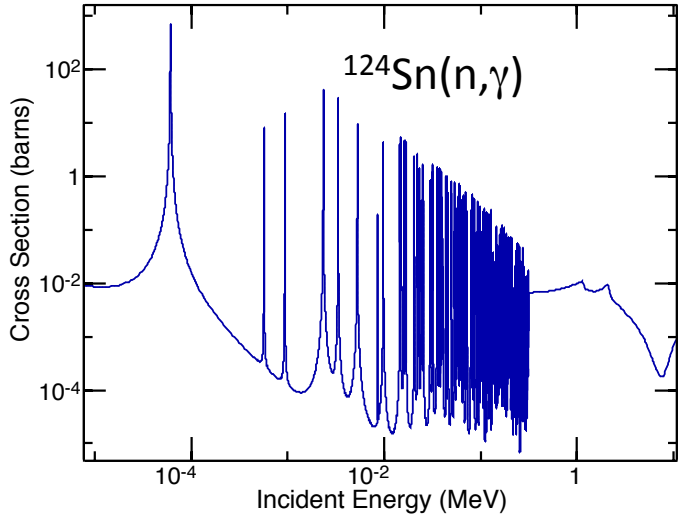
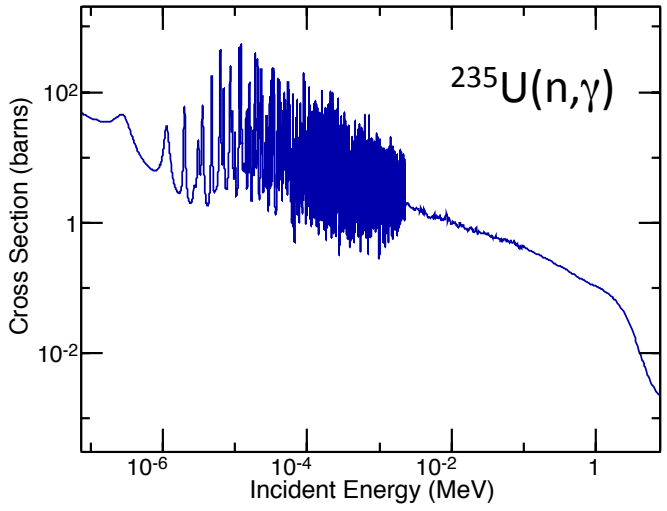
Neutron Radiative Capture

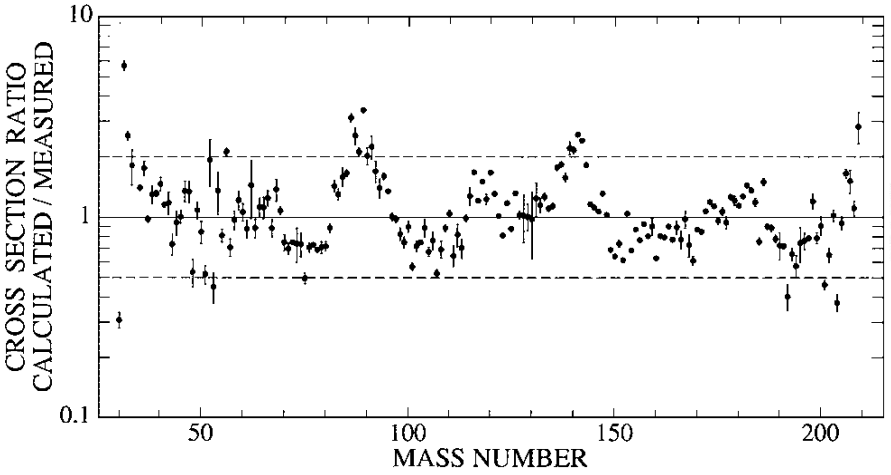
- Neutron capture cross sections
  - Used in astrophysical nucleosynthesis models
    - Maxwellian-averaged cross sections and capture rates
  - Used in neutron transport codes for various applications in nuclear technology



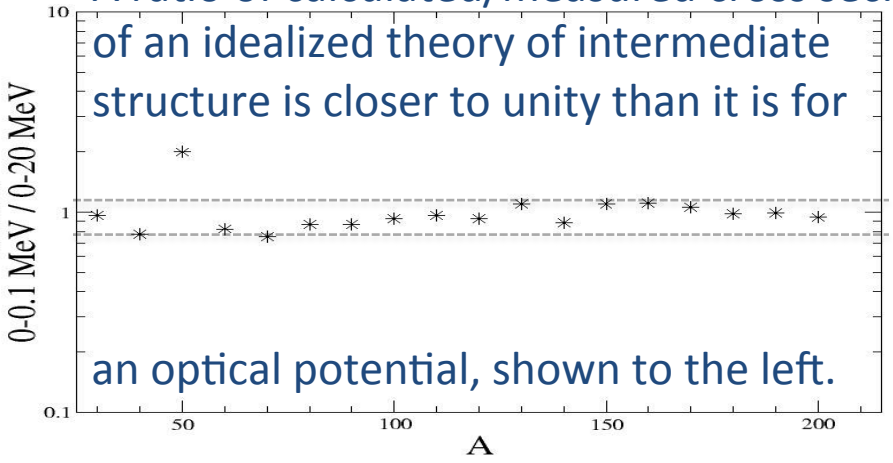


Neutron Capture: Present Status

- Statistical capture based on strength functions
  - HFB informs input parameters for Hauser-Feshbach models
- Direct capture computed separately
  - Using single-particle spectroscopy from (d, p) data
  - Semidirect capture via GDR can be included
- Models do not include effects of doorways on capture
  - MACS at kT = 30 keV sensitive to doorways (see below):



A ratio of calculated/measured cross sec. of an idealized theory of intermediate structure is closer to unity than it is for an optical potential, shown to the left.



Neutron Capture: Future Challenges

- Incorporating many-body nuclear structure methods into a self-consistent unified framework of direct, doorway, and compound nuclear reactions may illuminate their interplay for medium and heavy nuclides, from stable to drip-lines:
  1. Consider HFB + QRPA as input for reaction models:
     - QRPA states as channels/doorways in coupled-channels,
     - Or, for direct computation of non-local optical potentials
  2. Consider effects of higher order (*2p-1h*, *3p-2h*) components in bound/resonant states on (n,γ) in Gamow Shell Model
  3. Use statistical methods for narrow compound resonances
- Computational challenges:
  1. Large number of coupled channels anticipated
  2. Large dimension of GSM for capture on e.g. $^{130\text{-}136}$Sn
- Collaboration of reactions and structure theory needed
  - FTE Staff/Faculty + postdocs + grad. students
  - computing resources