Width of longitudinal momentum considerations

From historical model of Goldhaber to ABRABLA calculations

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Width of longitudinal momentum considerations

-gaussian shape of longitudinal momentum distribution ; standard deviation

-new signature for break-up ?

-prediction for technical purposes (energy deposition…)

Goldhaber model

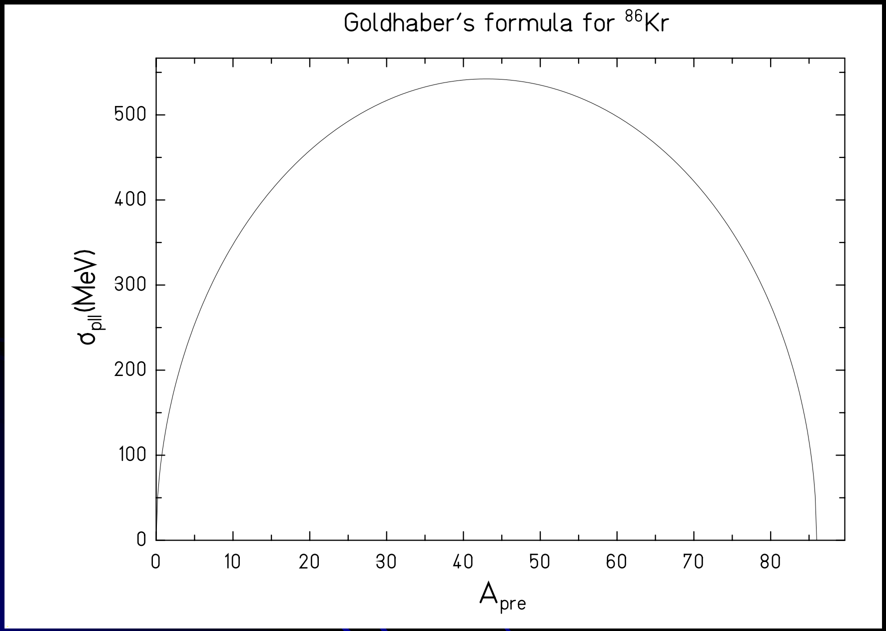
Only describing abrasion process

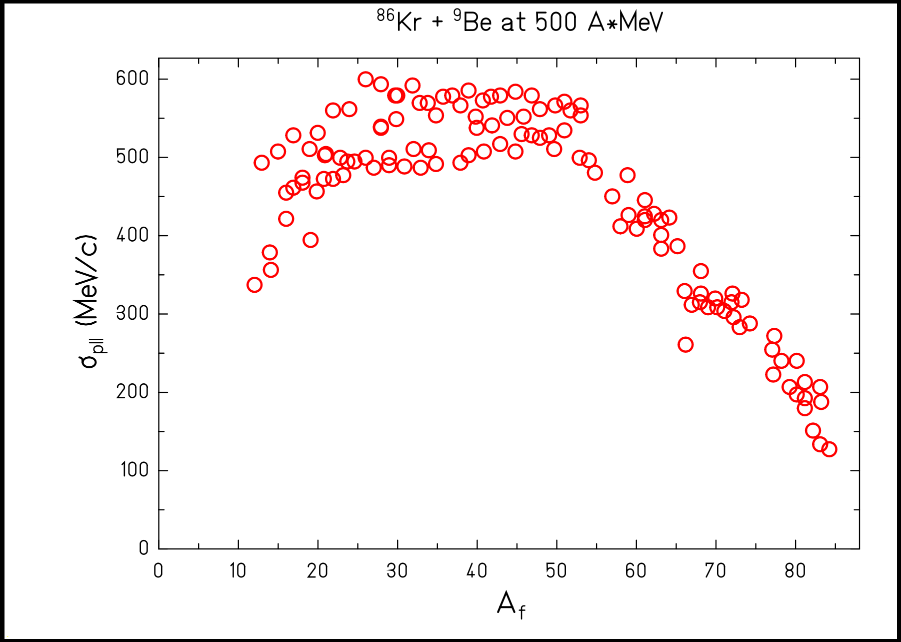
- Fermi momentum
- Combinatorics

$$\sigma_{GH}^{2}\left(A_{abr}\right)=\frac{p_{F}^{2}}{5}\cdot\frac{A_{abr}\cdot(A_{p}-A_{abr})}{A_{p}-1}$$

Goldhaber, Phys. Lett. 53B (1974)

Goldhaber model





Weber et al., Nucl. Phys. A 578 (1994)

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Morrissey systematics

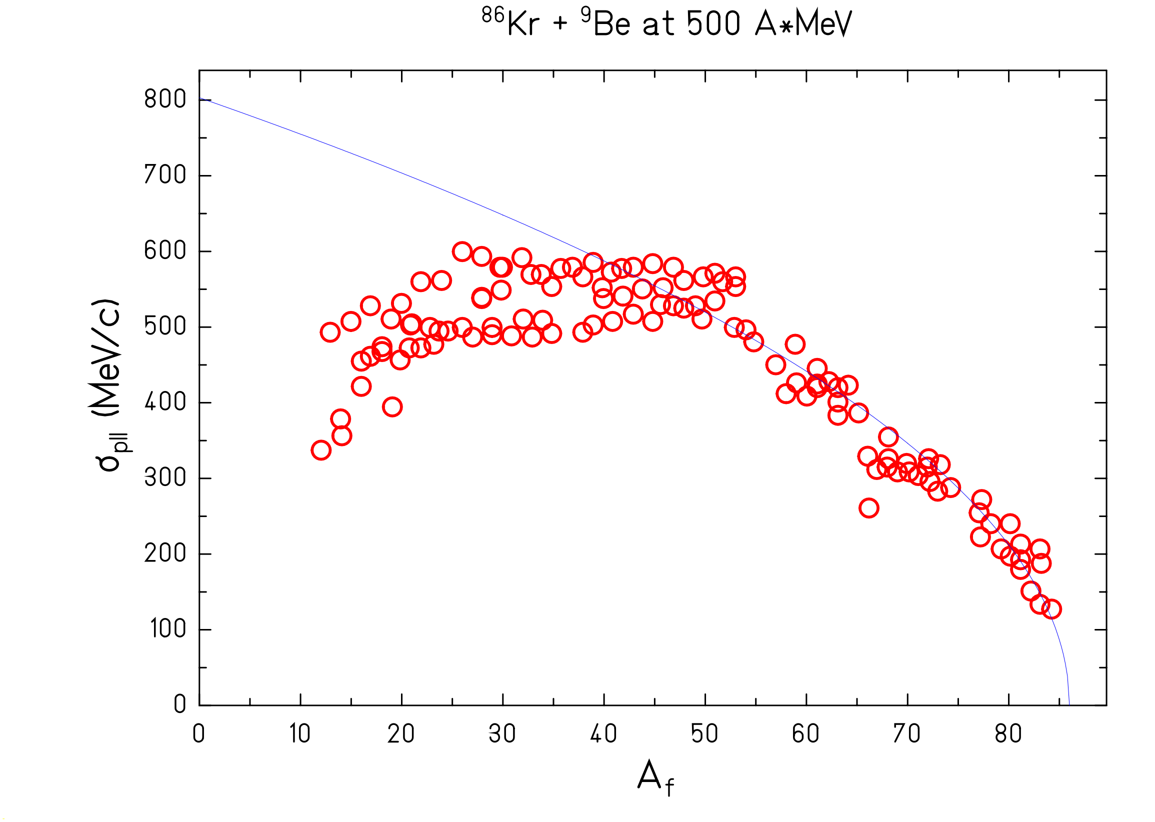
- Formula to fit data

$$\sigma^2 = \frac{150^2}{3} \cdot (A_p - A_f)$$

Morrissey, Phys. Rev. C 39 (1989)

- Not adapted to big mass losses

Morrissey systematics



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Evaporation

$\text{Energy gain per abraded nucleon} : 27\,MeV$

$\text{Energy loss per evaporated nucleon } \delta_{ev} = 15\,MeV$

$$A_{pre} = \frac{\delta_{ev} \cdot A_f + 27 \cdot A_p}{27 + \delta_{ev}}$$

$$\sigma_{ev} = \frac{A_f}{A_{pre}} \cdot \sigma_{GH}\left(A_{pre}(A_f)\right)$$

GSI

Recoil

- Contribution to the width : mean recoil momentum per particle evaporated

$$< p_{evap}^2 > = \frac{p_F^2}{5} \cdot \eta^2$$

η is a parameter ~ 0.6

$$\sigma_{v_n}^2 = \sigma_{v_0}^2 + p_{evap}^2 \cdot \sum_{i=0}^{n} \frac{1}{(A_{pre} - i)^2}$$

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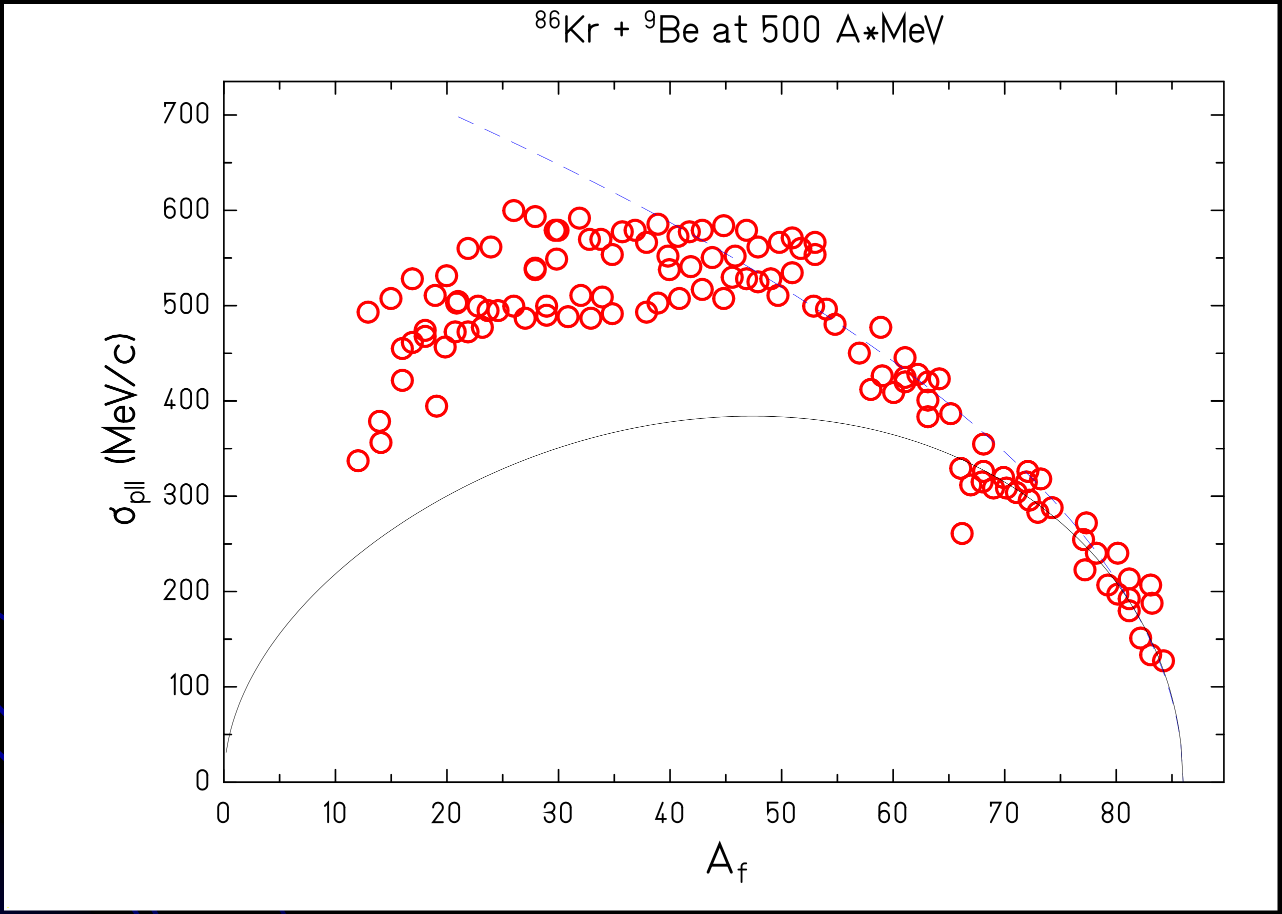
Recoil

- Approximation by an integral :

$$\sigma^2 = \sigma_{ev}^2 + A_f^2 \cdot \frac{p_F^2}{5} \cdot \eta^2 \cdot \left(\frac{1}{A_f} - \frac{1}{A_{pre}} \right)$$

η is a parameter ~ 0.6

Evaporation



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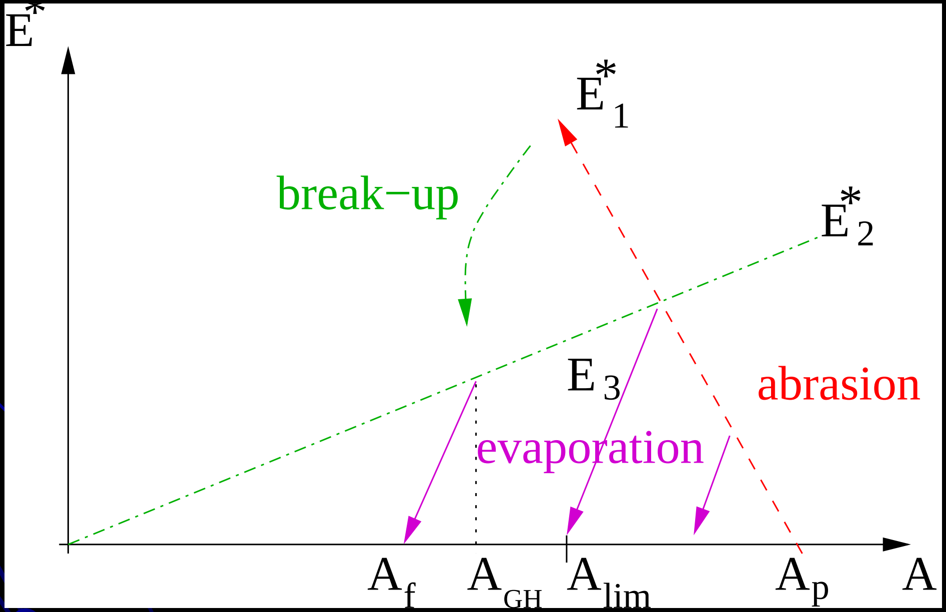
Introduction of break-up

- Excitation energy vs mass
- Different processes, two regimes



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- Abrasion : $E^*_{abr} = 27 \cdot (A_p - A)$

- Break-up : $E^*_{bu} = \frac{T_{bu}^2}{11} \cdot A$, with $T_{bu} = 5\,MeV$

- Evaporation : $E^*_{ev} = \delta_{ev} \cdot (A - A_f)$, with $\delta_{ev} = 15\,MeV$

$$A_{\lim} = \frac{27 \cdot 11}{27 \cdot 11 + T_{bu}^2} \cdot \frac{11 \cdot \delta_{ev} - T_{bu}^2}{11 \cdot \delta_{ev}} \cdot A_p = \frac{126}{161} \cdot A_p$$

$$A_{\lim} = \frac{126}{161} \cdot A_p$$

$$\sigma = \frac{A_f}{A_{pre}} \cdot \sigma_{GH}\left(A_{pre}(A_f)\right)$$

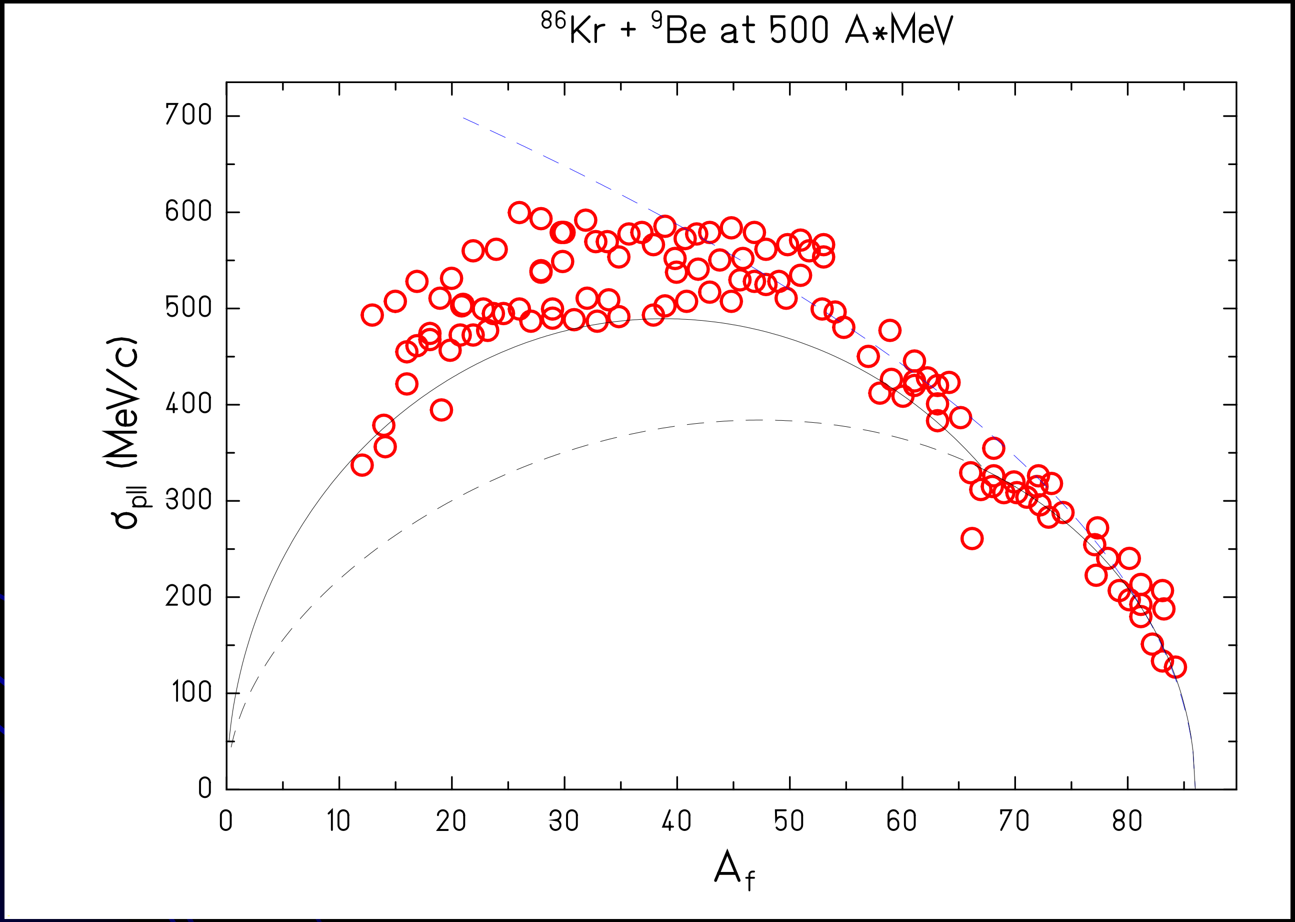
$for\ A \le A_{\lim},$

$$A_{pre} = \frac{11 \cdot \delta_{ev}}{11 \cdot \delta_{ev} - T_{bu}^2} \cdot A_f$$

$for\ A \ge A_{\lim},$

$$A_{pre} = \frac{\delta_{ev} \cdot A_f + 27 \cdot A_p}{27 + \delta_{ev}}$$

Introduction of break-up



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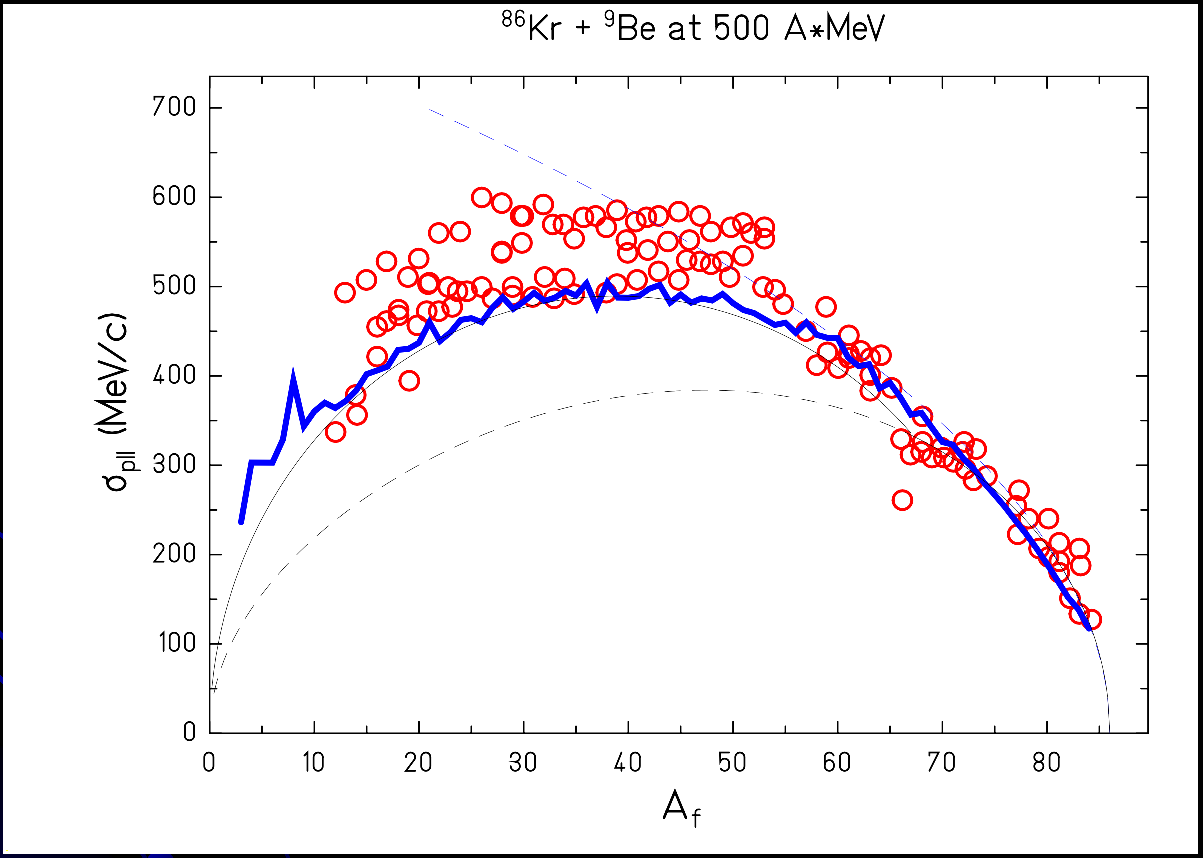
Numerical calculations with ABRABLA

- Relies on theoretical models
- No analytical prediction of σ^2

Numerical calculations with ABRABLA



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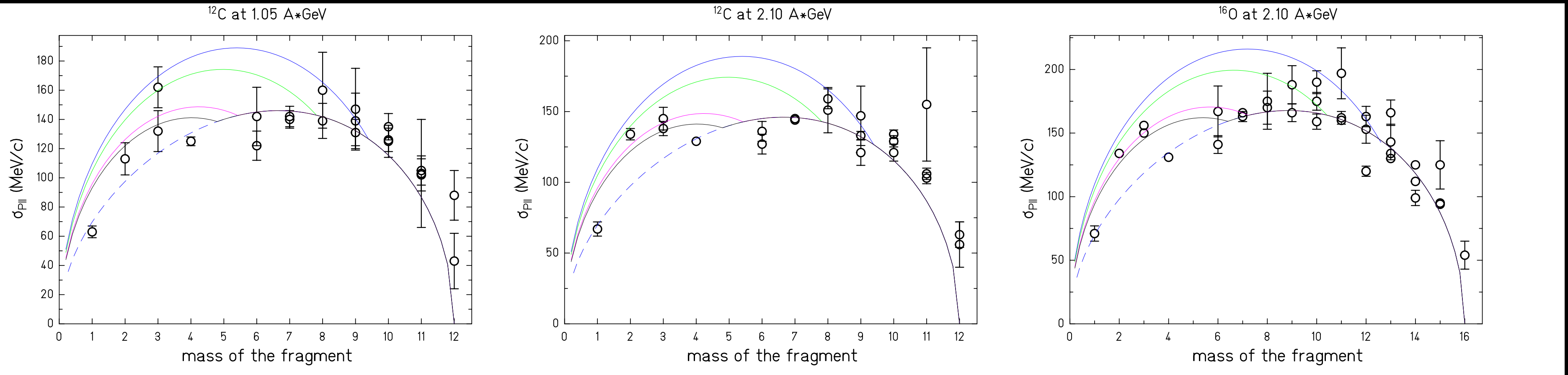
other systems



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