Status of p+p@3.5 GeV and p+Nb@3.5 GeV data analyses

Krzysztof Nowakowski

Two experiments

- pNb @3.5GeV
  - Sep 18 - Oct 20, 2008
  - $7.7 \cdot 10^9$ events
  - Multiplicity ≥ 3 trigger
- pp @3.5GeV
  - Apr 13 - Apr 30, 2007
  - $3 \cdot 10^9$ events
  - Multiplicity ≥ 3 trigger

A new DST was created. Its contain new leptons' reconstruction algorithm.

Already performed analysis

1. pp@ 3.5 GeV
   - ***"Inclusive Lambda production in proton-proton collisions at 3.5 GeV",* Phys. Rev. C 95, 015207**
   - *"Partial Wave Analysis of the Reaction p(3.5GeV)+p → pK+Λ to Search for the "ppK" Bound State"*, Phys.Lett. B742 (2015) 242-248
   - *"Lambda hyperon production and polarization in collisions of p(3.5 GeV)+Nb"*, Eur.Phys.J. A50 (2014) 81
   - *"Baryonic resonances close to the K¯N threshold: the case of Λ(1405) in pp collisions",* Phys.Rev. C87 (2013) 025201
   - *"Production of Sigma+- pi-+ pK+ in p+p reactions at 3.5 GeV beam energy"*, Nucl.Phys. A881 (2012) 178-186
   - *"Baryonic resonances close to the Kbar-N threshold: the case of Sigma(1385)^+ in pp collisions"*, Phys.Rev. C85 (2012) 035203
2. pNb@ 3.5 Gev
   - ***"Σ0 production in proton nucleus collisions near threshold",* Phys.Lett. B781 (2018) 735-740**
   - *"The Lambda-p interaction studied via femtoscopy in p + Nb reactions at sqrt(sNN)=3.18 GeV"* Phys.Rev. C94 (2016) no.2, 025201
   - *"Two-particle correlation measurements in p+Nb reactions √s(NN) = 3.18 GeV"*, J.Phys.Conf.Ser. 668 (2016) no.1, 012037
   - ***"Subthreshold Ξ- Production in Collisions of p(3.5..GeV)+Nb"*, Phys.Rev.Lett. 114 (2015) 212301**

Focus of present analysis

not looked at previously

Interesting final states:

- p π^- - Λ (1116) candidates
- Λ π^+ π^- - Λ (1520) candidates
- Λ π^+ - Σ^+(1385) candidates
- Λ e^+ e^- - Λ (1520) candidates
- Λ π^- - Ξ (1322) candidates

Ξ^- DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\Lambda\pi^-$	(99.887 ± 0.035) %	
Γ_2	$\Sigma^-\gamma$	$(1.27 \pm 0.23) \times 10^{-4}$	
Γ_3	$\Lambda e^-\overline{\nu}_e$	$(5.63 \pm 0.31) \times 10^{-4}$	
Γ_4	$\Lambda\mu^-\overline{\nu}_\mu$	$(3.5\ ^{+3.5}_{-2.2}) \times 10^{-4}$	
Γ_5	$\Sigma^0 e^-\overline{\nu}_e$	$(8.7 \pm 1.7) \times 10^{-5}$	
Γ_6	$\Sigma^0\mu^-\overline{\nu}_\mu$	$< 8 \times 10^{-4}$	90%
Γ_7	$\Xi^0 e^-\overline{\nu}_e$	$< 2.3 \times 10^{-3}$	90%

Λ(1520) DECAY MODES

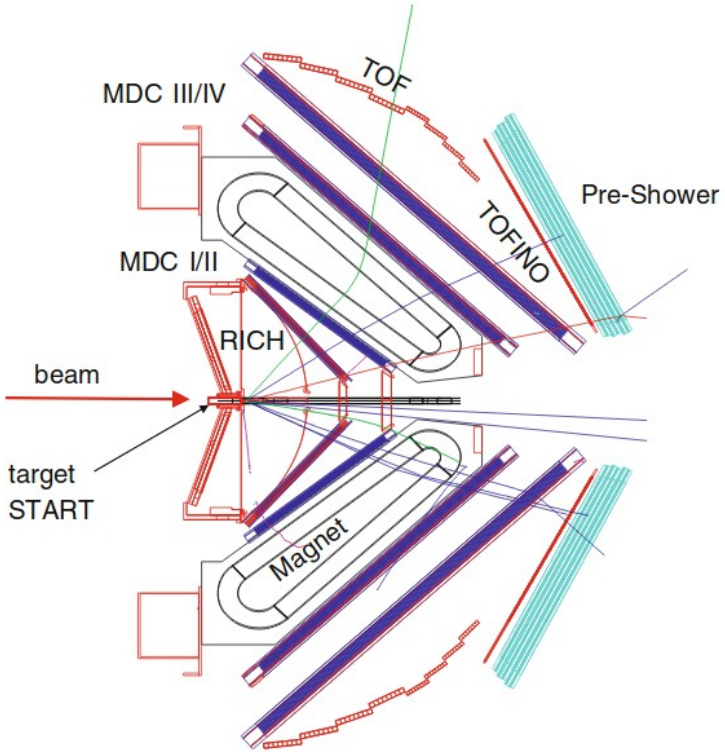
	Mode	Fraction (Γ_i/Γ)
Γ_1	$N\overline{K}$	(45 ±1) %
Γ_2	$\Sigma\pi$	(42 ±1) %
Γ_3	$\Lambda\pi\pi$	(10 ±1) %
Γ_4	$\Sigma(1385)\pi$, *S*-wave	
Γ_5	$\Sigma(1385)\pi$, *D*-wave	
Γ_6	$\Sigma(1385)\pi$	
Γ_7	$\Sigma(1385)\pi(\rightarrow \Lambda\pi\pi)$	
Γ_8	$\Lambda(\pi\pi)$*s*-wave	
Γ_9	$\Sigma\pi\pi$	(0.9 ±0.1) %
Γ_{10}	$\Lambda\gamma$	(0.85±0.15) %
Γ_{11}	$\Sigma^0\gamma$	

Σ(1385) DECAY MODES

	Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1	$\Lambda\pi$	(87.0 ±1.5) %	
Γ_2	$\Sigma\pi$	(11.7 ±1.5) %	
Γ_3	$\Lambda\gamma$	$(1.25^{+0.13}_{-0.12})$ %	
Γ_4	$\Sigma^+\gamma$	$(7.0 \pm 1.7) \times 10^{-3}$	
Γ_5	$\Sigma^-\gamma$	$< 2.4 \times 10^{-4}$	90%
Γ_6	$N\overline{K}$		

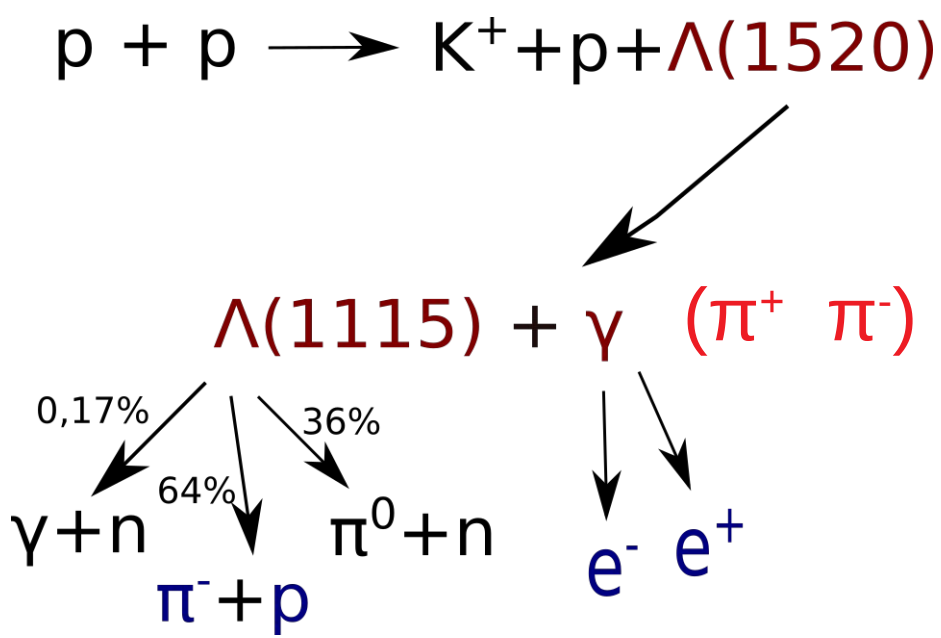
M. Tanabashi et al. (Particle Data Group), Phys. Rev. D 98, 030001 (2018)

Hyperons – identification in HADES

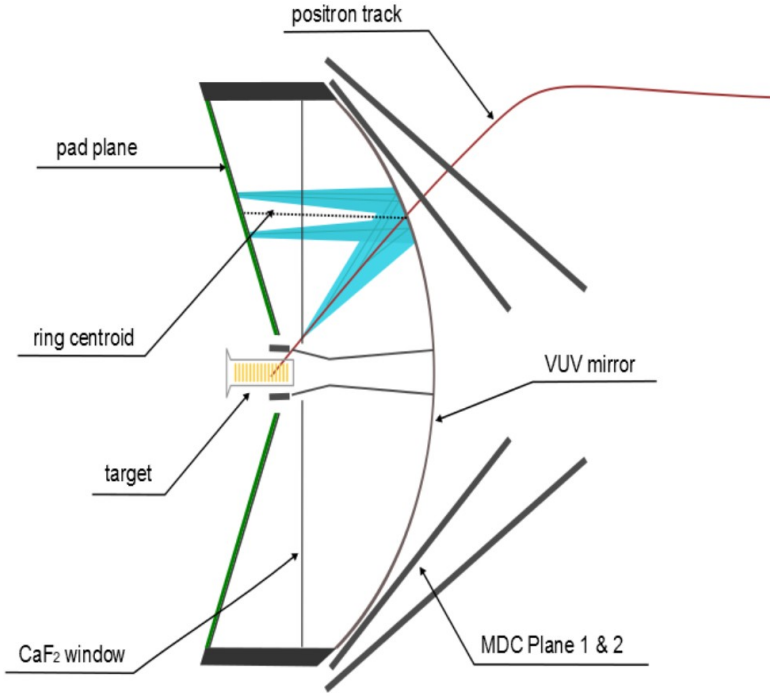


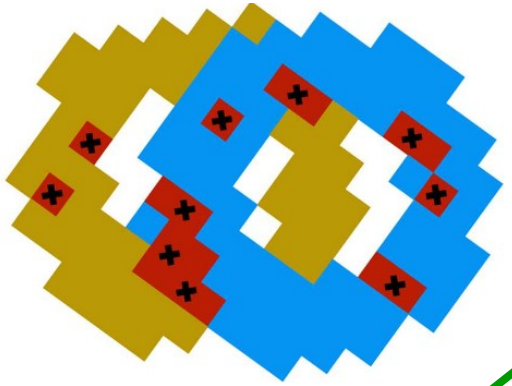
Eur. Phys. J. A 41, 243–277 (2009)

On example of L(1520)

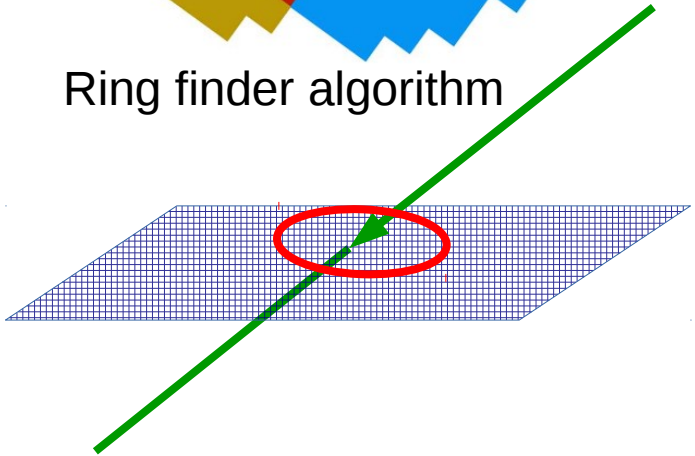


Two ways of lepton identification





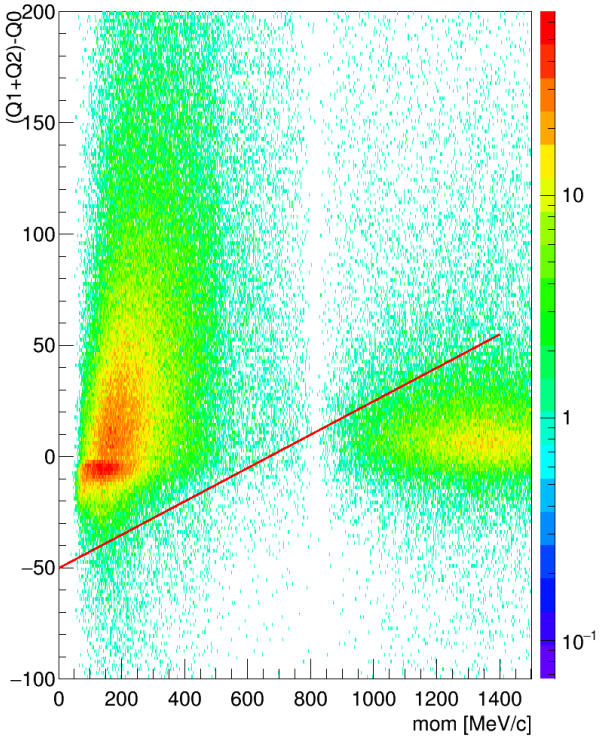
Ring finder algorithm



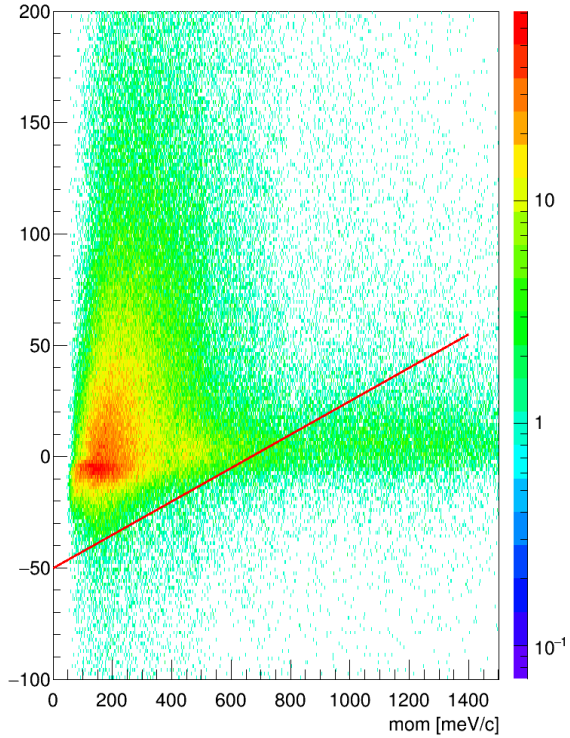
Back tracking - done by. P. Sellheim

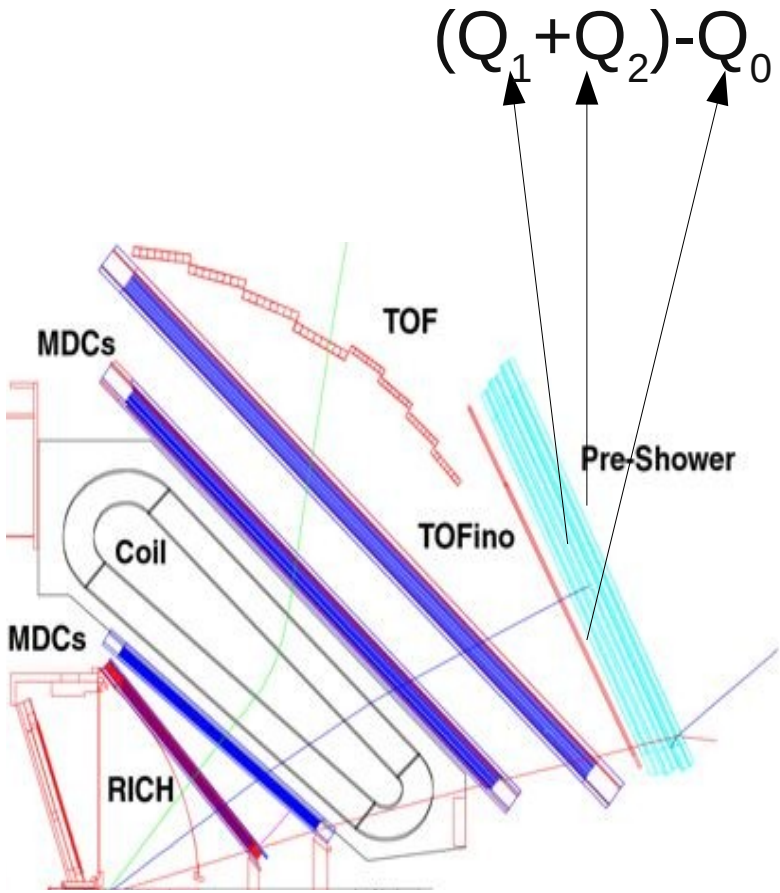
Lepton identification

RF

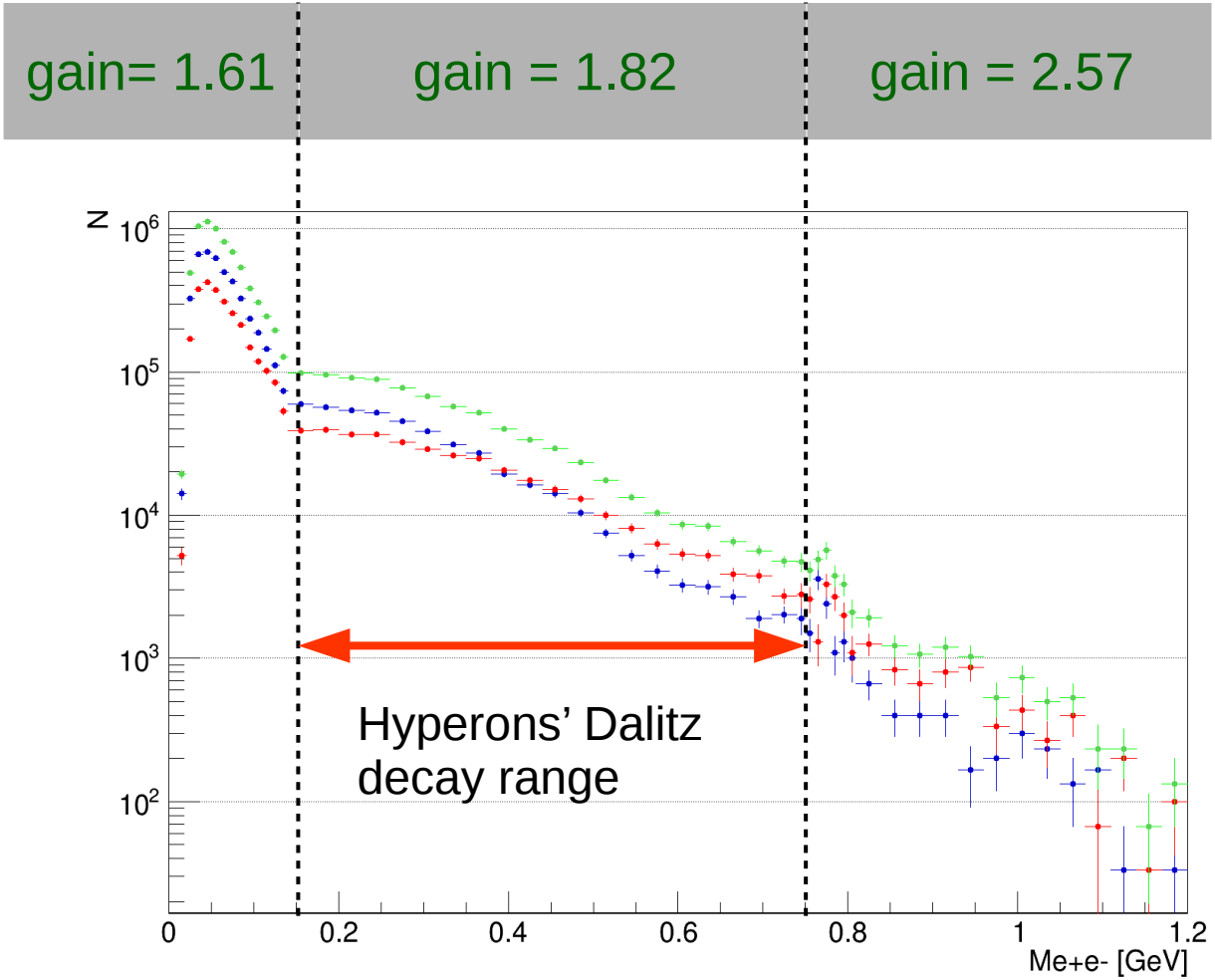


BT





Results for p Nb @ 3.5 GeV



Ring Finder algorithm

Profit – signals from BT not visible by RF

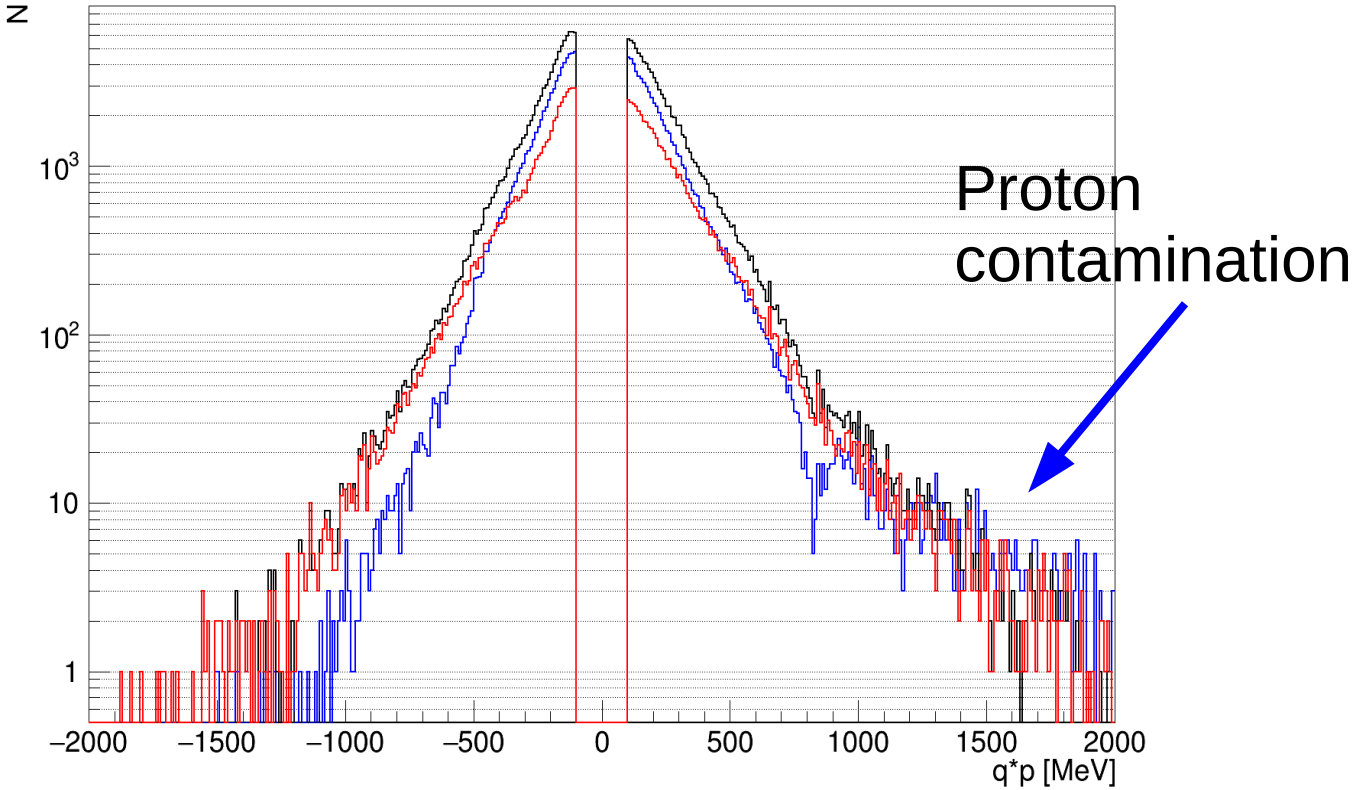
All possible candidates

Lepton purity

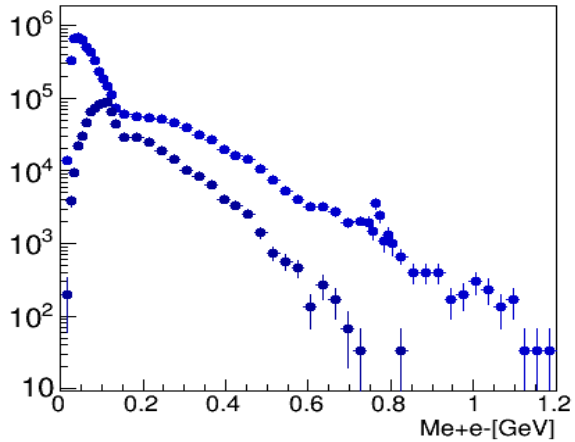
BT

RF

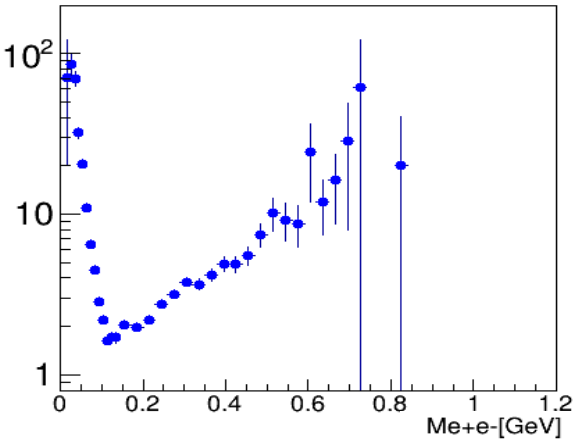
“profit”



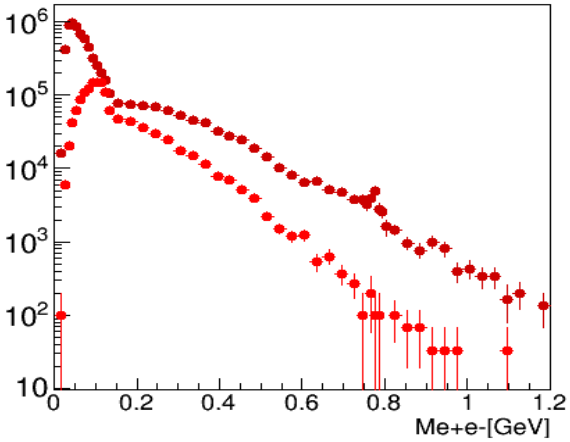
RF



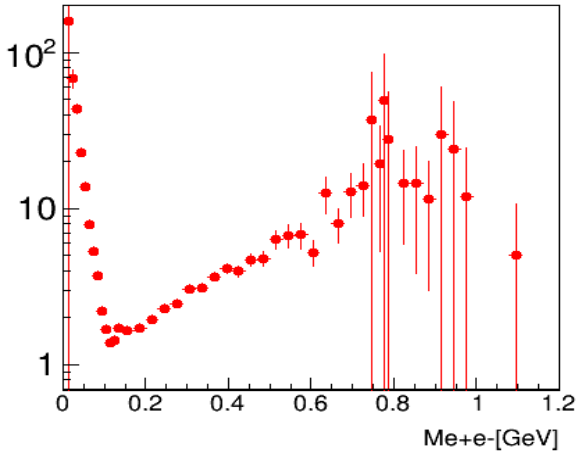
signal to background ratio



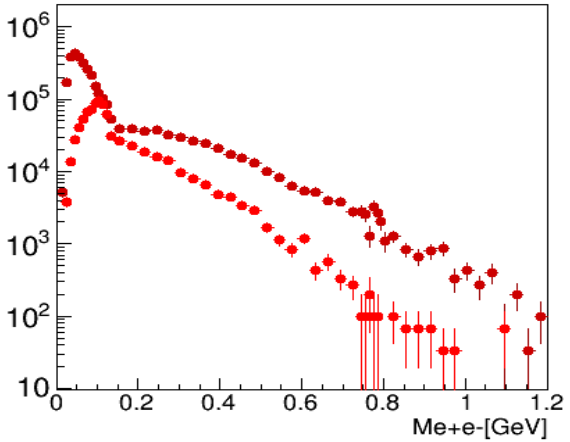
BT



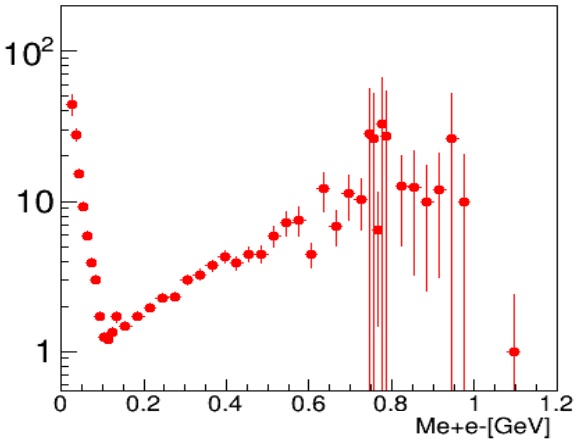
signal to background ratio



“profit”

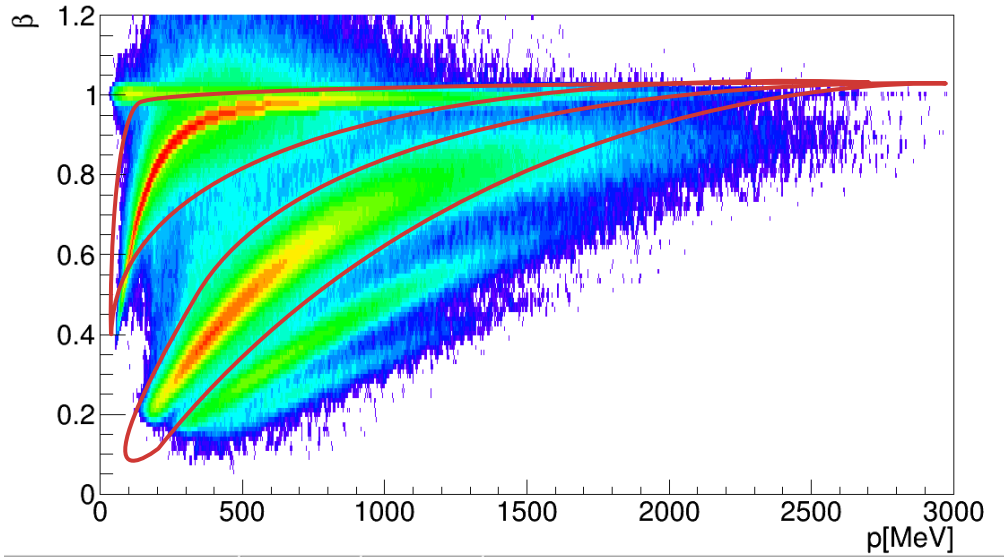


signal to background ratio

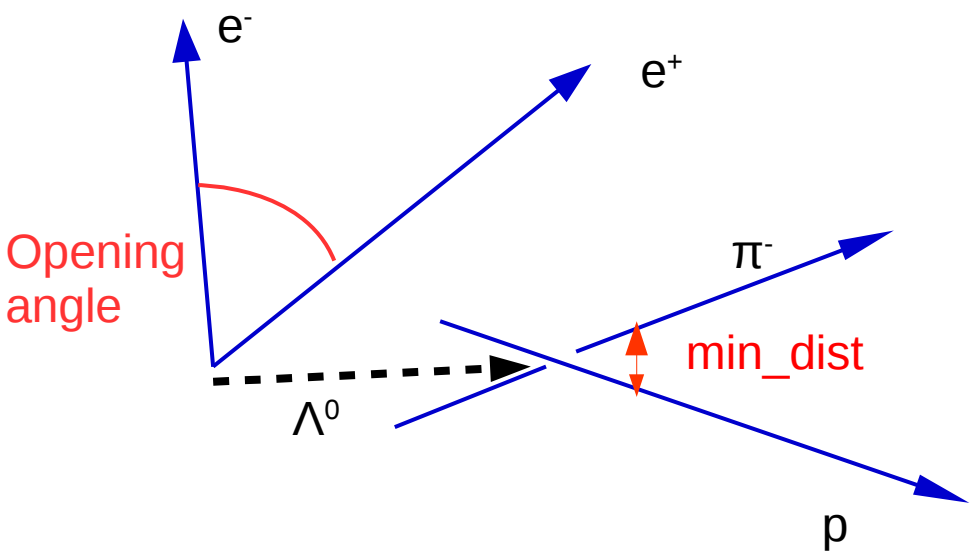


Hadrons analysis

(example for pNb data)



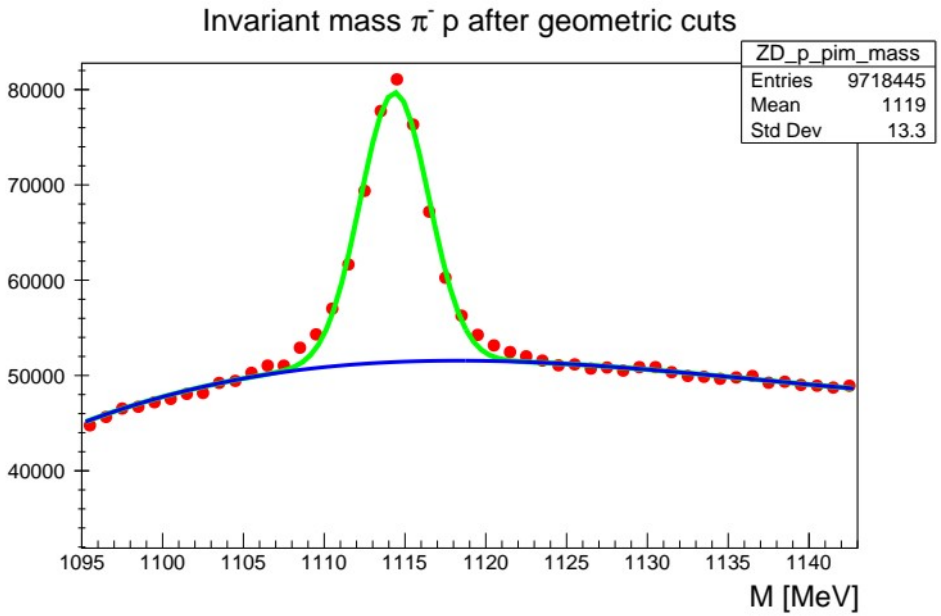
Protons: 650 MeV < M < 1127 MeV
Pions 40 MeV < M < 240 MeV



	min_dist [mm]	min_z [mm]	Target position [mm]
pp	15	20	[-65,-15]
pNb	30	4	[-55,-5]

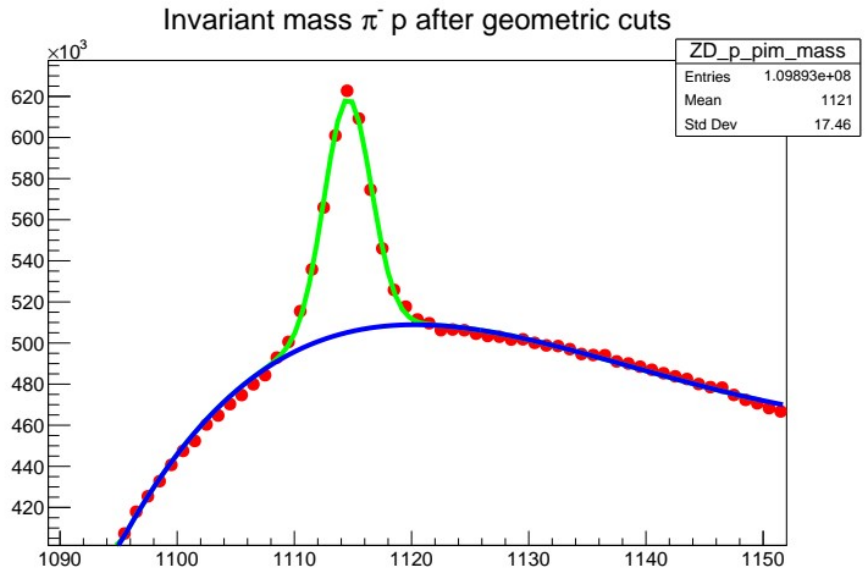
Present status of the Λ(1116) analysis

pp



$N_\Lambda = (147) \times 10^3 \qquad S/B = 0.28$

pNb



$N_\Lambda = 562 \times 10^3 \qquad S/B = 0.11$

To do list

- *β* vs. *p* identification cuts or *dE/dx* vs. *p* ? (expected gain in Lambda reconstruction – no TOF detector included)
- Study of Λe+e-, Λπ- , Λπ+ correlation and search for Λ(1520) Σ(1385) in combined pp and pNb data sets.