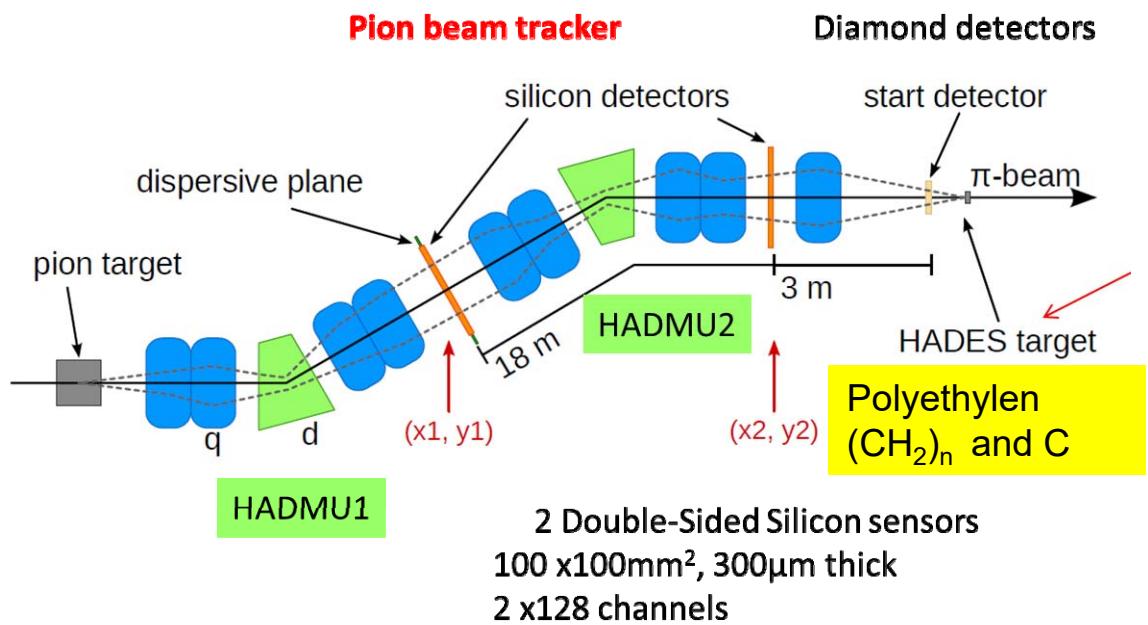
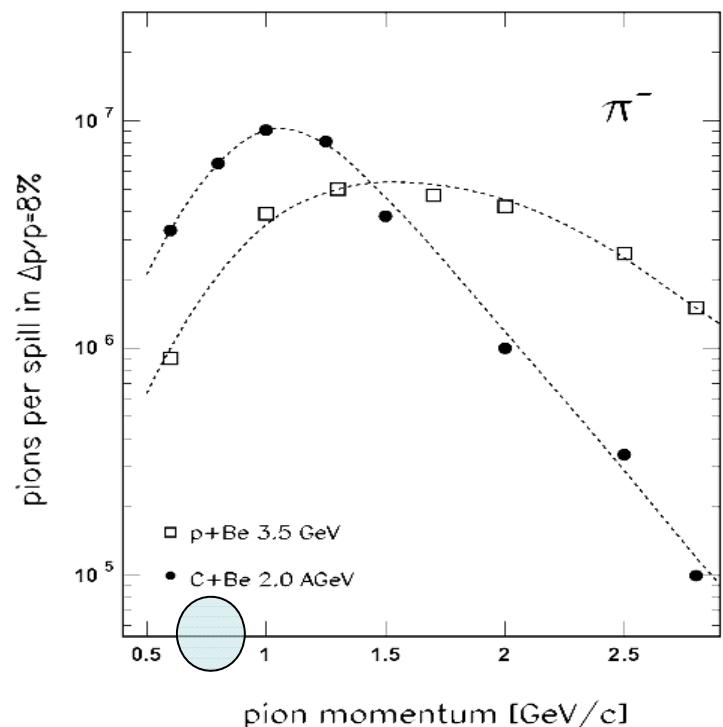


# pion beam in HADES 2014

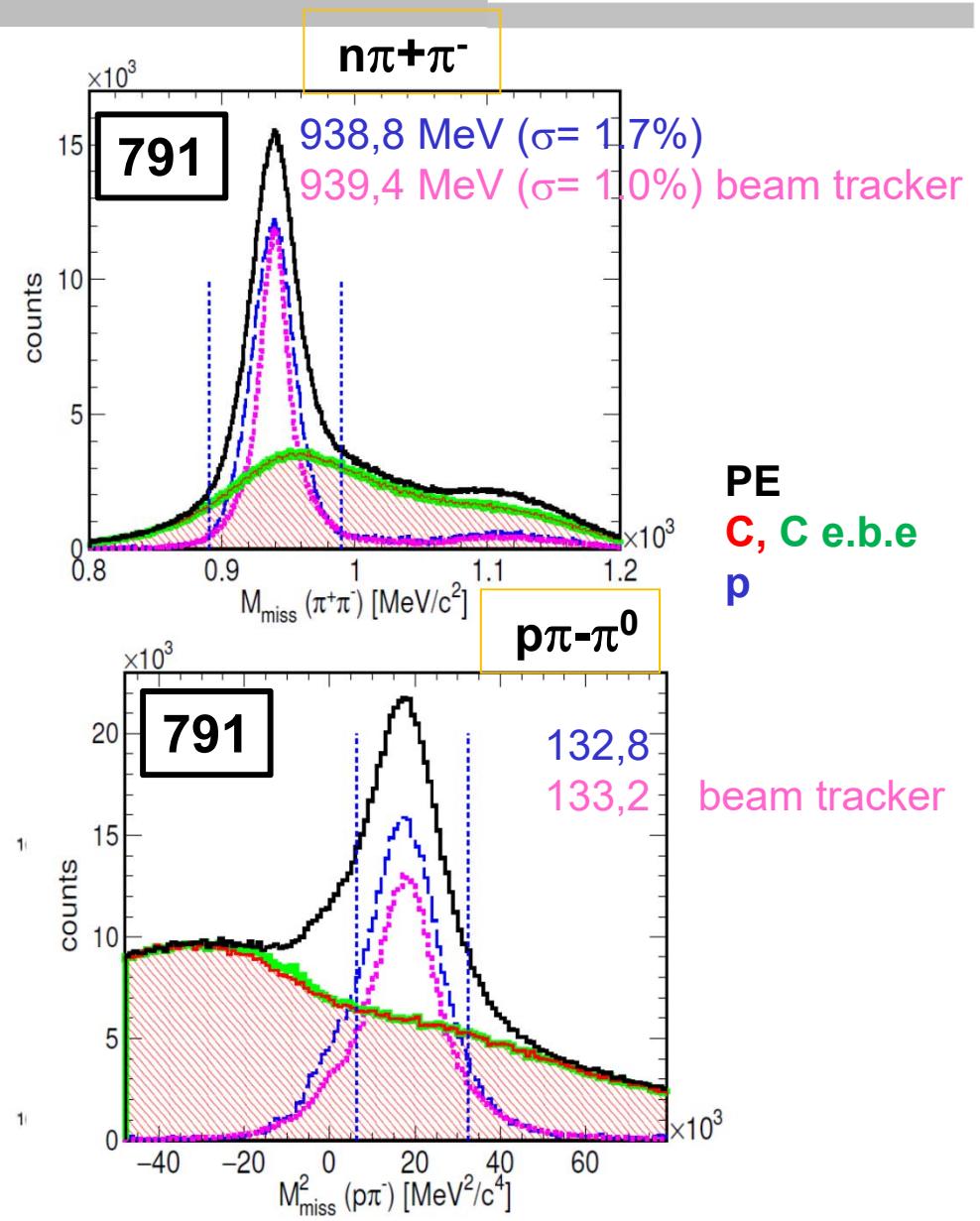
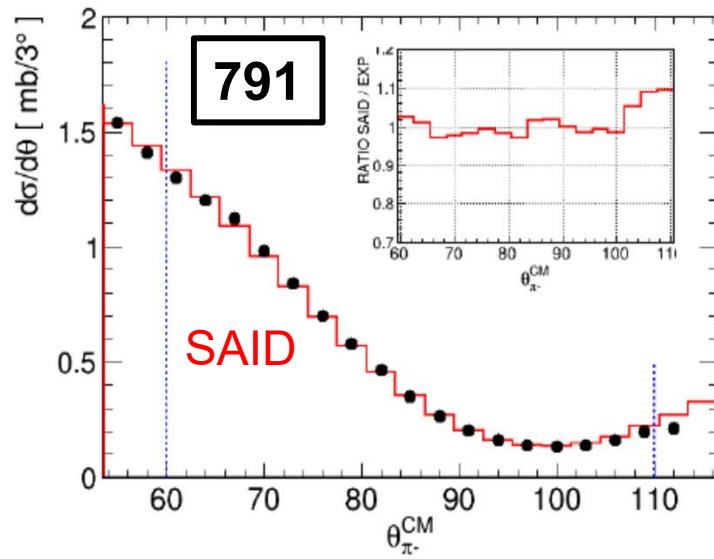
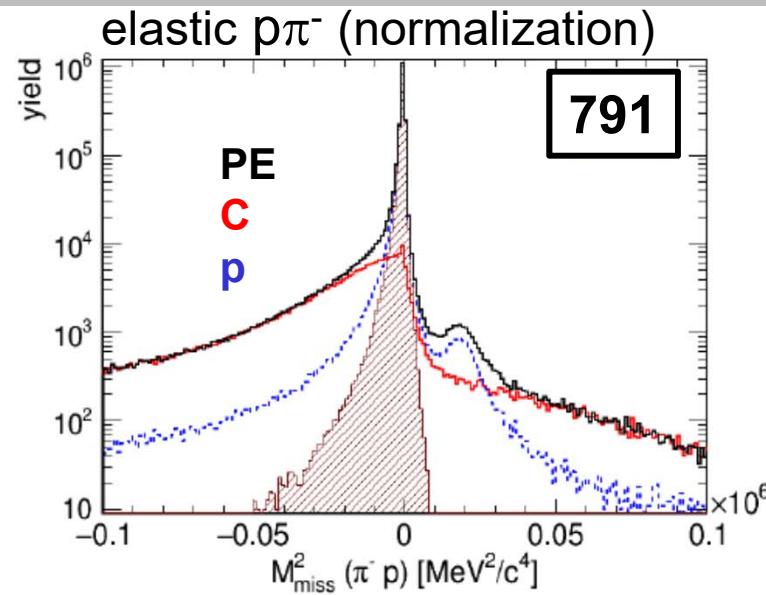
**HADES**



- Reaction  $\text{N} + \text{Be}$   $8-10^* 10^{10}$   $\text{N}_2$  ions/spill (4s)
- secondary  $\pi^-$  with  $I \sim 2-3 10^5/\text{s}$   $\textbf{p} = 654.1, 683.5, 738.9, 791 \text{ MeV/c}$  ( $\sqrt{s} \in 1.46-1.55 \text{ GeV}$ )
- PE ( $\text{CH}_2)_n$  and C targets
- Pion momentum  $\Delta p/p = 2.2\% (\sigma)$ , ~50% acceptance of pion beam line
- in beam tracking system:  $(X_1, X_2/Y_1/Y_2)$  for pion momentum determination :  $\Delta p/p = 0.1\%$
- Investigated channels:  $n \pi^+ \pi^- / p \pi^- \pi^0 / n e^+ e^-$  : off-shell coupling of  $\rho$  to resonance

# Separation of channels

**HADES**



**Baryon data base**

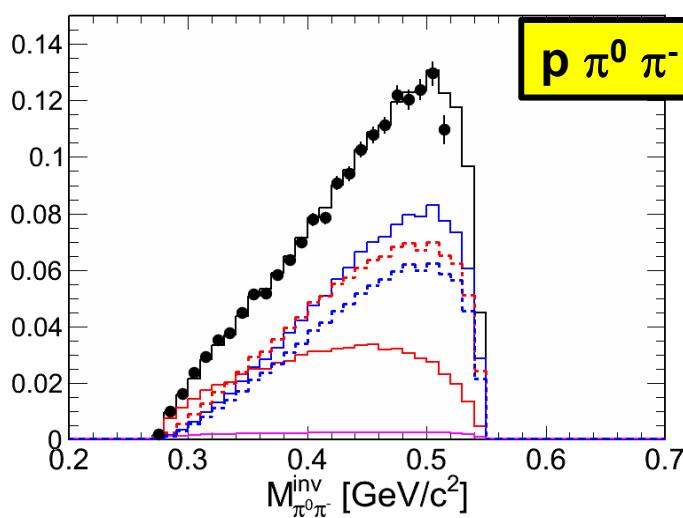
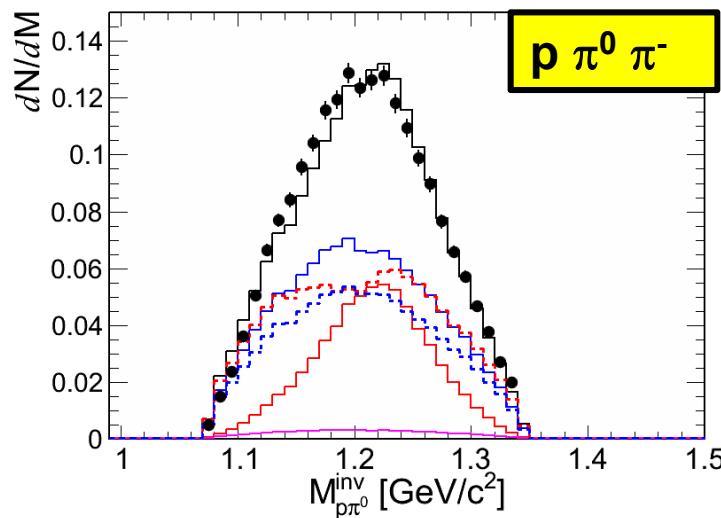
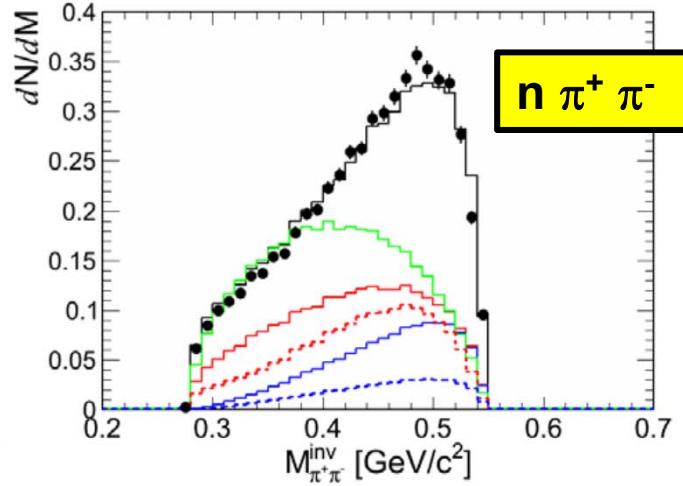
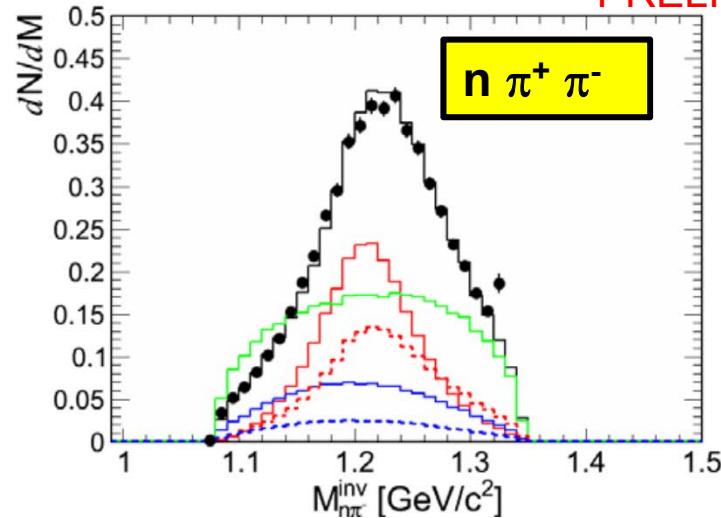
DATA	BG2013-2014	added in BG2014-2015
$\pi N \rightarrow \pi N$ ampl.	<b>SAID or Hoehler energy fixed</b>	
$\gamma p \rightarrow \pi N$	$\frac{d\sigma}{d\Omega}, \Sigma, T, P, E, G, H$	$E, G, T, P$ ( <b>CB-ELSA, CLAS</b> )
$\gamma n \rightarrow \pi N$	$\frac{d\sigma}{d\Omega}, \Sigma, T, P$	$\frac{d\sigma}{d\Omega}$ ( <b>MAMI</b> )
$\gamma n \rightarrow \eta n$	$\frac{d\sigma}{d\Omega}, \Sigma$	$\frac{d\sigma}{d\Omega}$ ( <b>MAMI</b> )
$\gamma p \rightarrow \eta p$	$\frac{d\sigma}{d\Omega}, \Sigma$	$T, P, H, E$ ( <b>CB-ELSA</b> )
$\gamma p \rightarrow \eta' p$		$\frac{d\sigma}{d\Omega}, \Sigma$
$\gamma p \rightarrow K^+ \Lambda$	$\frac{d\sigma}{d\Omega}, \Sigma, P, T, C_x, C_z, O_{x'}, O_{z'}$	$\Sigma, P, T, O_x, O_z$ ( <b>CLAS</b> )
$\gamma p \rightarrow K^+ \Sigma^0$	$\frac{d\sigma}{d\Omega}, \Sigma, P, C_x, C_z$	$\Sigma, P, T, O_x, O_z$ ( <b>CLAS</b> )
$\gamma p \rightarrow K^0 \Sigma^+$	$\frac{d\sigma}{d\Omega}, \Sigma, P$	
$\pi^- p \rightarrow \eta n$	$\frac{d\sigma}{d\Omega}$	
$\pi^- p \rightarrow K^0 \Lambda$	$\frac{d\sigma}{d\Omega}, P, \beta$	
$\pi^- p \rightarrow K^0 \Sigma^0$	$\frac{d\sigma}{d\Omega}, P$ ( $K^0 \Sigma^0$ )	$\frac{d\sigma}{d\Omega}$ ( $K^+ \Sigma^-$ )
$\pi^+ p \rightarrow K^+ \Sigma^+$	$\frac{d\sigma}{d\Omega}, P, \beta$	
$\pi^- p \rightarrow \pi^0 \pi^0 n$	$\frac{d\sigma}{d\Omega}$ ( <b>Crystal Ball</b> )	
$\pi^- p \rightarrow \pi^+ \pi^- n$		$\frac{d\sigma}{d\Omega}$ ( <b>HADES</b> )
$\gamma p \rightarrow \pi^0 \pi^0 p$	$\frac{d\sigma}{d\Omega}, \Sigma, E, I_c, I_s$	<b>CB-ELSA, MAMI</b>
$\gamma p \rightarrow \pi^0 \eta p$	$\frac{d\sigma}{d\Omega}, \Sigma, I_c, I_s$	$\frac{d\sigma}{d\Omega}, I_c, I_s$ ( <b>CLAS</b> )
$\gamma p \rightarrow \pi^+ \pi^- p$		
$\gamma p \rightarrow \omega p$		$\frac{d\sigma}{d\Omega}, \Sigma, \rho_{ij}^0, \rho_{ij}^1, \rho_{ij}^2, E, G$ ( <b>CB-ELSA</b> )
$\gamma p \rightarrow K^*(890)\Lambda$		$\frac{d\sigma}{d\Omega}, \Sigma, \rho_{ij}^0$ ( <b>CLAS</b> )

Included  
in fit

# Invariant masses

**HADES**

PRELIMINARY



683.5 MeV/c

acceptance  
corrected

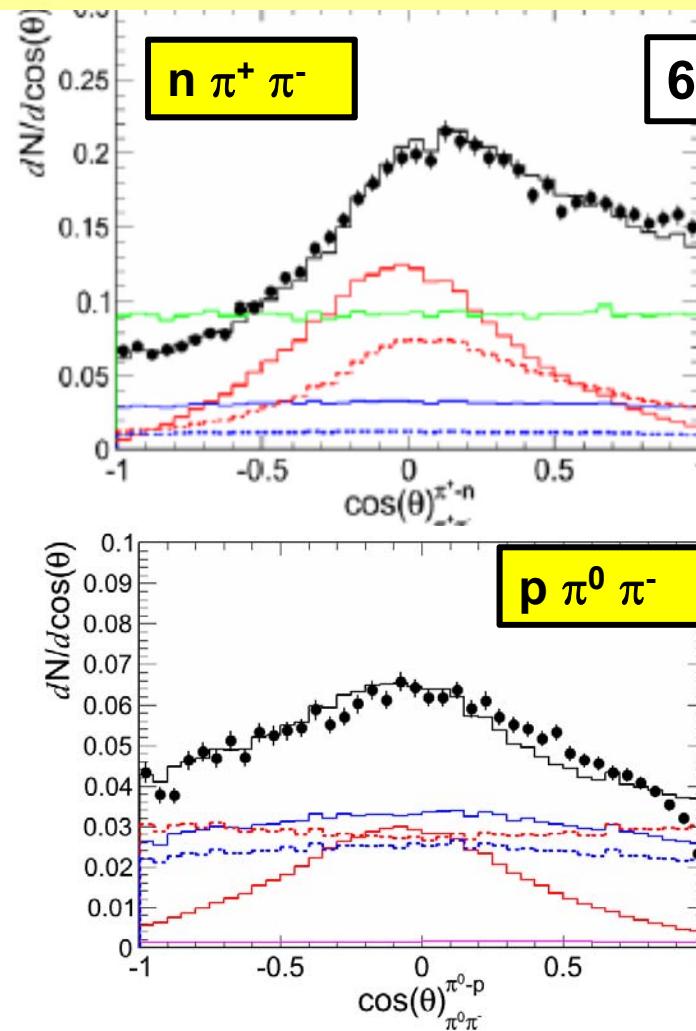
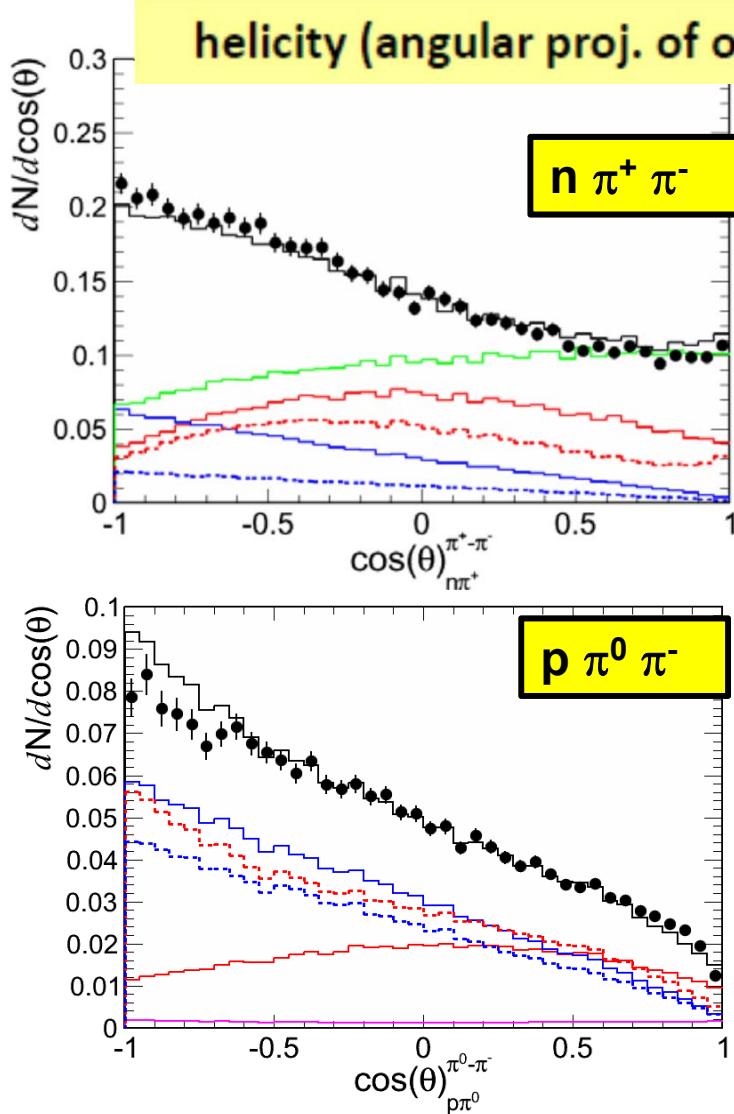
$\sigma N$ ,  $\Delta\pi$ ,  $\rho N$

$\rho N$ ,  $\Delta\pi$

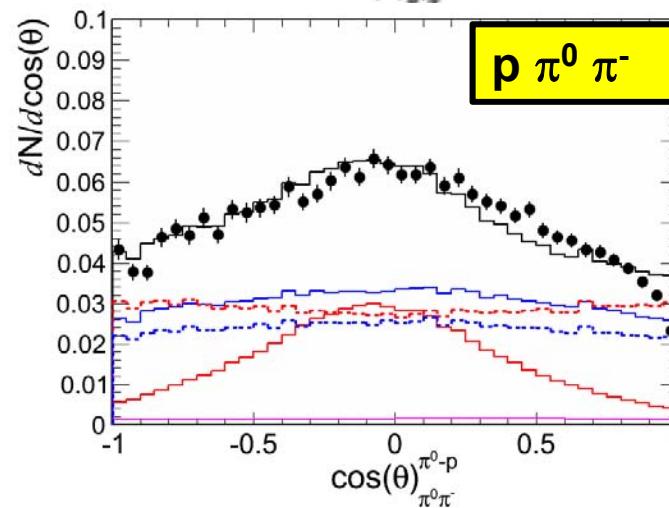
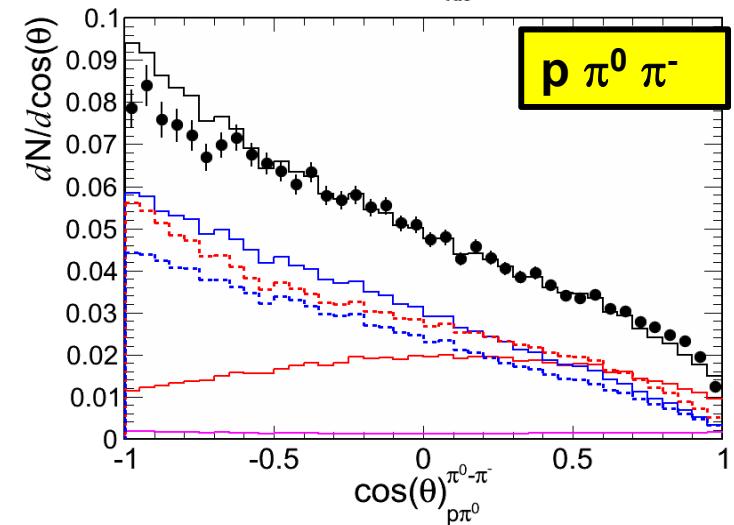
—  $N(1440)\pi$  —  $\sigma N(939)$  —  $\Delta(1232)\pi$  —  $\rho N(939)$  | - - -  $N(1520)$  - - -  $\rho N$

# Angular distributions

HADES



acceptance  
corrected

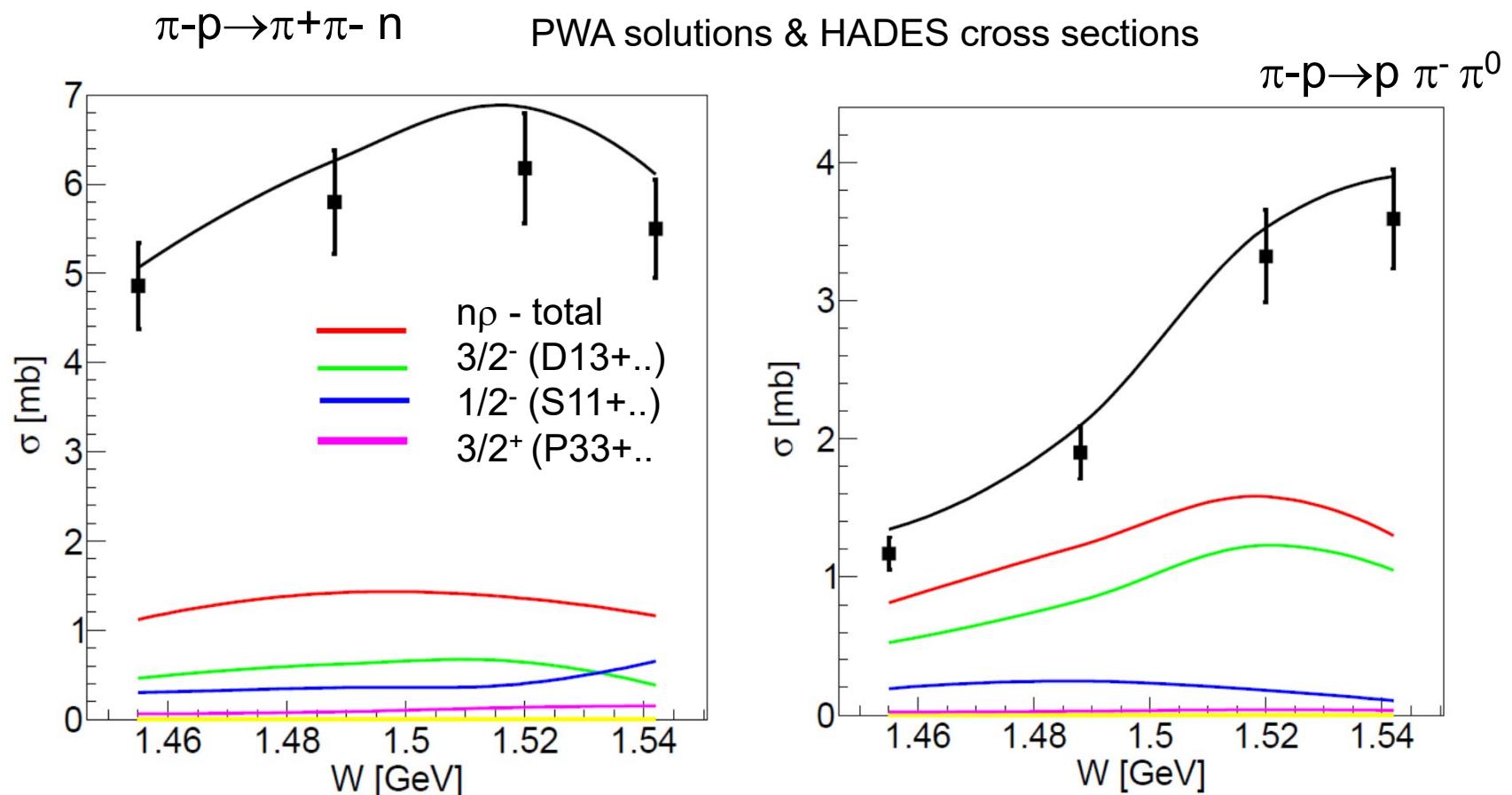


— N(1440) $\pi$  —  $\sigma$ N(939) —  $\Delta(1232)\pi$  —  $\rho$ N(939) | - - - N(1520) - - -  $\rho$ N

# Total cross sections

HADES

PRELIMINARY



Total  $\rho$  cross section:

$$\sigma_\rho = 1.3 \text{ mb (PWA solutions)} \quad \text{BR } D_{13}(1520) \rightarrow N\rho \sim 12 \pm 2 \%$$