Isotopic distributions of spallation residues and energy dependencies :

Results of the Pb+p at 500 AMeV experiment

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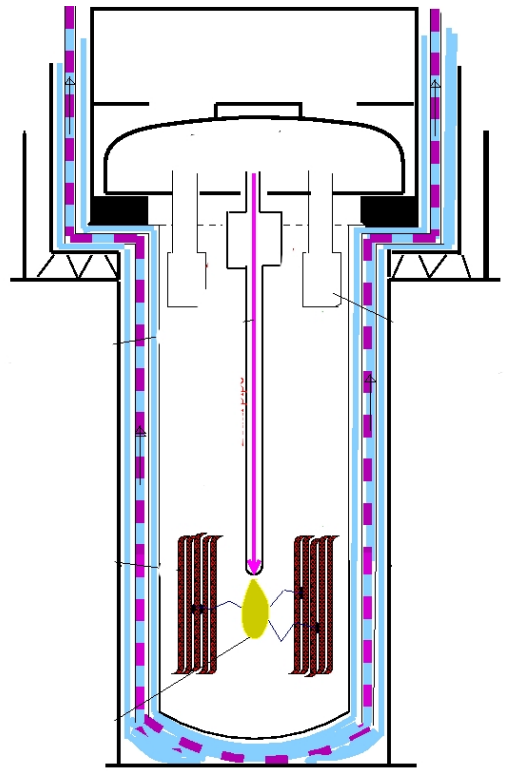
Motivations



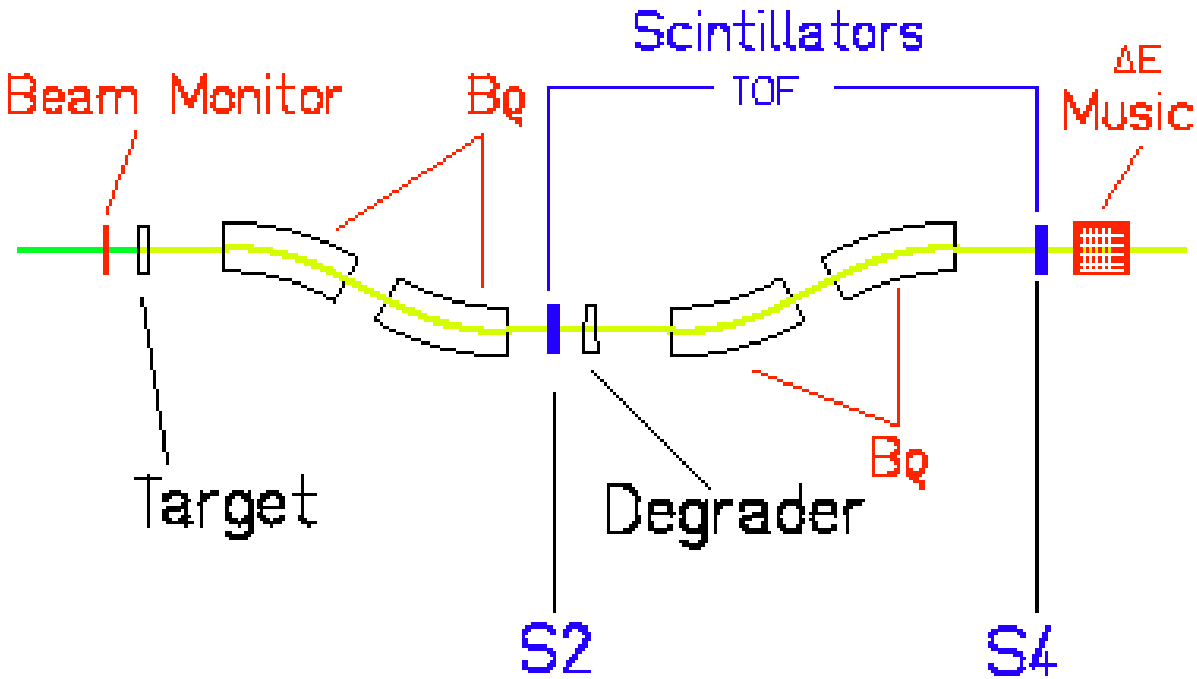
- Practical applications: industrial-scale neutron sources (ADS, nTOF,…)

- Importance of low energy reactions (thick targets: internuclear cascade)

→ Influence of incident energy on reaction?

→ Low energy experiment: p+Pb at 500 MeV

Experimental setup



Ionization chambers:
2,5m gas at 2 bars

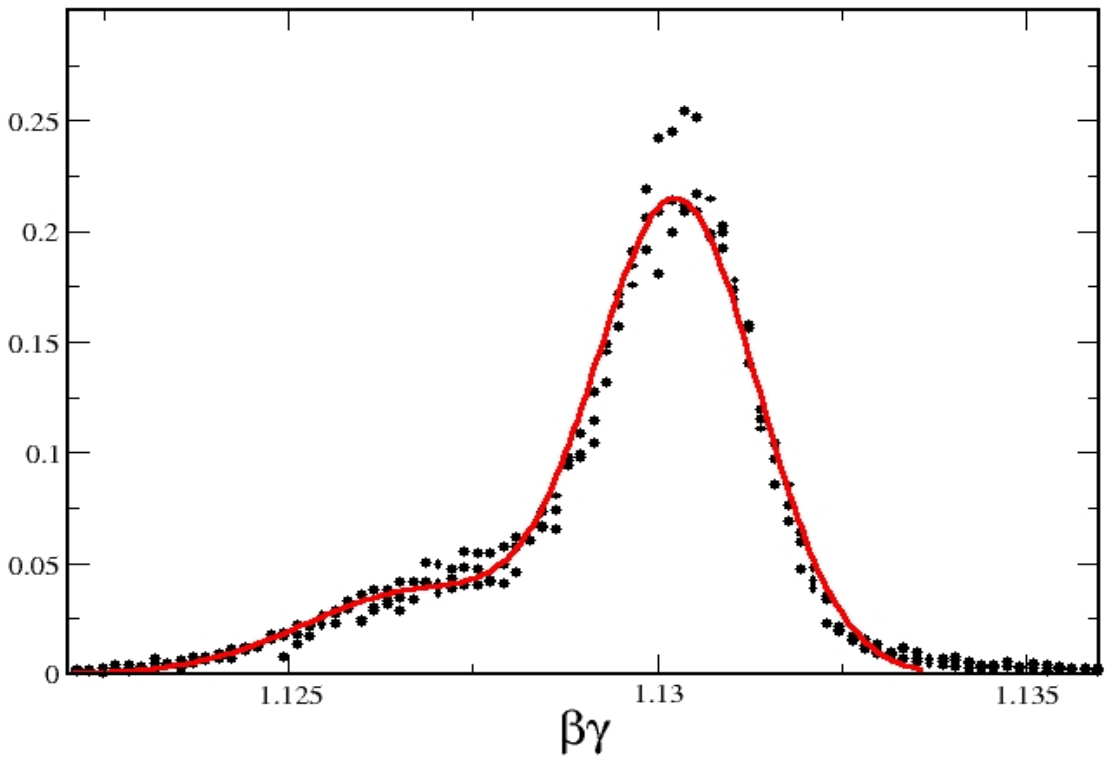
$$B\rho=(A/q).(\beta\gamma)$$

- Large proportion of non-stripped ions

→ **Problem with mass identification**

Kinematics of the fragments

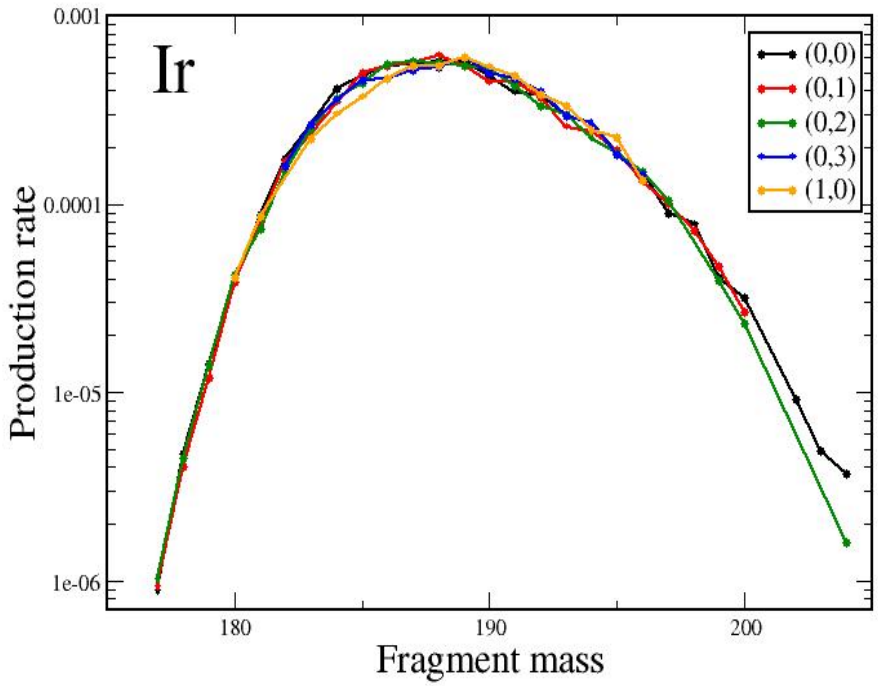
- Error in mass identification induces error when calculating the velocity in the first part of the FRS

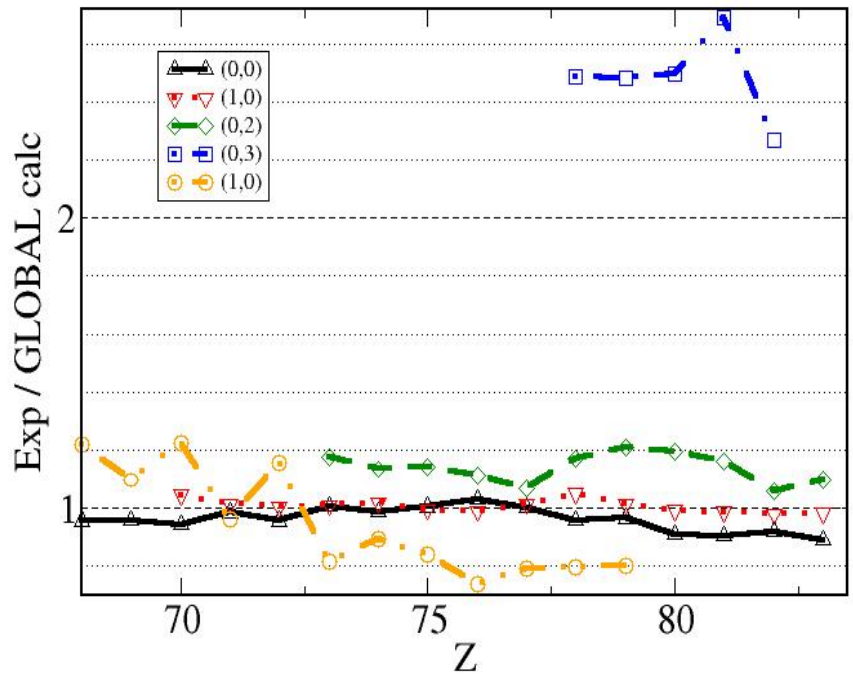


- Possibility to evaluate the contribution of stripped ions

Effective production rates

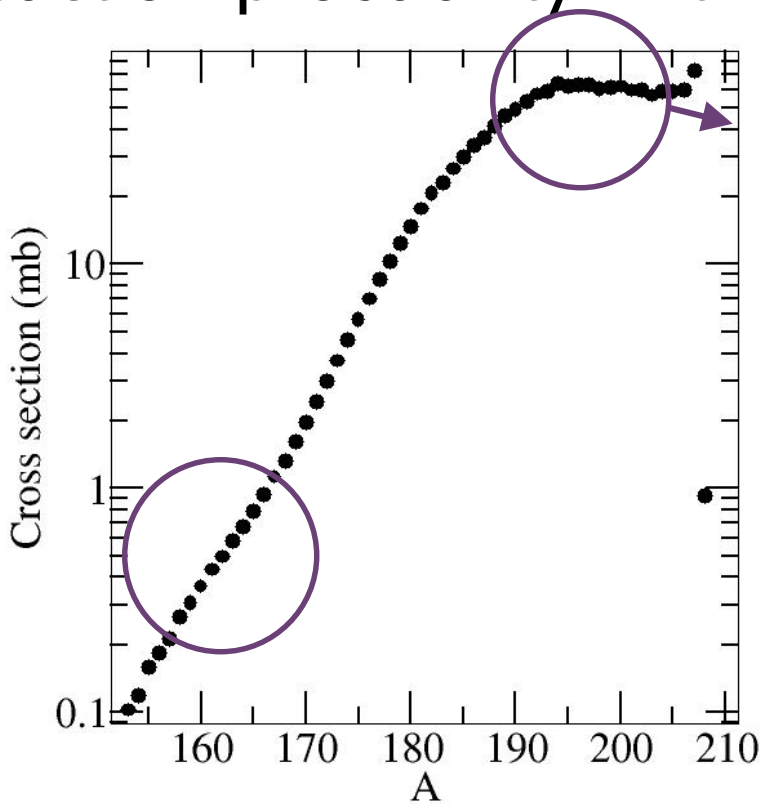
- Production rates obtained for each charge state combination
- Fit procedure provides absolute production rates *and* charge state probabilities





Multiple reactions in the target (1)

- Reaction probability in the target: 10%



Primary production is dominant

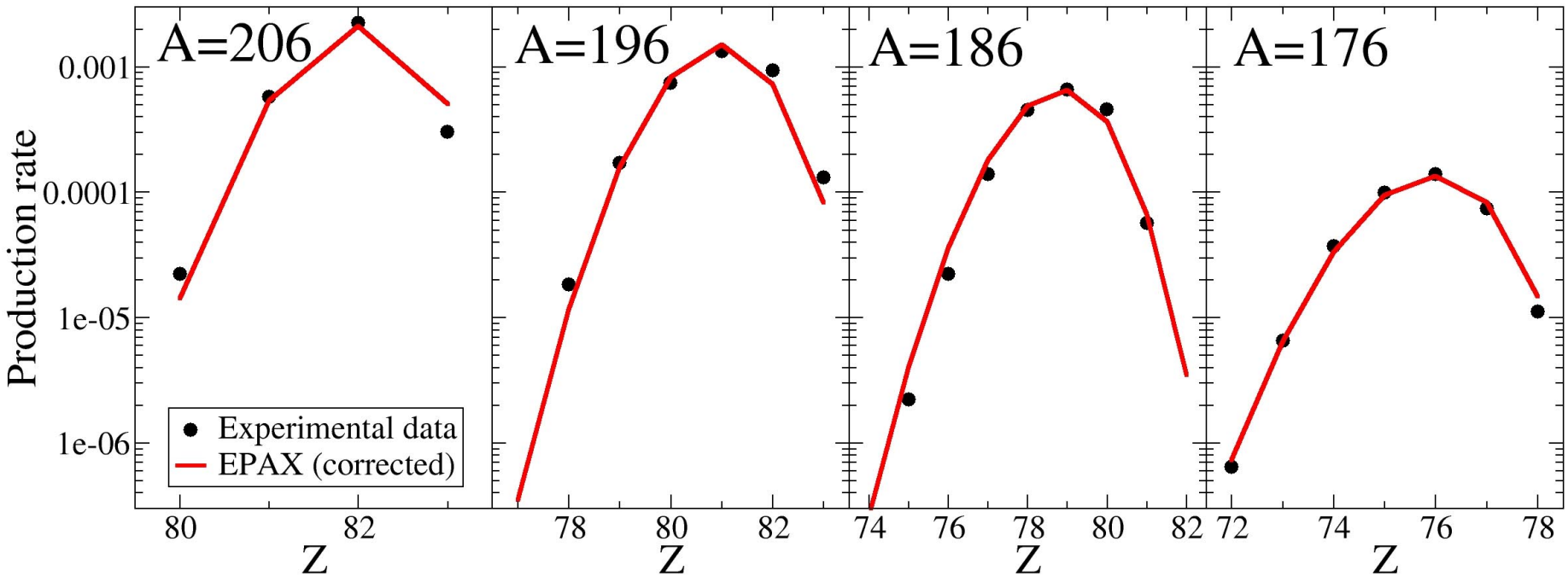
- Yields of largest mass loss decrease rapidly

→ Secondary reactions can be the main formation process

Estimation of yields

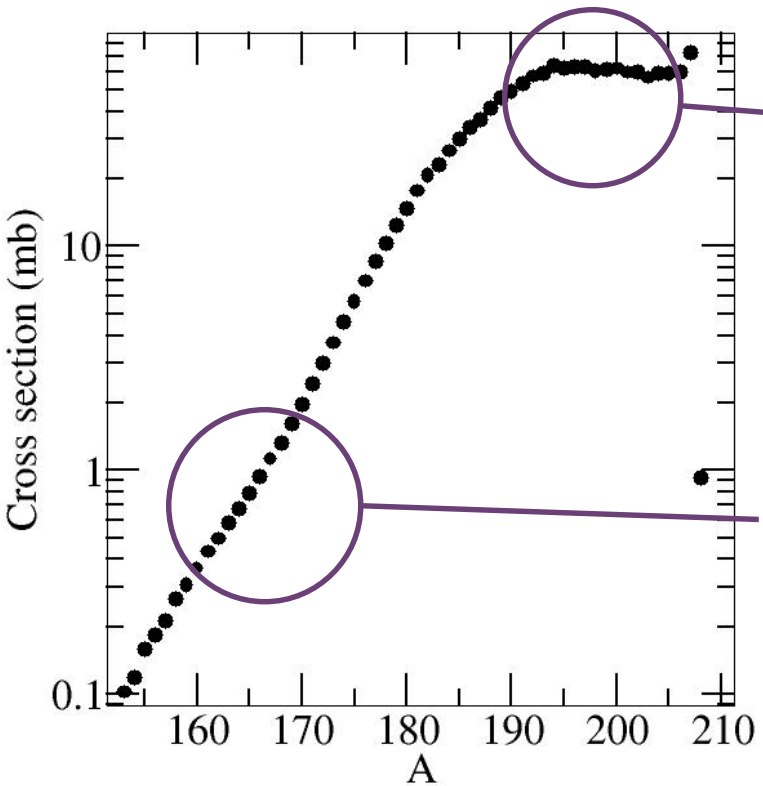
- EPAX-based formula to calculate the isospin of fragments (memory effect and residue corridor)

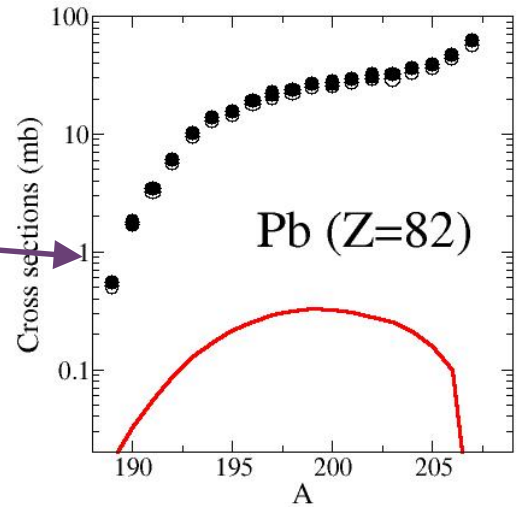
$$P(A_f,Z_f)=P(\Delta A).P_{Af}(Z_f)$$

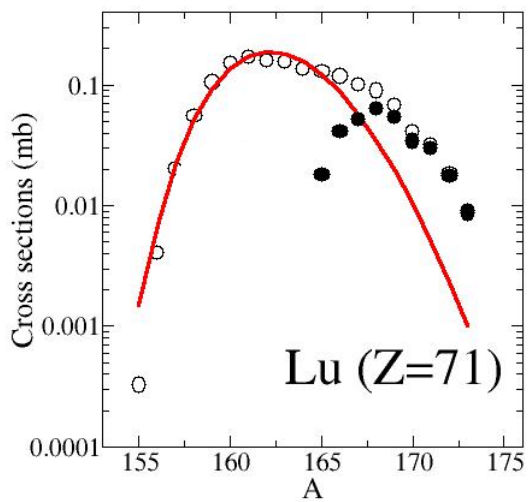


Multiple reactions in the target (2)

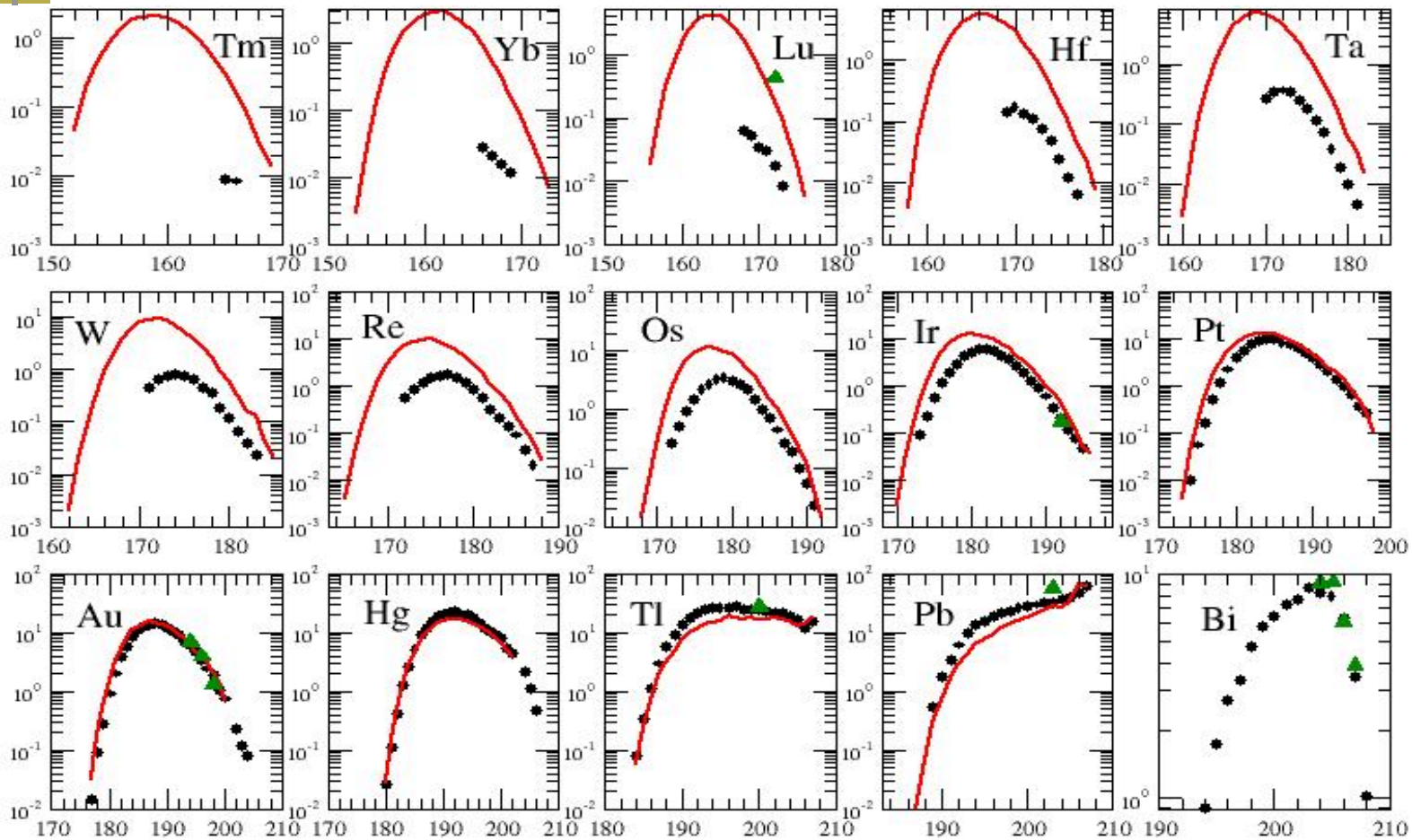
Complete mass distribution:





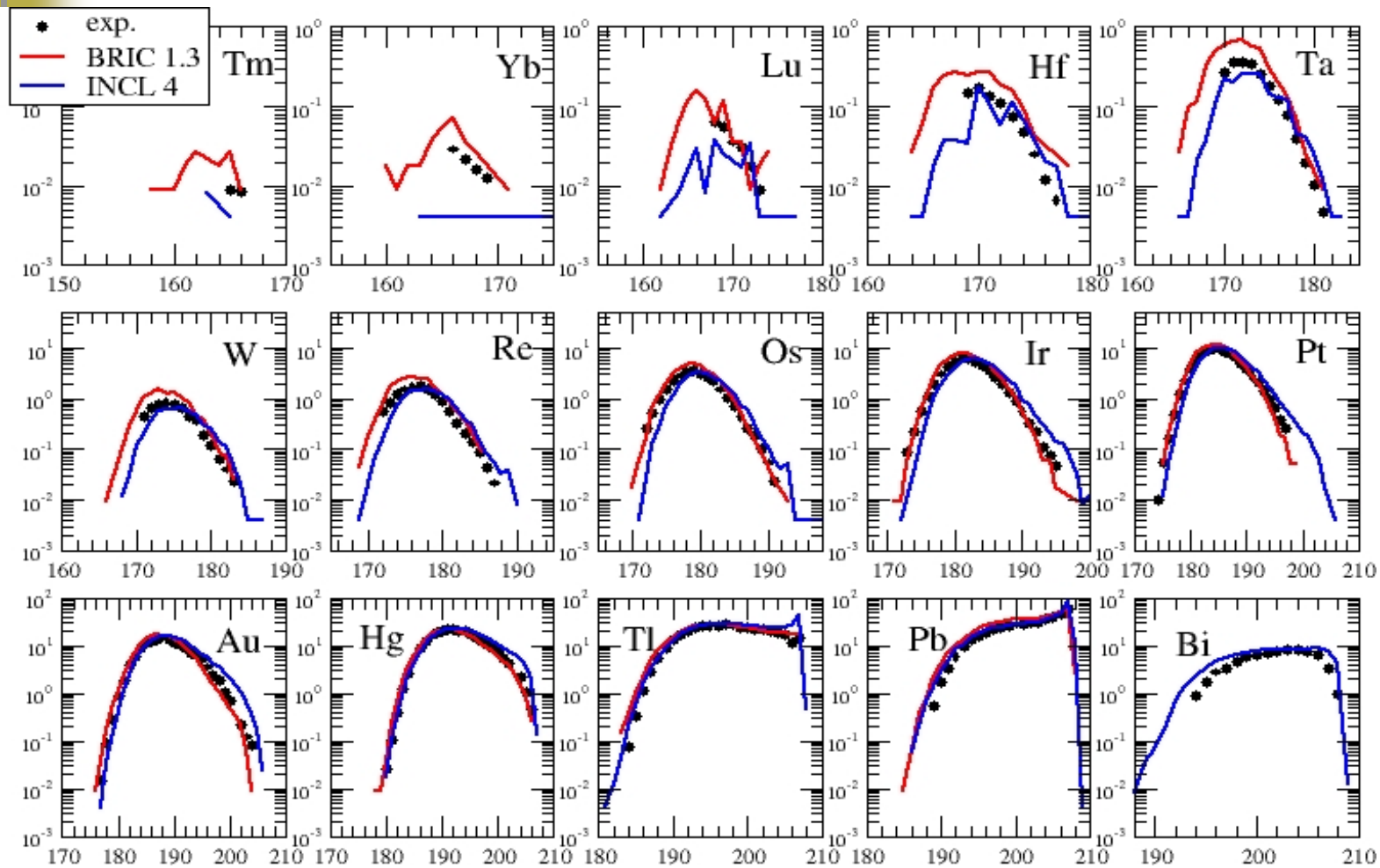


Experimental results



- This work — T. Enqvist et al. (FRS, 1AGeV Pb) ▲ M. Gloris et al (radiochemical, 500MeV)

Comparison to calculation codes



Total frag. cross section: 1537mb Optical model: 1690mb

Summary

- Despite atomic charge state ambiguities, reliable, complete isotopic cross sections have been obtained down to 10µb

- Excellent agreement with optical model calculations
- Fair agreement with available data (radiochemical)

- Secondary reactions in target prevent measurements of cross sections for very light, proton-rich fragments

Perspectives

- Codes results are in good agreement with data
- Charge state distribution induces difficulty to produce pure, tagged neutron-rich secondary beams
- Next steps:
  - Broader energy range: ^{136}Xe +p experiment (200AMeV)
  - Isospin effect (^{124}Xe+p experiment)
  - Exclusive experiment (SPALLADIN)
  - Transmission checks (fission, Fe)