# Highlights of FINUDA results
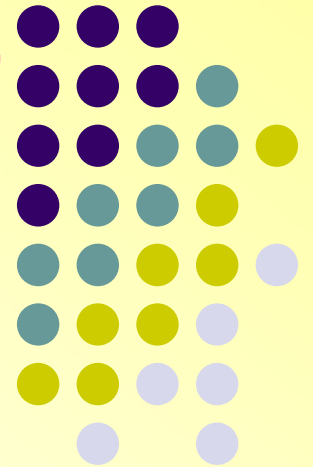
Stefania Bufalino **"Hypernuclear non-mesonic and mesonic decays"**
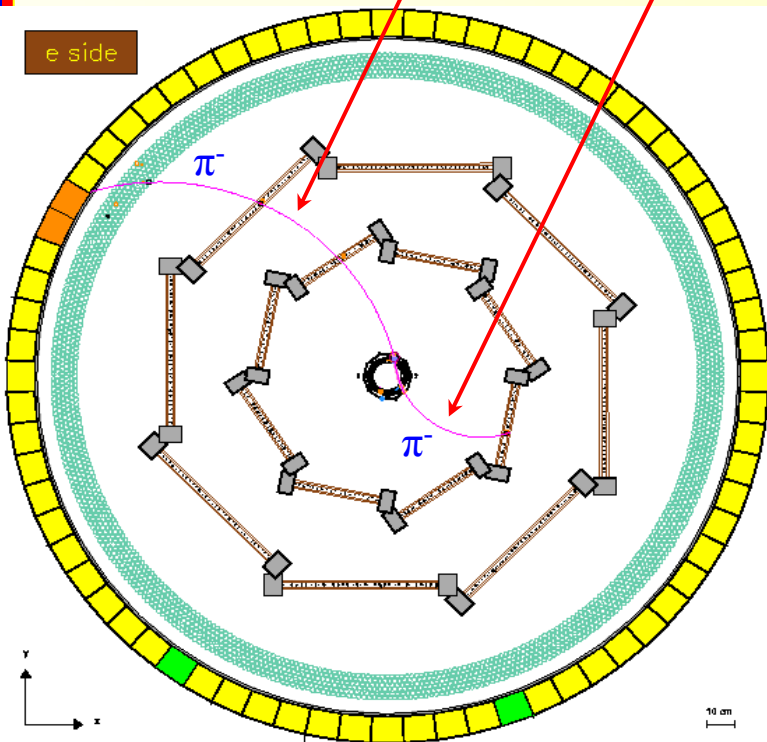
and

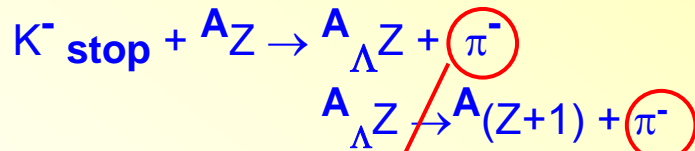Alessandra Filippi **"Hyperon-Nucleons/pions final states"**

I.N.F.N. Torino
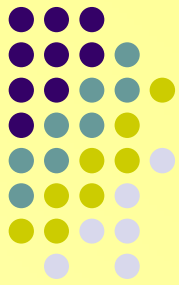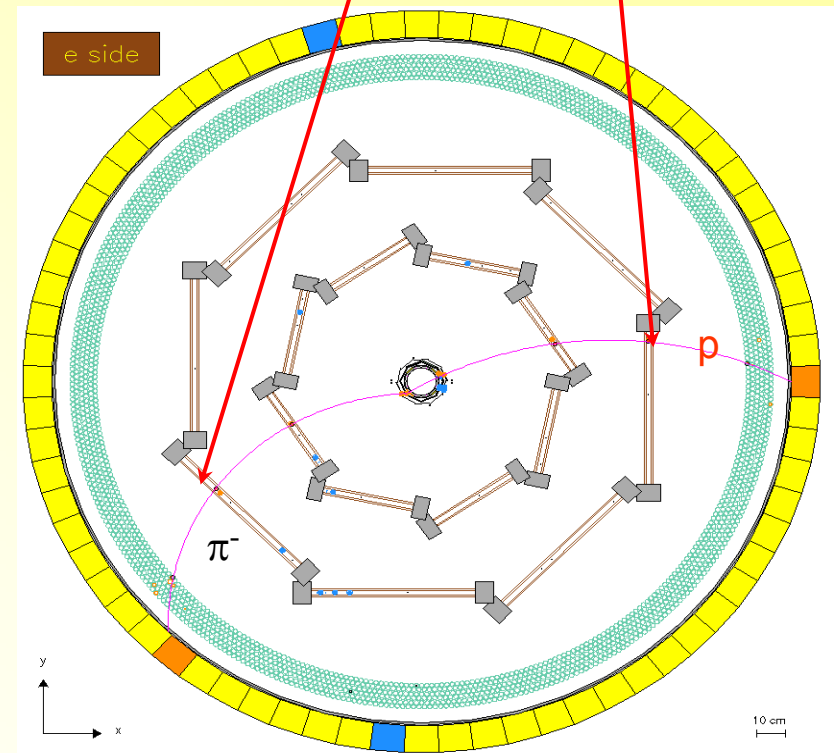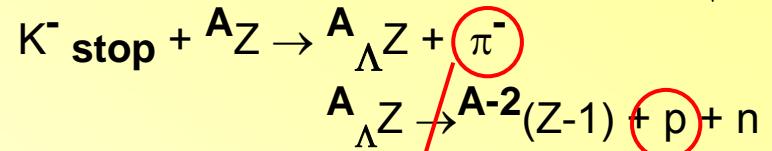
On behalf of the FINUDA Collaboration

# Hypernuclear weak decay study in FINUDA
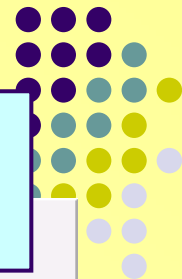
## Coincidence measurements

charged Mesonic channel

$$K^-_{stop} + {}^A Z \rightarrow {}^A_\Lambda Z + \pi^-$$
$${}^A_\Lambda Z \rightarrow {}^A(Z+1) + \pi^-$$

charged Non-Mesonic channel

$$K^-_{stop} + {}^A Z \rightarrow {}^A_\Lambda Z + \pi^-$$
$${}^A_\Lambda Z \rightarrow {}^{A-2}(Z-1) + p + n$$
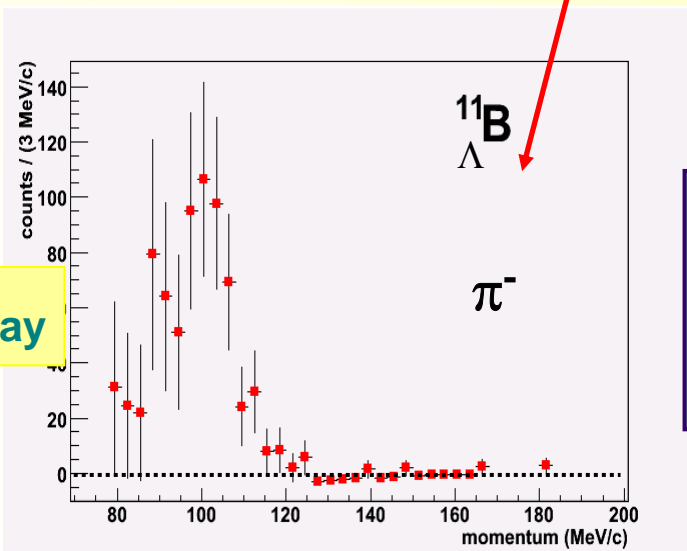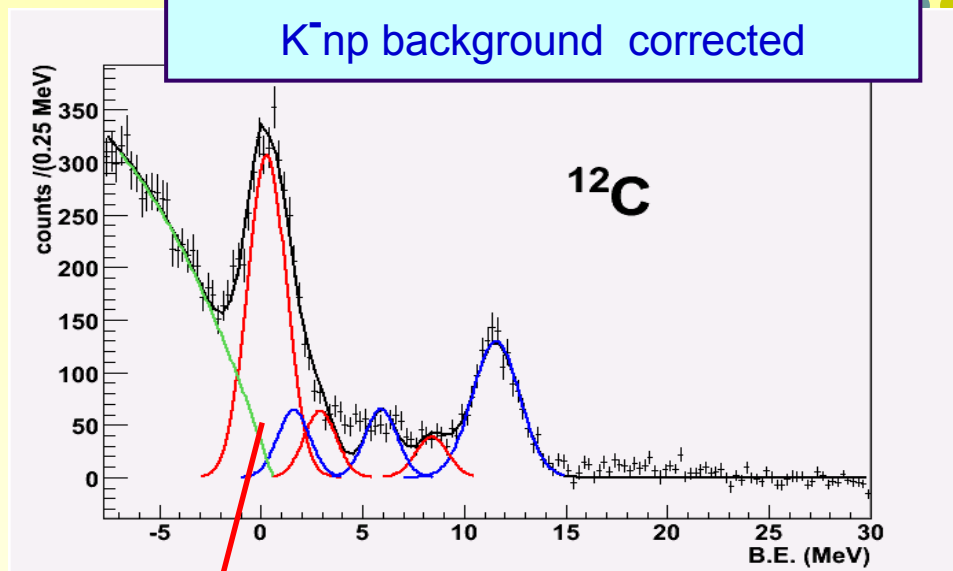
# Hypernuclear decay study in FINUDA

M. Agnello et al., PLB 622 (2005) 35
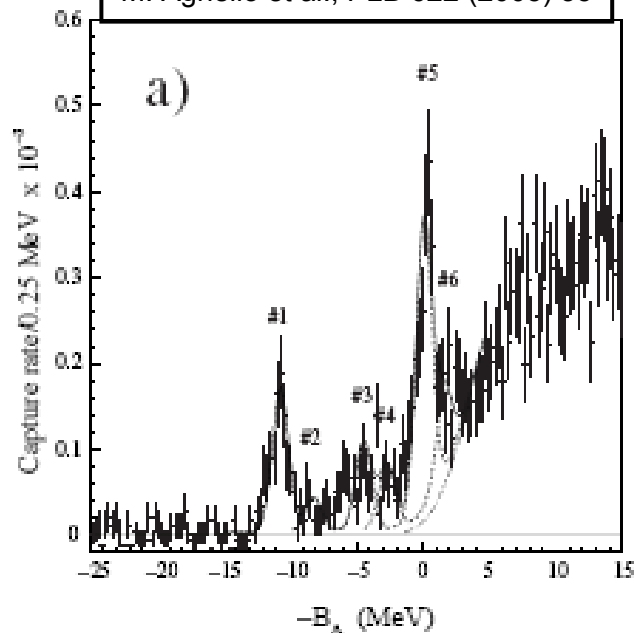


Inclusive production $\pi^-$ spectra

K$^-$np background corrected

$^{12}$C
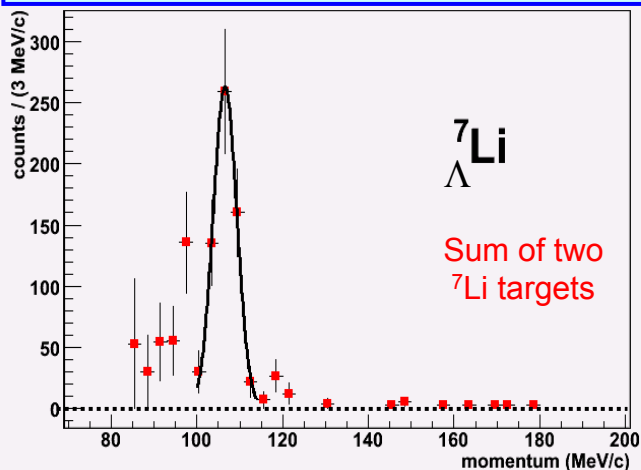
**Mesonic Weak Decay**

$^{11}_{\Lambda}$B

$\pi^-$

decay $\pi^-$ spectra

($\Lambda_{qf}$ decay)/K$^-$np background

subtracted & acceptance corrected

# Mesonic weak decay: $\pi^-$ spectra
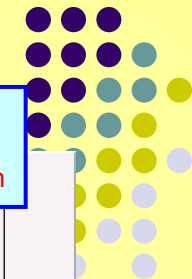
$\pi^-$ momentum spectrum from $^7_\Lambda$Li MWD

Coincidence events with $\pi^-$ of the $^7_\Lambda$Li bound region

$^7_\Lambda$Li

Sum of two
$^7$Li targets

$\pi^-$ momentum spectrum from $^9_\Lambda$Be MWD

Coincidence events with $\pi^-$ of the $^9_\Lambda$Be bound region

$^9_\Lambda$Be

Sum of two
$^9$Be targets
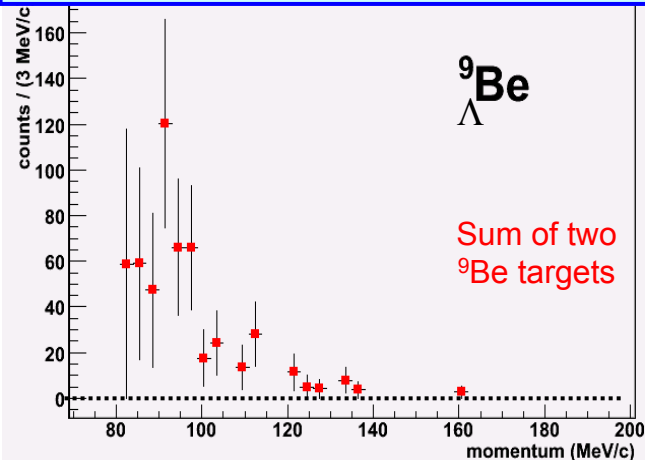
$\pi^-$ momentum spectrum from $^{11}_\Lambda$B MWD

Coincidence events with $\pi^-$ of the $^{11}_\Lambda$B momentum region

$^{11}_\Lambda$B

Sum of three
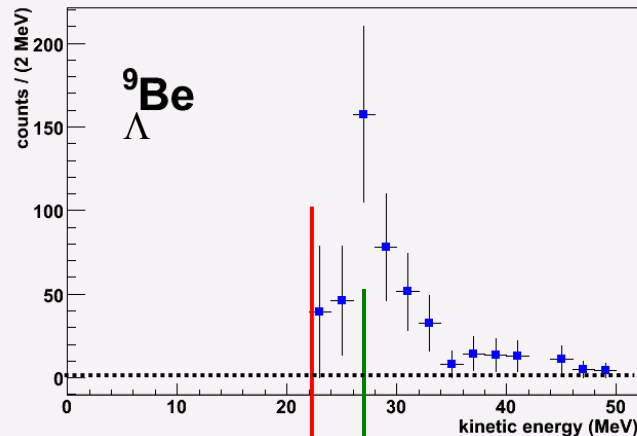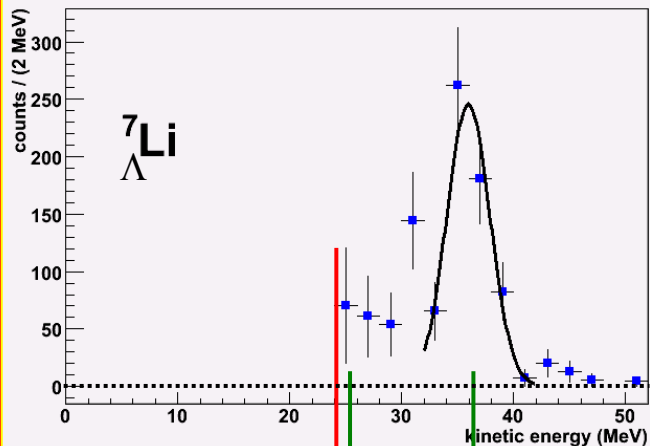$^{12}$C targets
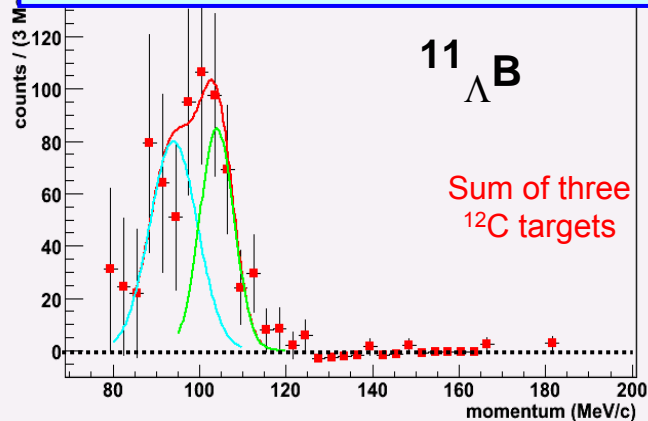
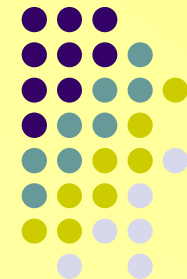$\pi^-$ momentum spectrum from $^{15}_\Lambda$N MWD

Coincidence events with $\pi^-$ of the $^{15}_\Lambda$N momentum region
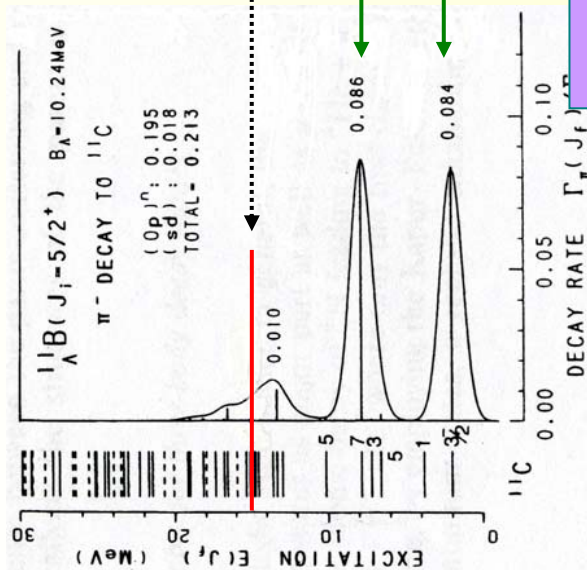
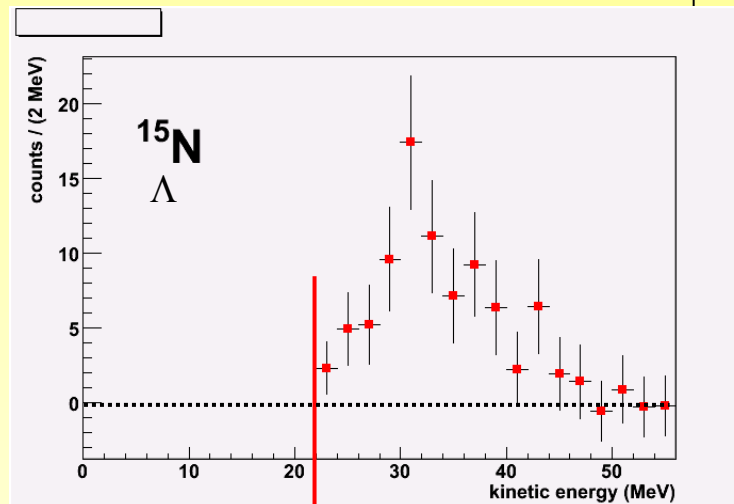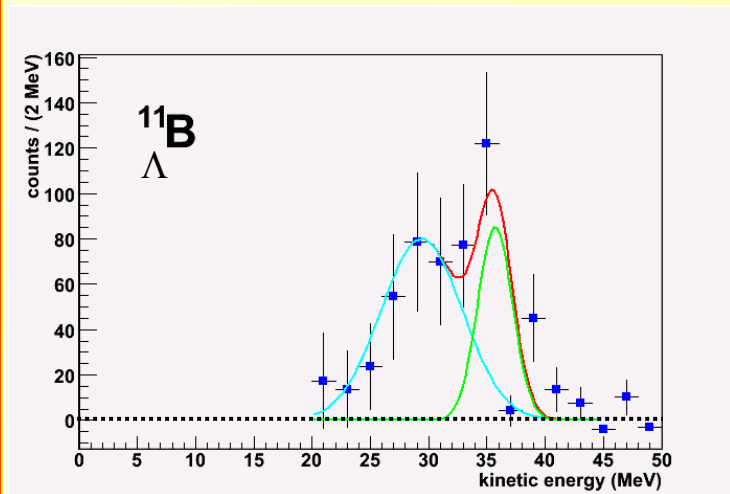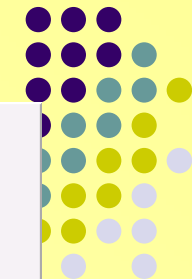$^{15}_\Lambda$N

One D$_2$O
target
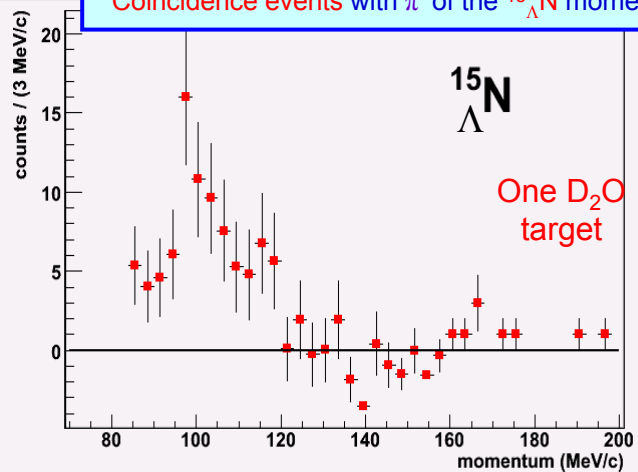
All the spectra are background subtracted & acceptance corrected

# MWD: Data vs Calculations
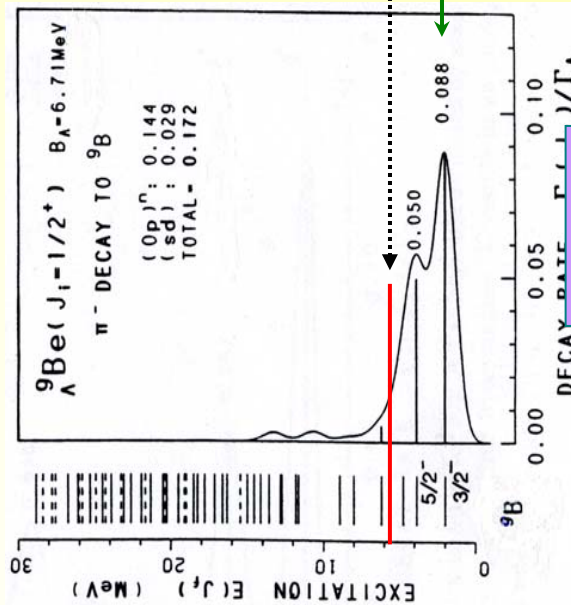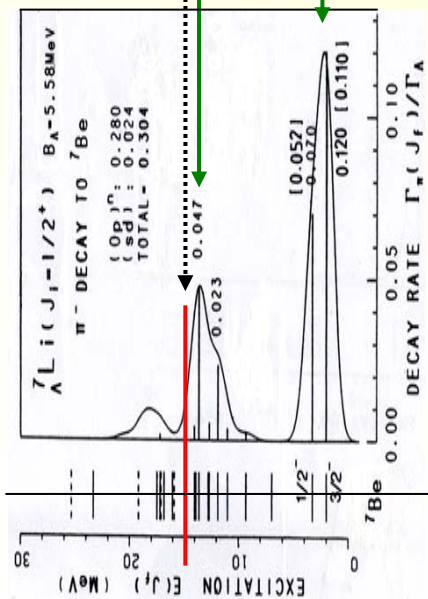
Calculated strenght function leading to the final nuclear states in the $\pi^-$ decay of $^7_\Lambda$Li and $^9_\Lambda$Be

T. Motoba and K. Itonaga, Progr. Theor. Phys. Suppl. 117 (1994), 477

# MWD: Data vs Calculations

Calculated strenght function for the $\pi^-$ decay of $^{11}_\Lambda B$ and $^{15}_\Lambda N$
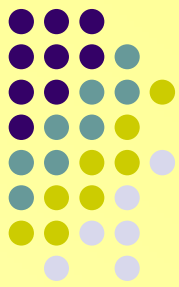
T. Motoba Pr. Th. Phys. Sup. 117 (1994), 477
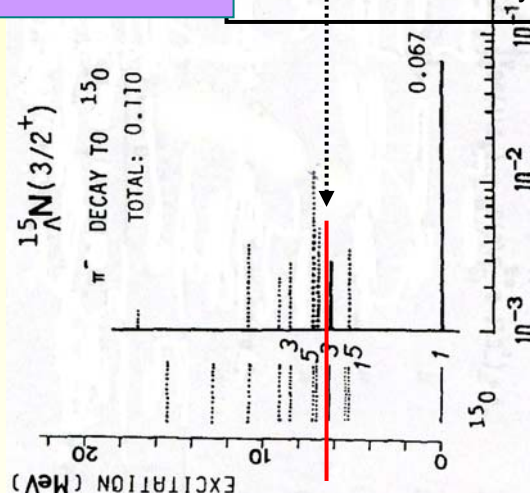
H. Bando et al., in Perspectives of Meson Science,
Eds. T. Yamazaki, K, Nakai and K. Nagamine, p.571

T. Motoba et al., NPA 489 (1988), 683

# MWD: Decay Rates

| | $\Gamma_{\pi^-}/\Gamma_\Lambda$ | T. Motoba Pr. Th. Phys. Sup. 117 (1994), 477 | experiments |
|---|---|---|---|
| $^5_\Lambda$He | $0.332\pm0.041^{+0.026}_{-0.021}$ | | $0.44\pm0.11$   PRC43 (1991) 849 <br><br> $0.340\pm0.016$   NPA 754 (2005) 173c |
| $^7_\Lambda$Li | $0.353\pm0.045^{+0.017}_{-0.013}$ <br><br> $0.233\pm0.029^{+0.017}_{-0.015}$ | 0.304 <br><br> 0.19 | |
| $^9_\Lambda$Be | $0.186\pm0.031^{+0.025}_{-0.017}$ | 0.172 | |
| $^{11}_\Lambda$B | $0.265\pm0.024^{+0.100}_{-0.043}$ | 0.213 | $0.22\pm0.05$   NPA 234 (1974) 413 <br><br> $0.23\pm0.06\pm0.03$   PRC 52 (1995) 2936 |
| $^{15}_\Lambda$N | $0.201\pm0.033^{+0.018}_{-0.014}$ | 0.09 | |

Good agreement with previous data and theoretical calculations

● present data

■ th. prediction

▲ previous data
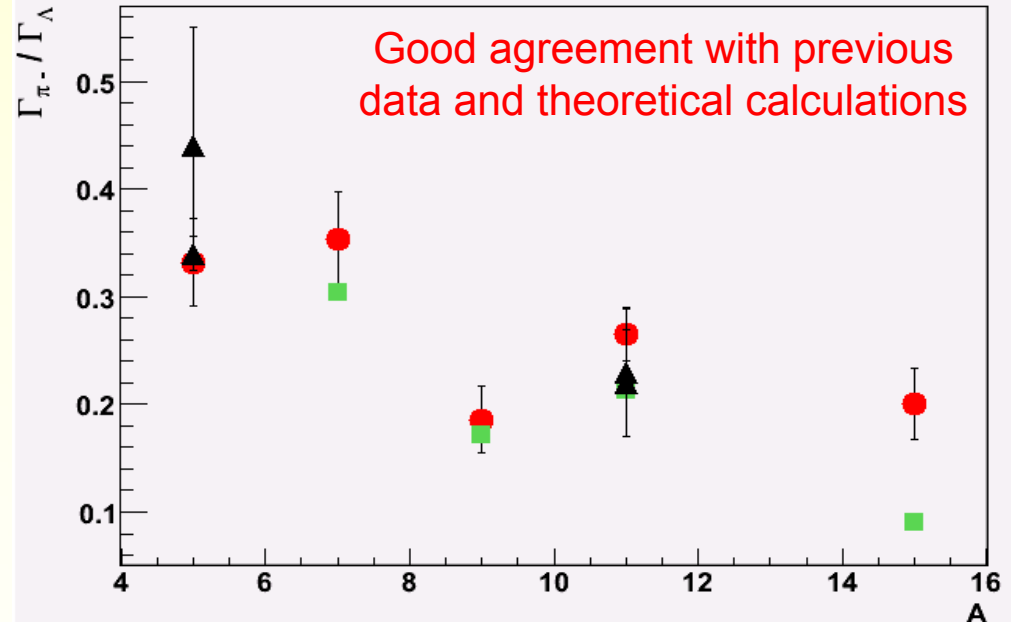
# Proton spectra from NMWD
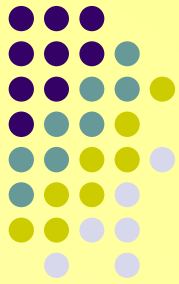
15 MeV

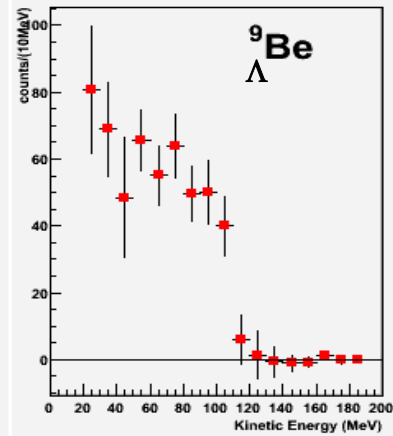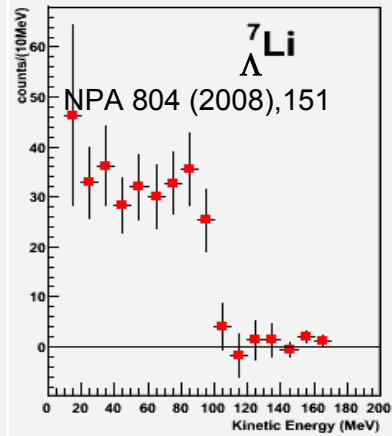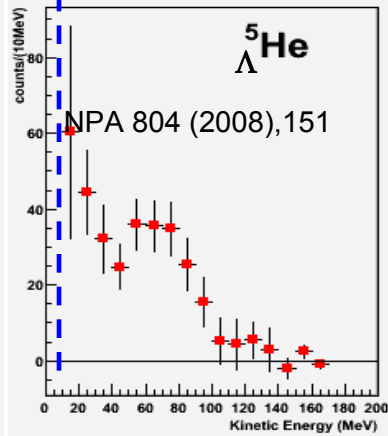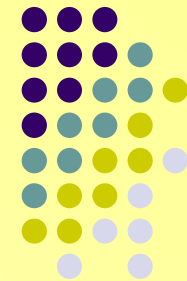K⁻np background subtracted and acceptance corrected
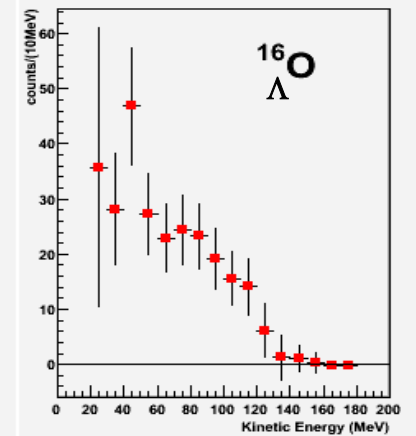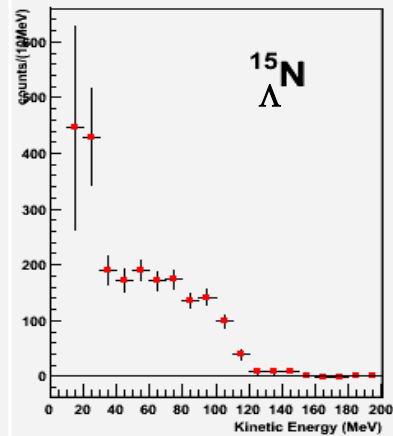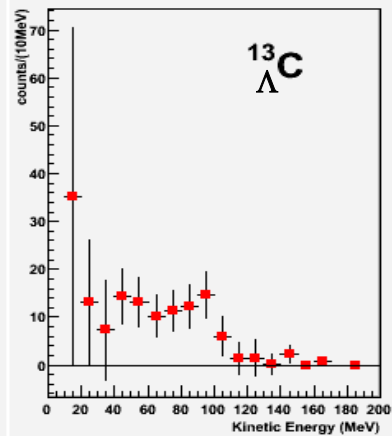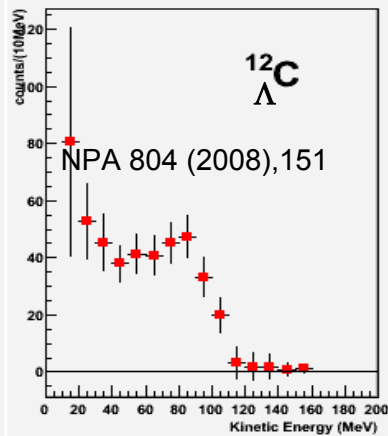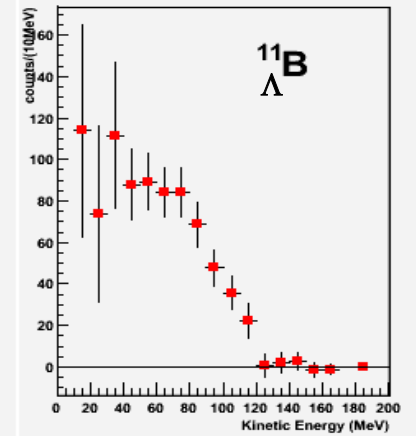
# NMWD: $R_p$

$$R_p = N_p^{detected} / (N_{hyp}^{detected} \, \varepsilon_p)$$
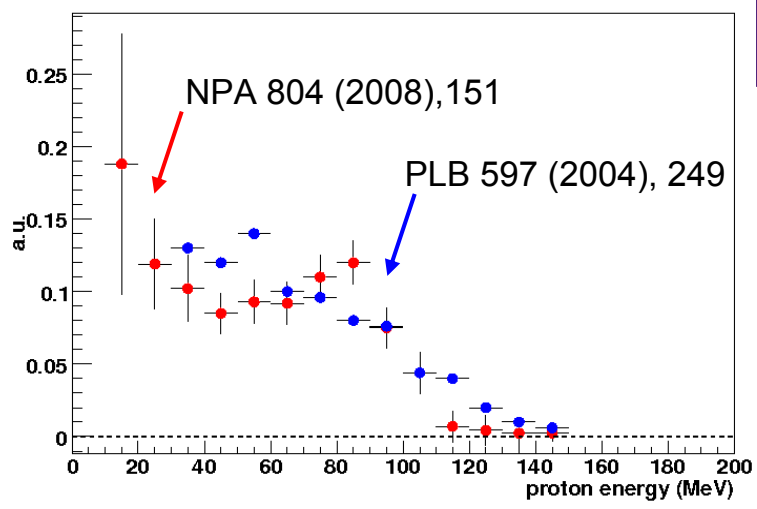
| Target | Hypernucleus | $R_p$ ($T_p > 15$ MeV) |
|---|---|---|
| $^6$Li & $^7$Li | $^5_\Lambda$He | 0.25±0.07 |
| $^7$Li | $^7_\Lambda$Li | 0.37±0.09 |
| $^9$Be | $^9_\Lambda$Be | 0.38±0.04 |
| $^{12}$C | $^{11}_\Lambda$B | 0.40±0.05 |
| $^{12}$C | $^{12}_\Lambda$C | 0.43±0.07 |
| $^{13}$C | $^{13}_\Lambda$C | 0.47±0.10 |
| $^{16}$O | $^{15}_\Lambda$N | 0.45±0.05 |
| $^{16}$O | $^{16}_\Lambda$O | 0.32±0.07 |

systematic error less than 5%
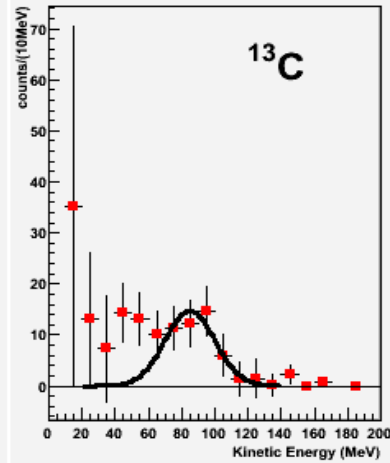
**$^{12}_{\Lambda}$C**

**$^{5}_{\Lambda}$He**

NPA 804 (2008),151

PLB 597 (2004), 249

PRC 69 (2004),054603

NPA 804 (2008),151

NPA 804 (2008),151

PLB 597 (2004), 249

PRC 69 (2004),054603
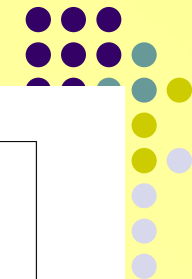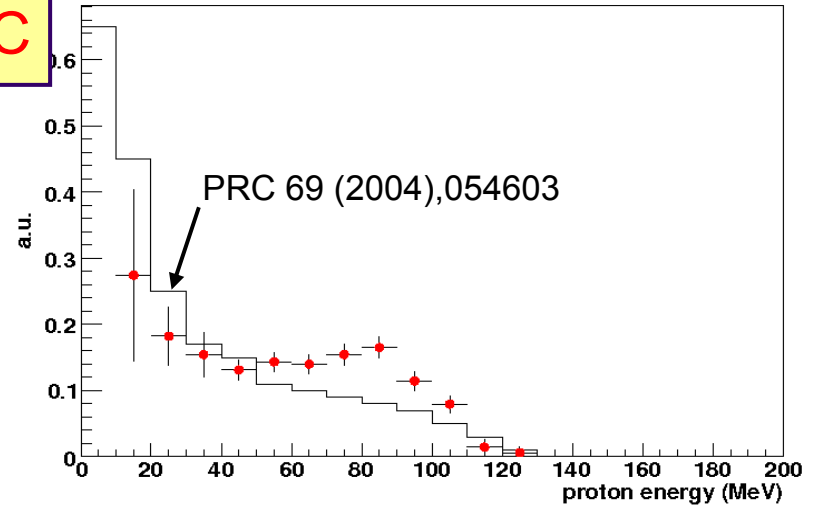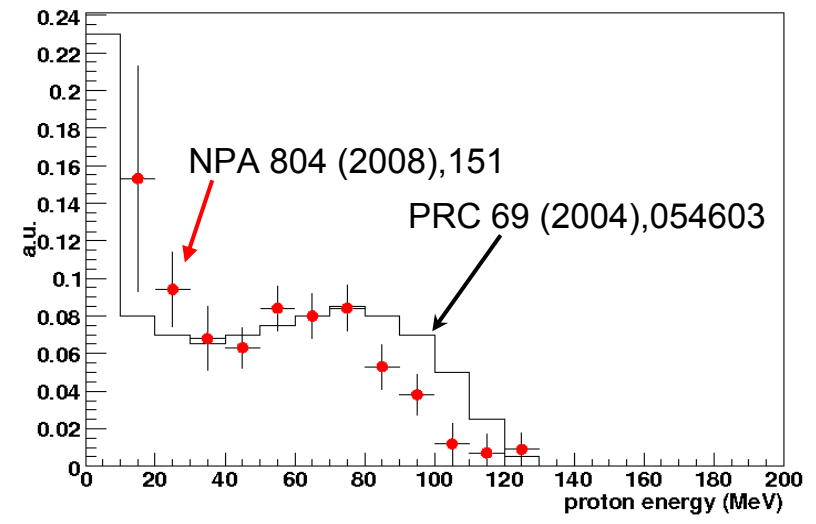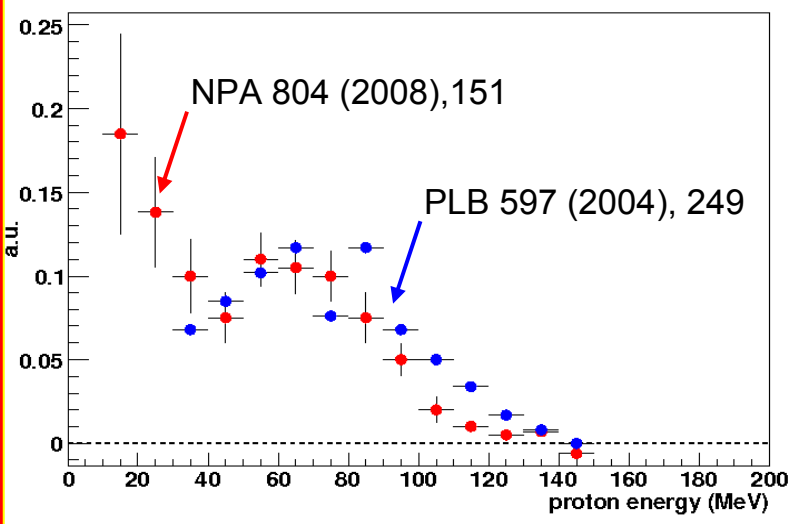
# NMWD: FSI & Λnp
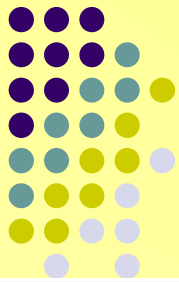
Low energy spectrum beyond gaussian : FSI and 2N induced NMWD

Area under gaussian: only 1N induced NMWD

# NMWD: FSI & Λnp evaluation

**Λnp contribution**

H. Bhang et al. EPJ A33 (2007), 259

W.M. Alberico et al., PRC 61 (2000) 044314

G. Garbarino et al., PRC69 (2004) 054603

Top graph:

χ² / ndf    0.3862 / 6
p0    0.3315 ± 0.08957
p1    0.02395 ± 0.01109

(FSI & Λnp) / total vs A-2
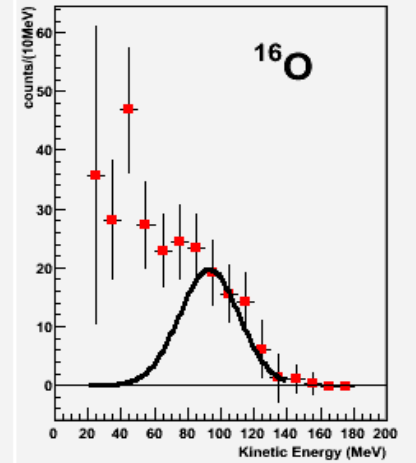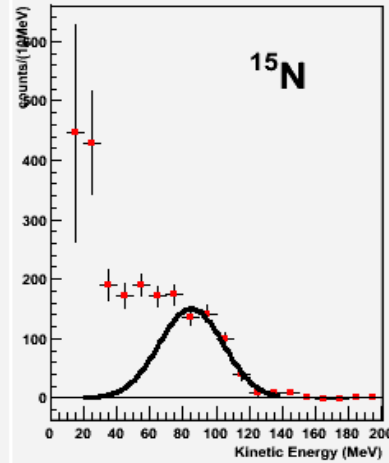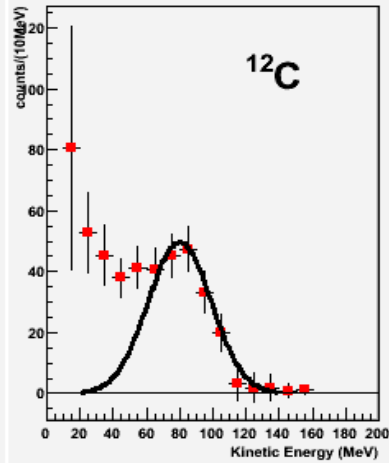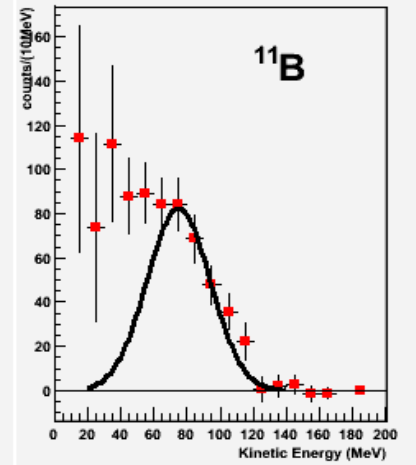
FSI
A-2 linear dependence

Bottom graph:

χ² / ndf    0.3256 / 6
p0    0.4504 ± 0.1043
p1    0.02118 ± 0.01237

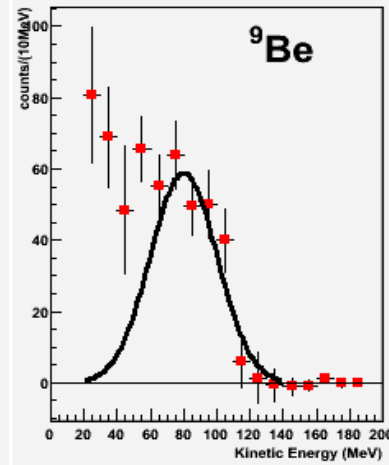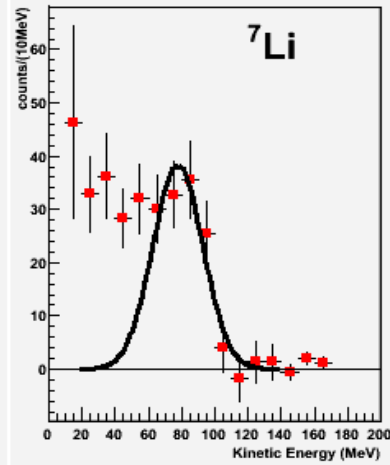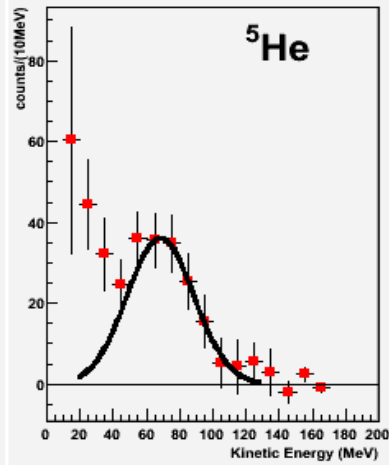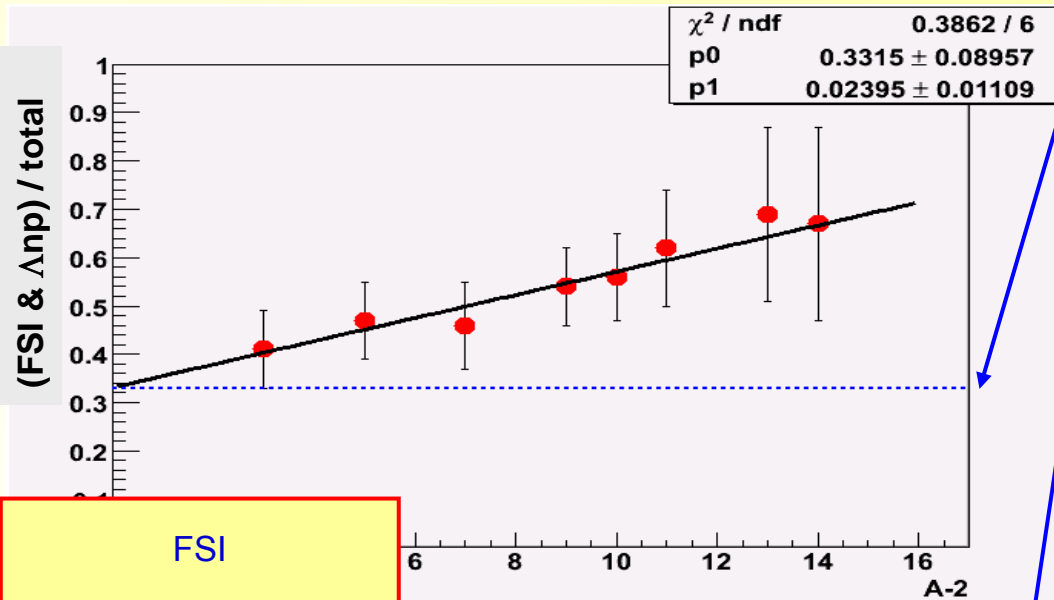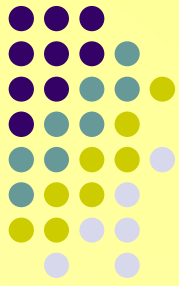(FSI & Λnp) / total vs A-2

| | (FSI + Λnp)/total | (FSI + Λnp)/total extrapolated |
|---|---|---|
| $^{5}_{\Lambda}$He | 0.41±0.08 | 0.53±0.10 |
| $^{7}_{\Lambda}$Li | 0.47±0.08 | 0.56±0.09 |
| $^{9}_{\Lambda}$Be | 0.46±0.09 | 0.61±0.10 |
| $^{11}_{\Lambda}$B | 0.54±0.08 | 0.62±0.09 |
| $^{12}_{\Lambda}$C | 0.56±0.09 | 0.64±0.09 |
| $^{13}_{\Lambda}$C | 0.62±0.12 | 0.73±0.12 |
| $^{15}_{\Lambda}$N | 0.69±0.18 | 0.75±0.19 |
| $^{16}_{\Lambda}$O | 0.67±0.20 | 0.77±0.20 |

# Conclusions

- Mesonic s,p-shell hypernuclei decay:

sistematic study from $^5_\Lambda$He to $^{15}_\Lambda$N: spectra and $\Gamma_{\pi-}$

first measurement of for $^7_\Lambda$Li, $^9_\Lambda$Be and $^{15}_\Lambda$N

momentum threshold: 80 MeV/c

- **Non-Mesonic s,p-shell hypernuclei decay:**

**sistematic study from $^5_\Lambda$He to $^{16}_\Lambda$O: spectra and $R_p$**

**first measurement of for $^7_\Lambda$Li, $^9_\Lambda$Be, $^{11}_\Lambda$B, $^{13}_\Lambda$C, $^{15}_\Lambda$N and $^{16}_\Lambda$O**

**energy threshold: 15 MeV**