Measurement of the $\eta \to \pi^+\pi^-\pi^0$ decay with WASA-at-COSY in pd and pp interactions

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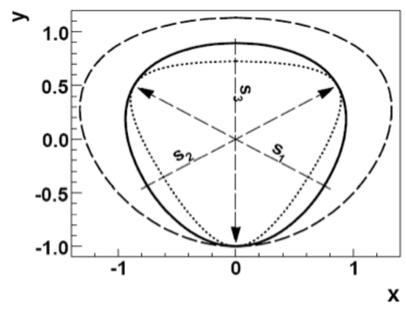
Motivation:

- Test of the Chiral Perturbation Theory (ChPT) by study of the Dalitz Plot density
- Investigation of Charge Conjugation Symmetry
- Constraints for the m_s/m_d and m_u/m_d
- Independent test of KLOE experimental result [1]



$$X = \frac{T_+ - T_-}{\sqrt{3} < T >}$$

$$Y = \frac{T_0}{< T >} - 1$$

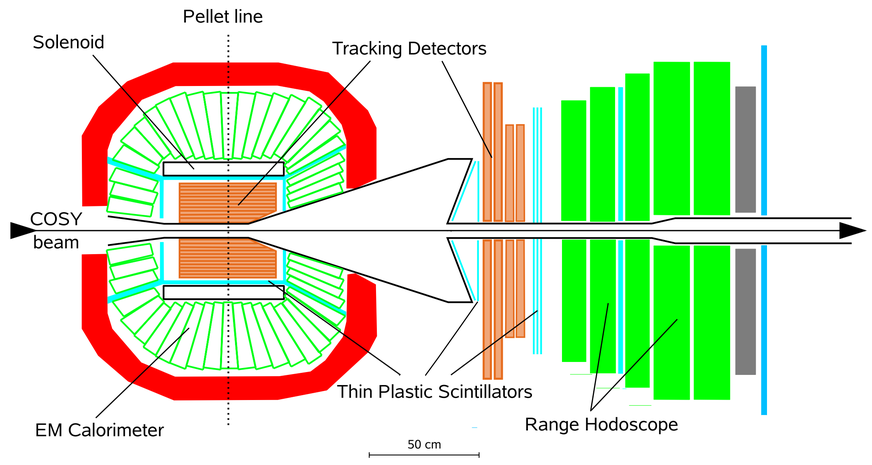
$$|A_{\pi^+\pi^-\pi^0}(X,Y)|^2 \propto 1 + aY + bY^2 + cX + dX^2 + fY^3 + ...$$

Experimental technique:

- Proton beam of COSY accelerator and protons or deuterons from a pellet target
- Conditions for meson production:

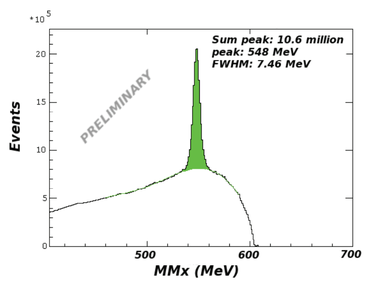
$pd \to {}^3He\,X$ (@1.0 GeV)	$pp \to pp\,X$ (@1.4 GeV)
+ clear trigger - only ^3He	+ large cross section (10 μb)
– low cross section (0.4 μb)	– trigger conditions for decays

- Decay identification and meson tagging by missing and invariant mass techniques

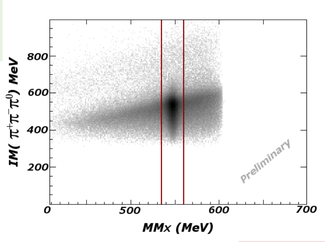


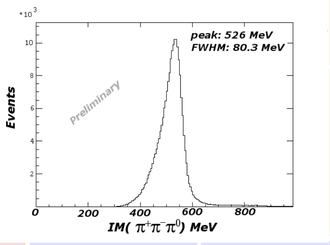
Geometrical acceptance:
Forward Detector for ^3He or p: $3^o < \theta < 18^o$
Central Detector for $\pi^\mp$, $e^\mp$, γ : $20^o < \theta < 169^o$

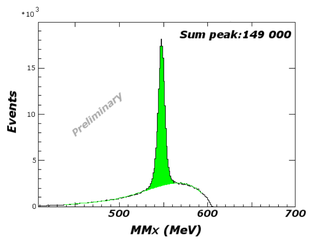
$pd \to {}^3He\,X$ Analysis



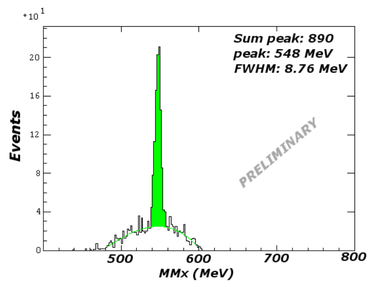
In 2008 approximately 10.6 million η events were detected and saved on disk.







With selection of a positively, a negatively charged track and a neutral π candidate with cut on MM(^{3}He $\pi^+\pi^-$) and MM(^{3}He π^0) approximately 150 000 events are found.



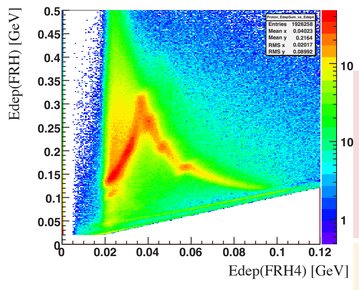
Estimation of η content in Dalitz plot is done by performing a polynomial fit over background region.

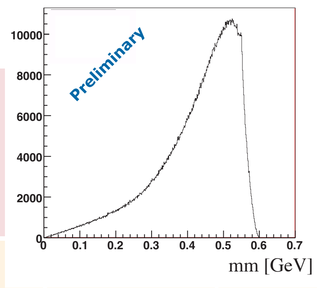
Total projections on X- and Y-axis for experimental data (black) with statistical errors after kinematical fit. For X a quadratic fit has been performed on the experimental values. Red stars represent Monte Carlo weighted with the Current Algebra result.

$pd \to {}^3He\,X$ Outlook

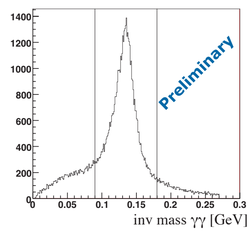
- Improve agreement between Monte Carlo and experiment.
- Improve kinematical fit efficiency.
- Get first estimate of Dalitz Plot parameters.
- Analyze 2009 data with 20 million more ^{3}He saved on disk.

$pp \to pp\,X$ Analysis

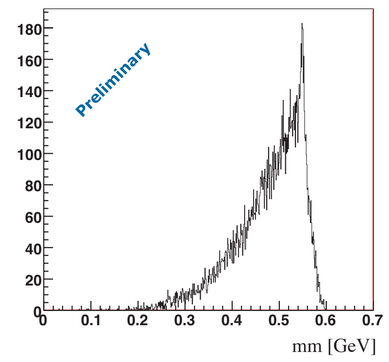




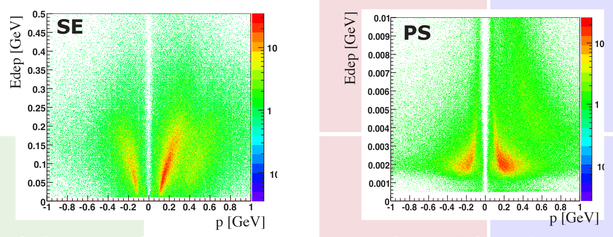
Selection of two charged tracks in the Forward Detector with condition on total energy dep. in FRH larger then 20 MeV



Invariant mass of two gamma quanta registered in CD with cuts to select π^0



Missing mass of two protons after π^0 cut



Selection of charged π^+ and π^- in the MDC with energy deposition in SE and PS

$pp \to pp\,X$ Outlook

- Improvement on calibration and reconstruction.
- Studies of the background from direct $\pi^+\pi^-\pi^0$ production.
- MC studies.
- Getting preliminary estimate of the Dalitz Plot.

Reference:

[1] KLOE collaboration, A.Antonelli *et al.*, *JHEP* **05** (2008) 006, 0801.2642

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