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LLNL CSEWG Report 2005

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Physics & Advanced Technologies

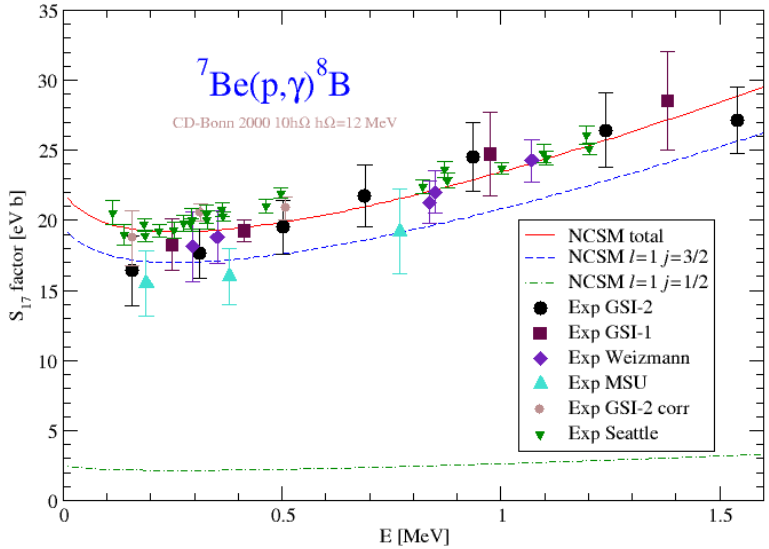
LLNL continues to be committed to increasing involvement in the national nuclear data community

- **ENDF/B-7**
  - ^{74,75}As
  - ^{240}Am
  - Beta-delayed gammas from fission
  - Updated thermal neutron capture gamma-ray spectra
- **Format development**
  - Paper in NIM/B, Format specification to be posted on web
  - We think we've developed something very useful
  - We need help to work toward making this an international standard
- **Future plans**
  - Weapons program is strongly supportive of our approach to uncertainty studies, so developments on this front will be front and center
  - Also supportive of new format development
  - We will be continuing to develop a partnership with homeland security sponsors

New theory for nuclear reactions

- Extension of our ab-initio nuclear structure effort
- Goal: Describe nuclear reactions with light nuclei using fundamental nuclear interactions
- Thermonuclear reactions
  - d(t,n)□at low temperature
  - 7Be(p,□)8B, 3He(□,□)7Be, □(2□,□)12C
- Neutron-induced reactions
  - 6Li(n,□)t, 11B(n,n'□)11B
  - 10Be(n,□)11Be

PIs: Erich Ormand, Petr Navratil
Collaborations w/ James Vary & others



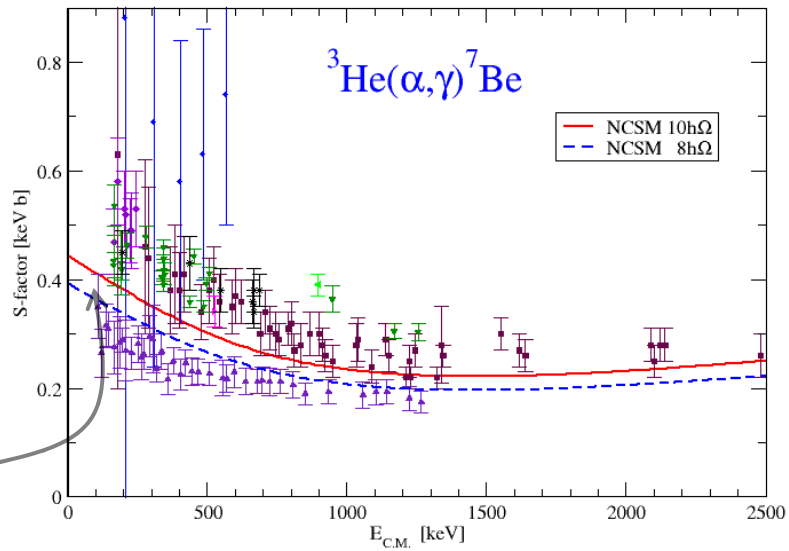
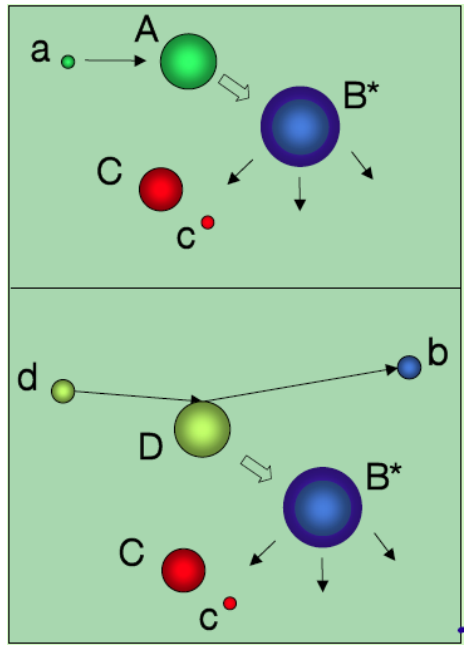


Illustration of convergence with model space

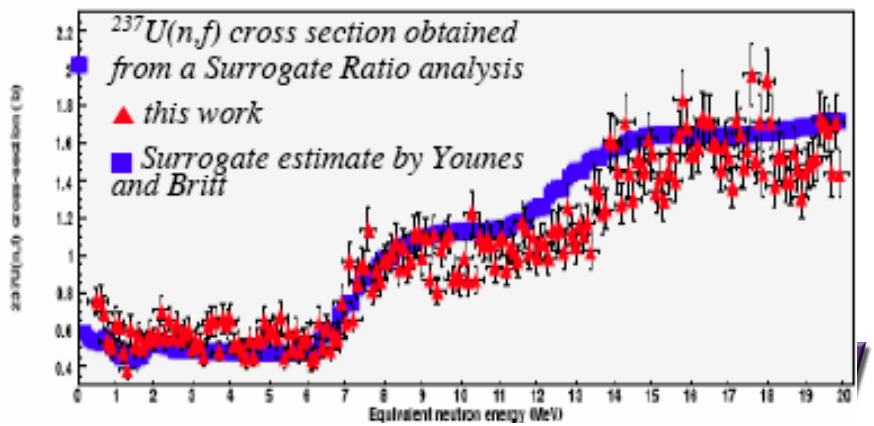
S-factors calculated down to zero energy

Continued investment in "surrogate" reactions as a way to deduce neutron cross section data

- Neutron-induced reactions on unstable nuclei can make for impractical experiments
- The approach being developed is to use a surrogate reaction on a stable nucleus that will lead to the same compound system
  - E.g., 238U(□,□'f) is a surrogate for 237U(n,f)
  - Measure the relative probability for decay channels of the compound
- But theoretical input is important
  - Optical model
  - Theory of the direct reaction process
  - Modeling the decay of the compound



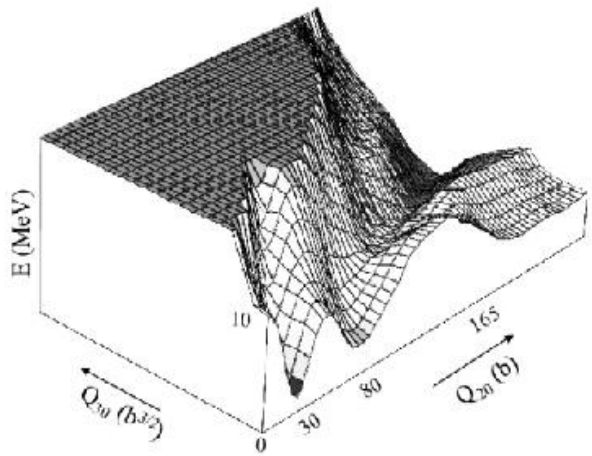
$$\sigma\left[^{237}\mathrm{U(n,f)}\right]/\sigma\left[^{235}\mathrm{U(n,f)}\right] \approx \sigma\left[^{238}\mathrm{U}(\alpha,\alpha'\mathrm{f})\right]/\sigma\left[^{236}\mathrm{U}(\alpha,\alpha'\mathrm{f})\right]$$



PI: Lee Bernstein
Collaborations w/ LBNL, Yale, others

We are also starting to develop a predictive fission effort

- Calculations in collaboration with BIII
- Microscopic calculation of fission in a nutshell
  - In-medium N-N interaction + Hartree-Fock
    - → Potential surface
  - Construct wave packet + "locality" approximation
    - → Schrödinger-like equation
  - Time-dependent solution of the Schrödinger equatio
    - → Wave function of the system at each instant in time
      - → Mass and energy distribution of fragments
      - → Nuclear structure of fragments (shape, excit
      - → Gamma emission spectrum
      - → Neutron emission spectrum
      - → Correlations …



PIs: Walid Younes, Mike Heffner
Collaborations w/ Daniel Gogny, BIII

The experimental counterpart is to use a TPC to completely resolve the kinematics of fission events