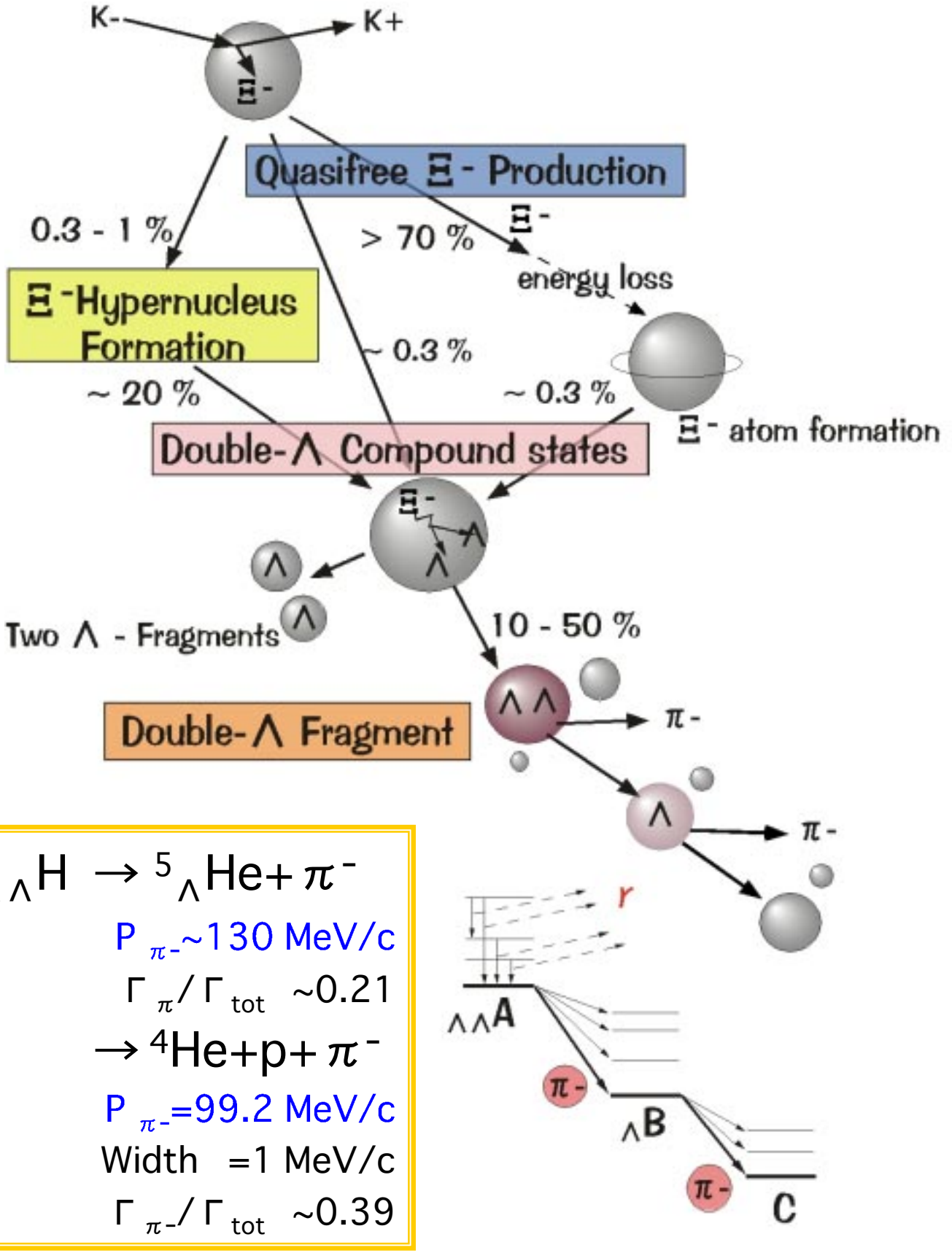
Experimental Principle



$^{5}_{\Lambda\Lambda}H \rightarrow {}^{5}_{\Lambda}He + \pi^-$

$P_{\pi^-} \sim 130$ MeV/c

$\Gamma_{\pi^-}/\Gamma_{tot} \sim 0.21$

$\rightarrow {}^{4}He + p + \pi^-$

$P_{\pi^-} = 99.2$ MeV/c

Width = 1 MeV/c

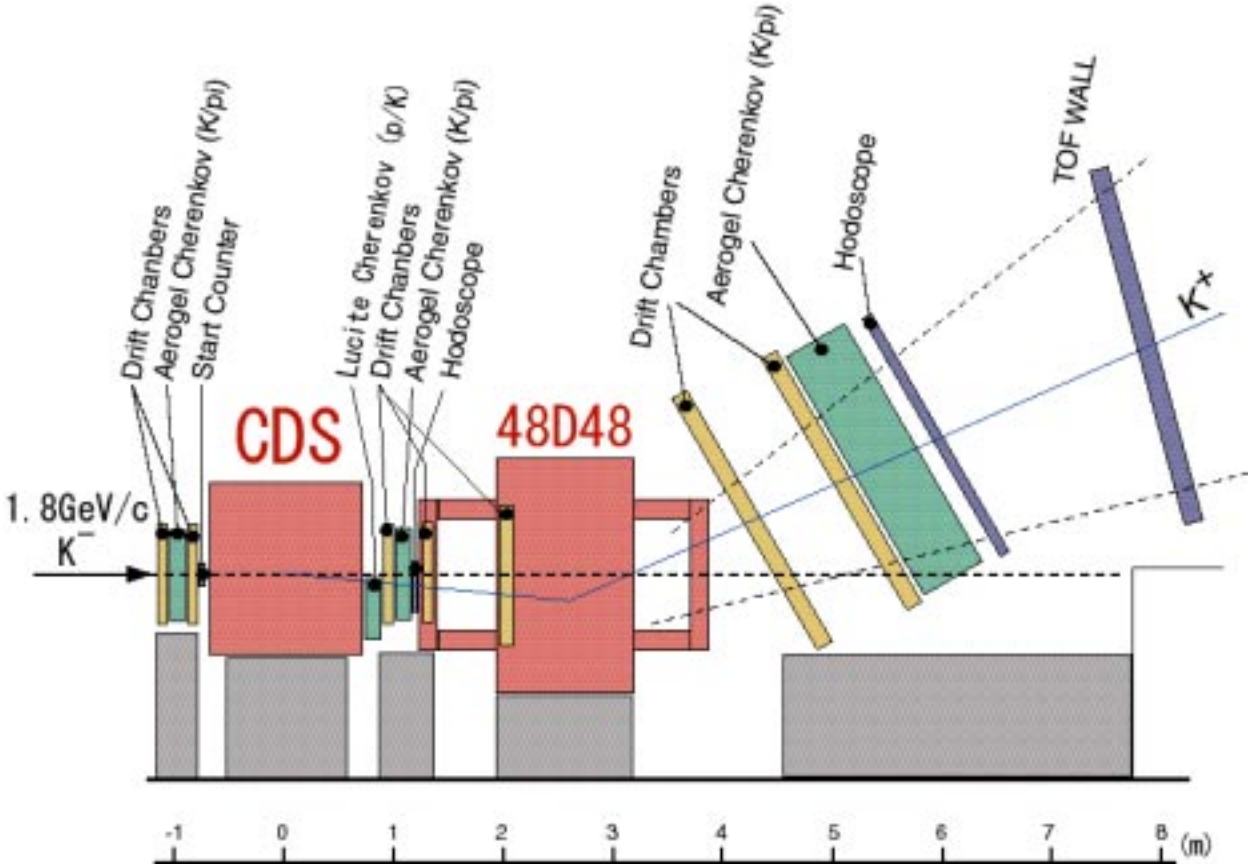
$\Gamma_{\pi^-}/\Gamma_{tot} \sim 0.39$

Experiment in 1998

- 1998 Run Summary
  - 0.9 x 10^{12} K^- (1.8 GeV/c) was irradiated
  - Target was a ^{9}Be plate (6“x 2”x1/2“ high)

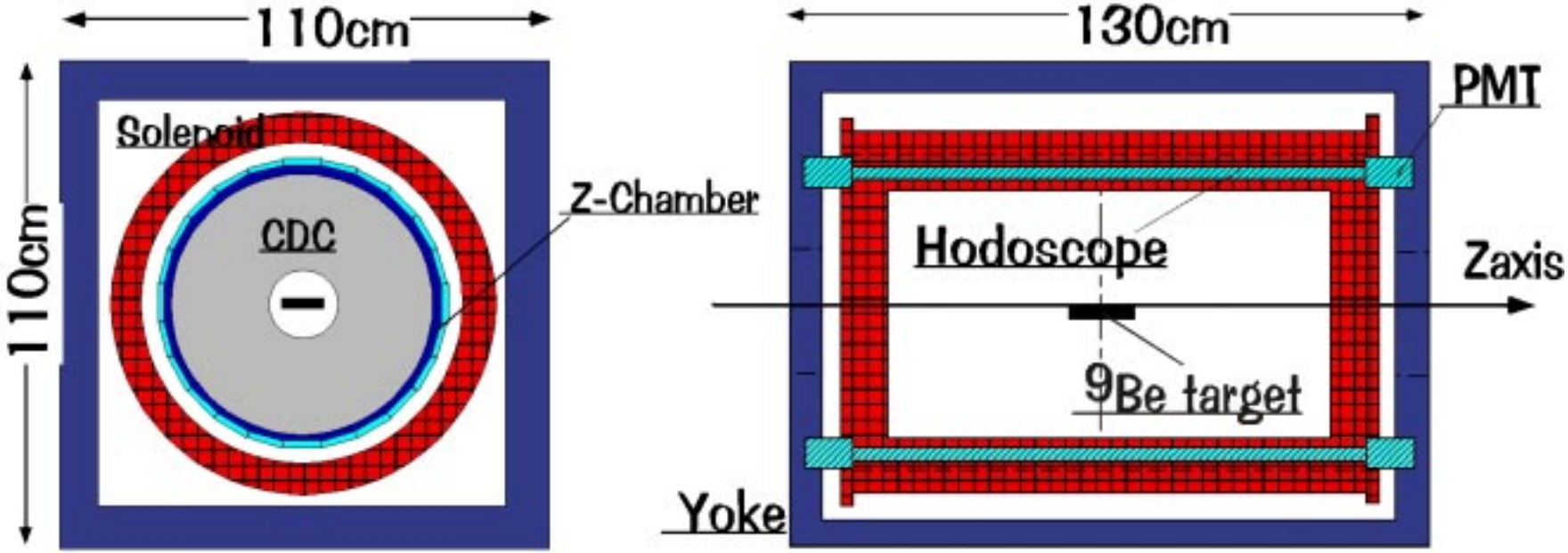
- 1.1x10^5 (K^-,K^+) reactions were identified by 48D48 spectrometer, which covers 2-10 deg.

48D48 spectrometer system and CDS

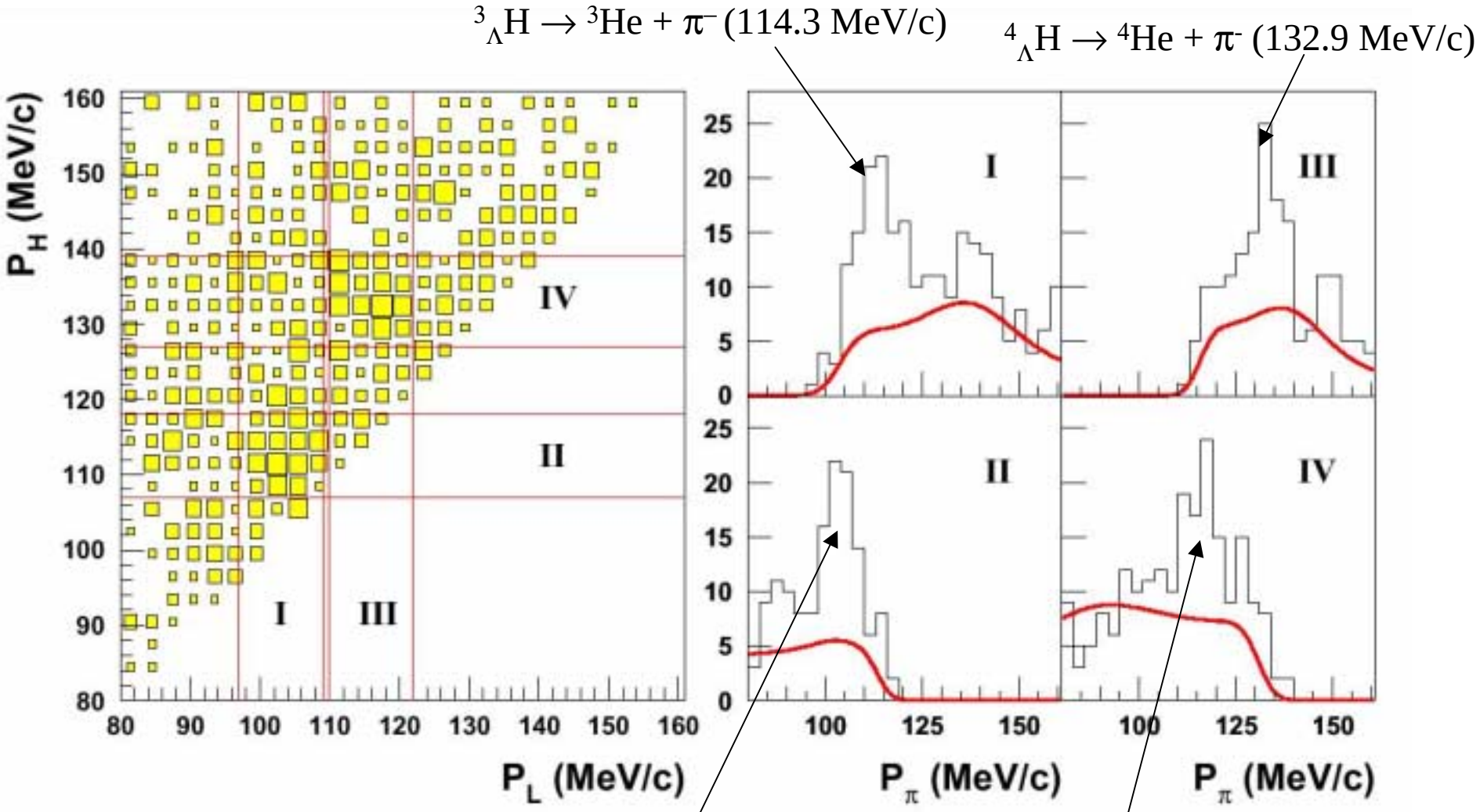


Cylindrical Detector System

- Large solid angle — 72% of 4π
- Momentum resolution for 100MeV/c π — 9-10MeV/c(FWHM)
  - **Solenoid magnet** — Uniform field; variation less than 0.5%
  - **Cylindrical Drift Chamber (CDC)** — Low Z materials; gas ; He:C_2H_6=50%:50%; field-wire ; gold plated aluminium; 12 layers; 6 stereo layers, 6 axial layers, 576 cells
  - **Z-Chamber** — 5.5mm pitch Cathode strip readout-MWPC
  - **Hodoscope** — Finemeshed-PMT in Magnetic field

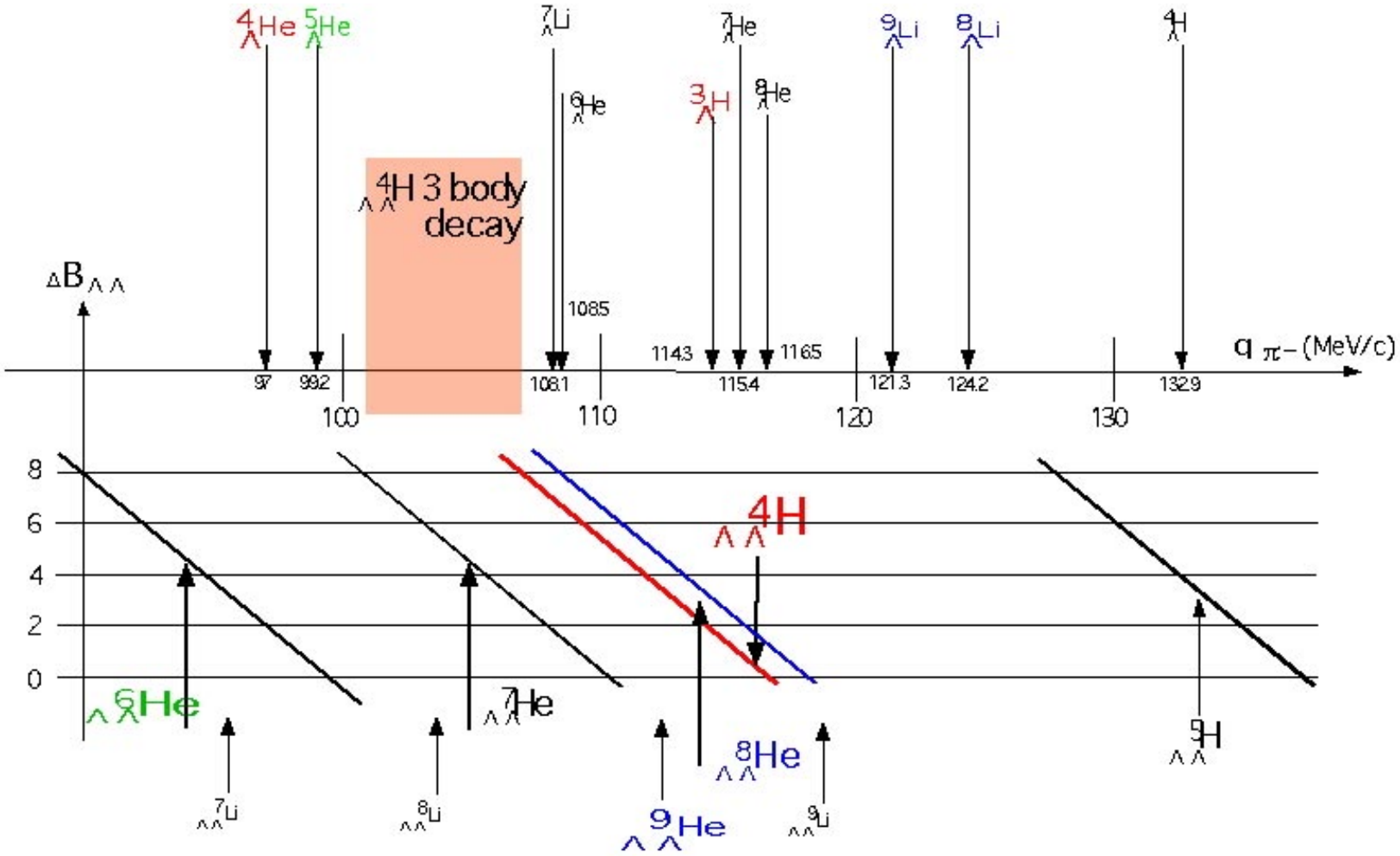


E906 result – Phys. Rev. Lett. **87**, 132504 (2001)



π^- momentum from Hypernuclei

$^{9}Be + \Xi^{-} \rightarrow {}^{10}_{\Lambda\Lambda}Li^{*}$



Possible Hyperfragments other than $\Lambda\Lambda$

- Direct process ($^{8}_{\Lambda\Lambda}$He* or $^{8}_{\Lambda\Lambda}$H*)
  - $^{4}_{\Lambda}$H + $^{4}_{\Lambda}$H
  - $^{3}_{\Lambda}$H + $^{4}_{\Lambda}$H ; observed
  - $^{3}_{\Lambda}$H + $^{3}_{\Lambda}$H

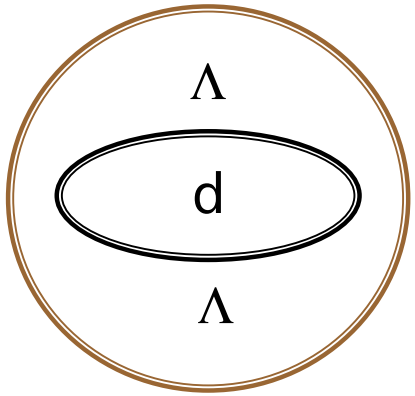
- stopped cascade process ($^{10}_{\Lambda\Lambda}$Li*)
  - Twin
  - $^{3}_{\Lambda}$H + $^{5}_{\Lambda}$He + 2n ; P= 99.2 MeV/c
  - $^{3}_{\Lambda}$H + $^{6}_{\Lambda}$He + n ; P= 108.5 MeV/c & Motoba-san's calculation
  - $^{3}_{\Lambda}$H + $^{7}_{\Lambda}$He ; P= 115.4 MeV/c
  - Single
  - $^{8}_{\Lambda}$He + p + Λ, $^{7}_{\Lambda}$He + d + Λ ; too broad
  - $^{3}_{\Lambda}$H + ^{6}He + Λ ; FWHM ~ 19 MeV/c

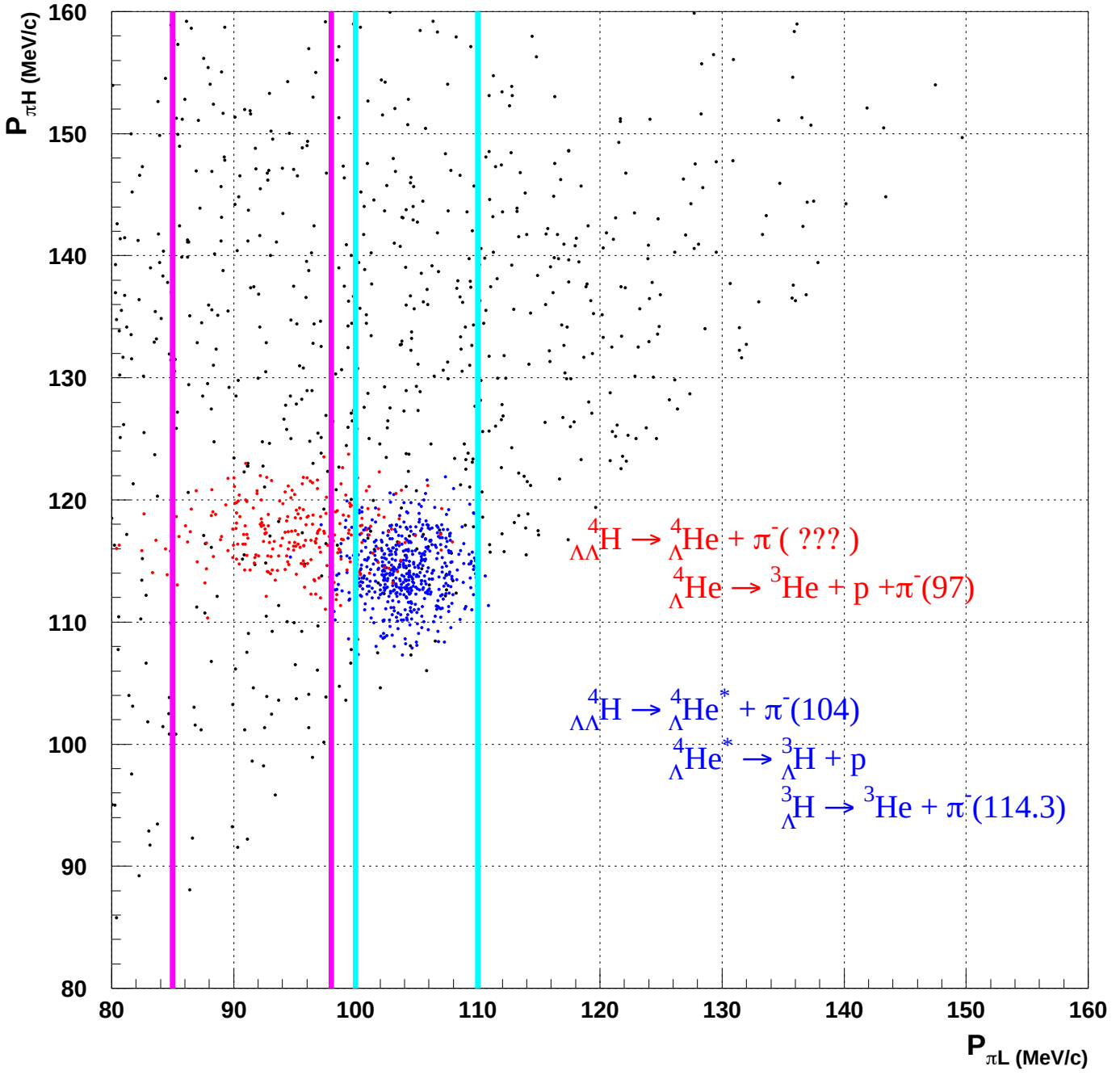
${}^{4}_{\Lambda\Lambda}H$; decay mode

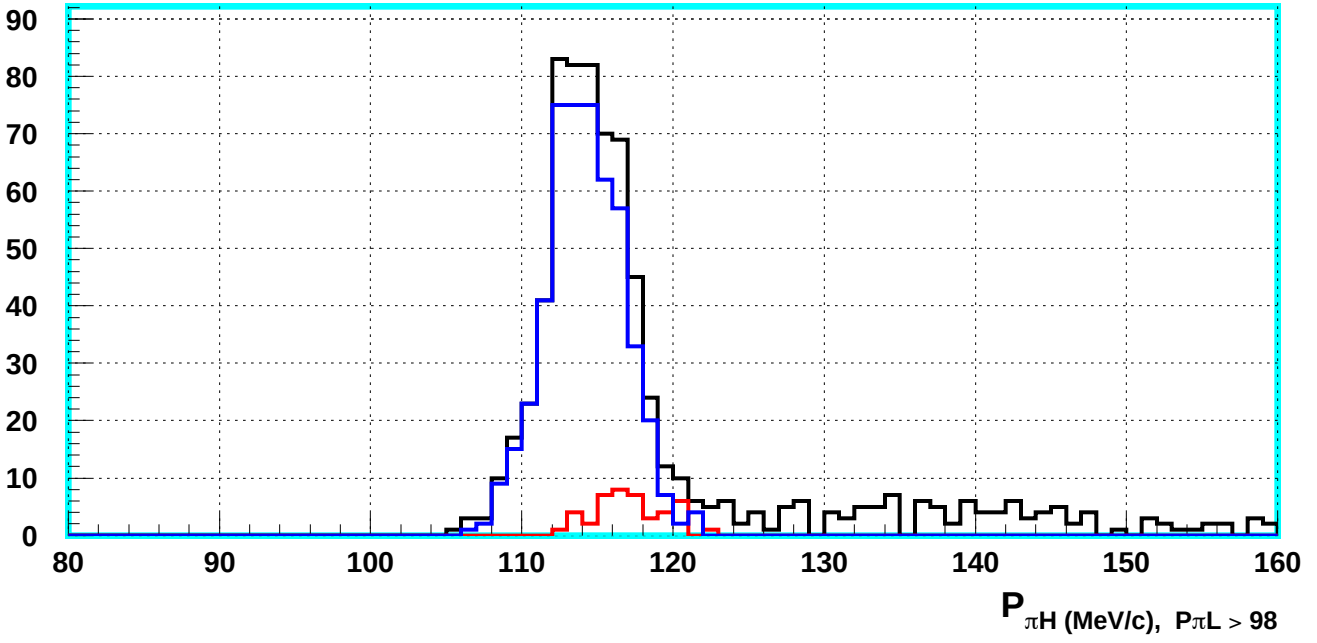
- 3 body ; ${}_{\Lambda\Lambda}{}^{4}H \rightarrow {}_{\Lambda}{}^{3}H + p + \pi^{-}$, (broad; ~ 100 MeV/c ?)
  - ${}_{\Lambda}{}^{3}H \rightarrow {}^{3}He + \pi^{-}$ (114.3 MeV/c)

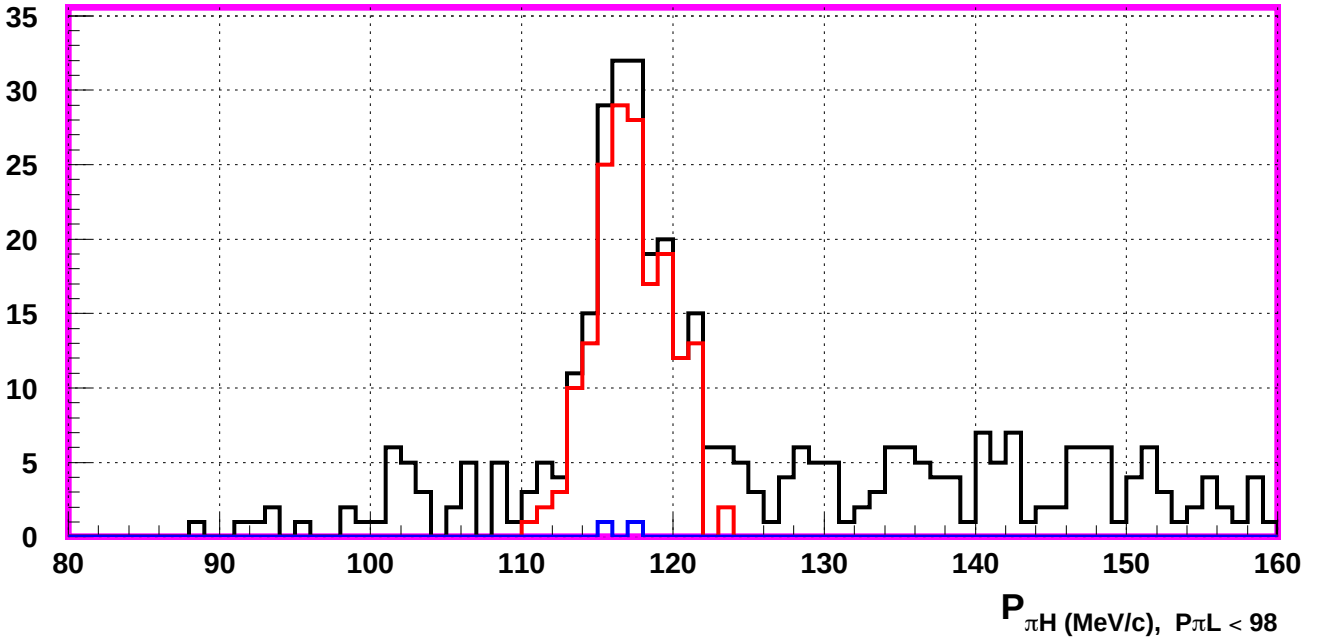
- or (??); ${}_{\Lambda\Lambda}{}^{4}H \rightarrow {}_{\Lambda}{}^{4}He^{*} + \pi^{-}$, ${}_{\Lambda}{}^{4}He^{*} \rightarrow {}_{\Lambda}{}^{3}H + p$,
  - ${}_{\Lambda}{}^{3}H \rightarrow {}^{3}He + \pi^{-}$ (114.3 MeV/c)

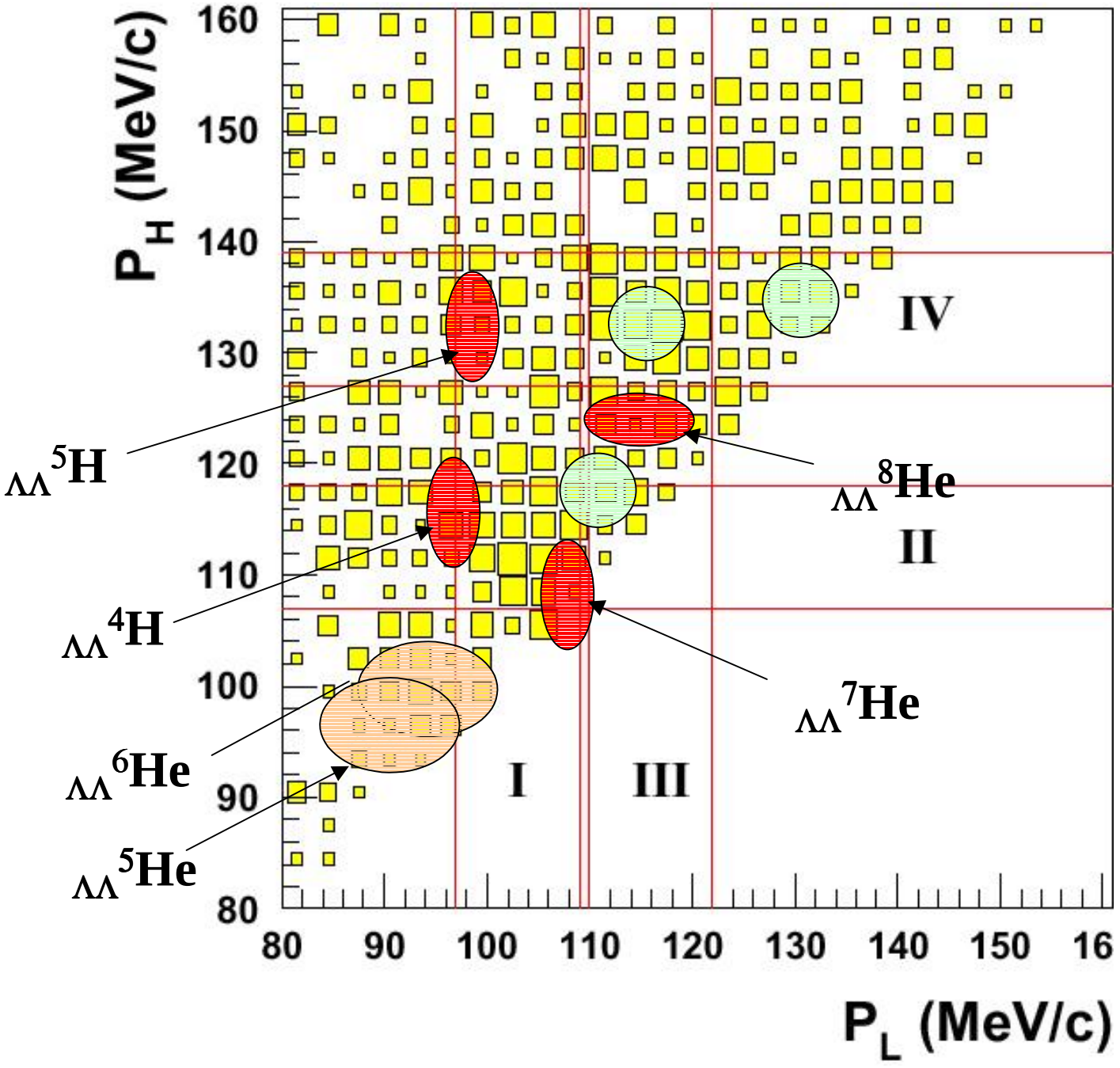
- 2 body ; ${}_{\Lambda\Lambda}{}^{4}H \rightarrow {}_{\Lambda}{}^{4}He(1^{+}) + \pi^{-}$, (116 MeV/c ?)
  - ${}_{\Lambda}{}^{4}He \rightarrow {}^{3}He + p + \pi^{-}$ (85-97 MeV/c)




$P_{\pi H}$ (MeV/c)
160
150
140
130
120
110
100
90
80
80
90
100
110
120
130
140
150
160
$P_{\pi L}$ (MeV/c)
$^{4}_{\Lambda\Lambda}H \rightarrow {}^{4}_{\Lambda}He + \pi^{-}(???)$
$^{4}_{\Lambda}He \rightarrow {}^{3}He + p + \pi^{-}(97)$
$^{4}_{\Lambda\Lambda}H \rightarrow {}^{4}_{\Lambda}He^{*} + \pi^{-}(104)$
$^{4}_{\Lambda}He^{*} \rightarrow {}^{3}_{\Lambda}H + p$
$^{3}_{\Lambda}H \rightarrow {}^{3}He + \pi^{-}(114.3)$


90
80
70
60
50
40
30
20
10
0
80
90
100
110
120
130
140
150
160
P πH (MeV/c), PπL > 98


35
30
25
20
15
10
5
0
80
90
100
110
120
130
140
150
160
P πH (MeV/c), PπL < 98


P_H (MeV/c)
160
150
140
130
120
110
100
90
80
80
90
100
110
120
130
140
150
16
P_L (MeV/c)
$\Lambda\Lambda^5$H
$\Lambda\Lambda^4$H
$\Lambda\Lambda^6$He
$\Lambda\Lambda^5$He
$\Lambda\Lambda^8$He
$\Lambda\Lambda^7$He
I
II
III
IV

summary

- Objectives
  - To confirm the existence of ${}^{4}H_{\Lambda\Lambda}$ by looking for its 2-body decay mode to ${}^{4}He_{\Lambda}$
  - To search for other hypernuclei ; ${}^{5}H_{\Lambda\Lambda}$, ${}^{6}He_{\Lambda\Lambda}$ etc.
  - To determine the pairing energy of ΛΛ's to an accuracy of 0.5 MeV
- Improvements
  - ~ 10 times higher statistics
  - ~ twice better momentum resolution
- Requirements
  - Beam: 1.8 GeV/c K^- ; $3x10^6$ K^- /spill
  - Beam line : D6 and associated spectrometer
  - Detector : CDS
  - Time : 1000 hours production + 200 hours setup