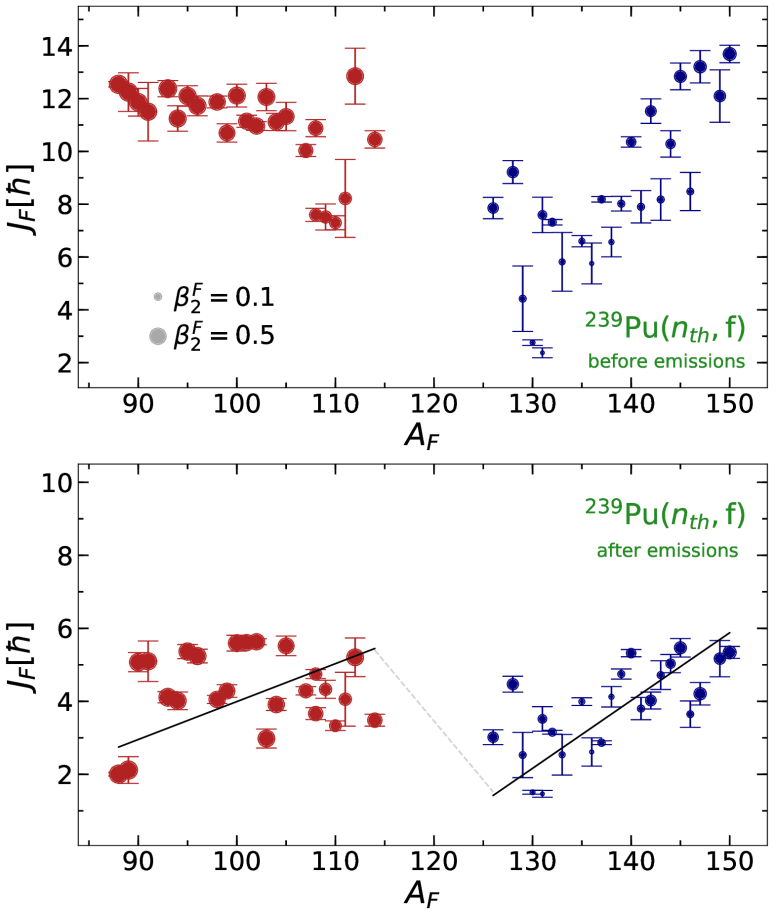
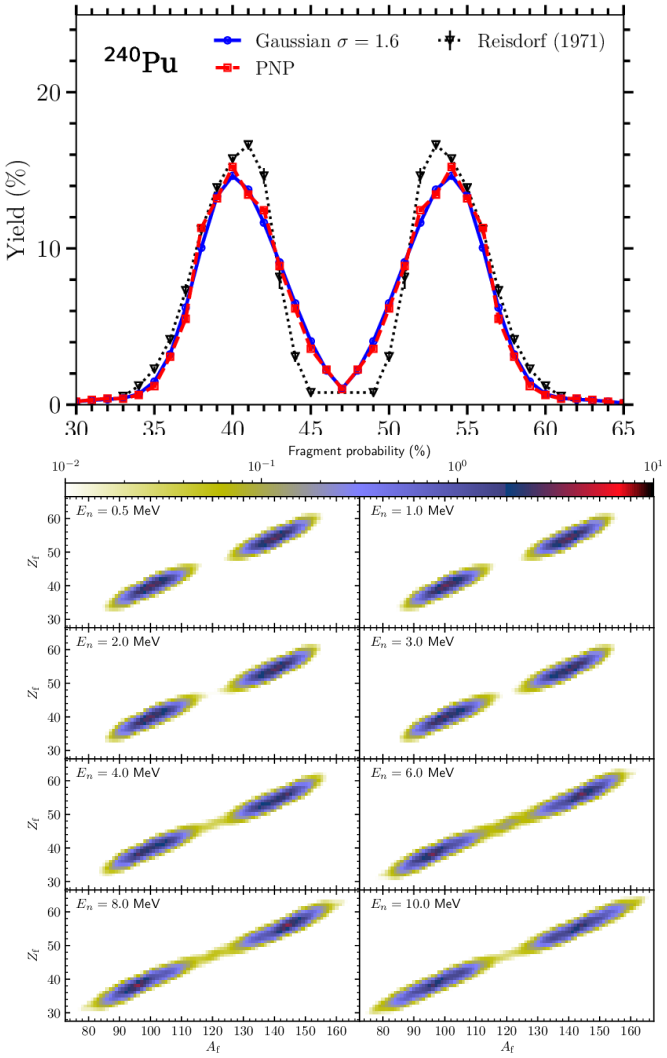
Initial Conditions of Fission Fragments

Symmetry restoration techniques from nuclear structure theory can be extended to predict initial conditions of fission fragments at the point of scission

- Fission yields are related to probability to populate scission configurations
- For each scission configuration
  - Particle number projection gives dispersion in Z and N – no need for Wahl systematics
  - Angular momentum projection gives spin distribution of fission fragment – no adjustable parameter
  - TDGCM gives probability of being populated

M. Verriere *et al.*, PRC **103**, 054602 (2021);
P. Marevic *et al.*, PRC **104**, L021601 (2021)





Prepared by LLNL under Contract DE-AC52-07NA27344.

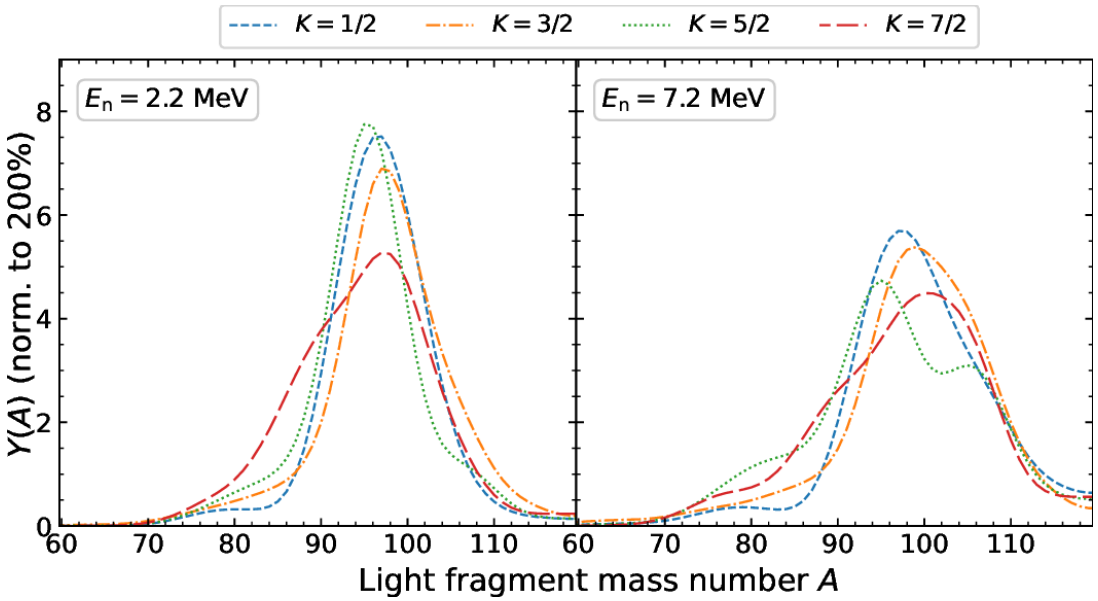
Role of Entrance Channel

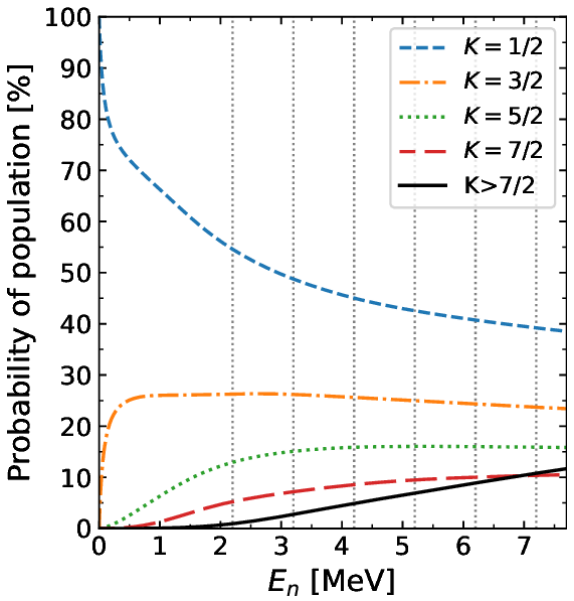
We computed the primary (=pre-neutron emission) charge and mass distributions odd-mass fissioning nuclei by combining fission models and reaction theory description of the entrance channel

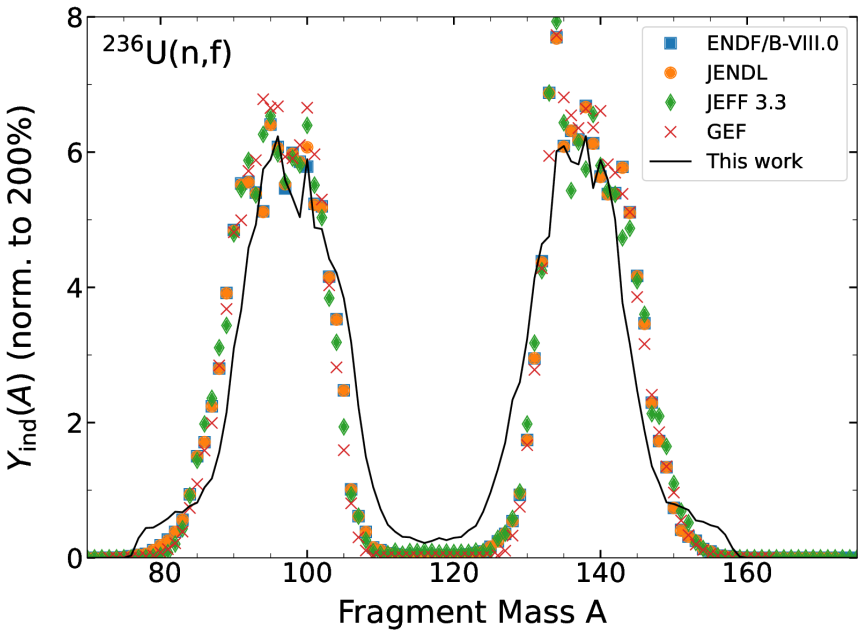
- In induced fission, the compound nucleus has a potentially quite broad spin distribution
- For each spin projection *K*, nuclear deformation properties (=barriers) are different
- We used LLNL fission models to estimate the yields for each *K* channel and coupled channels to weigh them

$$Y(A) \propto \sum p_K Y_K(A)$$

N. Schunck *et al*. PRC **107**, 044312 (2023)





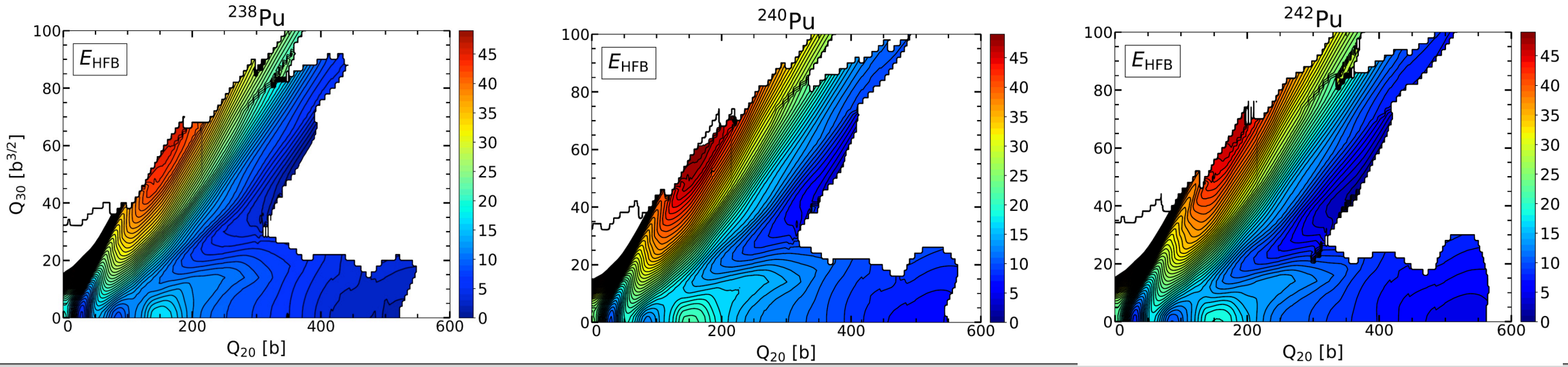


Prepared by LLNL under Contract DE-AC52-07NA27344.

Automatization

We are deploying a new Python framework called PESO (Potential Energy Surface Optimizer) to simplify, automatize and accelerate the determination of potential energy surfaces

- Potential energy surfaces (PES) are the key inputs to nearly all physics models of fission fragment distributions
  - In density functional theory (DFT), PES are generated by imposing (shape) constraints on the solutions
  - Self-consistent nature of DFT equations yield PES that can be discontinuous
- PESO is a plug-and-play software that automatically generates continuous PES from scratch in about 1-2 days on a medium-size cluster



Prepared by LLNL under Contract DE-AC52-07NA27344.