Experimental confirmation of the Λ(1405) Anzatz from resonant formation of a K^-p quasi-bound state in the K^- absorption by ^3He, ^4He and d

Where is the position of the I=0 L=0 K^-p quasi-bound state?

$\Lambda^*(1405)$ or $\Lambda^*(1420)$?

J. ESMAILI,

Y. AKAISHI & T. YAMAZAKI

t-spectator process for stopped K^- on ^{4}He

Separable potential with a Yukawa type form

$$\left\langle \vec{k}' \middle| v_{ij} \middle| \vec{k} \right\rangle = g(\vec{k}') U_{ij} g(\vec{k}) \qquad g(\vec{k}) = \frac{\Lambda^2}{\Lambda^2 + \vec{k}^2}$$

$$U_{ij} = \frac{1}{\pi^2} \frac{\hbar^2}{2\sqrt{\mu_i \mu_j}} \frac{1}{\Lambda} s_{ij} \qquad \Lambda = 770 MeV/\hbar c = 3.9\, fm^{-1}$$

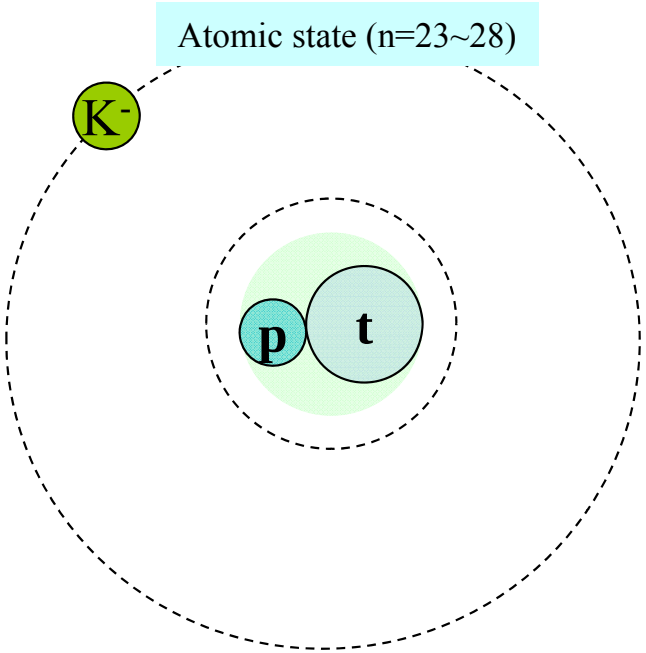
T-matrix of elementary process

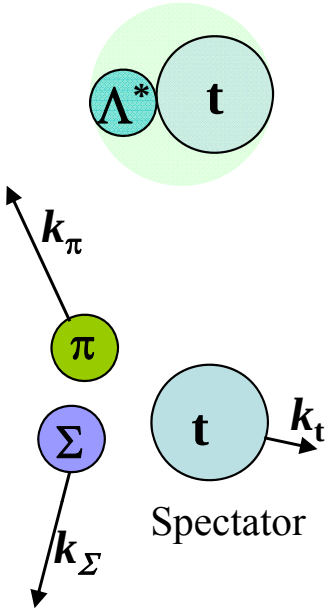
$$T = \left[1 - UG\right]^{-1} U, \qquad -(UG)_{ij} = \frac{s_{ij}\Lambda^2}{(\Lambda - ik)^2} \sqrt{\frac{\mu_j}{\mu_i}}$$

Partial invariant mass spectra

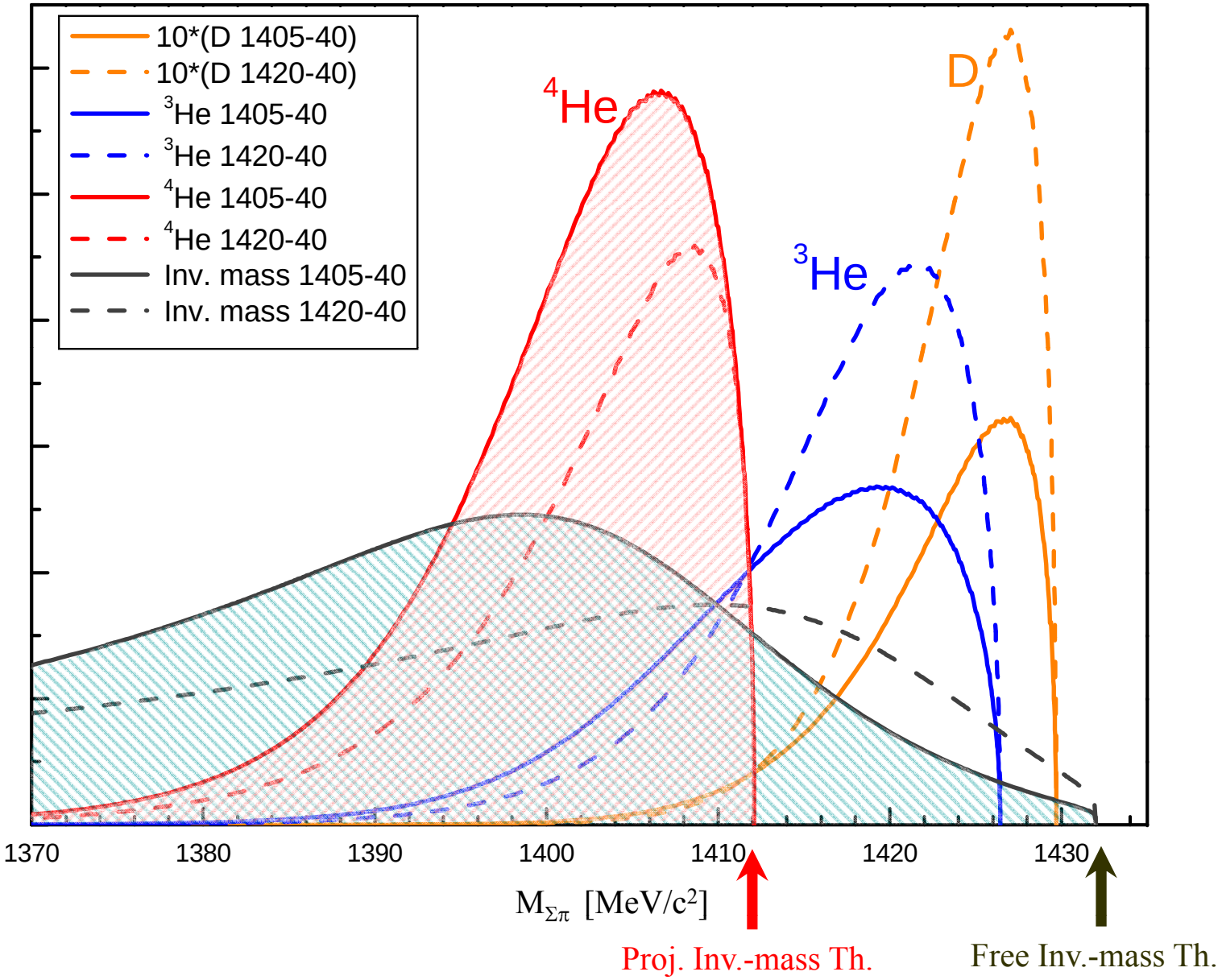
$$\frac{d\Gamma}{dk_t} = \int_0^\infty dk_\Sigma \frac{d^2\Gamma}{dk_\Sigma dk_t}$$

$$\frac{d\Gamma}{d(M_{\Sigma\pi}c^2)} = \frac{E_t}{\hbar^2 c^2 k_t} \frac{\sqrt{E_i^2 + M_t^2 c^4 - 2E_i E_t}}{E_i} \frac{d\Gamma}{dk_t}$$



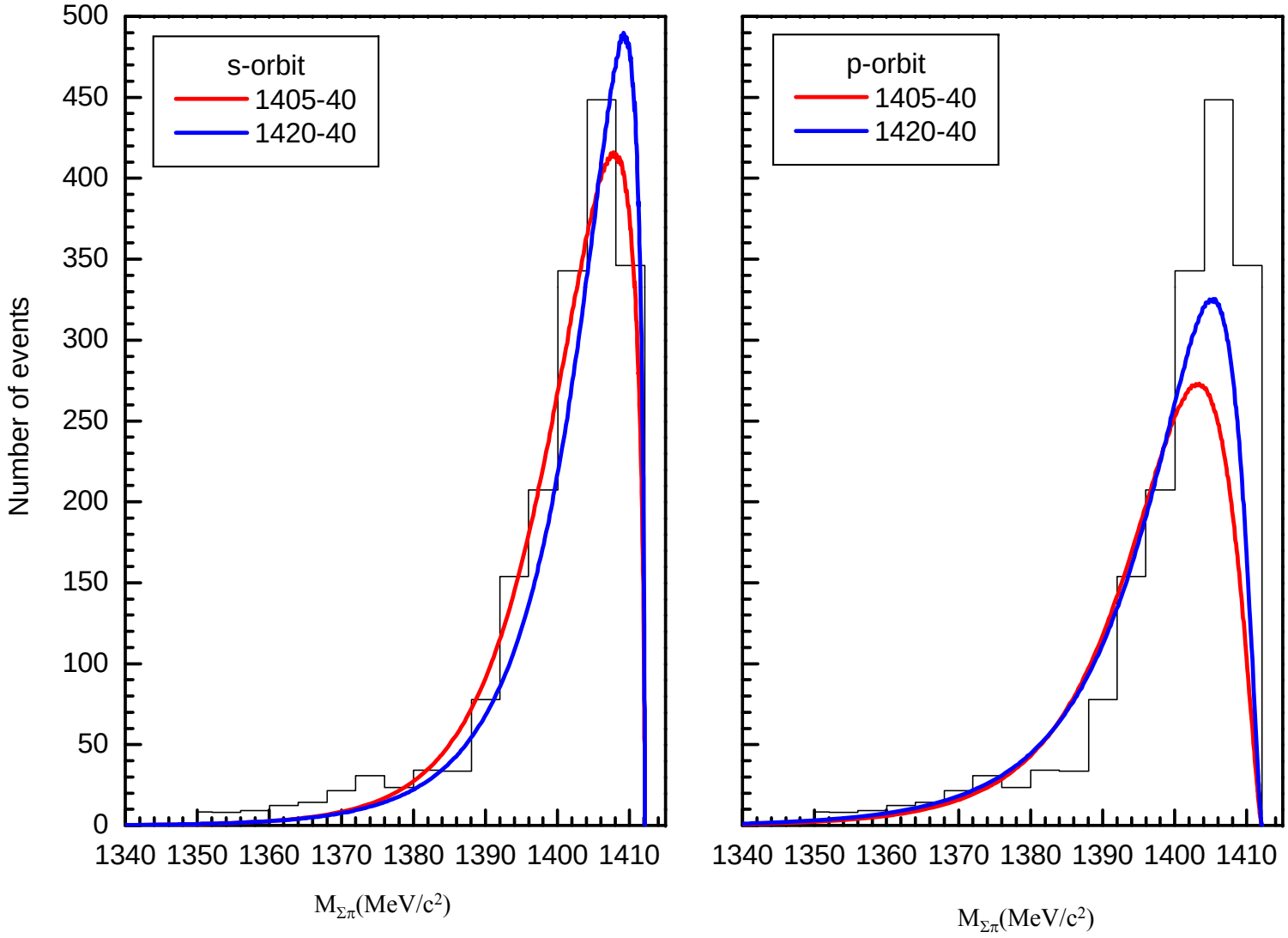


$\Sigma\pi$ partial invariant-mass spectra

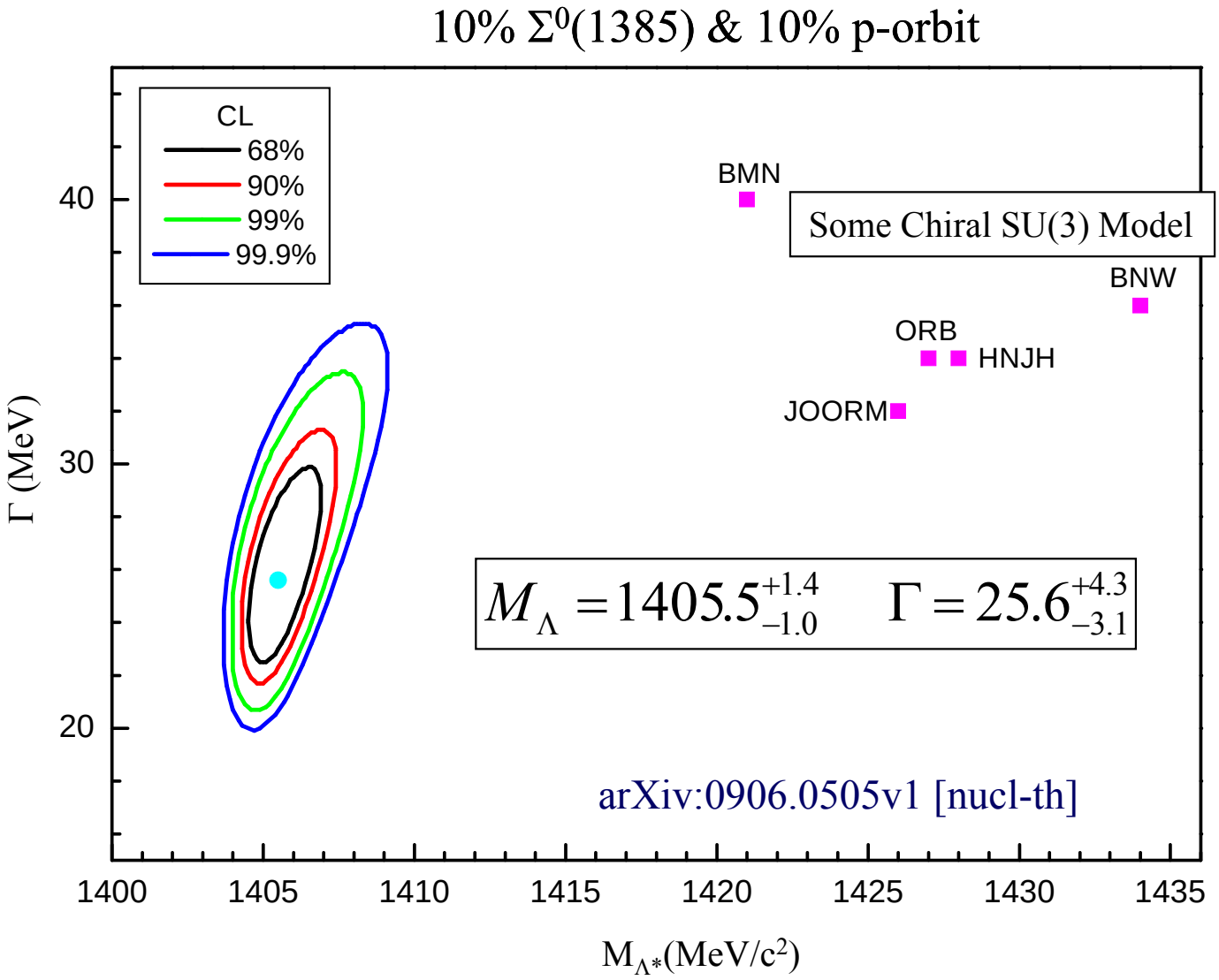


S or P ?

$K^- {}^4He \to \pi^{\pm} {}^3H \Sigma^{\mp}$ Riley et al. Phys. Rev. D **11** (1975) 3065



Confidence Level

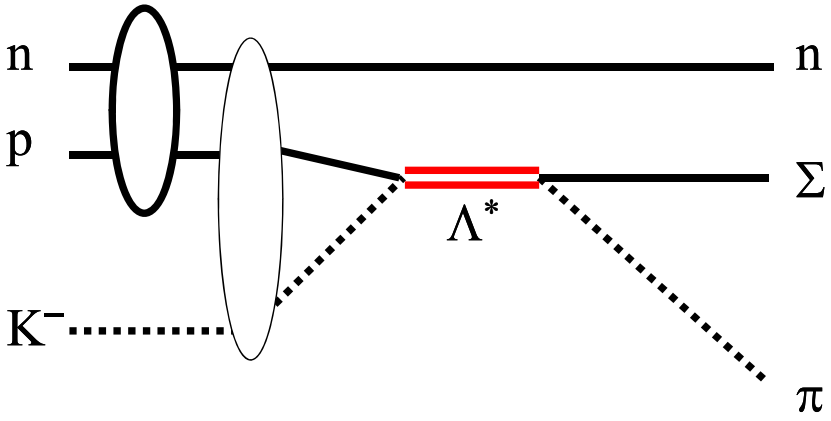


"**ORB**": E. Oset, A. Ramos & C. Bennhold, Phys. Lett. B 527 (2002) 99
"**HNJH**": T. Hyodo, S.I. Nam, D. Jido & A. Hosaka, Phys. Rev. C 68 (2003) 018201
"**BNW**": B. Borasoy, R. Nissler & W. Weise, Eur. Phys. J. A 25 (2005) 79
"**BMN**": B. Borasoy, U.G. Meissner & R. Nissler, Phys. Rev. C 74 (2006) 055201
"**JOORM**": D. Jido, J.A. Oller, E. Oset, A. Ramos & U.G. Meissner, Nucl. Phys. A 725 (2003) 181

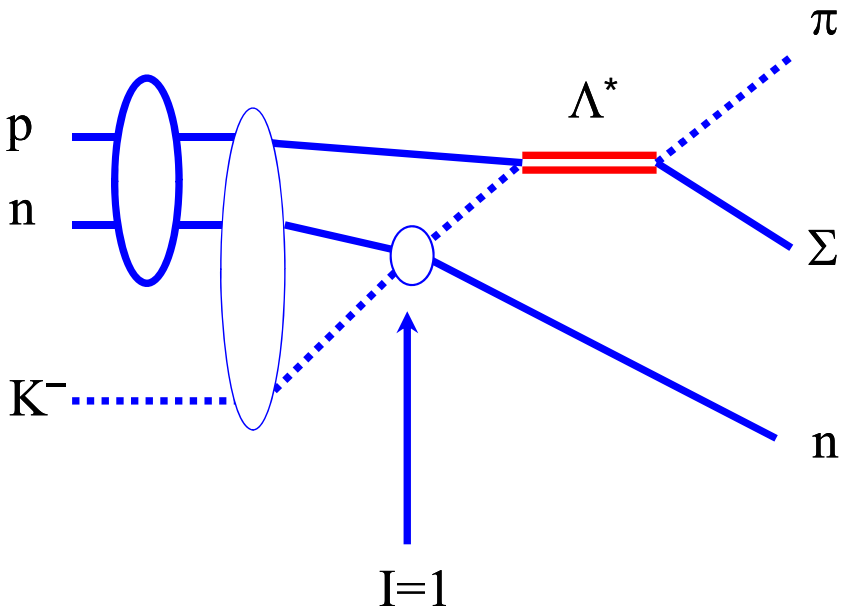
Deuteron target

Feasibility of an experiment with deuteron target was investigated by T. Suzuki and R.S. Hayano.

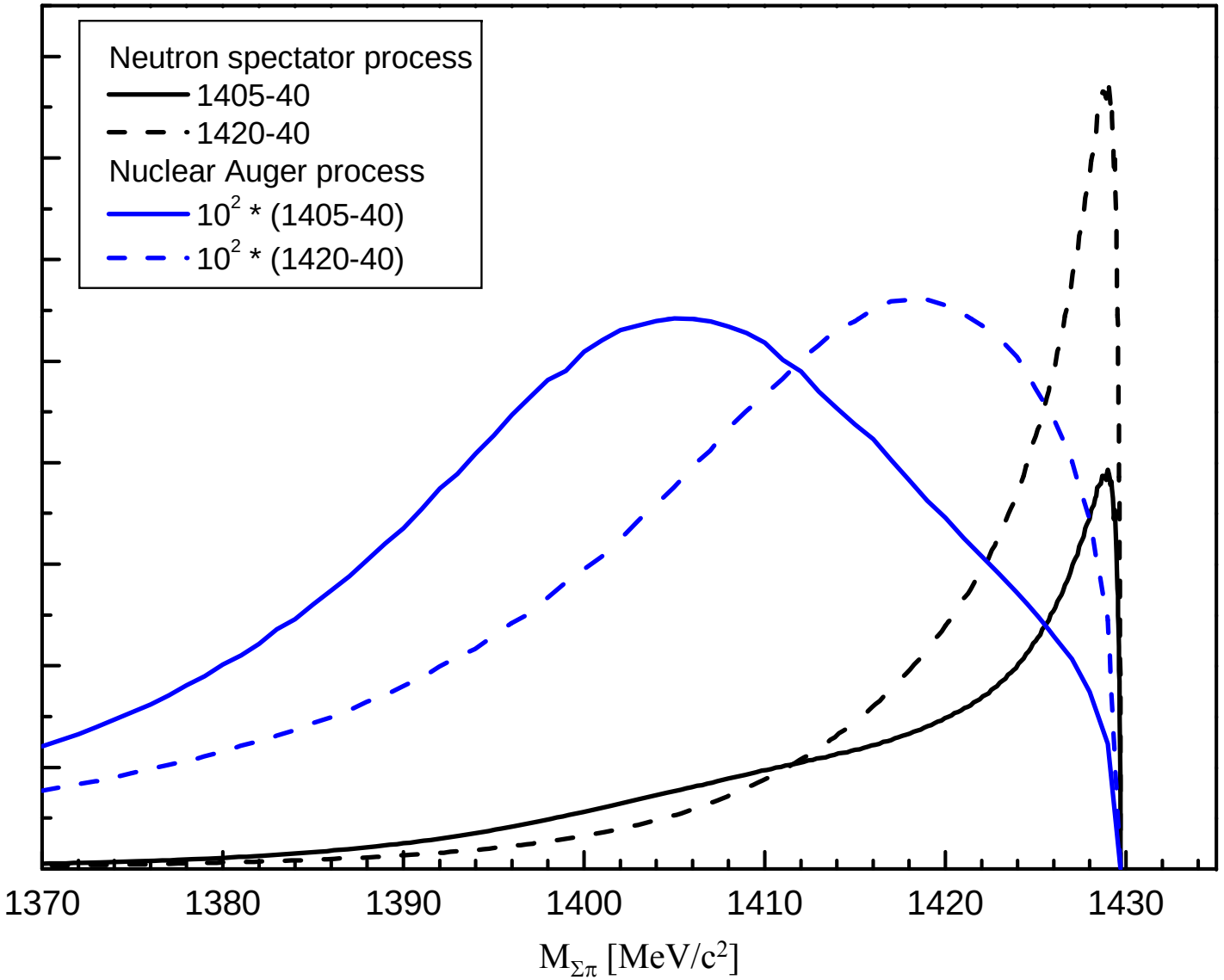
Neutron spectator process



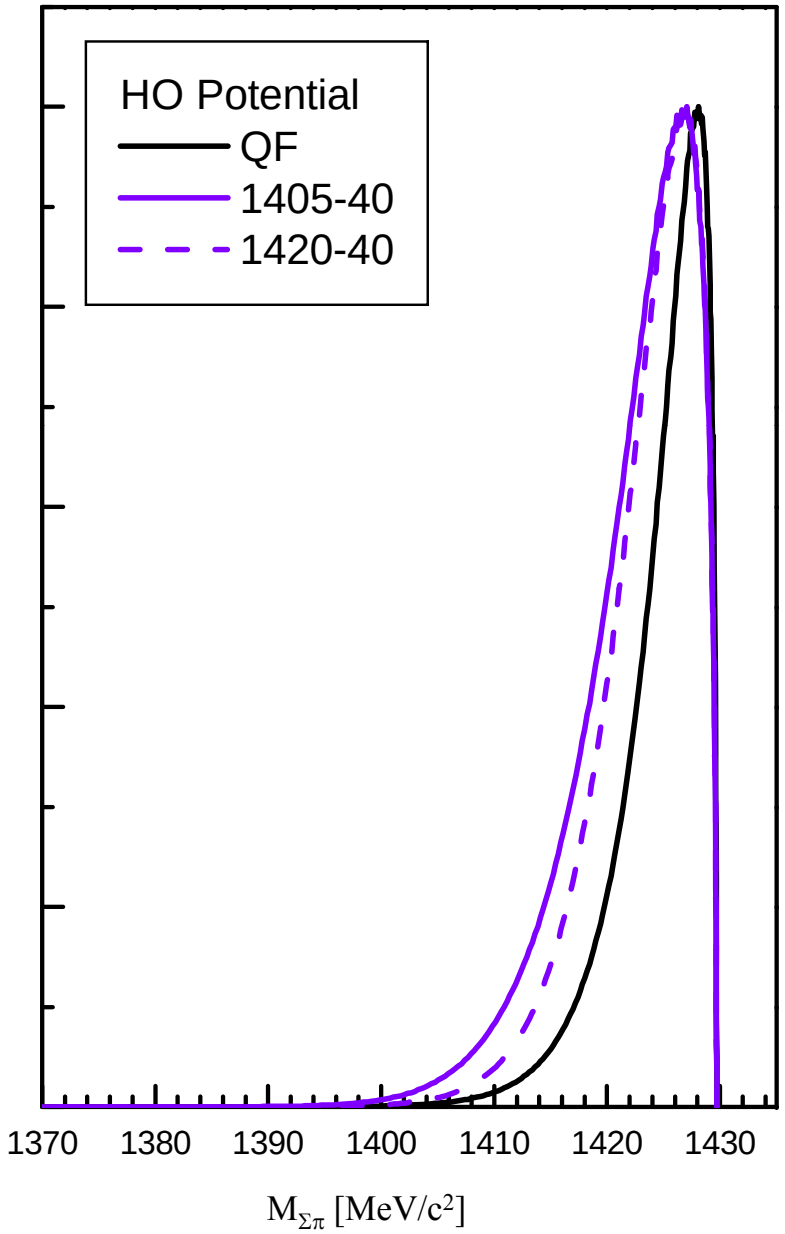
Nuclear Auger process

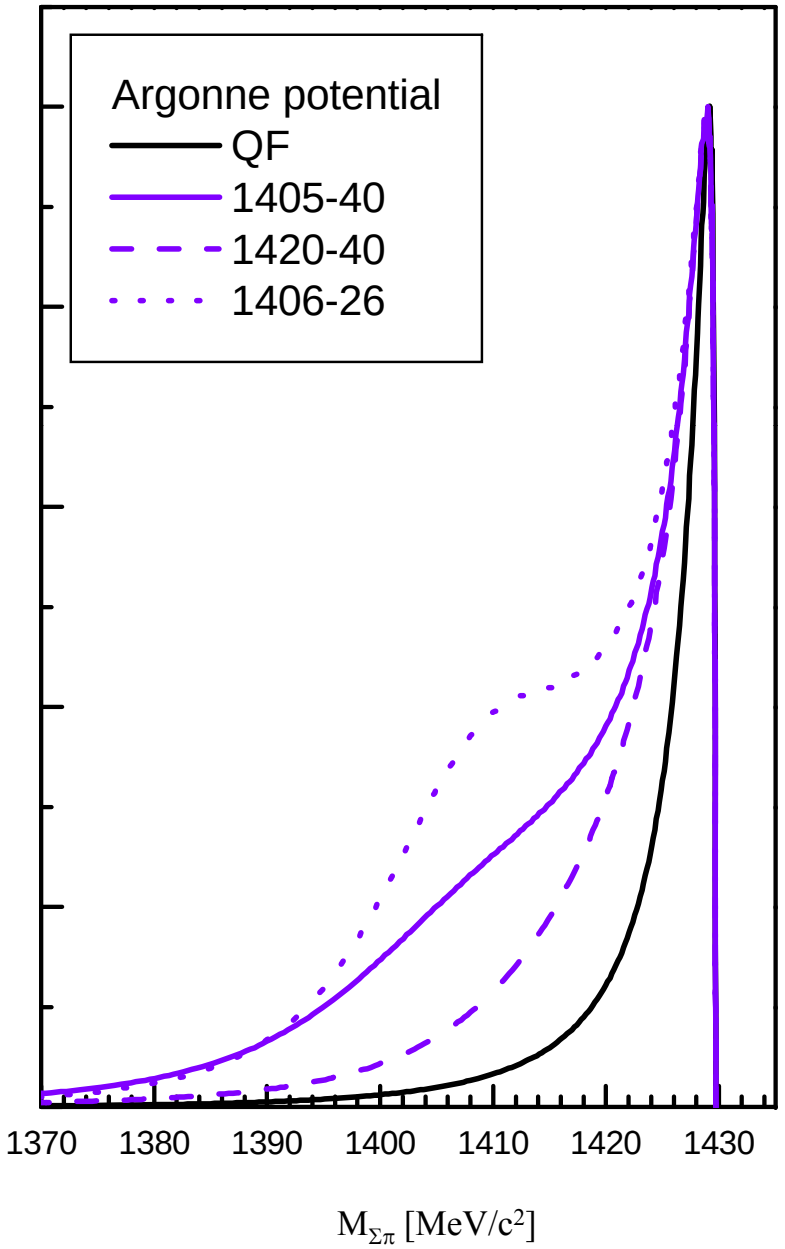


Neutron spectator & nuclear Auger process



Neutron spectator process with Argonne v18 SC & HO

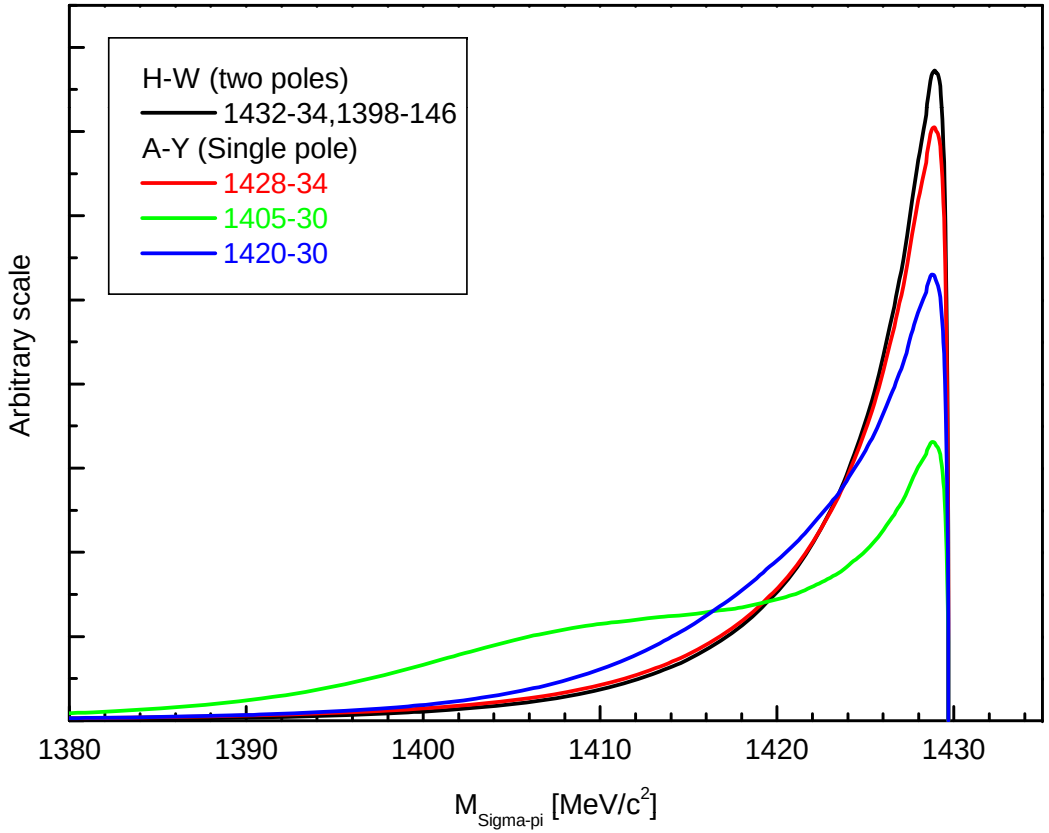


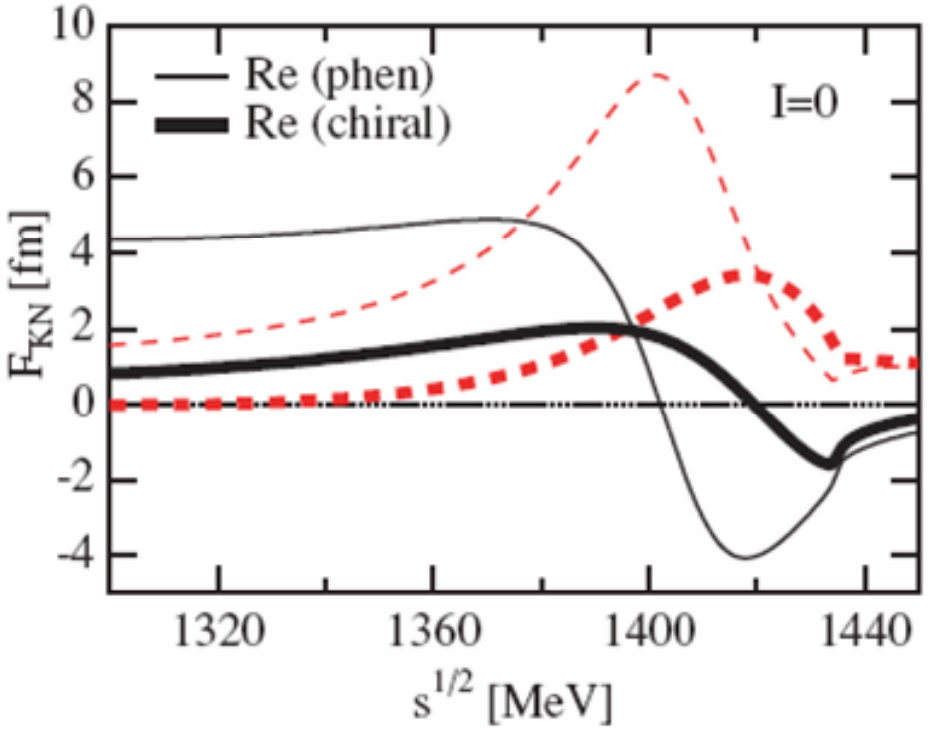


Second pole effect on spectrum

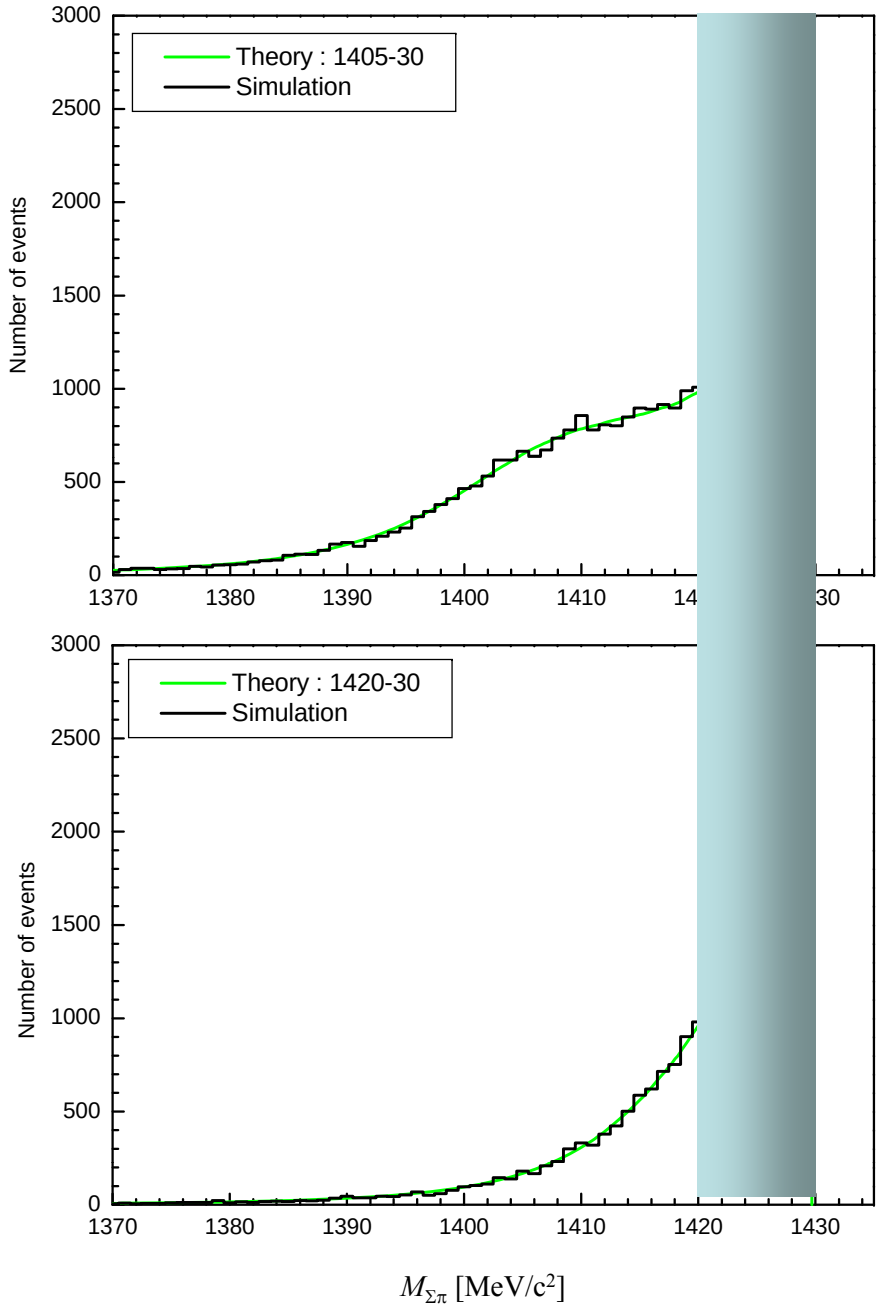
$$T^{-1} = U^{-1} - G$$

below the K^{bar}+N threshold → $|T_{21}|^2 \,\mathrm{Im}\, G_2 = \mathrm{Im}\, T_{11}$

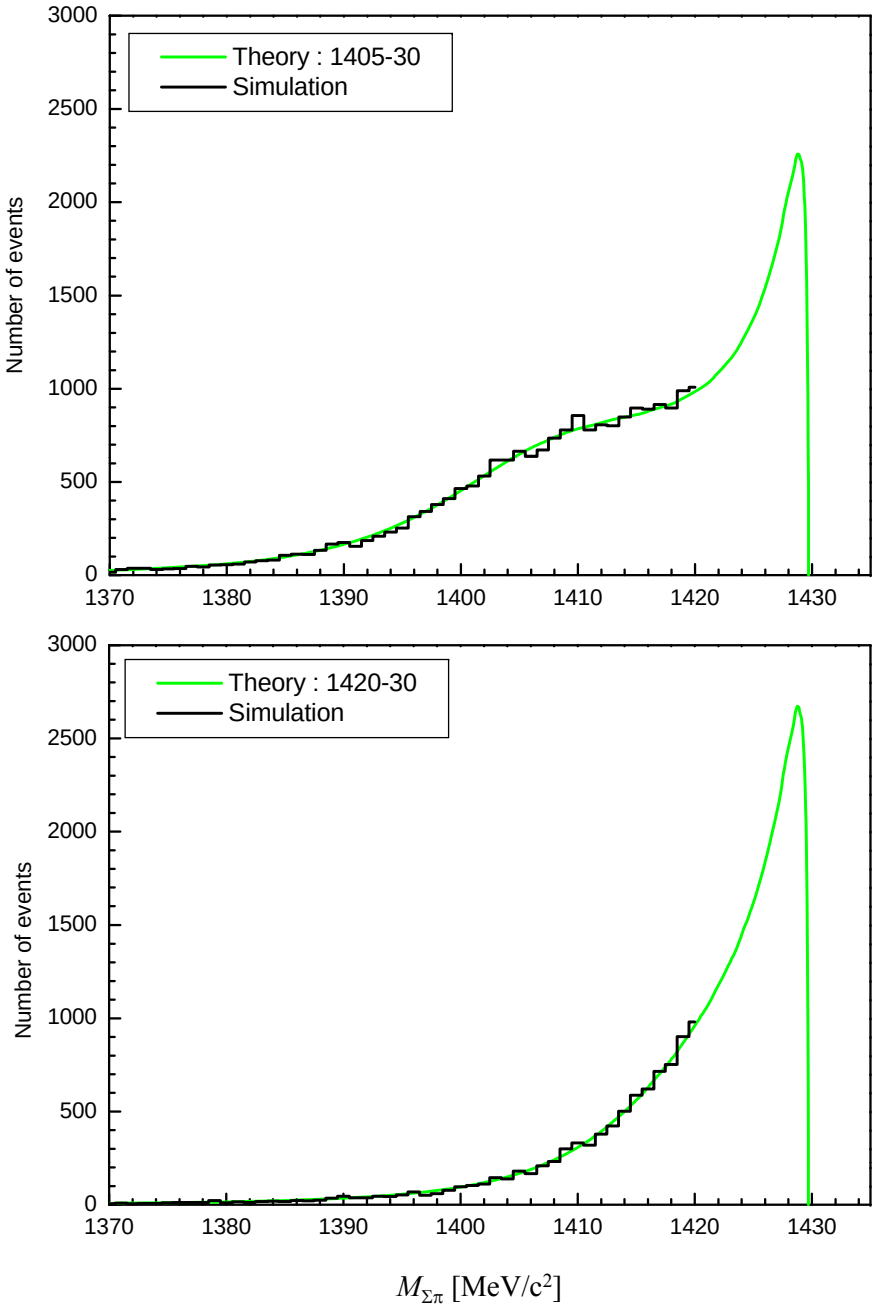


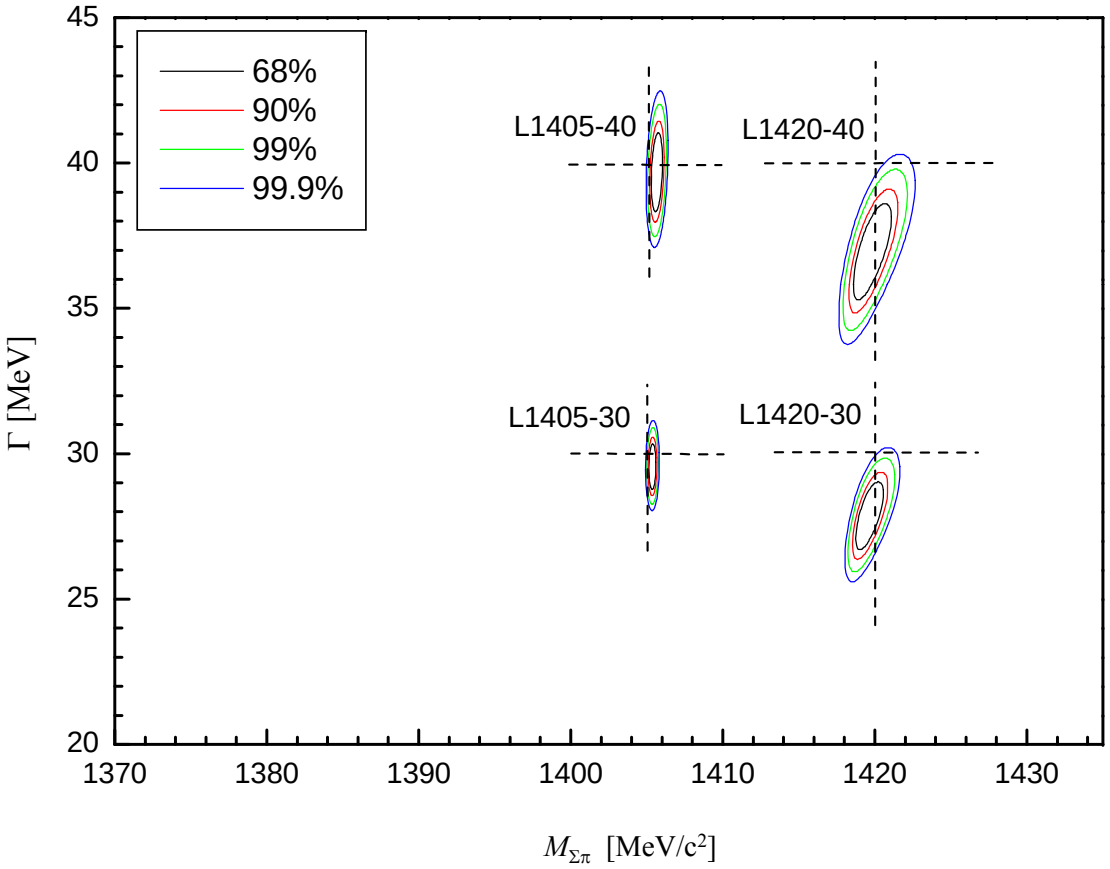


Data simulation and fitting



Data simulation and fitting





T. Suzuki *et al.*, Proposal for J-PARC (July,2009)

J. Esmaili, et al., arXiv:0909.2573v1 [nucl-th]

Conclusions

- *The K^- ^4He bubble chamber data favors the mass of Λ^* around 1405 MeV/c^2.*
- *The mass of Λ^* that was extracted with some chiral SU(3) models are far from 99.9% C.L.*
- *In stopped kaon on Deuteron target, neutron spectator process is dominant effect.*
- *Low momentum components are correctly considered with a more realistic potential in deuteron case. This effect appears as a cusp-like shape close to the threshold.*
- *The effect of the presence of a second pole is negligible in the such spectra which T_{21} is responsible.*

- *An experiment with D target should determine the mass of Λ^* more accurately.*

Thank you!