Search for Pentaquarks at

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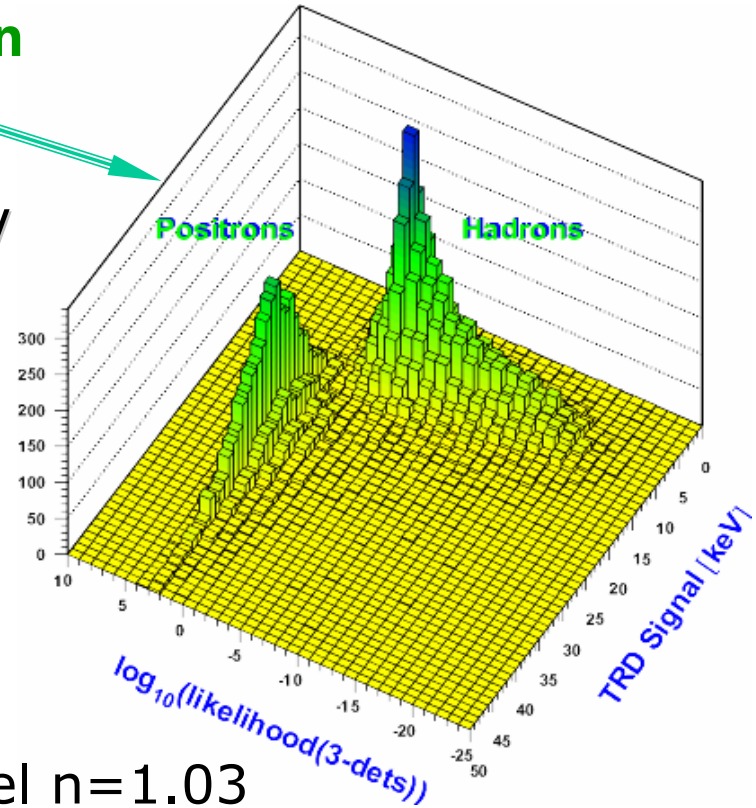
for the HERMES Collaboration

- HERMES Experiment PID
- Topology of the search for resonances decaying into longlived daughters
- Results
- Conclusions

P I D over wide P-range

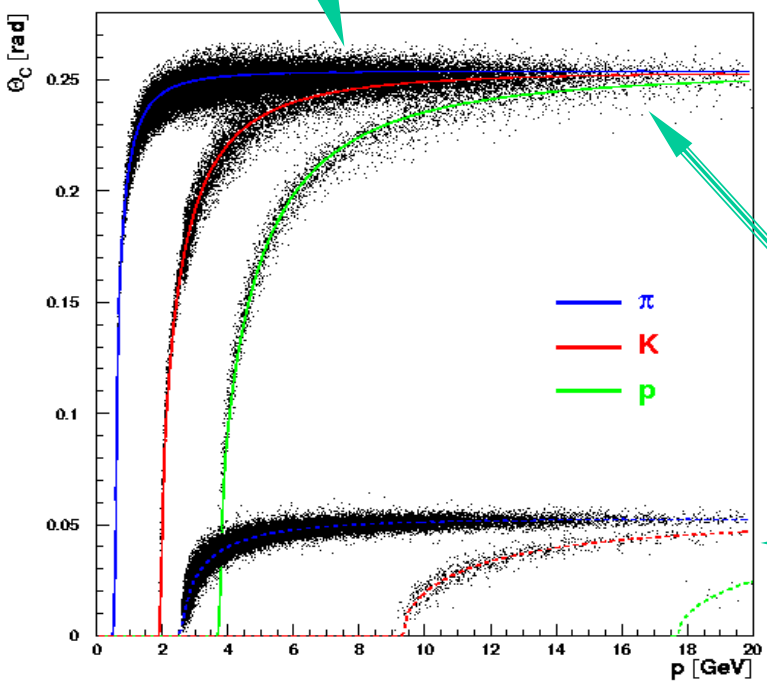
hadron / positron separation

combining signals from:
TRD, calorimeter, preshower,
RICH→P-range : 0.5-15.0 GeV



hadron separation

Dual radiator RICH for π, K, p

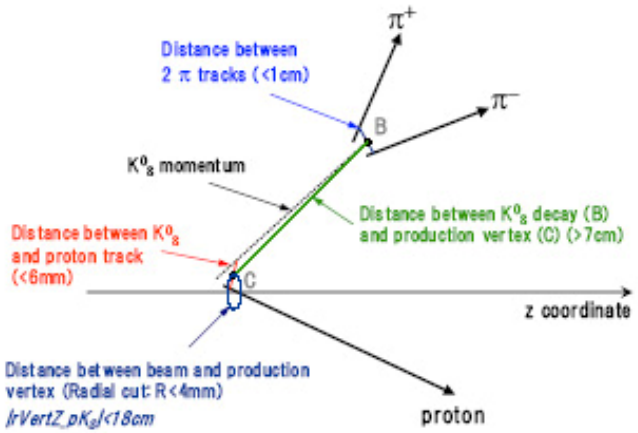


Aerogel n=1.03

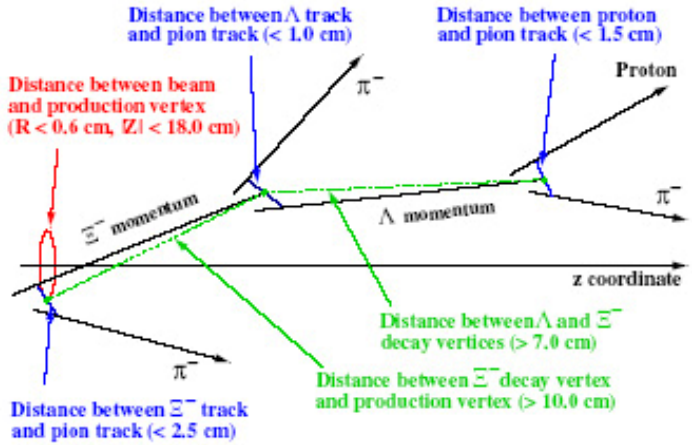
Gas C_4F_{10} n=1.0014

Event Reconstruction

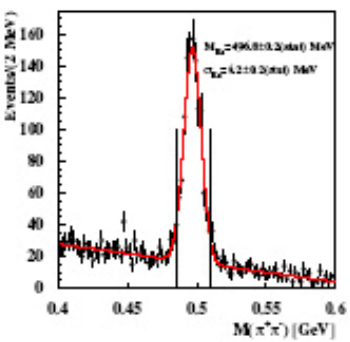
▶ $\Theta^+ \rightarrow pK^0_S$



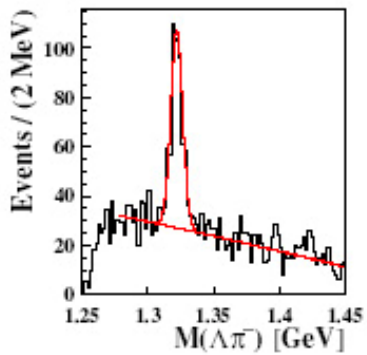
▶ $\Xi^{--} \rightarrow \Xi^-\pi^- \rightarrow \Lambda^0\pi^-\pi^-$



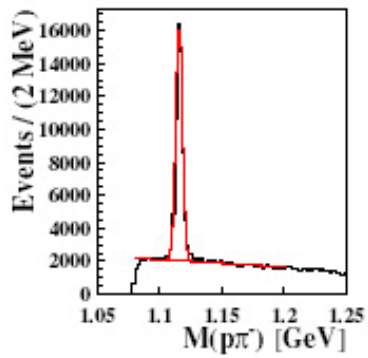
▶ K^0_S



▶ Ξ^-



▶ Λ



Results (Phys.Lett.B585:213,2004)

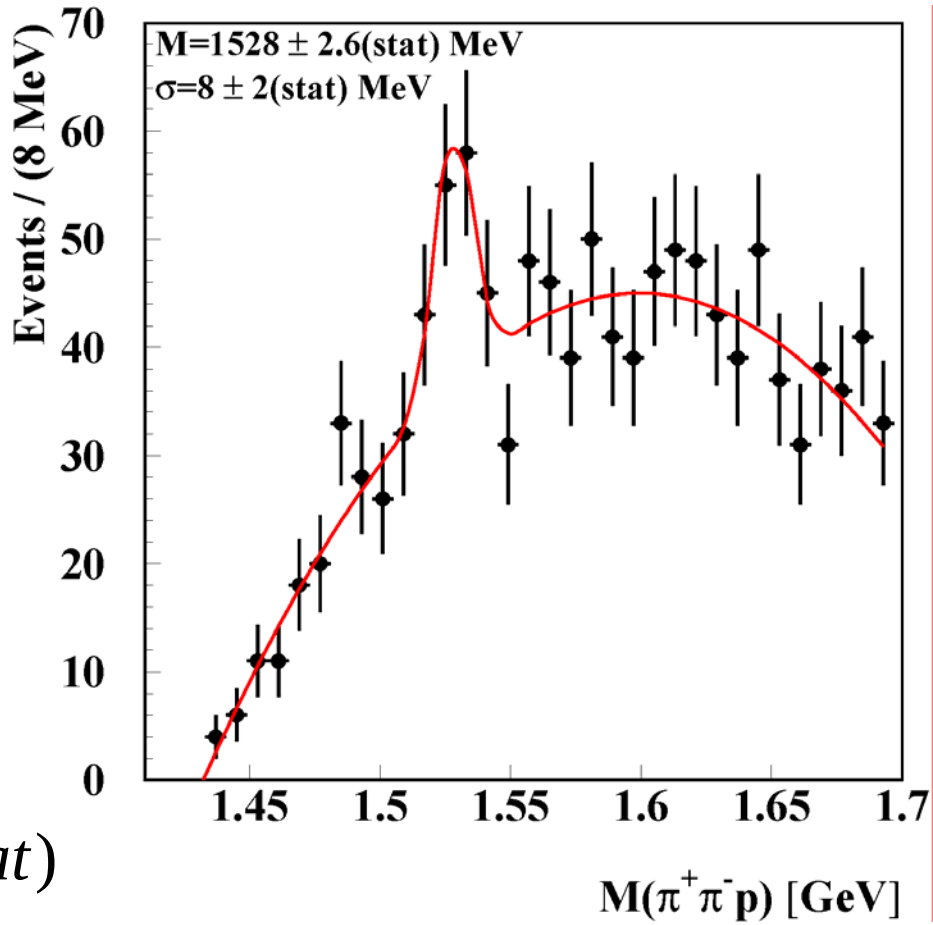
Peak at:

M= 1528 ± 2.6 MeV

σ= 8 ± 2 MeV

Significance:

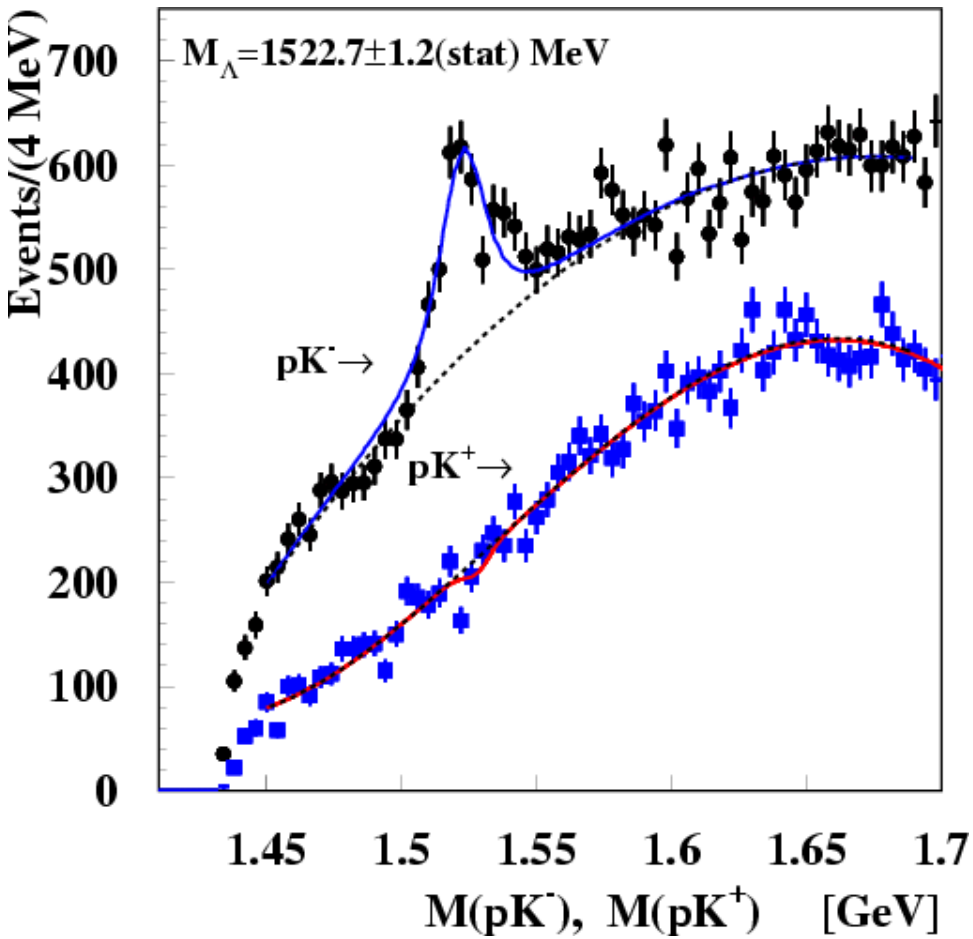
$N_s / \delta N_s = 3.7$



$\sigma(\Theta^+) = 100 - 200nb \pm 25\%(stat)$

- (additional factor 2 from production kinematics)

Θ^+ Isospin



- Well established
  $\Lambda(1520) \rightarrow pK^-$
  with acceptance: 1.5%
  $\sigma(\Lambda(1520)) = 62 \pm 11(stat) nb$
- No peak structure for
  $\Theta^{++} \rightarrow pK^+$
  zero counts at 91% CL

→ Θ^+ not isotensor
probably **isoscalar**

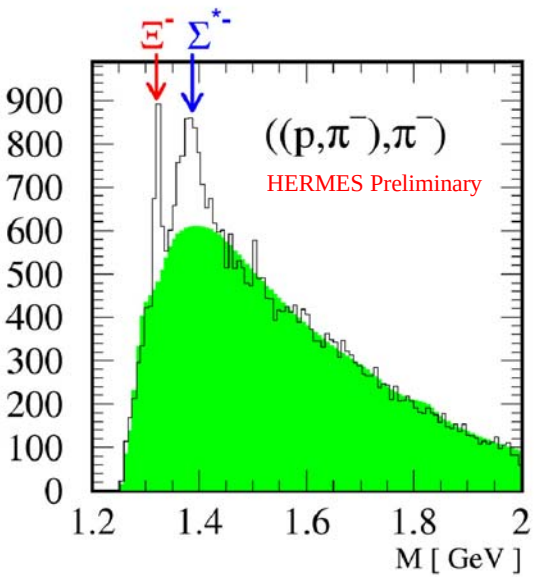
How real is the Θ^+

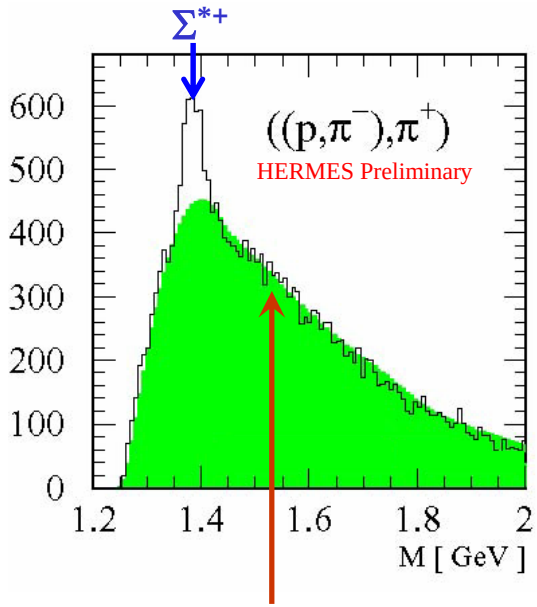
- check for
  - "kinematic reflections"
  - detector acceptance and cuts (PYTHIA6 MC / Toy MC)
- Θ^+ vs Σ^{*+}
  - is Θ^+ a pentaquark or a previously unobserved Σ^{*+}?
- add a fourth hadron
  - is the peak still there?
  - can we guess the production process for the Θ^+?
  - can we suppress background?

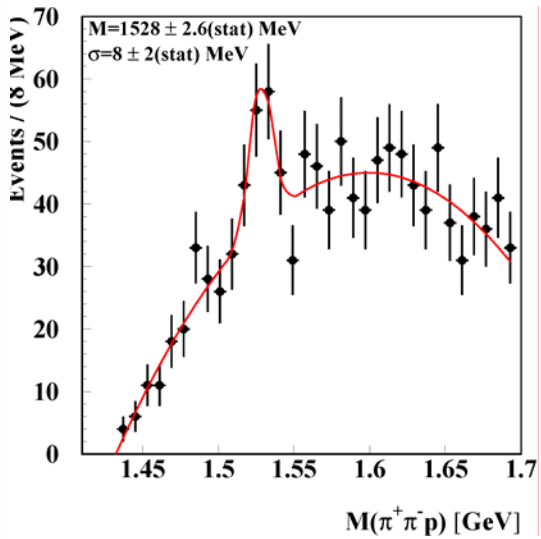
Θ^+ vs Σ^{*+}

- Is peak a new Σ^{*+} or a pentaquark state?
- If peak is Σ^{*+} $\Rightarrow$ also see a peak in $M(\Lambda\pi^+)$

$b.r.(\Lambda\pi^+)/(pK_s) = 3/2$

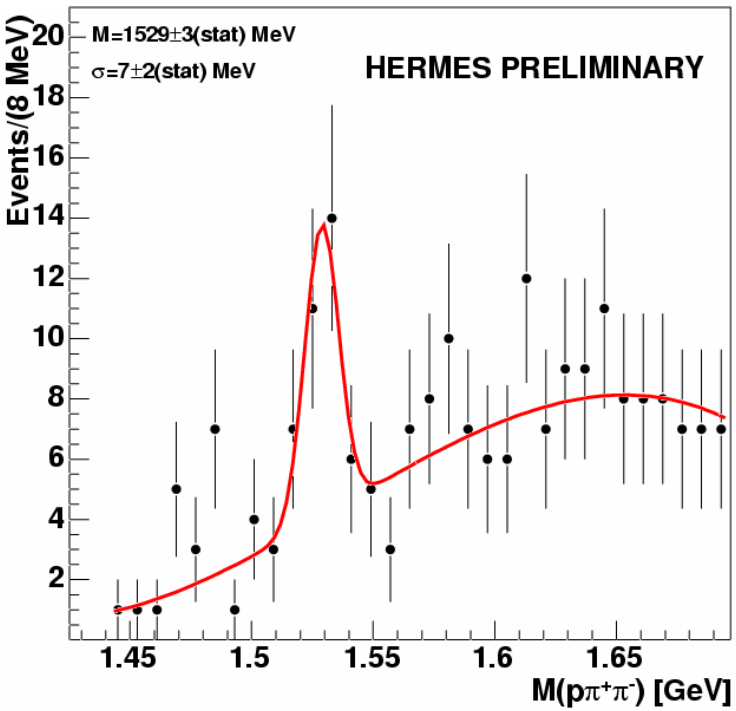


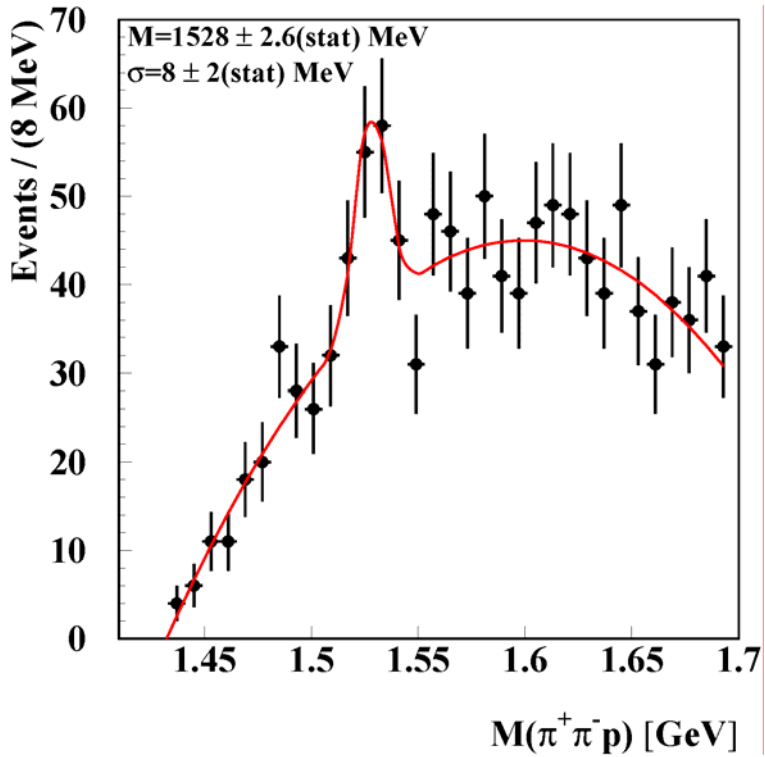




No peak in $\Lambda\pi^+$ spectrum near 1530 MeV

Θ^+ Mass spectrum with additional π



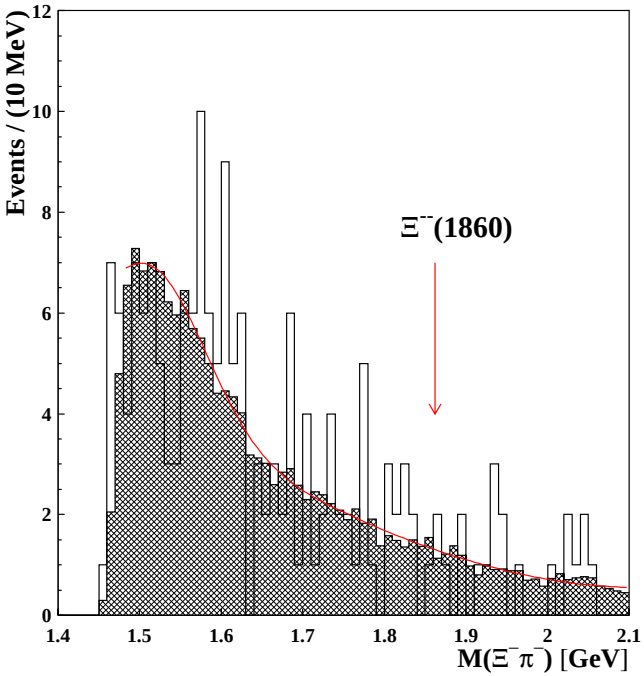


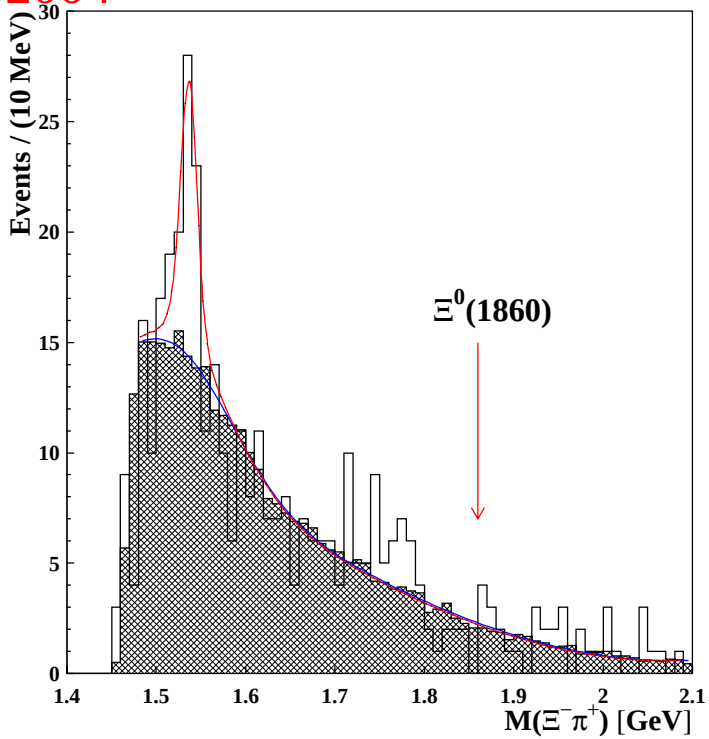
- standard cuts applied + K^* and Λ veto
- signal/background: 2:1

- signal/background: 1:3

Final spectra for Ξ^{--} and Ξ^{0}

Phys. Rev. D71(2005) 032004





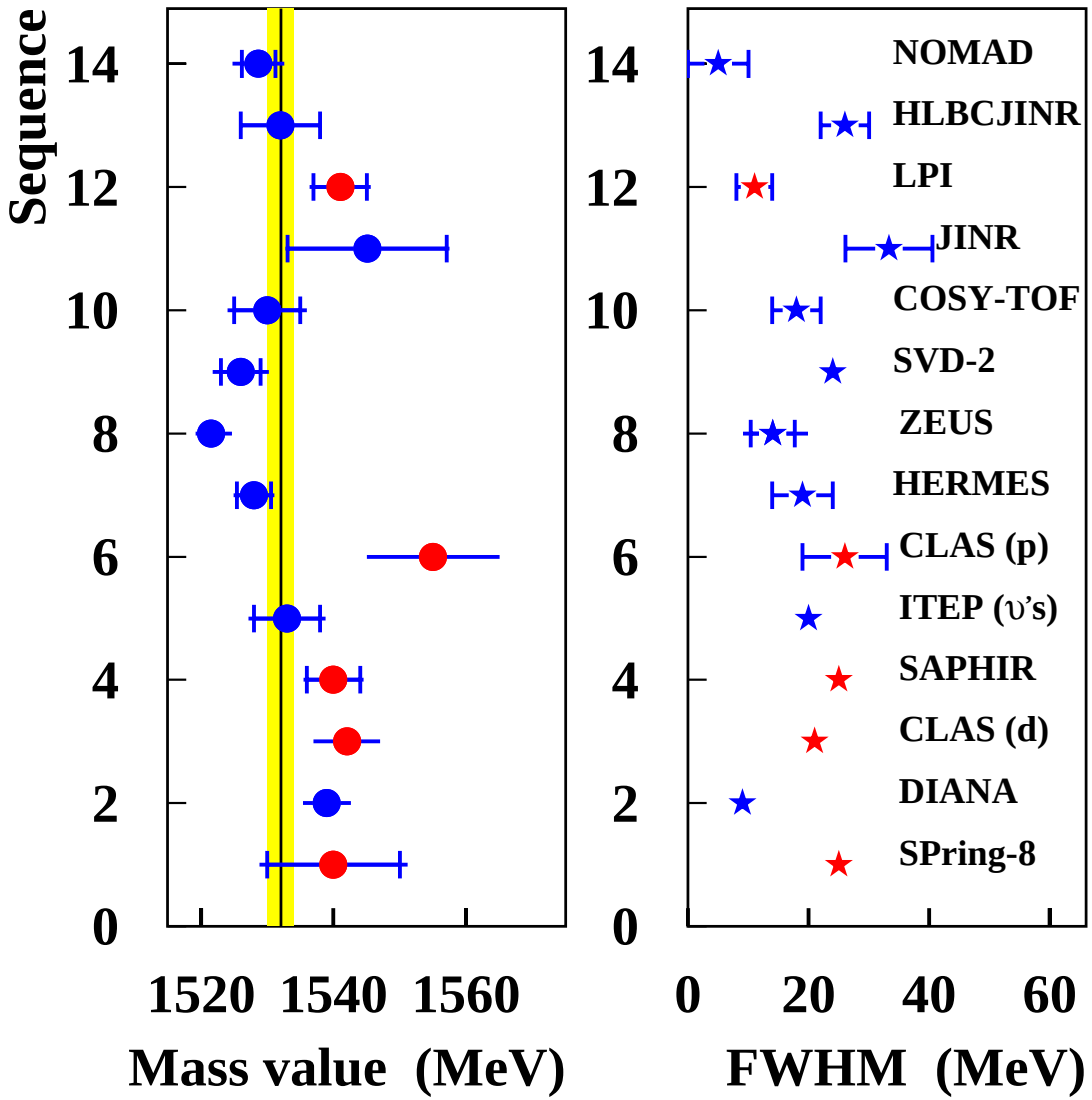
UL for $\Xi^{--}(1860)$ cross-section is 1.0-2.1nb 90% C.L.
UL for $\Xi^{0}(1860)$ cross-section is 1.2-2.5nb 90% C.L.
Cross-section for Ξ^{0} (1530) is 8.8-24nb

Conclusions

- Direct reconstruction of Θ^+ invariant mass
- Confirmation of Θ^+ (results carefully checked)
- No peak in $\Theta^{++} \rightarrow pK^+$:probably isoscalar
- Third π improves signal → :production mechanism?
- Ξ^{--} is not seen → $\sigma_{\Xi^{--}} < 2.1nb(90\%C.L.)$

Outlook: analyzing old and new data

For discussions…
Comparison with other experiments



nK^+

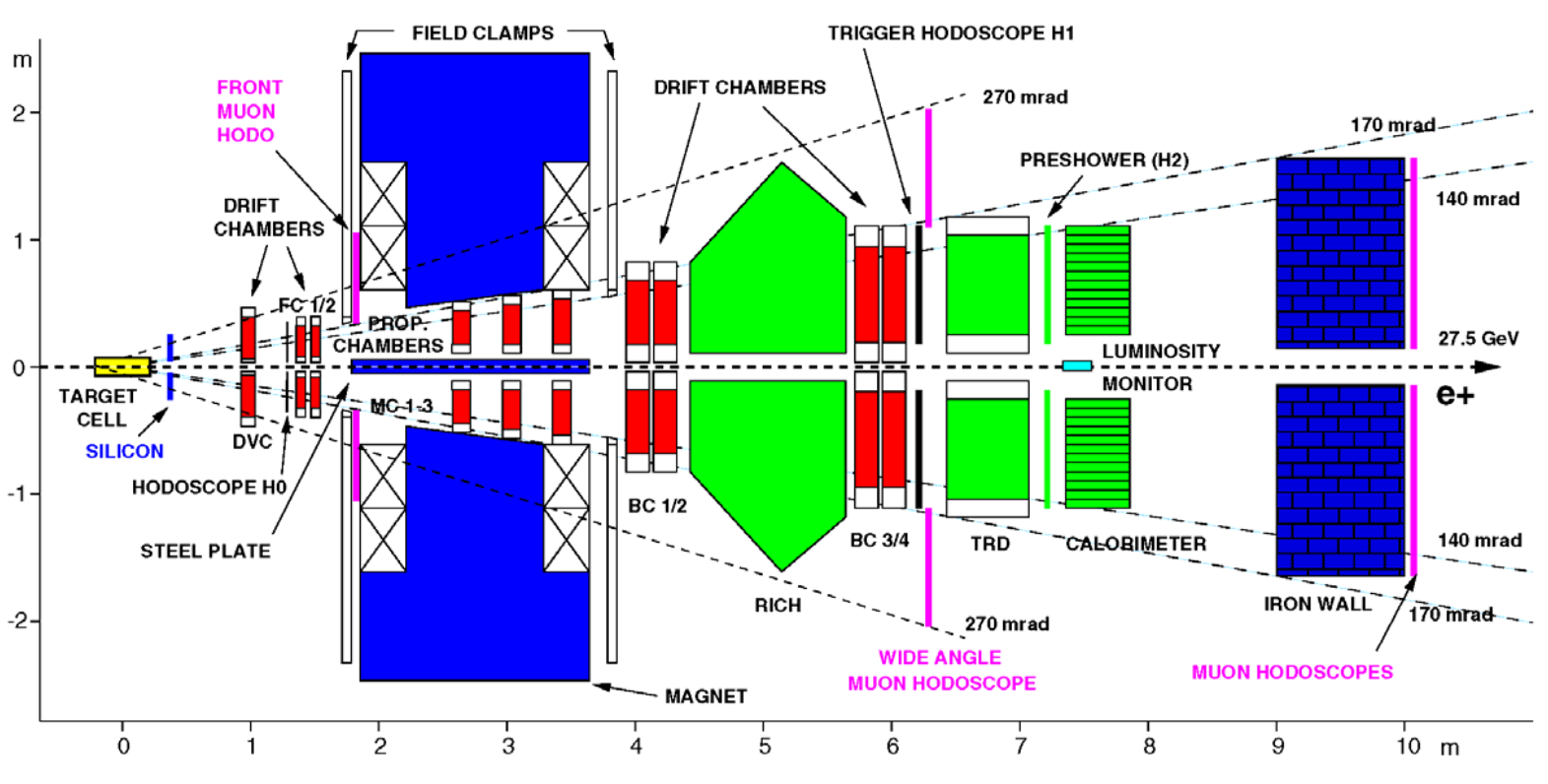
pK^0_s

World Average:
1532.1±2.1 MeV

Large variation in mass not uncommon for new, decaying particles

→ but need to better estimate exp. uncertainties

For questions…
The HERMES Spectrometer



Beam: 27.6 GeV e^+/e^- from HERA accelerator

Track reconstruction: $\Delta p/p < 2\%$, $\Delta\theta < 0.6$ mrad

Particle ID: TRD, Preshower, Calorimeter (hadron/lepton sep.)

dual radiator RICH (π, **K**, **p** separation)