(n,xα) Cross-sections with Clustering Pre-equilibrium Model

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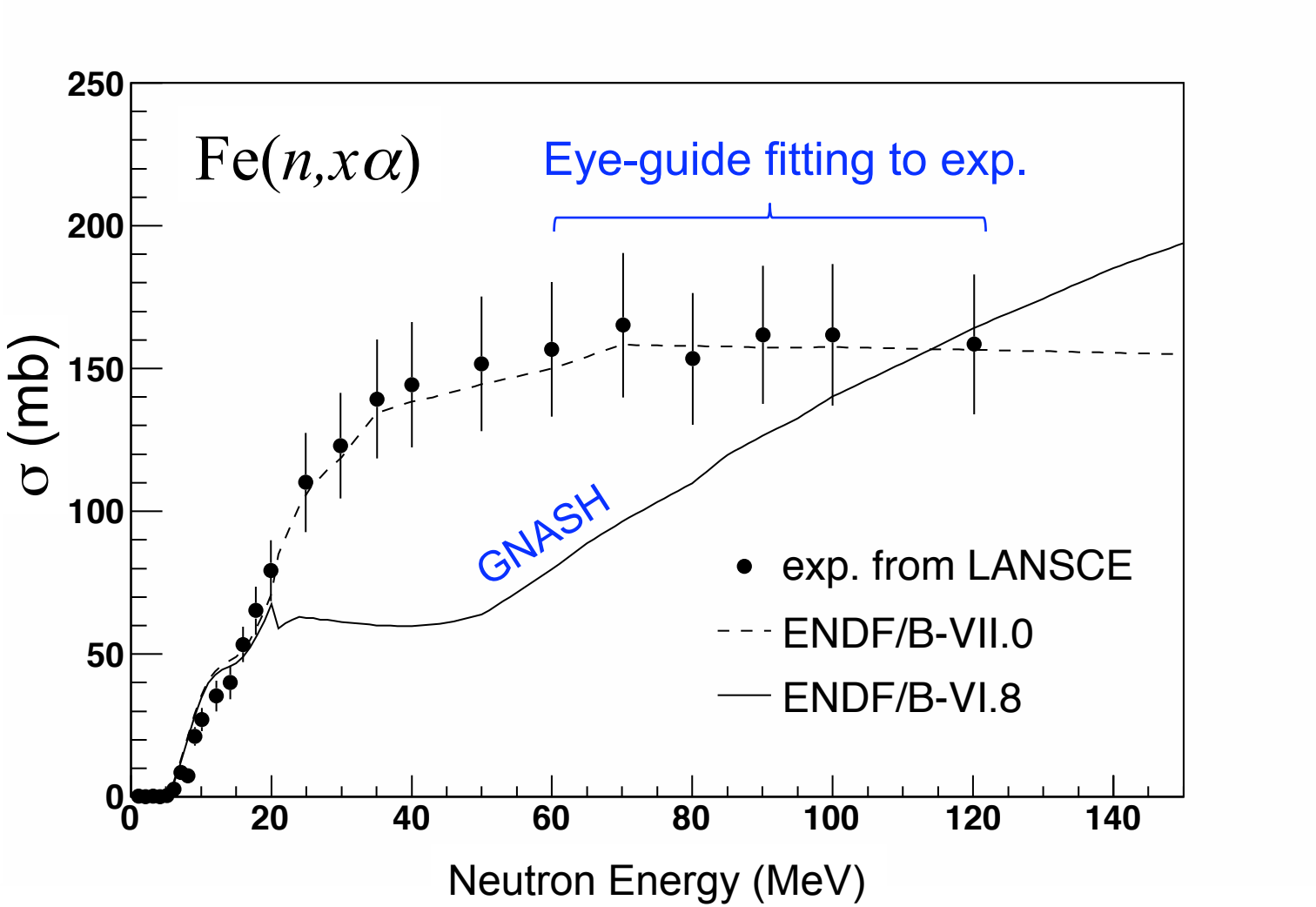
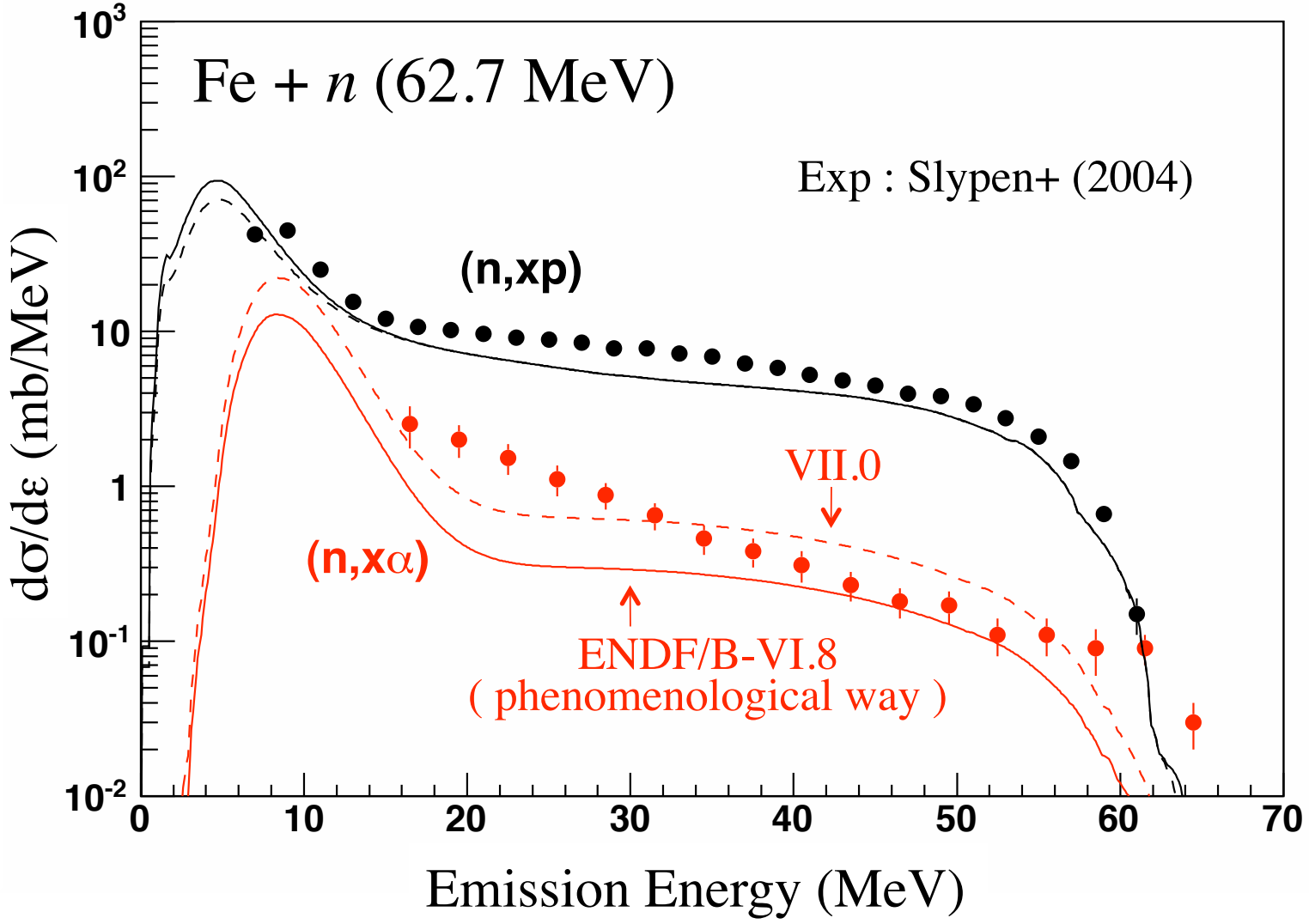
  (^{50,52,53,54}Cr, ^{54,56,57}Fe and ^{58,60}Ni)

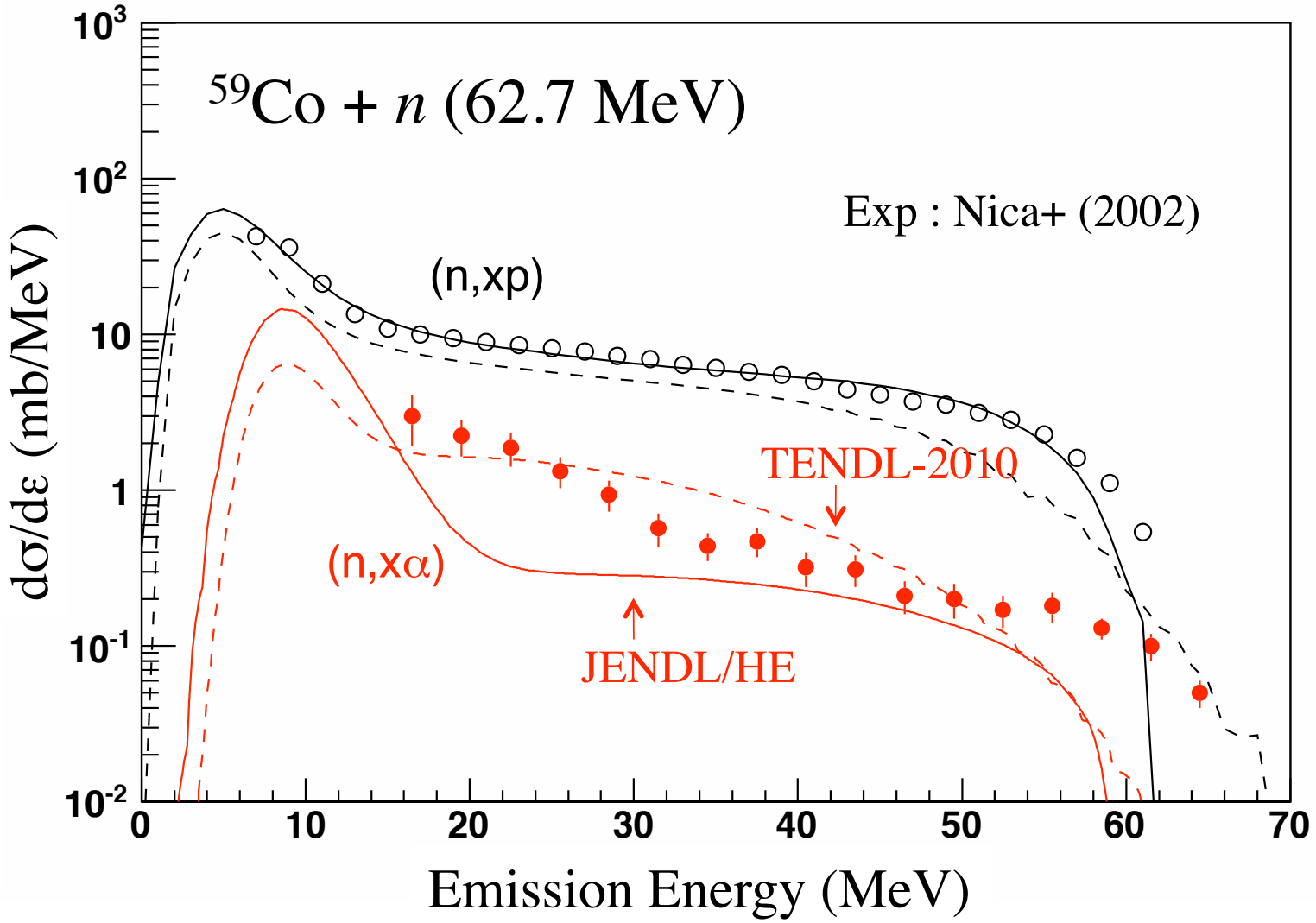
Status of ENDF (>20 MeV)



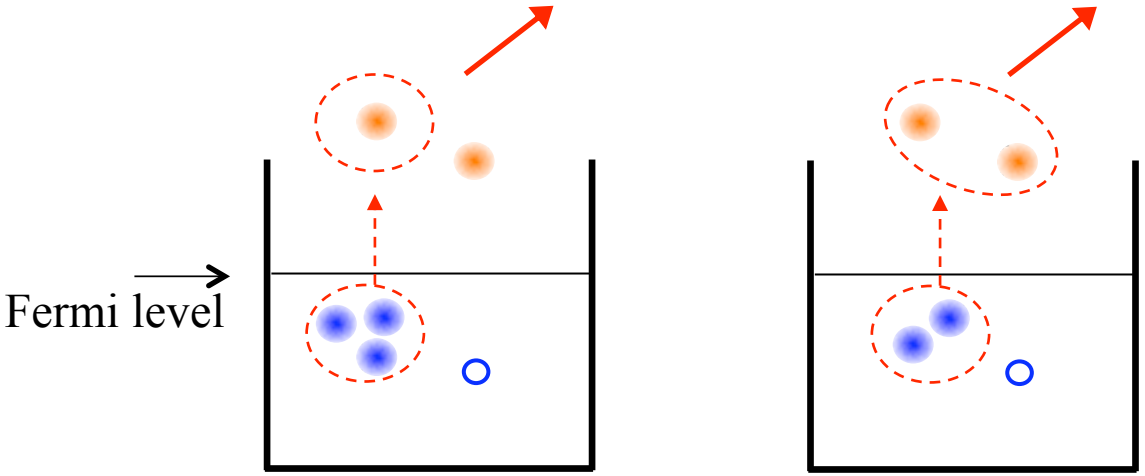
Status of ENDF (>20 MeV)



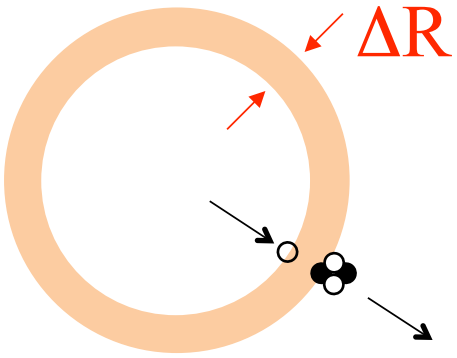
Status of Other Libraries



Iwamoto-Harada Model



e.g., from 2p-1h stage



@ nuclear surface

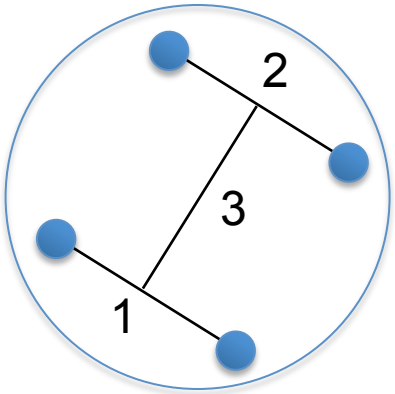
Emission rate

$$W_\alpha(p,h,\epsilon_\alpha) = \frac{\mu_\alpha \epsilon_\alpha \sigma_\alpha}{\pi^2\hbar^3} \frac{\sum_{l+m=4} F_{l,m}(\epsilon_\alpha)\left[\sum_{j=0}^{2}\omega(p-l,h-j,U)+\sum_{j=1}^{2}\omega(p-l-j,h,U)\right]}{\sum_{j=0}^{2}\omega(p,h-j,E)+\sum_{j=1}^{2}\omega(p-j,h,E)}$$

Formation Factors

$$\left|\langle\varphi_\alpha\chi^{(\epsilon_\alpha)}(\mathbf{R})|\phi_1\phi_2\phi_3\phi_4\rangle\right|^2$$

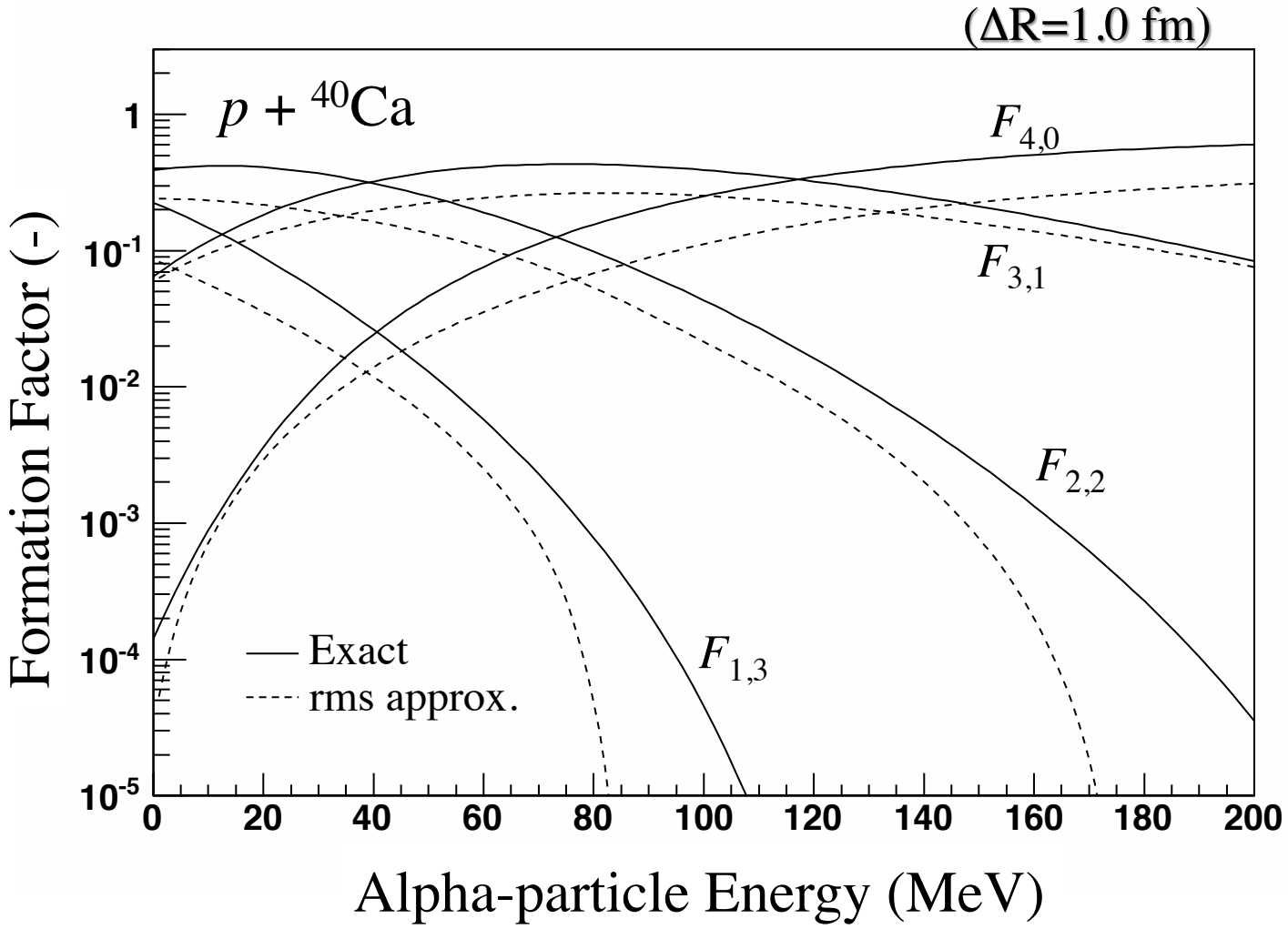
$$F_{l,m}(\epsilon_\alpha) \sim \int_S \prod_{i=1}^{3} d\xi_\mathbf{i} d\mathbf{p}_{\xi_\mathbf{i}}$$



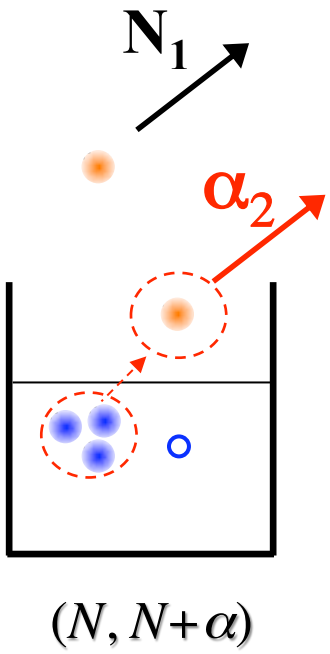
Original : root-mean-square approximation

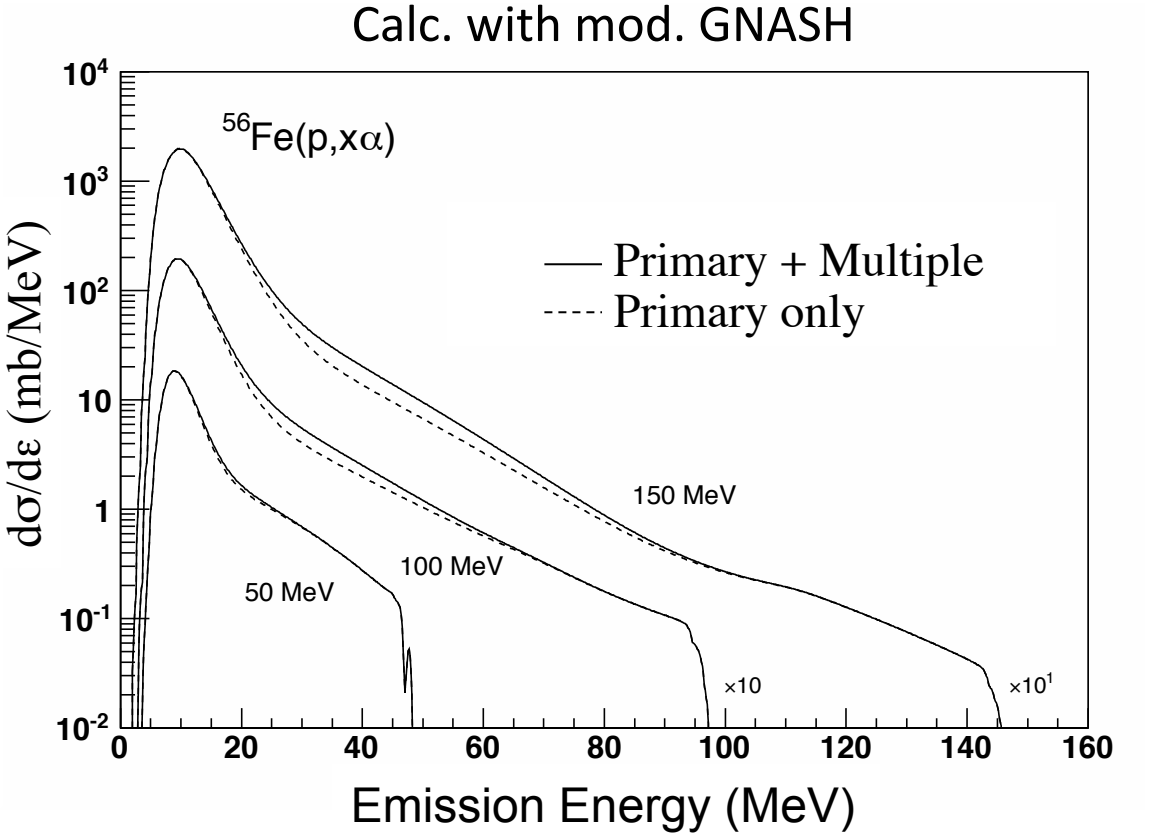
Present : numerical integration

Exact Calculations for $F_{l,m}(\varepsilon_\alpha)$



Spectra with Multiple Emission

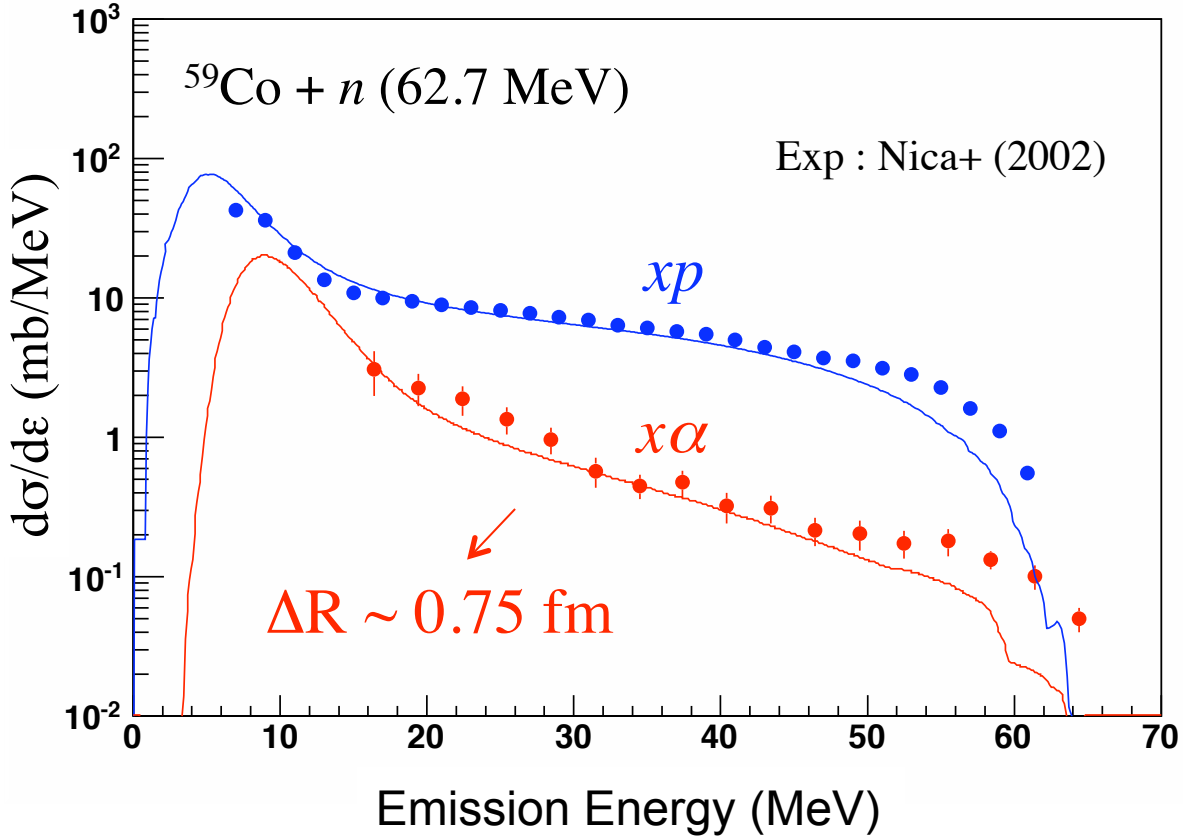




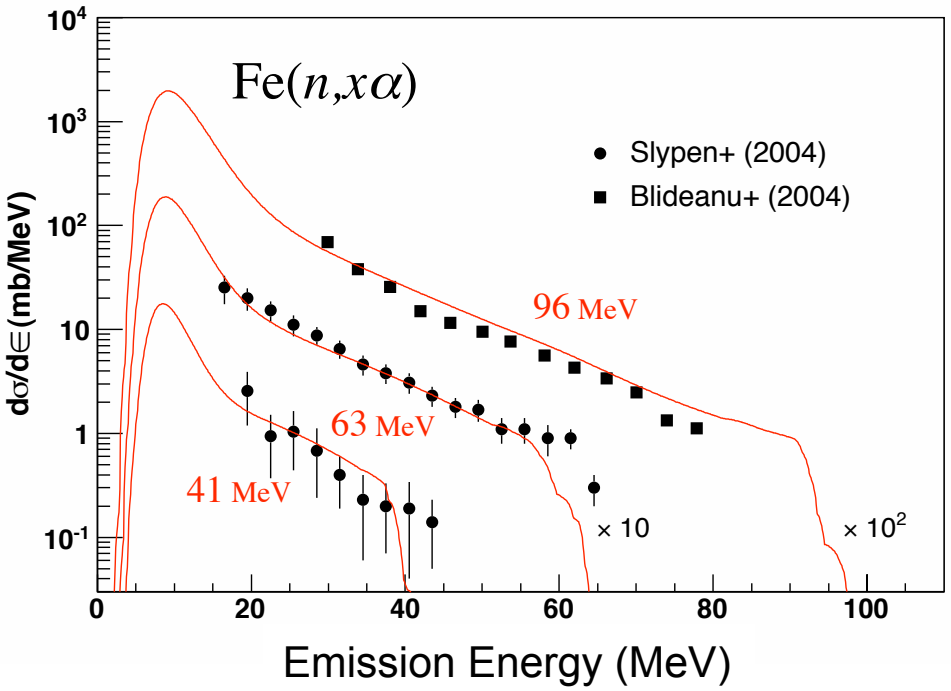
Model Parameters

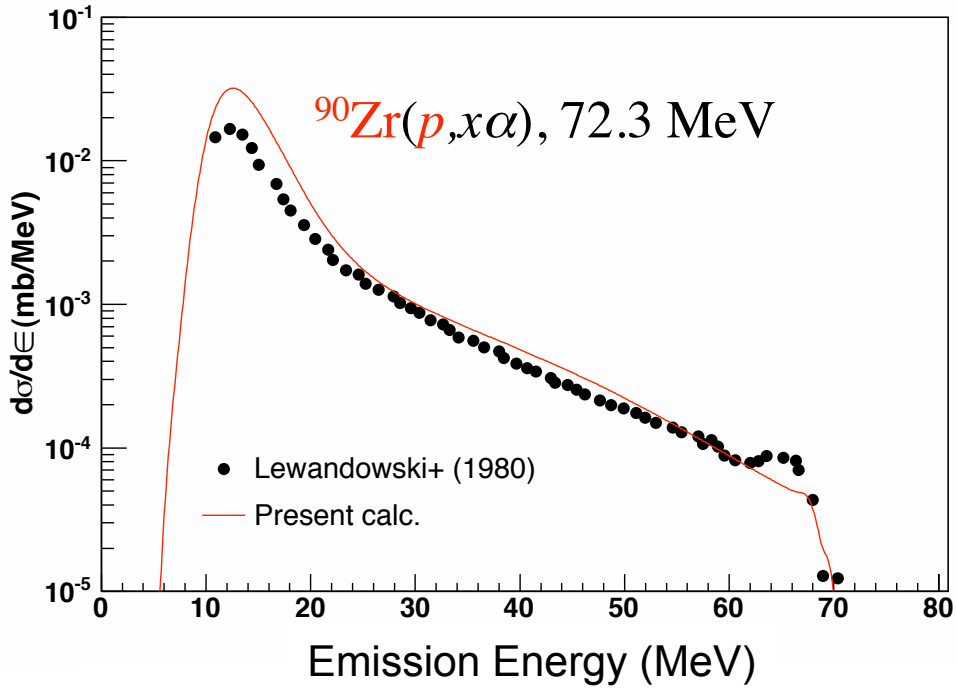
M^2 : Average Matrix Element $\longrightarrow$ $(n,xp)_{\mathrm{exp.}}$

ΔR : Clustering Model Parameter $\longrightarrow$ $(n,x\alpha)_{\mathrm{exp.}}$



Calculation with ΔR=0.75 fm

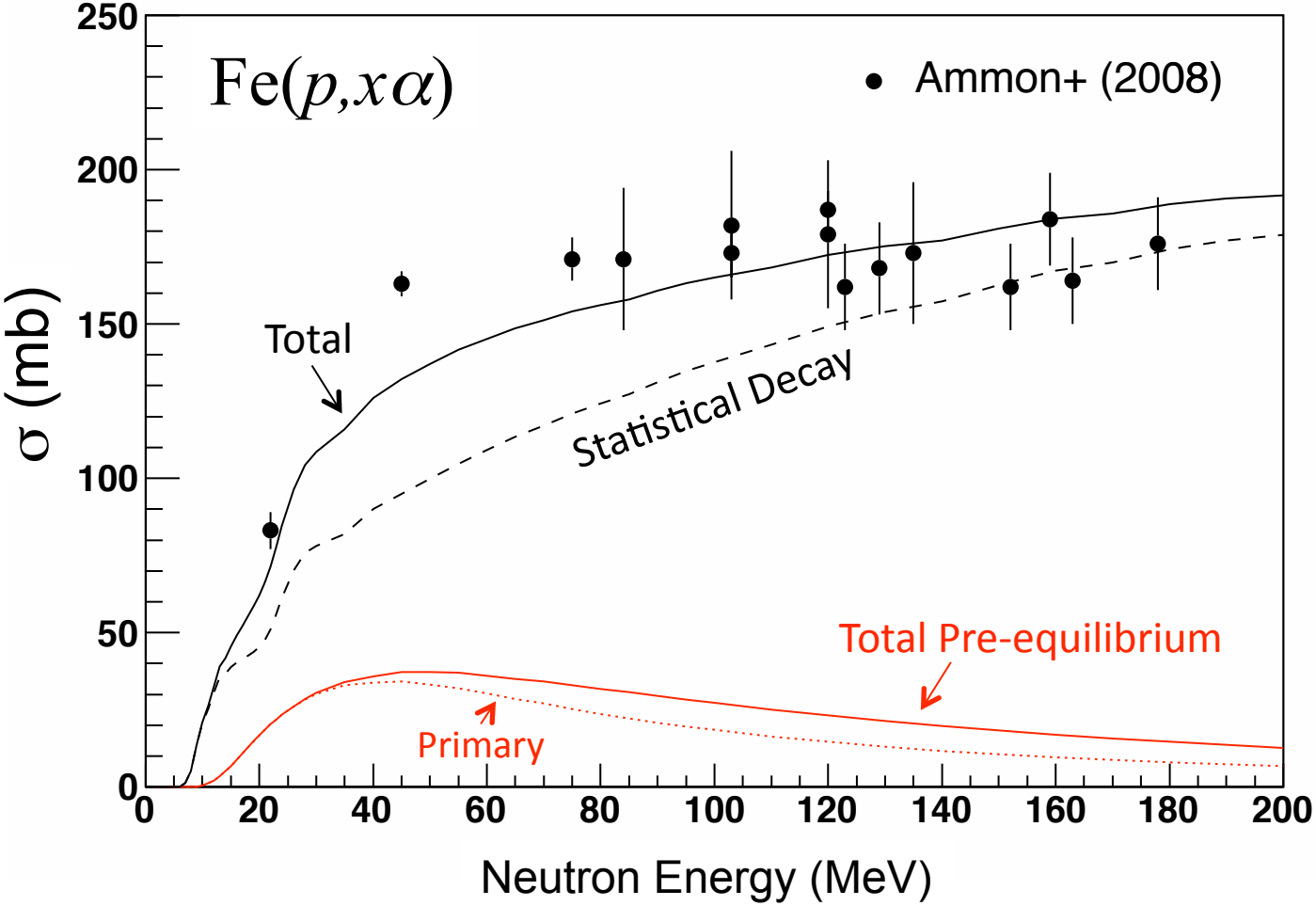




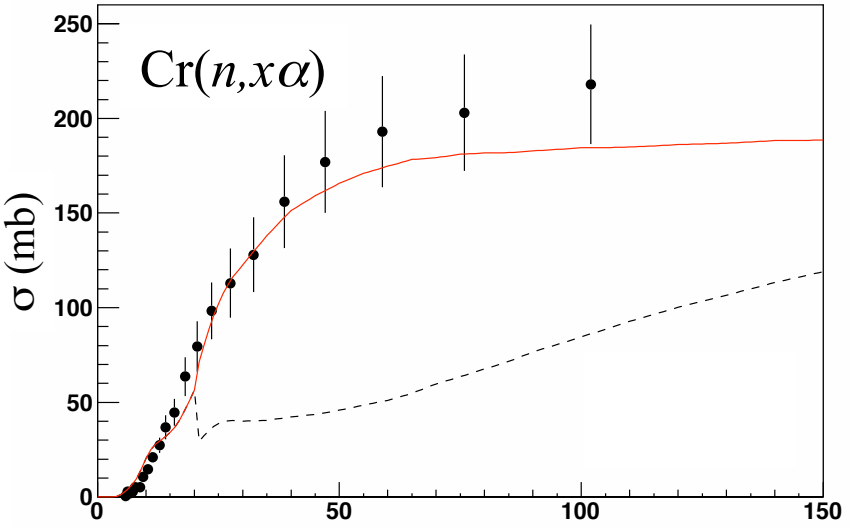
ΔR is less energy-dependent

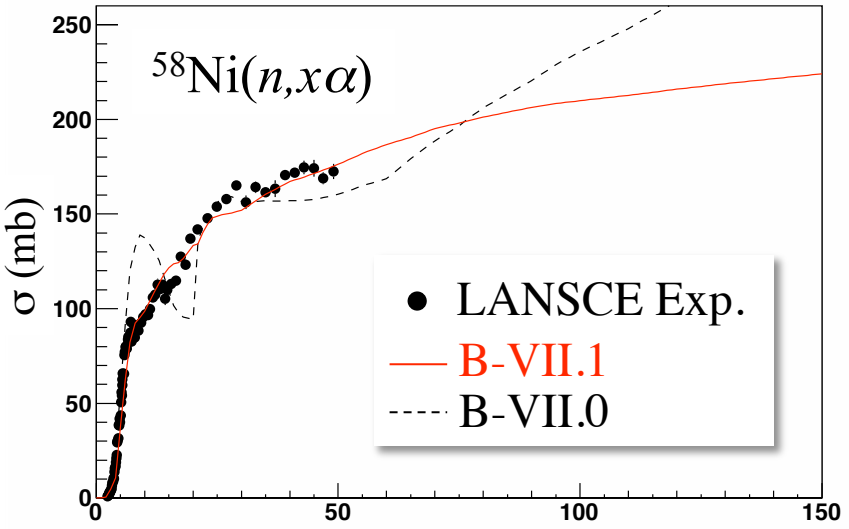
ΔR is independent of inc. n/p (& nuc ?)

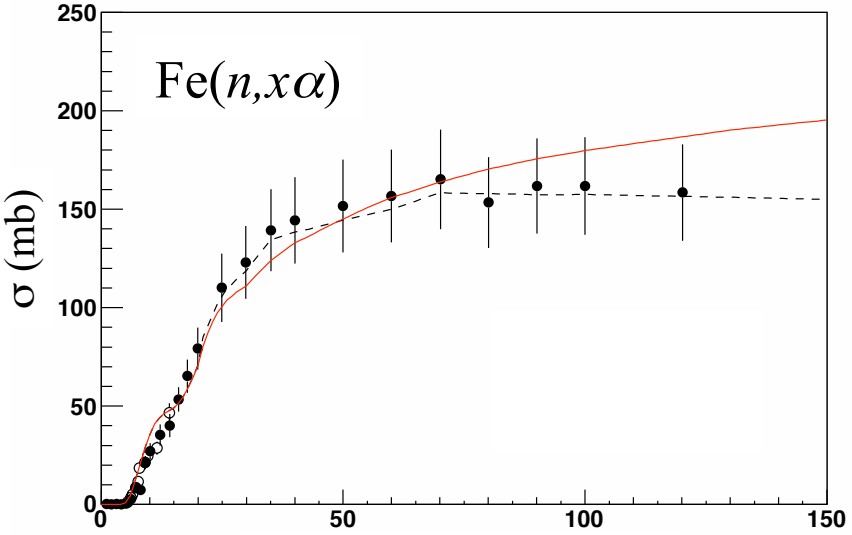
Absolute C. S. - example

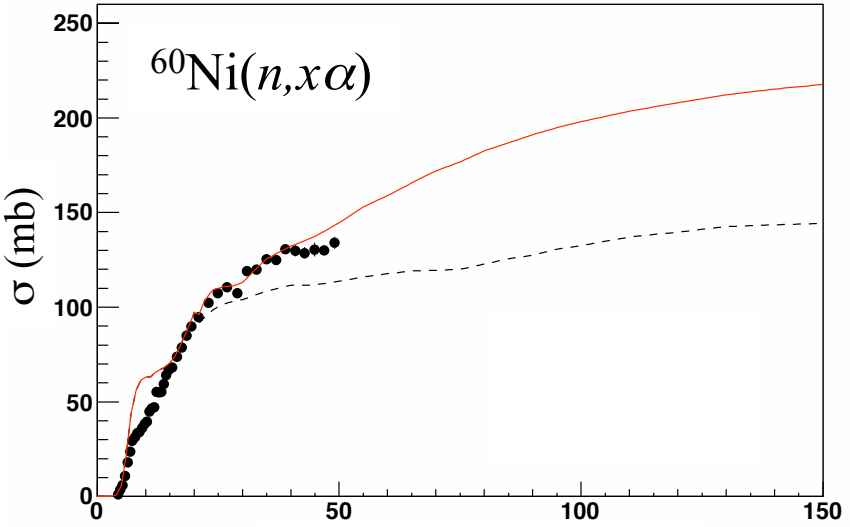


New Evaluations for B-VII.1









Summary & Conclusion

- Iwamoto-Harada model with exact overlap-integration for alpha-particle
- Multiple emission (alpha-particle) is calculated with I-H model
- ΔR may be less dependent on nucleus (Constraint to the level density parameter)
- New evaluations with those findings for $^{50,52,53,54}Cr$, $^{54,56,57}Fe$ and $^{58,60}Ni$

Backups

Status of Pre-equilibrium Model

Kalbach's works

☺ **Exciton model** → nucleons

☹ **Phenomenological (exciton) model**

→ Composite particles (d, t, ^{3}He, α)

Overlap Integral

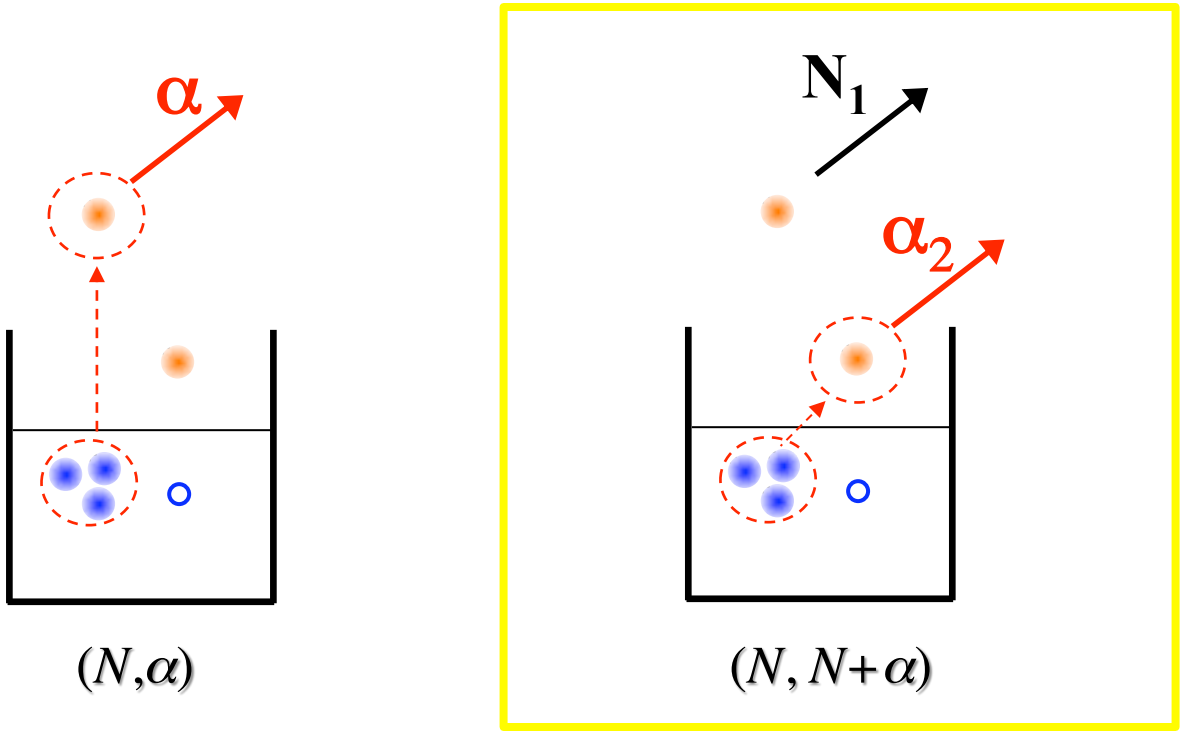
Original : root-mean-square approximation

$$\int_S \xi^2 P_\xi^2 \mathcal{I}(\mathbf{p}_\xi, \xi) d\xi d\Omega_\xi dP_\xi d\Omega_{P_\xi}$$

$$\longrightarrow \sim \int_S \delta(\xi - \overline{\xi})\delta(p_\xi - \overline{p_\xi}) \mathcal{I}(\mathbf{p}_\xi, \xi) d\xi d\Omega_\xi dP_\xi d\Omega_{P_\xi}$$

Present : numerical integration

Multiple Emission



$$\left(\frac{d\sigma}{d\epsilon_\alpha}\right)_{p,h} = \sum_{i=\pi,\nu} \int_{\epsilon_\alpha+B}^{U_{max}} \left(\frac{d\sigma}{dU}\right)_i T_\alpha(\epsilon_\alpha) \sum_{l+m=4} F_{l,m}(\epsilon_\alpha) \frac{g}{p} \frac{\omega(p-l,h,U-\epsilon_\alpha-B)}{\omega(p,h,U)} dU$$

Model Parameters

Optical Potential (OMP)

N : Kunieda+ (2007) α : Avrigeanu+ (2009)

Single-particle State Density

$\omega(p, h, E, \infty) f(p, h, E, V)$ Beták & Dobeš (1976)

V : Koning & Duijvestijn (2004)

$g = 6a/\pi^2$

Deuteron Spectra