The 12th International Conference on Hyper Nuclear and Strange Particle Physics (HYP2015)
Sendai, Japan (7th-12th, September, 2015)

Λ^*-p Structure of K^-pp and Theoretical Analysis of Recent Data from J-PARC

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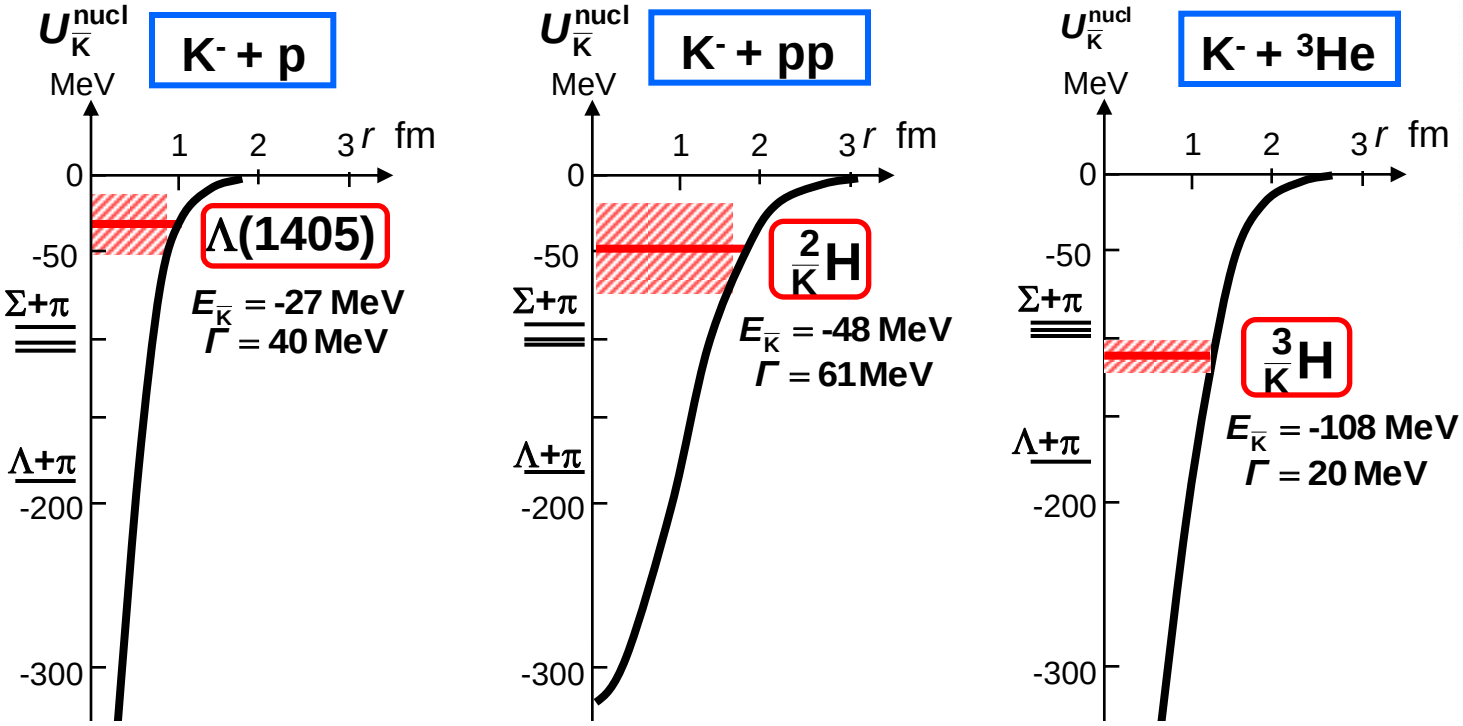
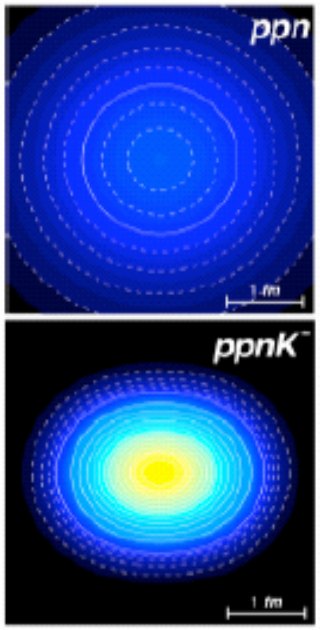
"Λ(1405) Ansatz"

The most relevant issue is:

⟸ 1405 or 1420 ?



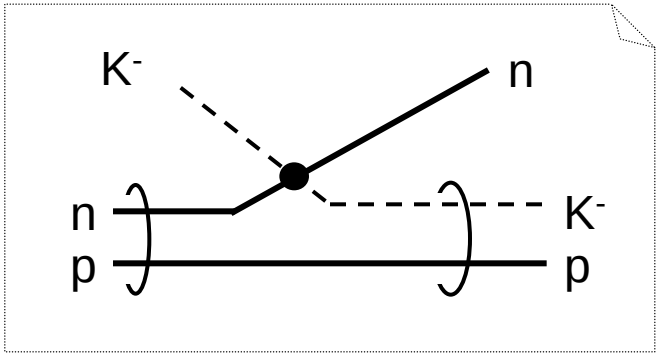


Shrinkage!

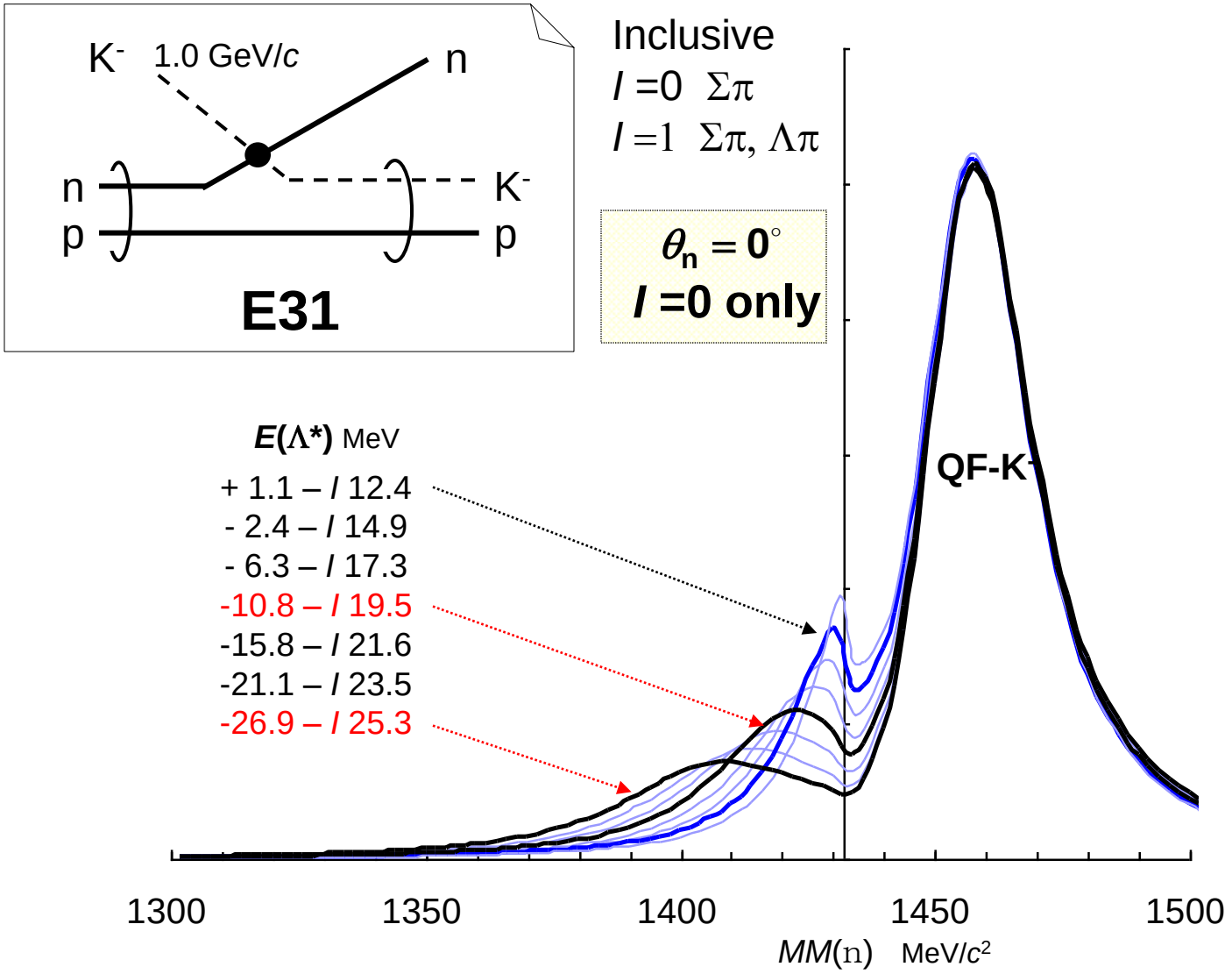
N.V. Shevchenko, A. Gal & J. Mares, Phys. Rev. Lett. 98 (2007) 082301
E = **-55~-70** MeV, Γ = **90~110** MeV
Y. Ikeda & T. Sato, Phys. Rev. C 76 (2007) 035203
E = **-80** MeV, Γ = **73** MeV
A. Dote, T. Hyodo & W. Weise, Phys. Rev. C 79 (2009) 014003
E = **-20**+-**3** MeV, Γ = **40~70** MeV

Y. Akaishi & T. Yamazaki, Phys. Rev. C 65 (2002) 044005
T. Yamazaki & Y. Akaishi, Phys. Lett. B 535 (2002) 70

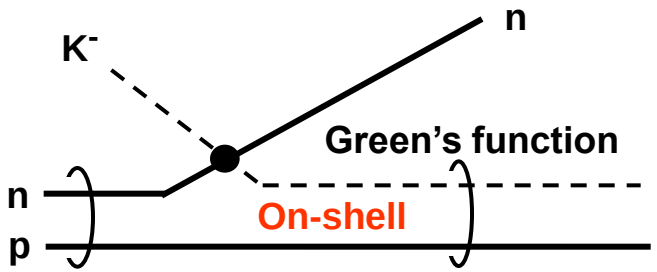
J-PARC E31 experiment



D(K⁻, n) missing mass spectrum



Missing and invariant mass spectra

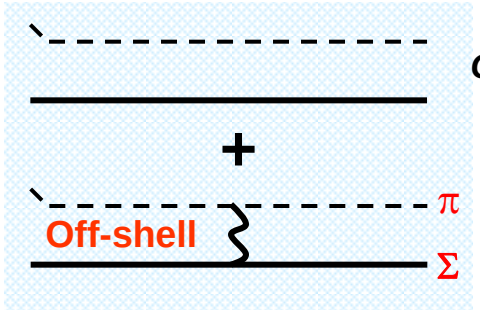


$$\left.\right) \equiv \lim_{\varepsilon\to 0'} \frac{i\varepsilon}{E-H+i\varepsilon} = |\Psi_E\rangle\langle\Psi_E|, \quad (E-H)\Psi_E=0$$

$$G = \frac{1}{E-H+i\varepsilon}$$ **Missing mass**

Eigenstate of *H*(Kp-Σπ)

=

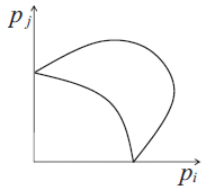


$$G_0 = \frac{1}{E-H_0+i\varepsilon}$$ **Quasi-free K** :

G_0TG_0 **Invariant mass** (Σπ, ..)

Non-eigenstate of *H*

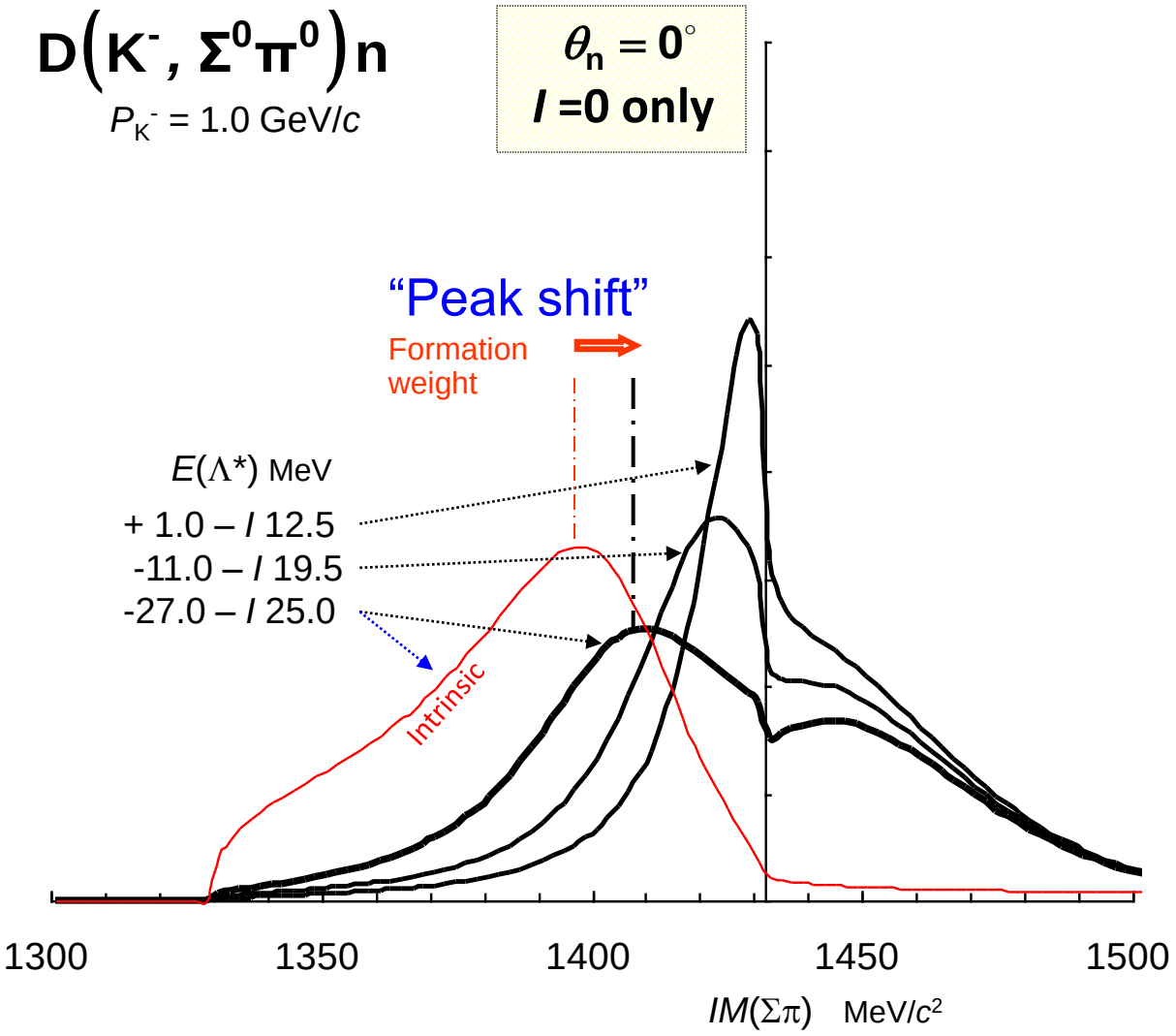
Singularities appear above threshold.



Moon-shaped singularity

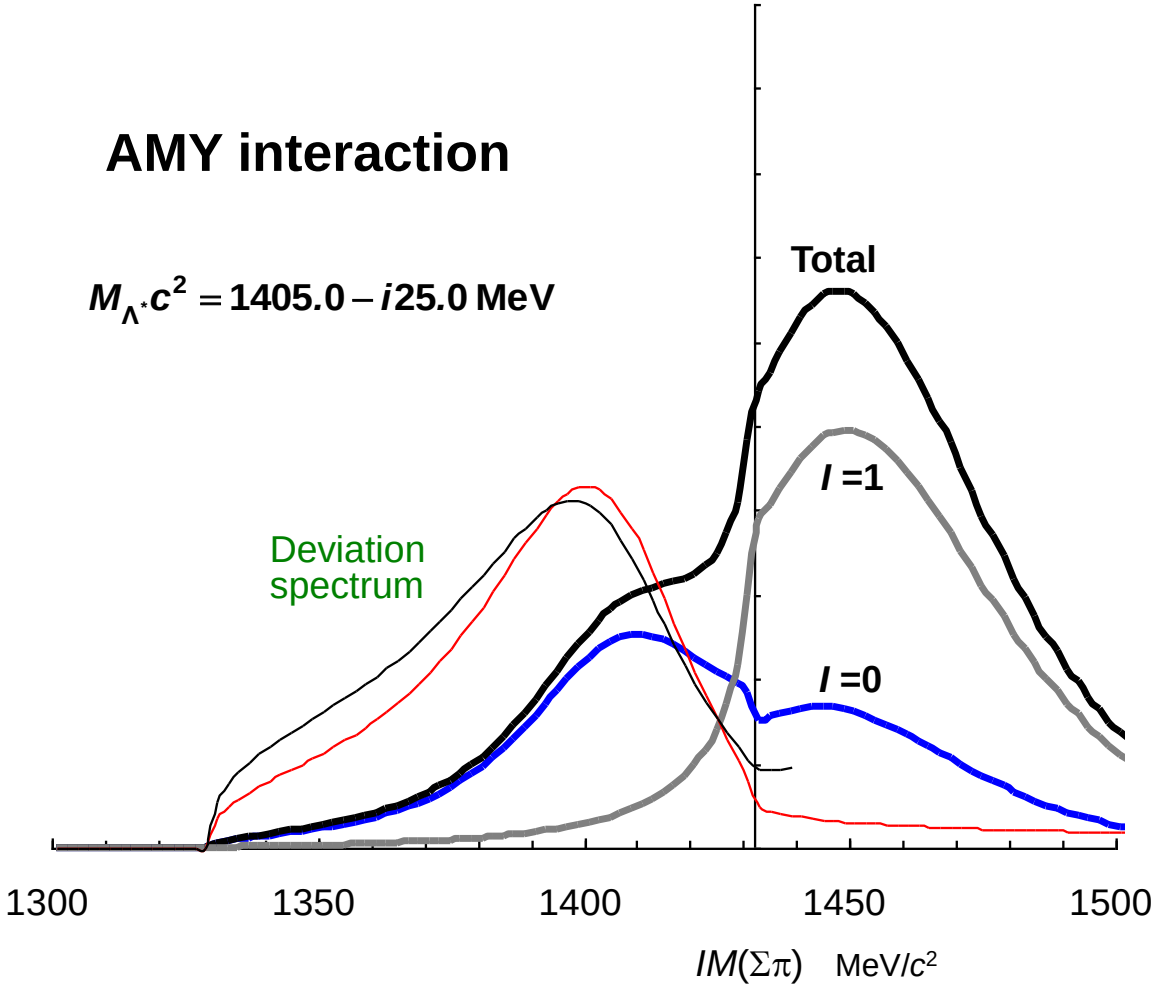
ε=0.1 MeV with $\Delta\cos\theta$=0.002

$\Sigma^0\pi^0$ invariant-mass spectrum



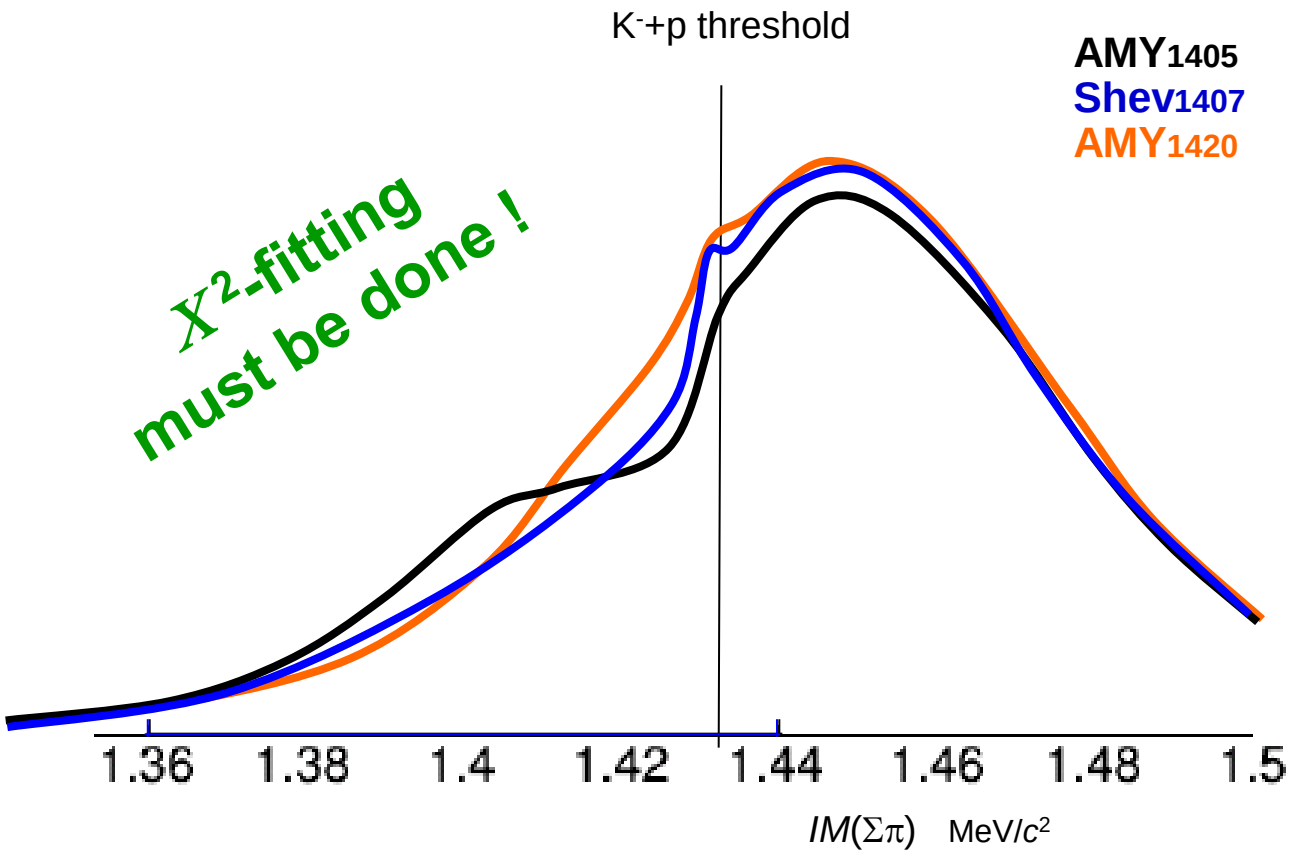
$\Sigma^{\pm}\pi^{\mp}$ invariant-mass spectrum

$D\left(K^{-}, \Sigma^{\pm}\pi^{\mp}\right)n_{\theta_n = 0^{\circ}}$



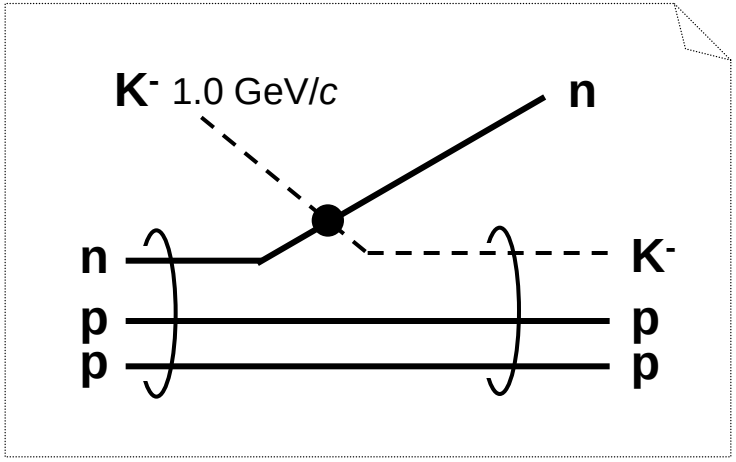
Invariant-mass spectrum of $D(K^-, \Sigma^{\pm}\pi^{\mp})n$

$\theta_n = 0^\circ$



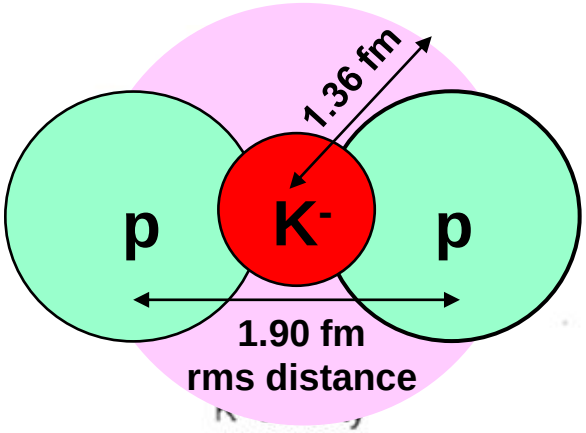
The $\Lambda(1405)$ peak position is shifted on the order of 10 MeV
by the formation weight of Λ^* ,
and is masked by I=1 tail component in the E31 spectrum.

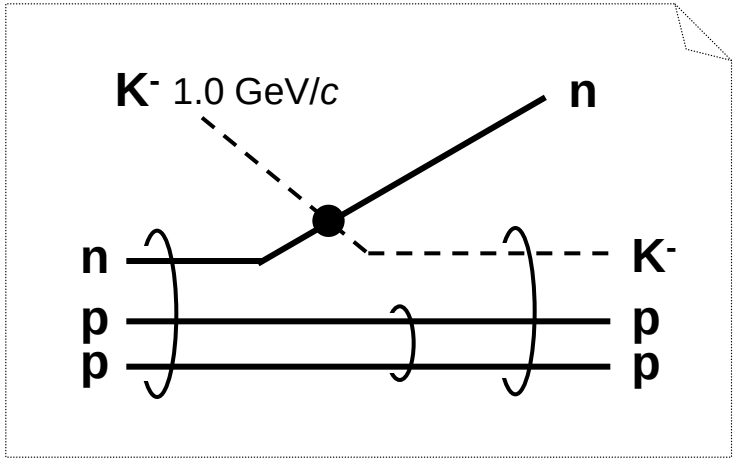
Missing mass spectrum from ^{3}He(K^{-},n) E15 experiment

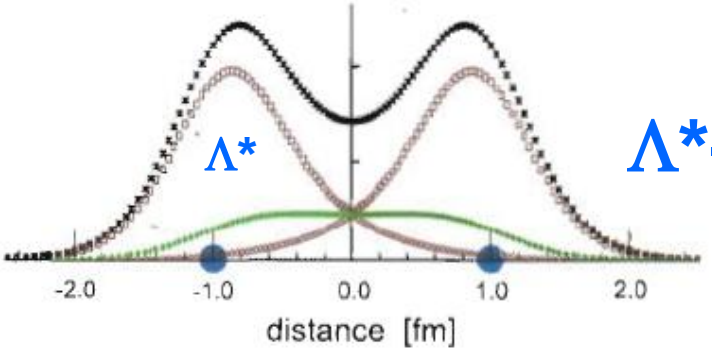


K^-pp quasi-bound state

2002

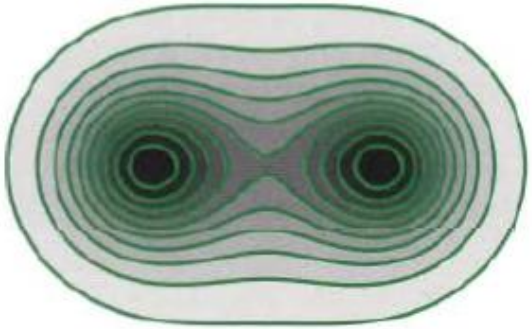


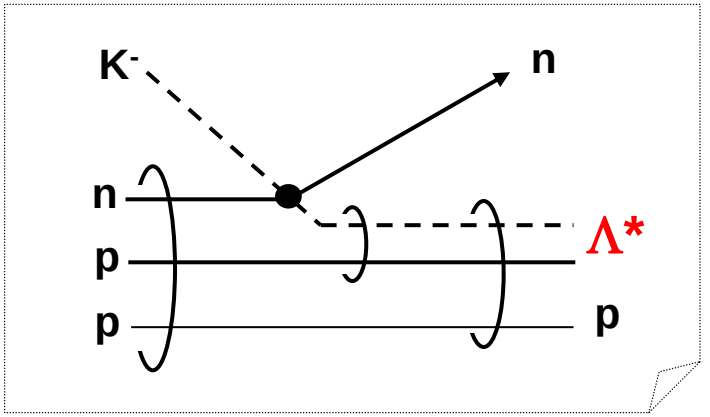




Λ*-p structure

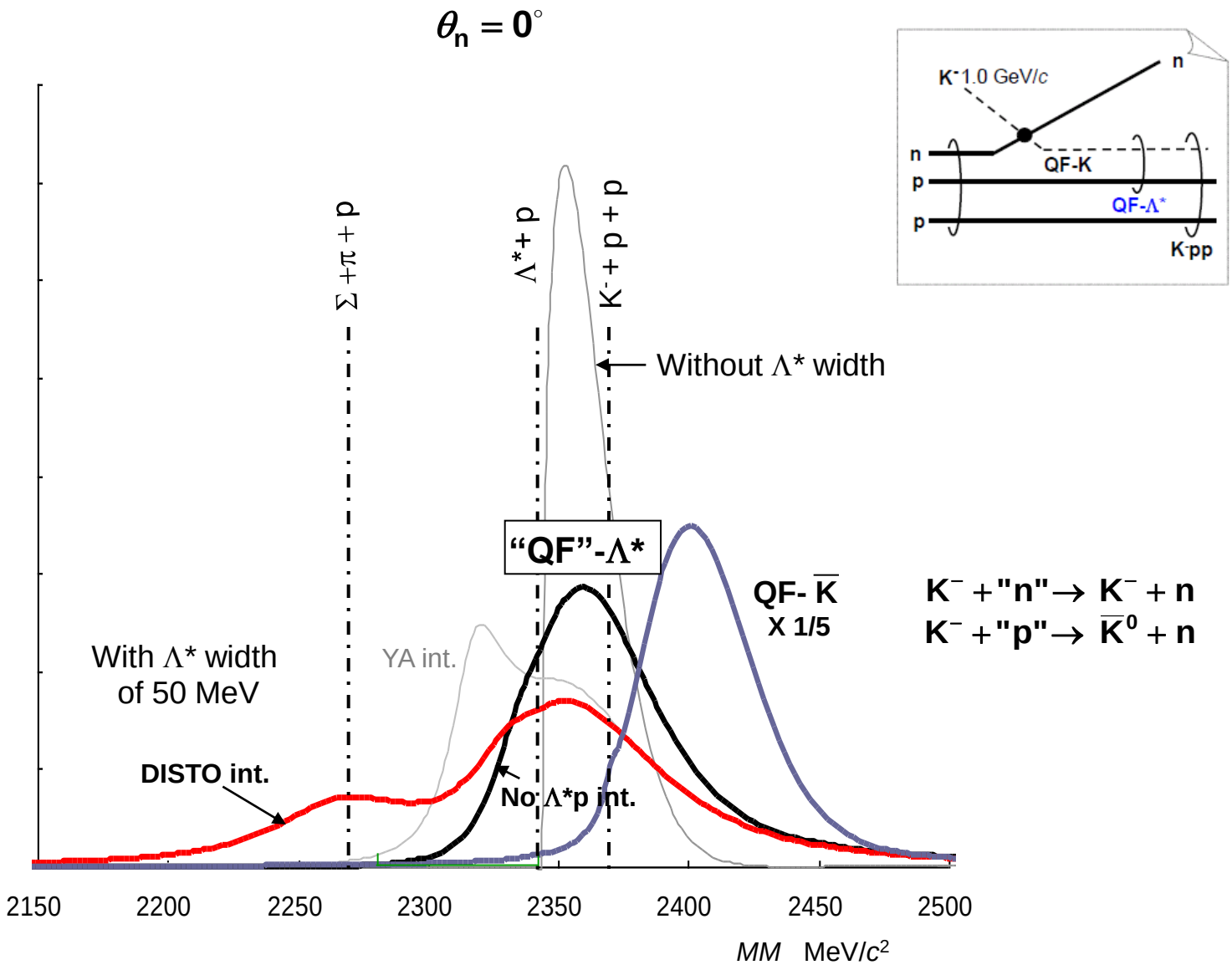
2007



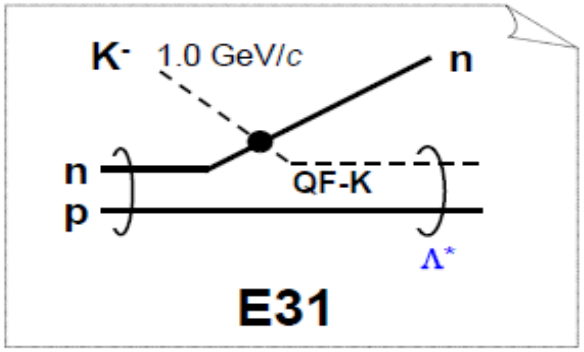


T. Yamazaki and Y. Akaishi, Phys. Rev. C 76 (2007) 045201

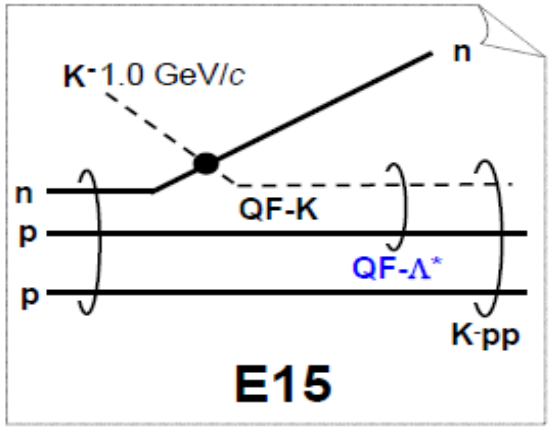
Missing mass spectrum of Λ*-p system



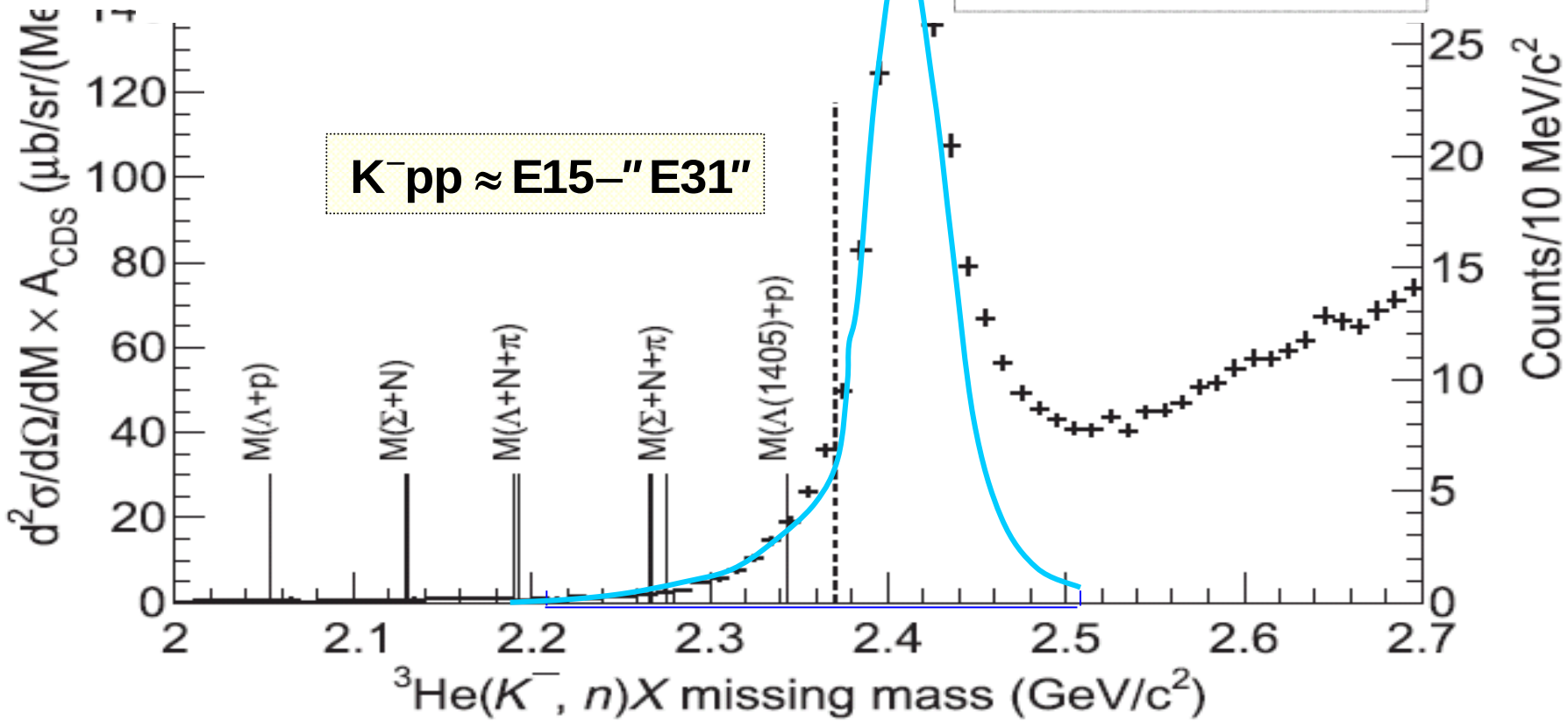
Semi-inclusive neutron spectrum



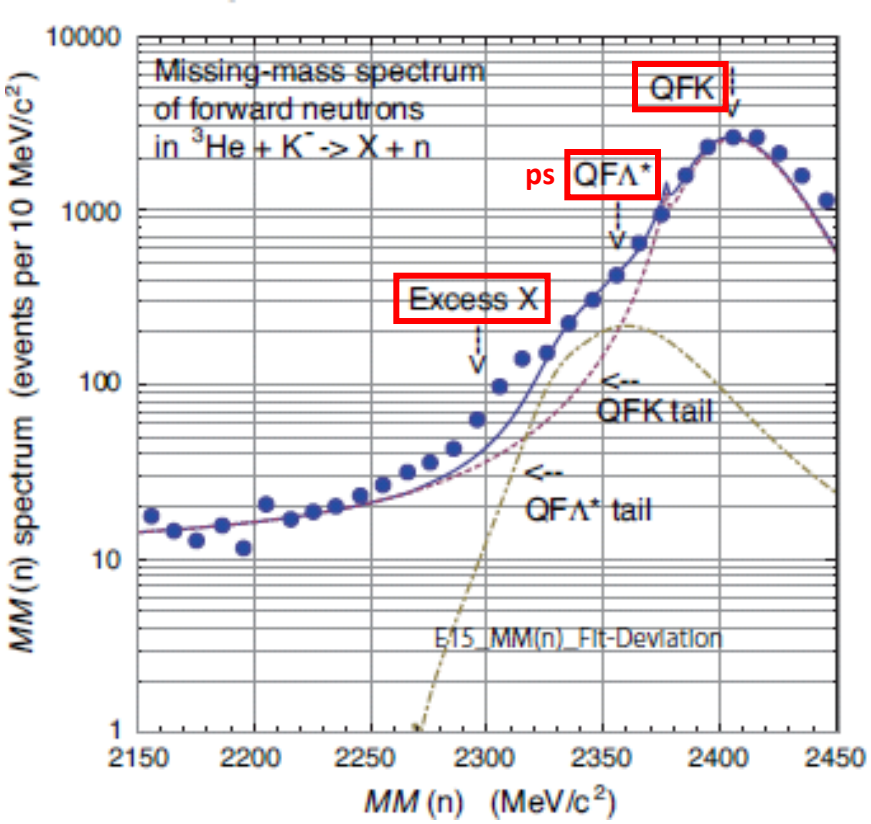
Useful information



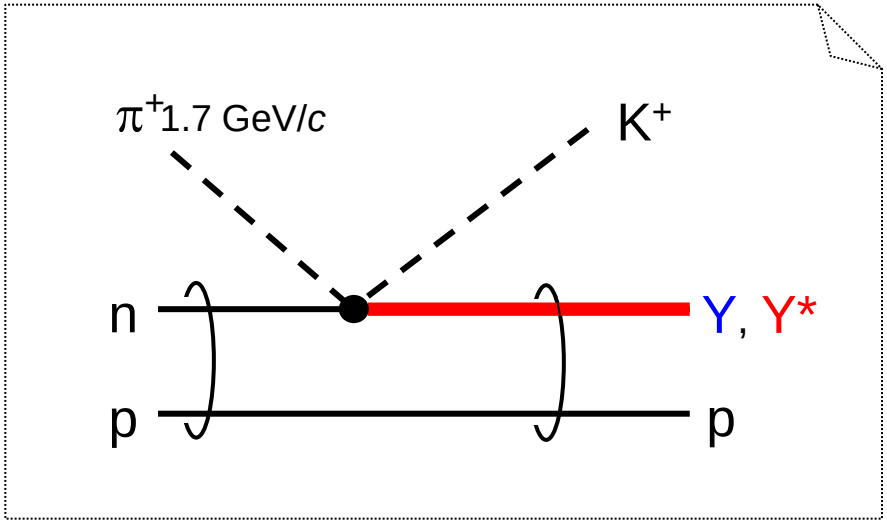
$K^-pp \approx$ E15 – "E31"



Semi-inclusive neutron spectrum

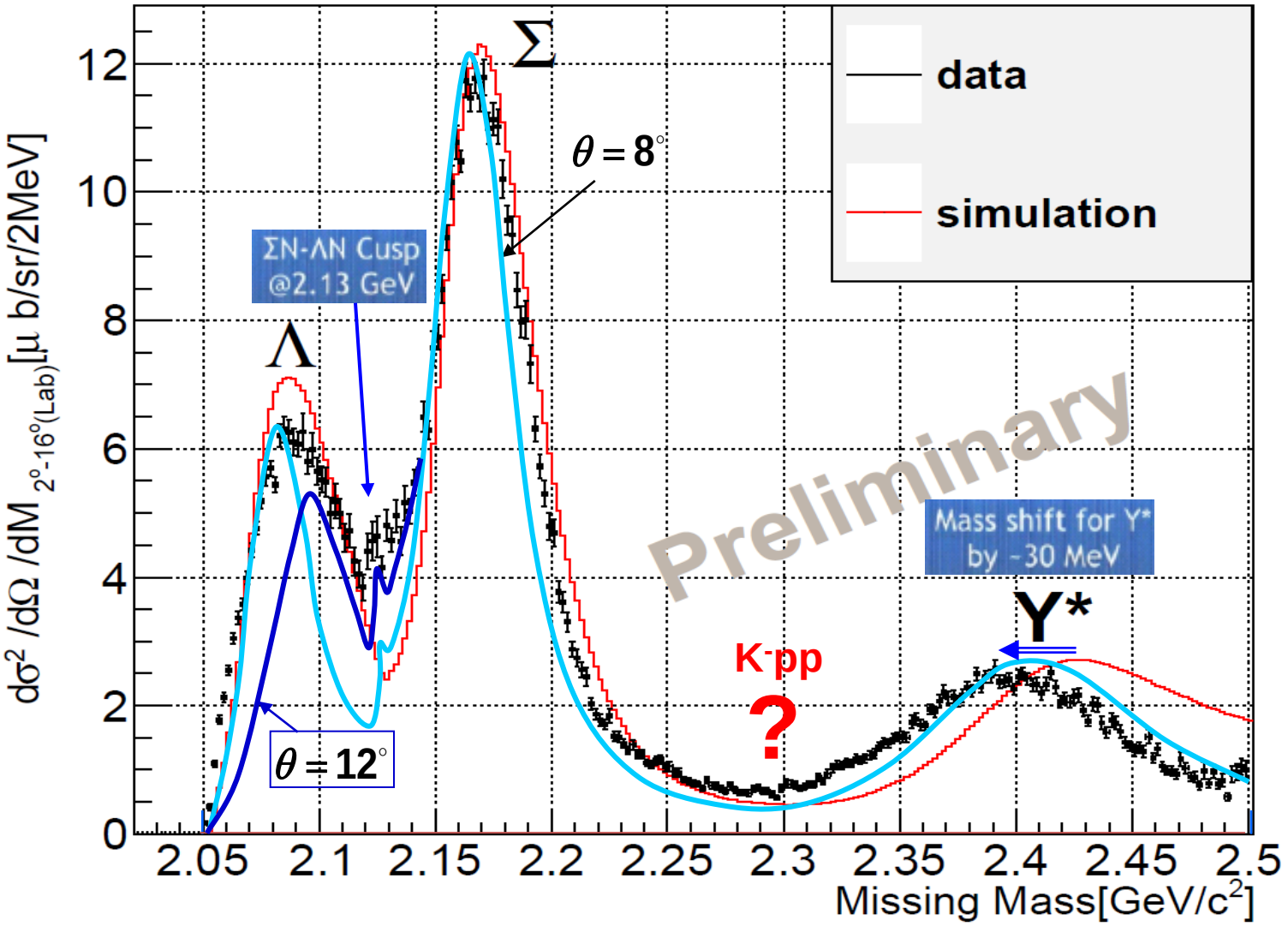


Missing mass spectrum from D(π^+,K^+) E27 experiment



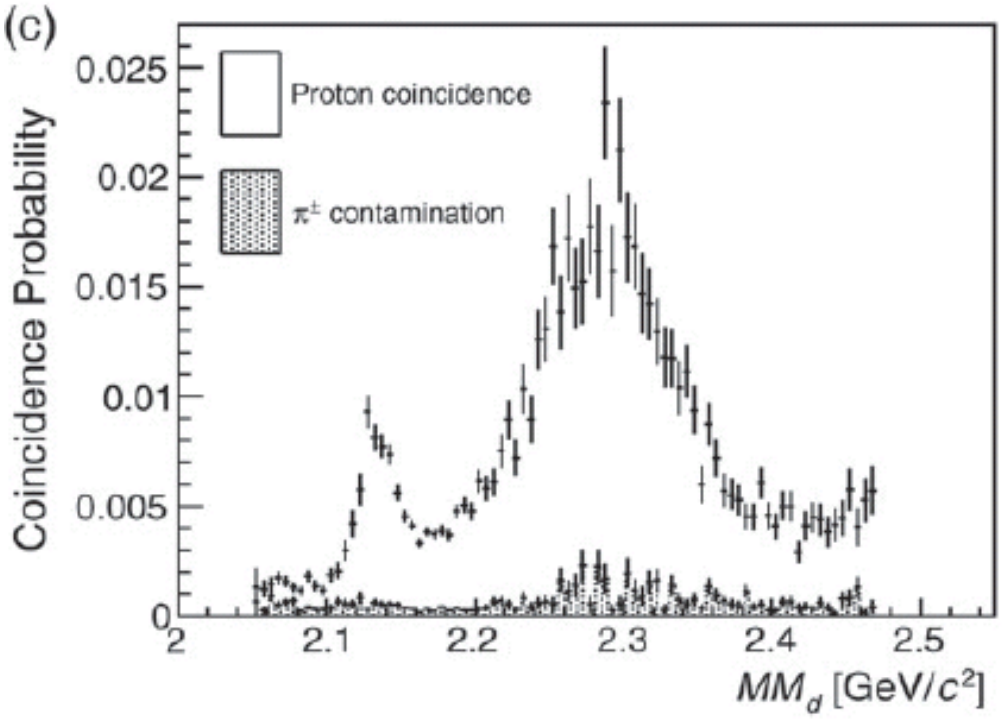
Inclusive spectrum

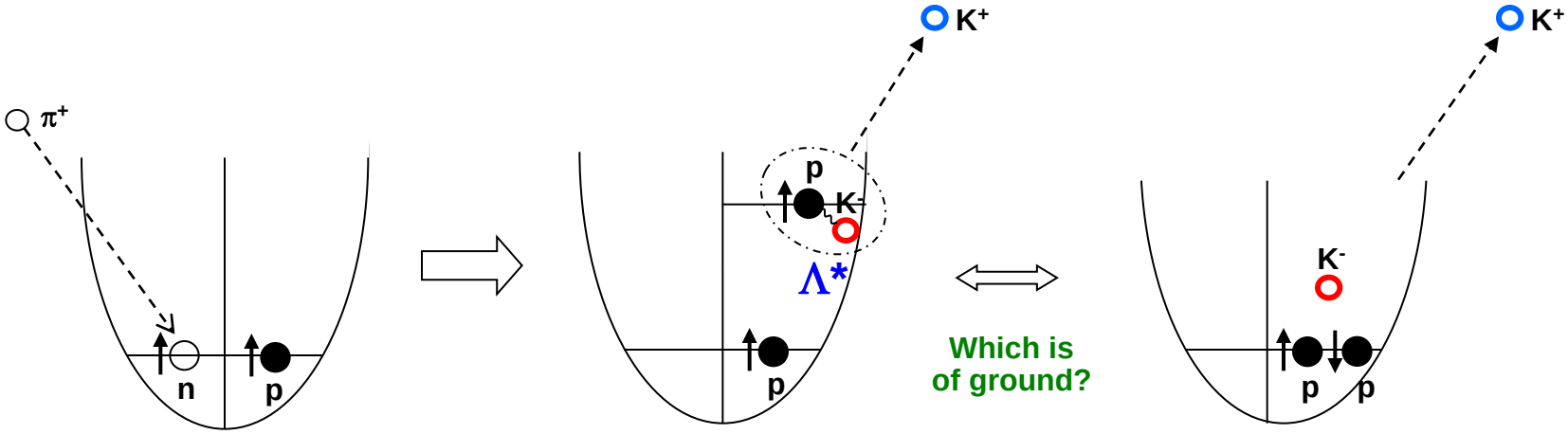
Y. Ichikawa et al., Proc. Science (Nara Conf. 2013)



E27@J-PARC

Y. Ichikawa et al.,
Prog. Theor. Exp. Phys. 2015, 021D01

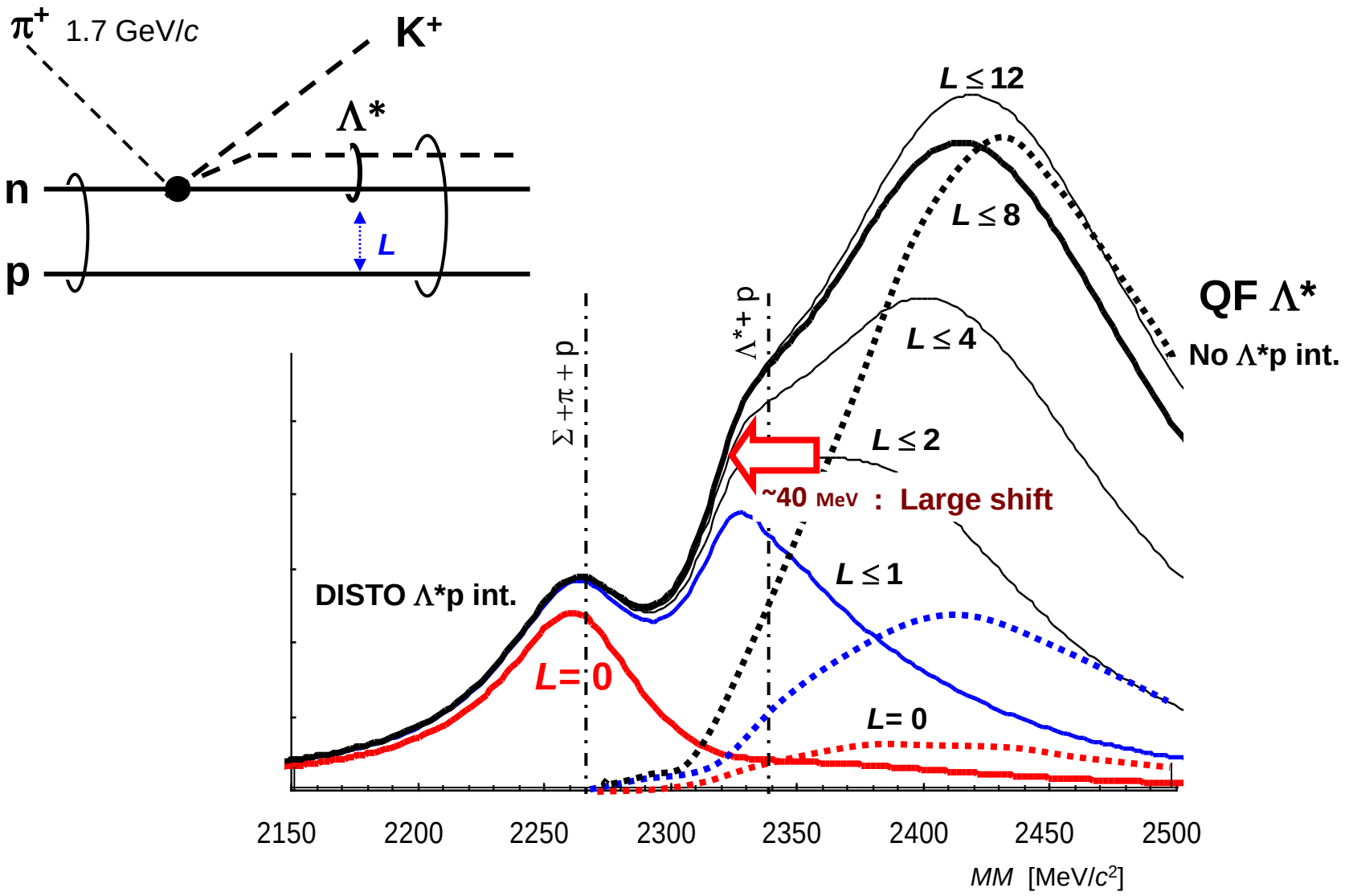




Λ^*- p structure

K^-pp structure

Angular-mom. decomposition of the Λ*-p pair



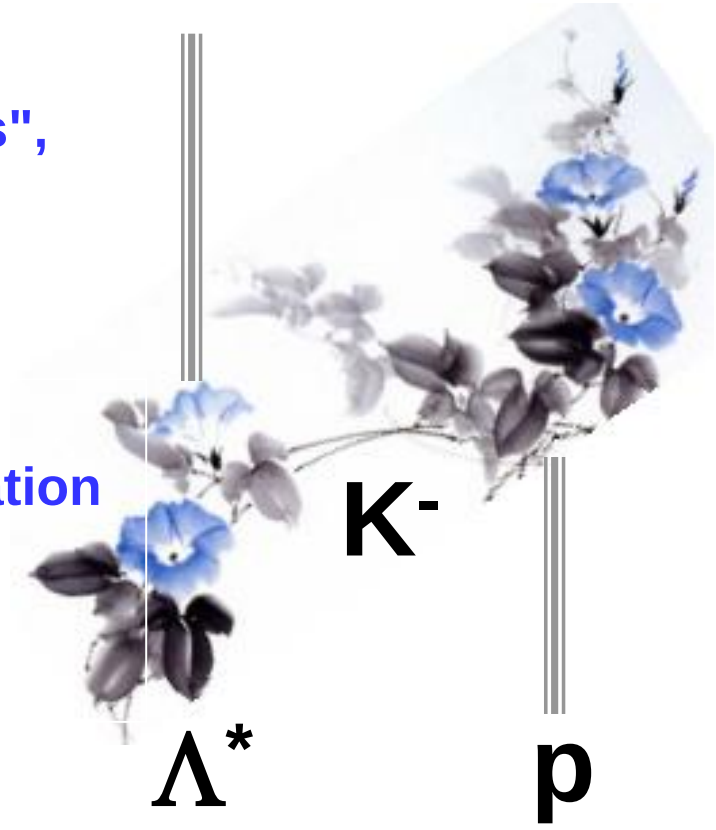
react-piK/D_piK_Mod1B.f

Concluding remarks

The Λ^*= Λ(1405) plays an essential role in forming "anti-Kaonic Nuclear Clusters", the simplest one of which is

$$K^-pp = (K^-p)–p = \Lambda^*–p.$$

The Λ^*–p structure interacting with super-strong attraction due to K^{bar} migration provides a possible explanation of recent J-PARC data, E31, E15 and E27, consistently.



Thank you very much!