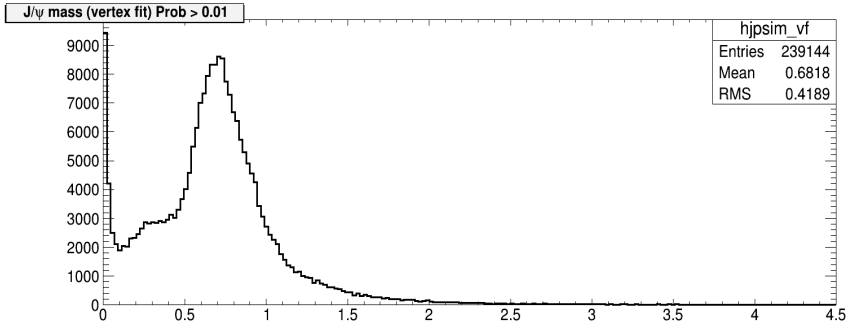
J/ψ reconstruction

- **J/ψ candidates reconstruction:**
  - **select electron and positron candidates,**
  - **combine electron-positron pairs to form J/ψ -candidates,**
  - **kinematic fit of J/ψ candidates with vertex constraint (cut on confidence level of the fit: $P_{J/\psi} > 0.01$),**
  - **mass window: $2.95\ \text{GeV/c}^2 \le M_{e^+e^-} \le 3.25\ \text{GeV/c}^2$;**









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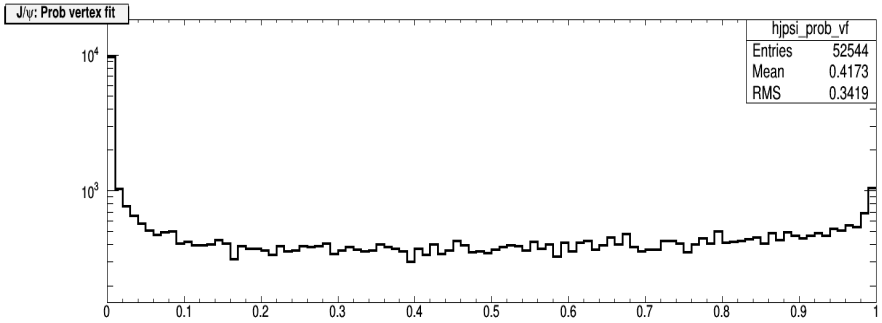
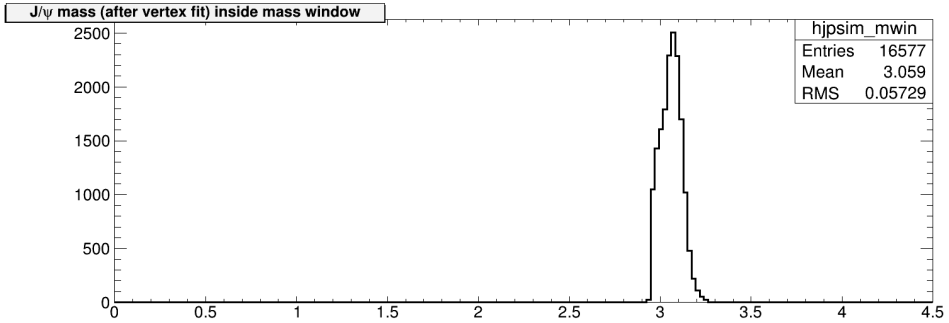
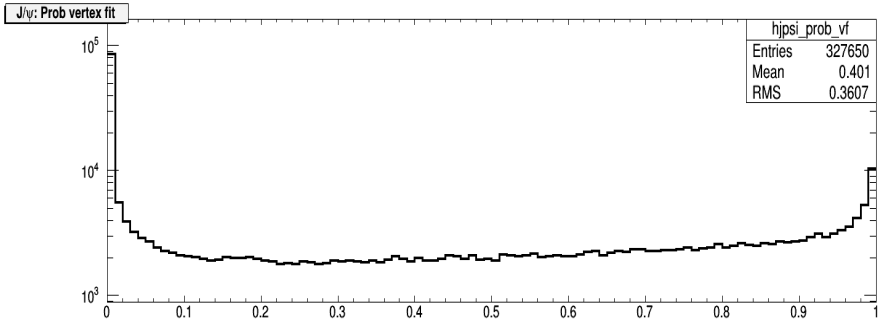
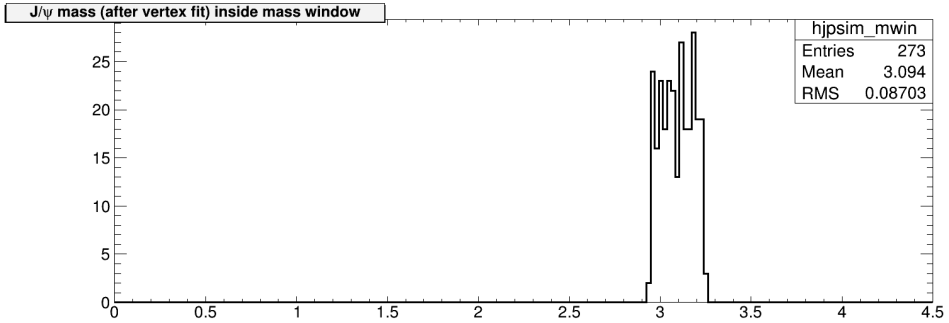


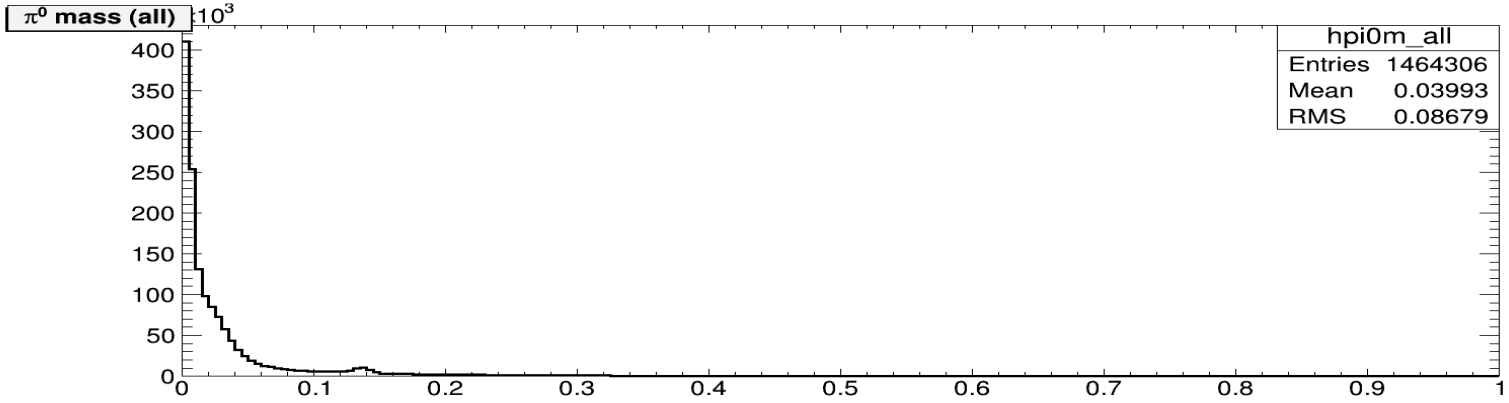


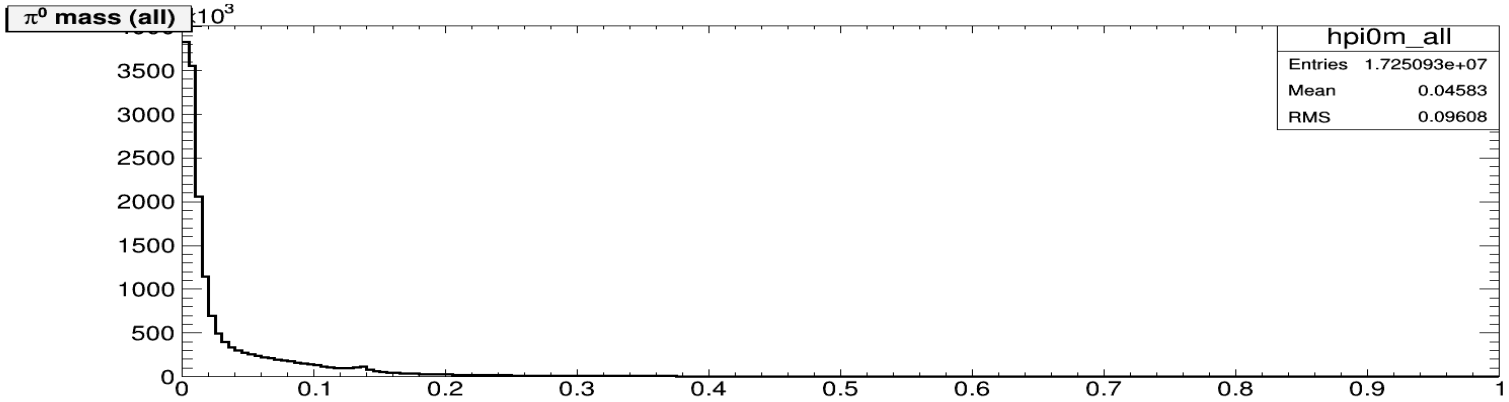




π^0 reconstruction

- **π^o candidates reconstruction:**
  - **select photon candidates,**
  - **combine photon pairs to form π^o-candidates,**
  - **cut on $E_{\gamma 1} + E_{\gamma 2} > M_{\pi 0}$,**
  - **cut on asymmetry of photons energies: $Z_{\gamma\gamma} = |E_{\gamma 1} - E_{\gamma 2}| / (E_{\gamma 1} + E_{\gamma 2}) < 0.7$,**
  - **mass window cut: 110 MeV/c^2 ≤ $M_{\nu\nu}$ ≤ 160 MeV/c^2;**





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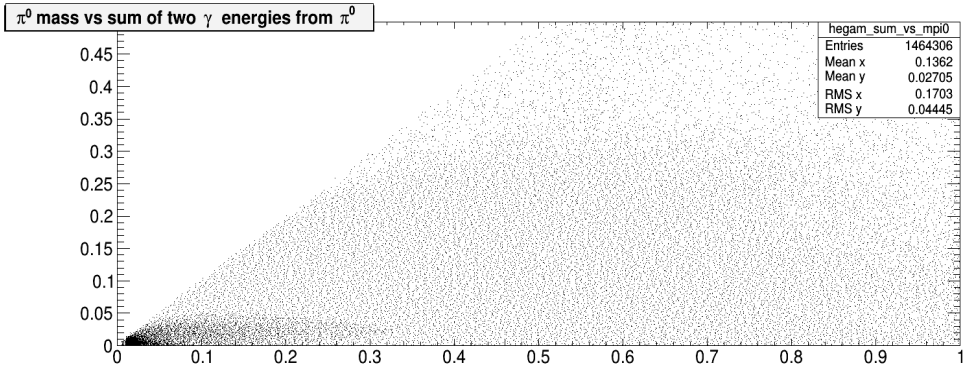

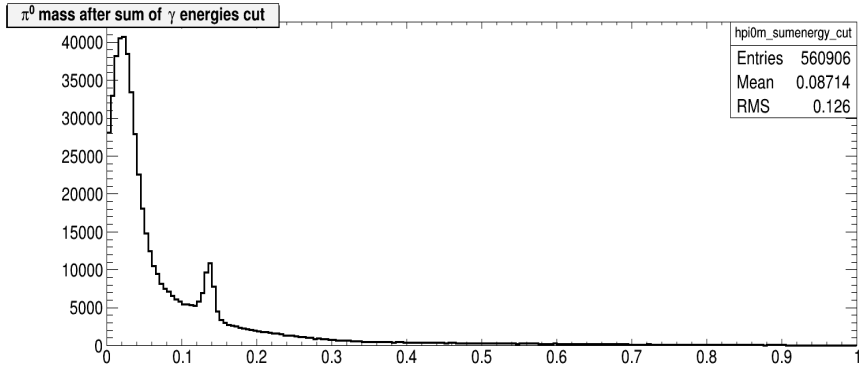

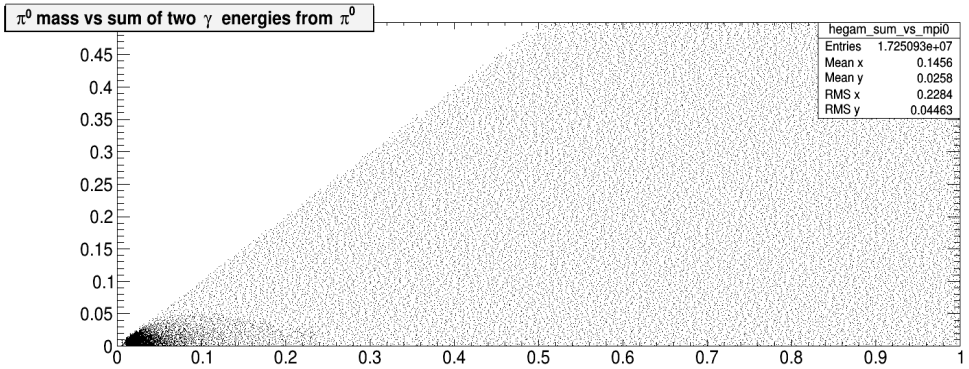

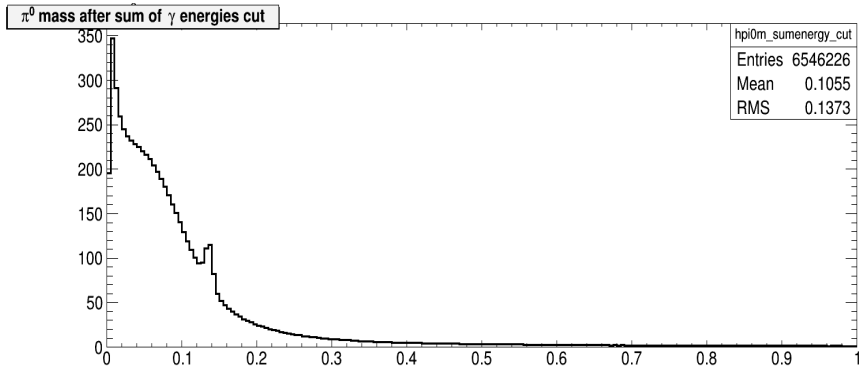

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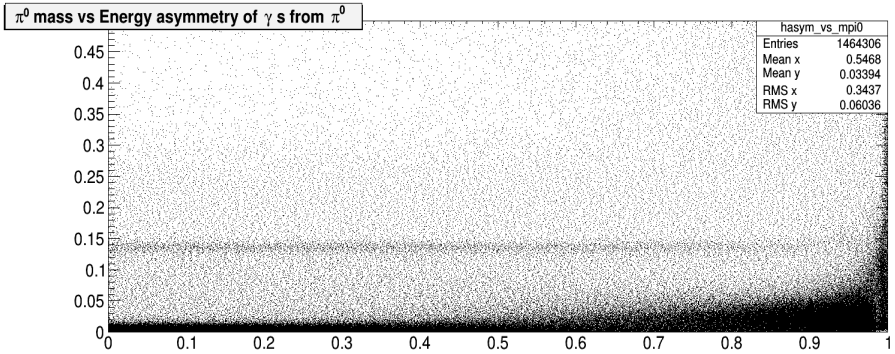

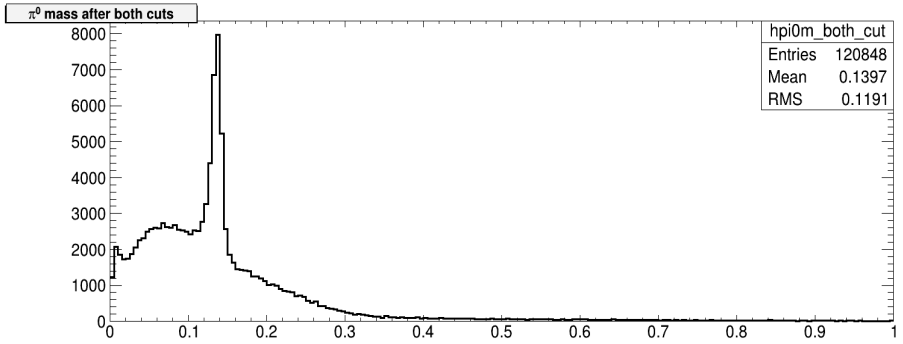

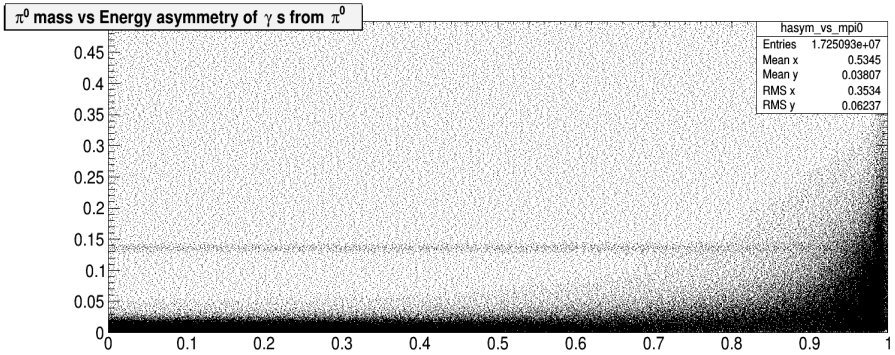

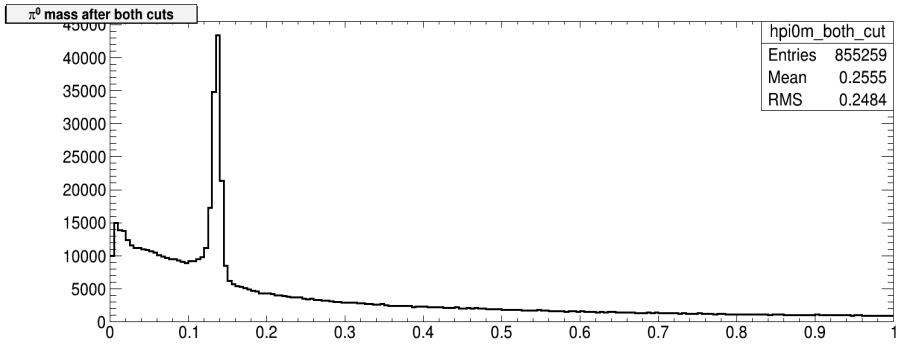

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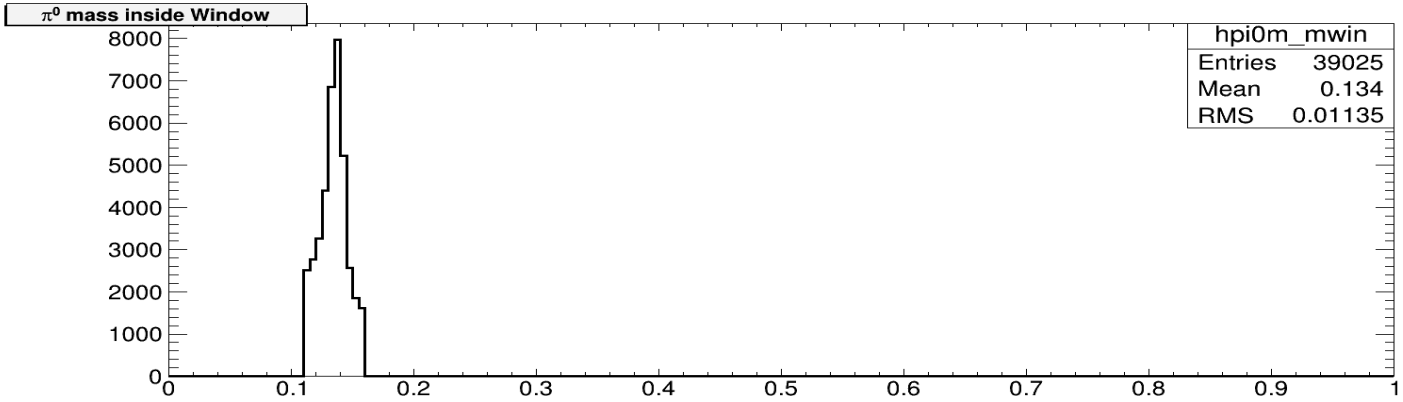
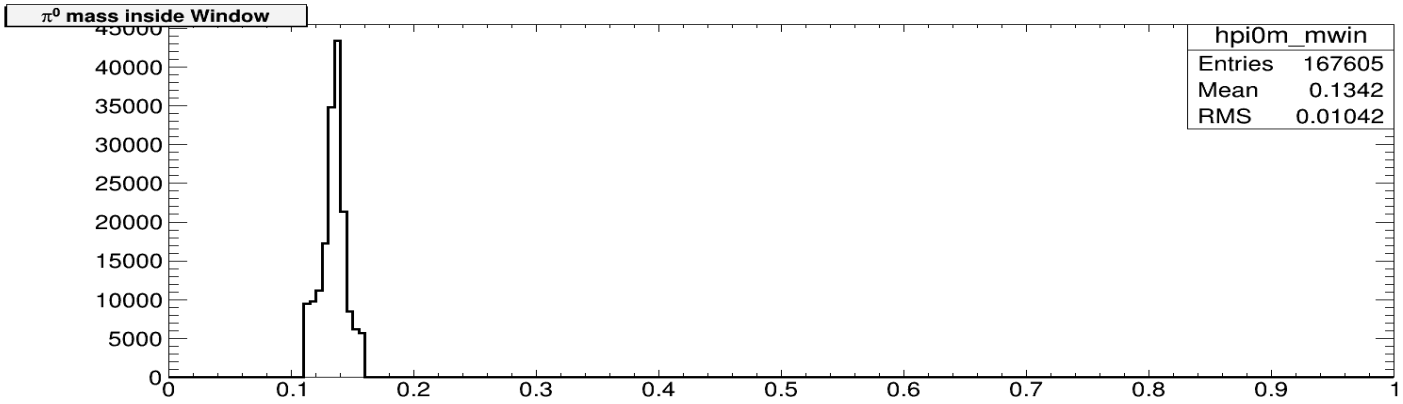
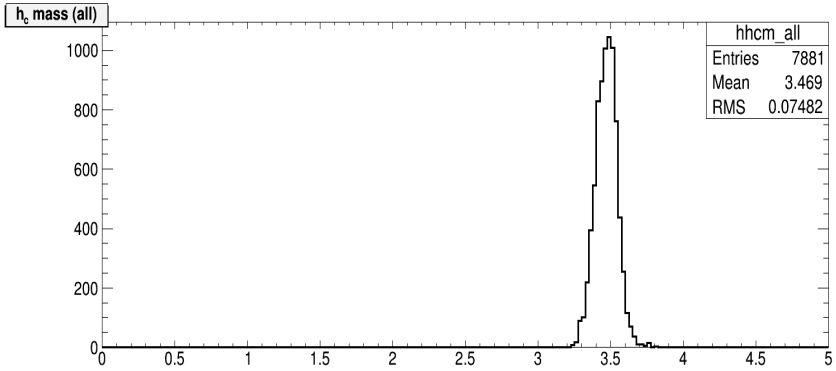
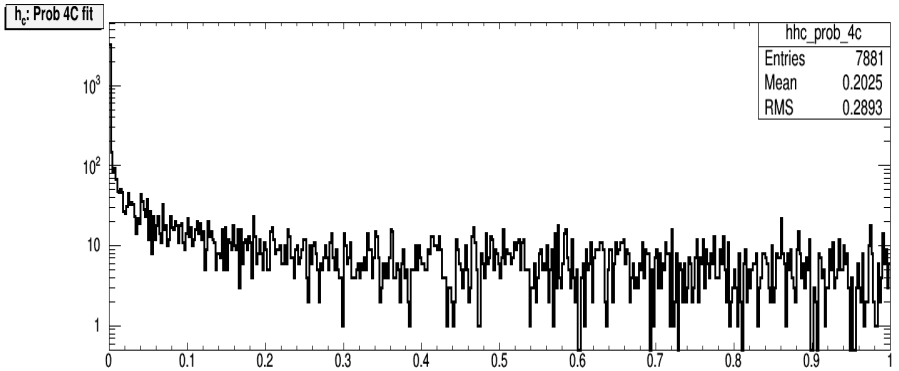


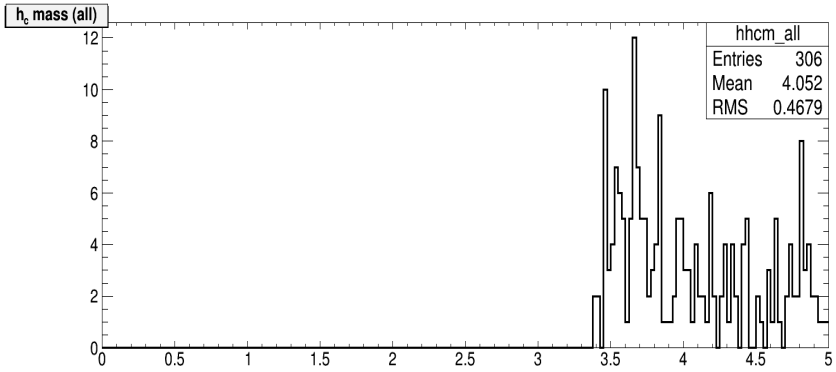


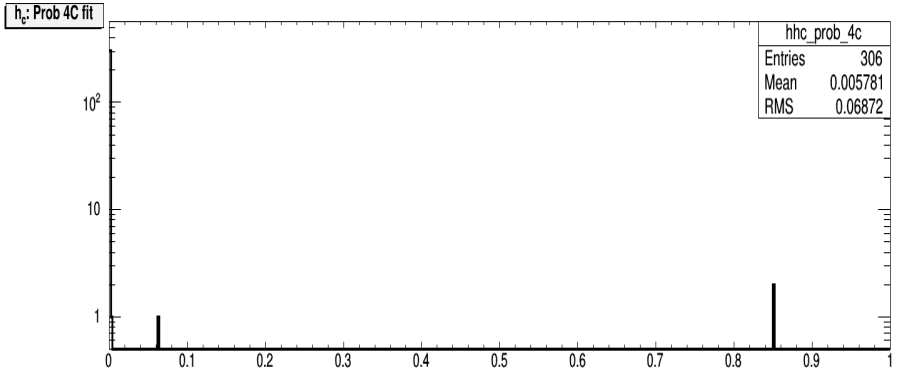
h_c reconstruction

- **h_c candidates reconstruction:**
  - **combine J/ψ and π^o pairs to form h_c-candidates;**
  - **kinematic 4C-fit with initial h_c state 4-momentum constrain**
  - ***$P_{4C} > 0.01$***



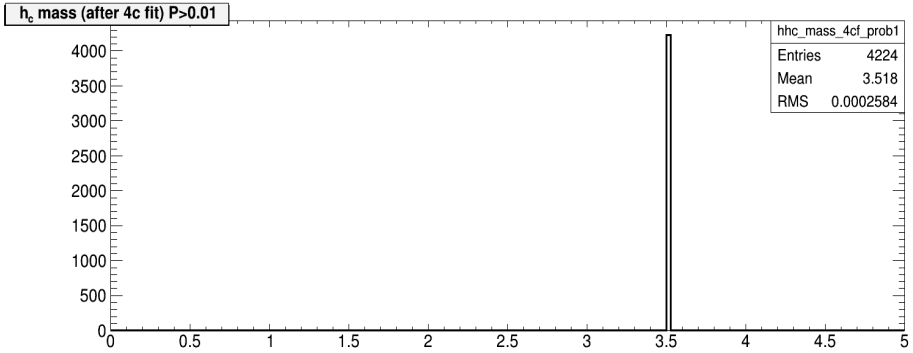


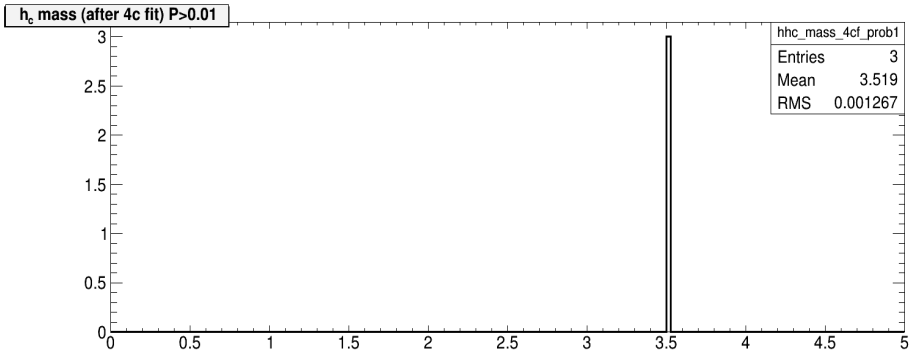




Results

channel	with calorimeter			without calorimeter		
	reconstruction efficiency	N_{ev} per day	S/B	reconstruction efficiency	N_{ev} per day	S/B
$pp \to J/\psi\,\pi^0\pi^0$	21.1 %	$1.5 \cdot 10^5$		17.3 %	$1.2 \cdot 10^5$	
$pp \to \pi^+\pi^-\pi^0\pi^0$	3/100000	2400	65	3/100000	2400	50





- **PANDA is suitable to register $h_c \to J/\psi\pi^o\pi^o$**
- **FSC increases the reconstruction efficiency by 20% with only 0.75% of solid angle**
- **main background $p\bar{p} \to \pi^+\pi^-\pi^o\pi^o$ may be efficiently suppressed**

Plans on h_c simulation

- Update simulation and analysis with latest PandaRoot version
- Correct numbers with respect to realistic Luminosities
- Improve analysis
- In the future investigate processes at higher energies and add more bkg. channels: $p\bar{p} \rightarrow J/\psi\eta\pi^0$…

Simulation plans

- To finish $p\bar{p} \rightarrow h_c \rightarrow J/\psi\pi^o\pi^o$ simulation
- Feasibility studies of X(3872)$\rightarrow J/\psi\rho(\omega) \rightarrow J/\psi$ J/psi + 2(3)π → $\mu^+\mu^-$ (e^+e^-) + 2(3) π – before November
- The same for X(3940) and X(4160) - the end of the year.