

Status of $\bar{p}p \rightarrow \phi\phi\eta$ Analysis with FSIM

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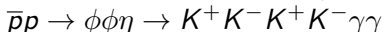
General Considerations

- Search for (heavy) glueballs in mass range 3 – 5 GeV/c²
- Explore mass range in production, followed by detailed investigation in formation
- Assume glueball production cross section of 1 nb (guided by f₀(1500) results from CB@LEAR)
- Glueball width could be small (assume 10 MeV)
- Main background channels (cross section about 1 mb each):
 - $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\eta$
 - $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0$
 - $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\pi^0\pi^0$
- Figure of Merit: Signal >100 events, S/N>1

Overview

- Decay channels to be analyzed:
 $\bar{p}p \rightarrow G\eta, \bar{p}p \rightarrow G\pi^0$ with
 - $G \rightarrow \phi\phi$
 - $G \rightarrow \omega\omega$
 - $G \rightarrow \eta'\eta'$
 - $G \rightarrow KK\pi^0$
- Started with $\phi\phi\eta / \phi\phi\pi^0$ channel at $p_{\bar{p}} = 15 \text{ GeV}/c$
- For comparison: Full simulation of this channel has been performed in 2008 with the BaBar-like analysis software (diploma thesis B.Roth)
- Using scrut14 release, revision #24684

- Generated signal events w/o Glueball resonance:



→ 100.000 events, PHSP

- One of the main background channels: $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\eta$

→ Generated $2 \cdot 10^7$ events (need 100 times more → disk space problematic)

- Choosing best candidate for each event:

→ candidate with minimal

$r = \sqrt{(m(\phi_1) - m(\phi_{\text{PDG}}))^2 + (m(\phi_2) - m(\phi_{\text{PDG}}))^2}$ is selected to reduce combinatoric background

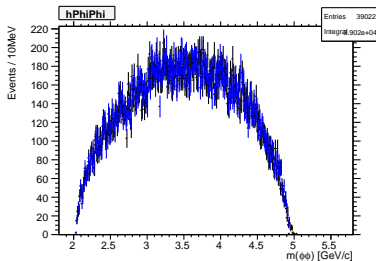
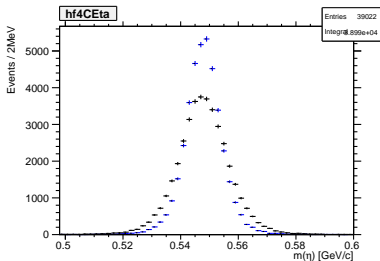
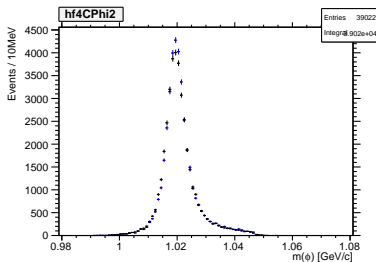
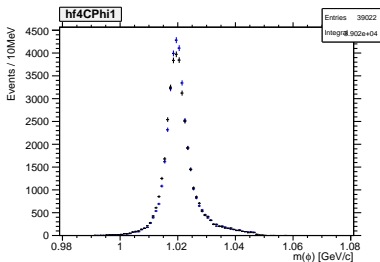
- Some struggles in the beginning, but now 4C kinematic fit works also with neutral particles in the final state

→ Cut on probability of 4C-Fit: $\text{Prob}(\chi^2, 4) > 0.05$

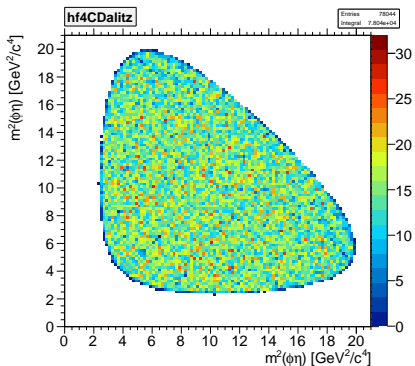
- So far using **full** detector setup and

PidChargedProbability:KaonAllPlus/Minus

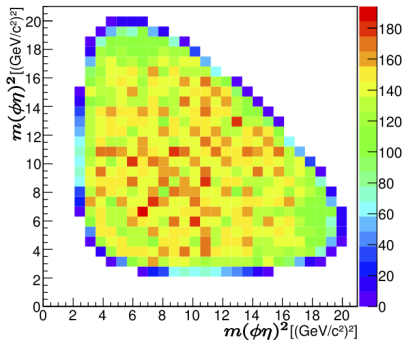
Mass spectra ($p_{\bar{p}} = 15 \text{ GeV}/c$, blue: 4C-Fit, black: unfitted)



Dalitz Plot



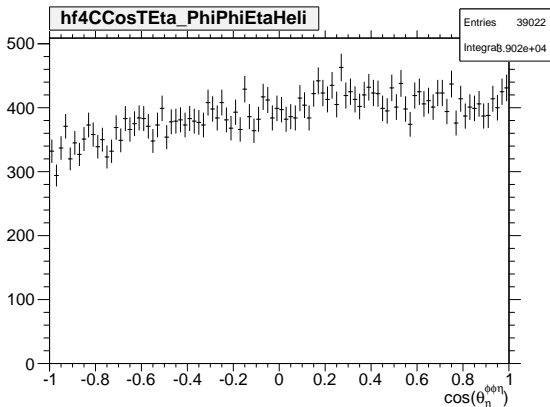
FastSim



Full simulation (diploma thesis
B.Roth)

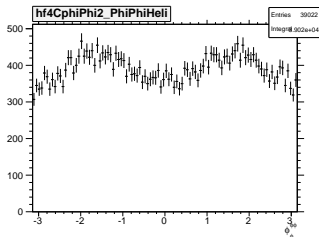
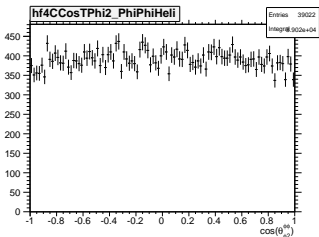
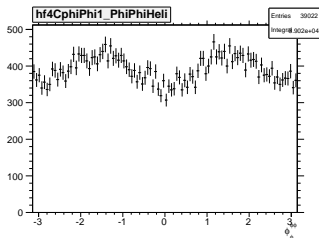
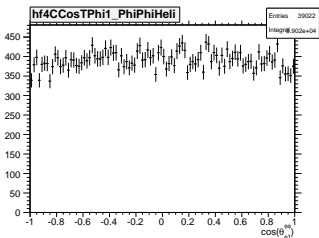
→ Homogeneous population of the dalitz plot also in FastSim

Angular distributions in FastSim



Production angle:
 $\cos(\theta)$ of η in center of mass system

Angular distributions in FastSim



$\cos(\theta)$ and φ angles of ϕ 's in the $\phi\phi$ -helicity frame

Todo...

- Selection efficiency is $\approx 39\%$ comparable to full simulation?
- Cut on probability of 4C-fit leads to **zero** surviving events of background channel $\bar{p}p \rightarrow \pi^+\pi^-\pi^+\pi^-\eta$
- Still no real PID was used \rightarrow have a more detailed look at kinematic kaon/pion separation and PID criteria
- Simultaneous 4C+mass constraint fits (5C) are not supported in PandaRoot (difference to old full analysis!)
- Work to do:
 - Check other strong background channels
 - Simulate different decay modes of a glueball (as listed above)
 - Vary the detector performance, i.e. not using the full $\bar{P}ANDA$ -setup, increasing thresholds, ...