Fission Fragments De-excitation

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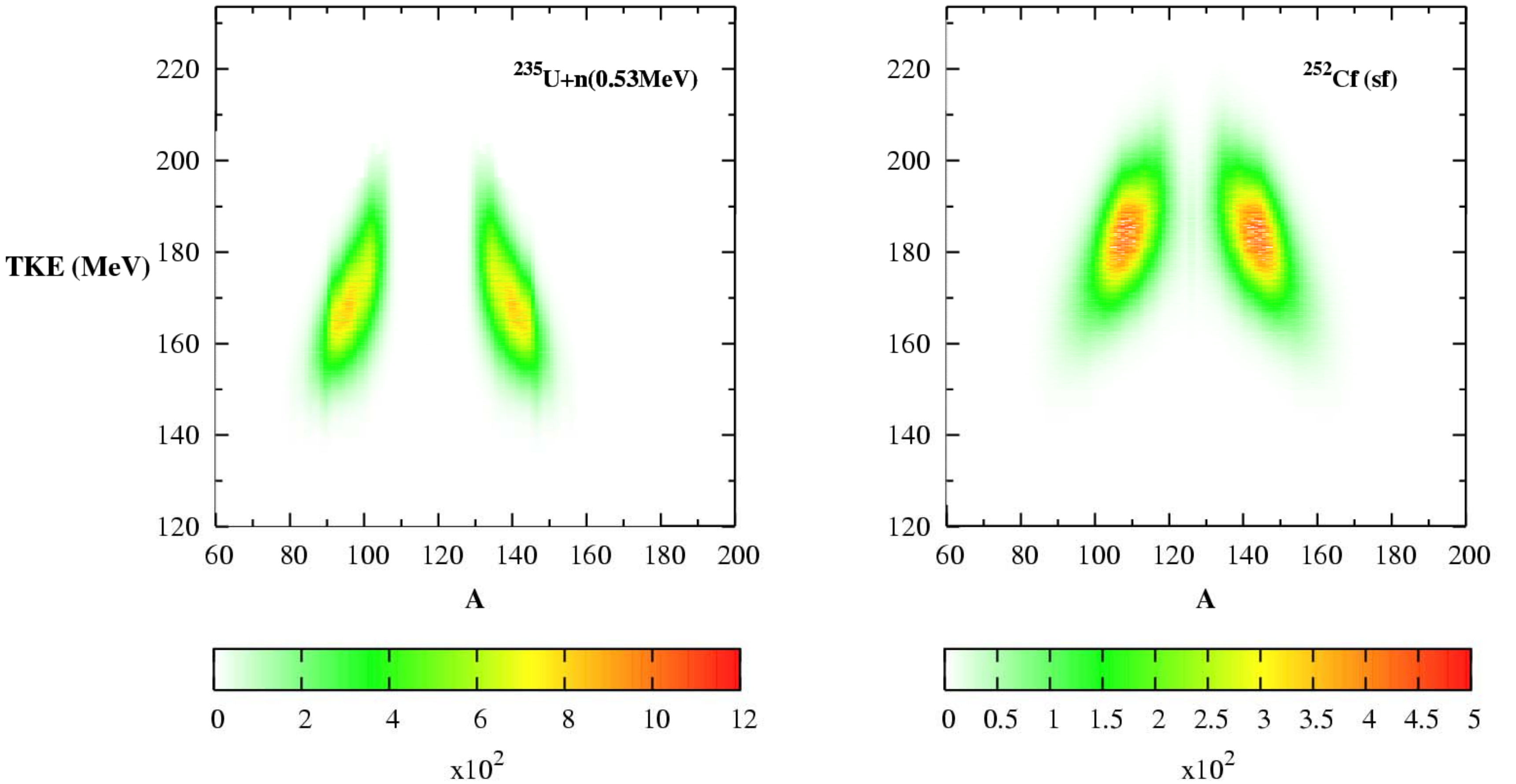
Applications

- Non-proliferation: detection of radioactive materials
  - Fluctuations in number of prompt fission neutrons can be a signature ;
  - Similar information can be obtained from prompt γ-rays ;
  - In a entire fission chain, fluctuations are amplified.
  - Need for $P(\nu)$ distribution, and not only the average $<\nu>$.
- Improved prediction of prompt neutrons spectrum (beyond Madland-Nix model)
- Simulation of neutrons and γ-rays detectors
- Fission physics near scission point

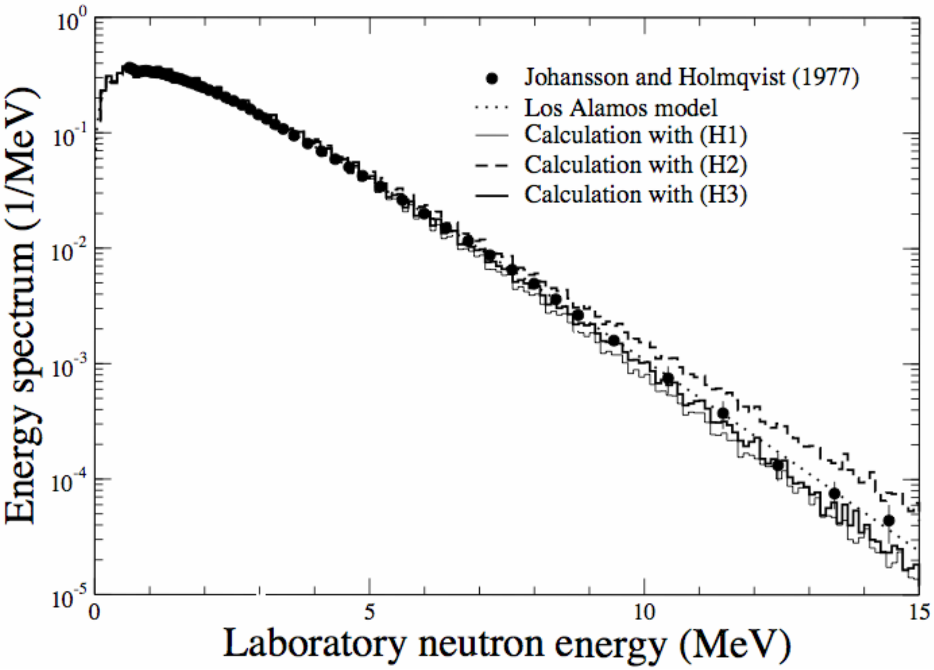
Our Approach

- Monte Carlo approach of the de-excitation of Fission Fragments by neutrons and γ-rays evaporation
- Neutrons are chosen from a Weisskopf evaporation spectrum at temperature $T=\sqrt{(E^*/a)}$ and emitted until the residual energy is too low. Then γ-rays are emitted in a Weisskopf-type spectrum.
- Sampling over Y(A,Z,TKE) and assumptions for the splitting of the Total Excitation Energy (TXE) among the light and heavy fragments.

Results for ^{252}Cf (*sf*) and n(0.53 MeV)+^{235}U



Prompt neutrons spectrum and P(ν) for ^{235}U



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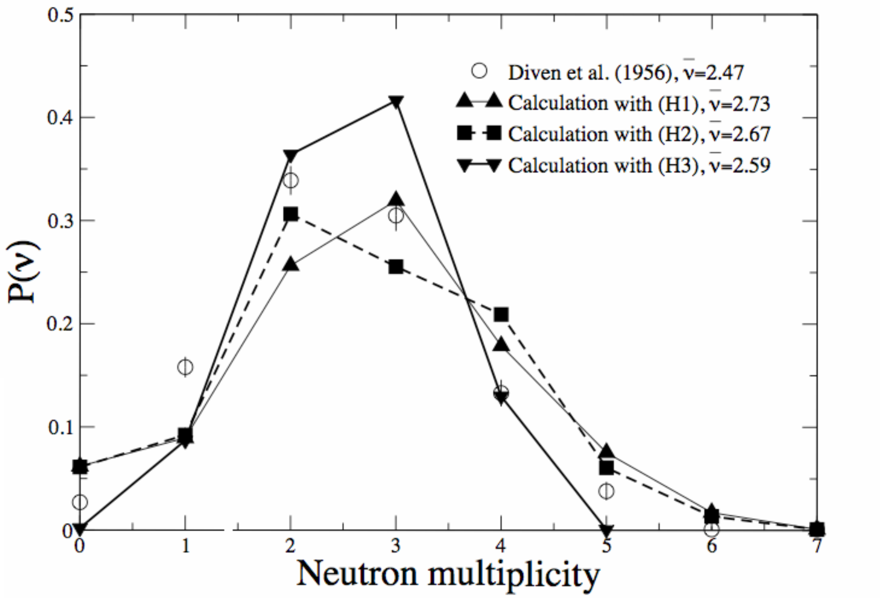
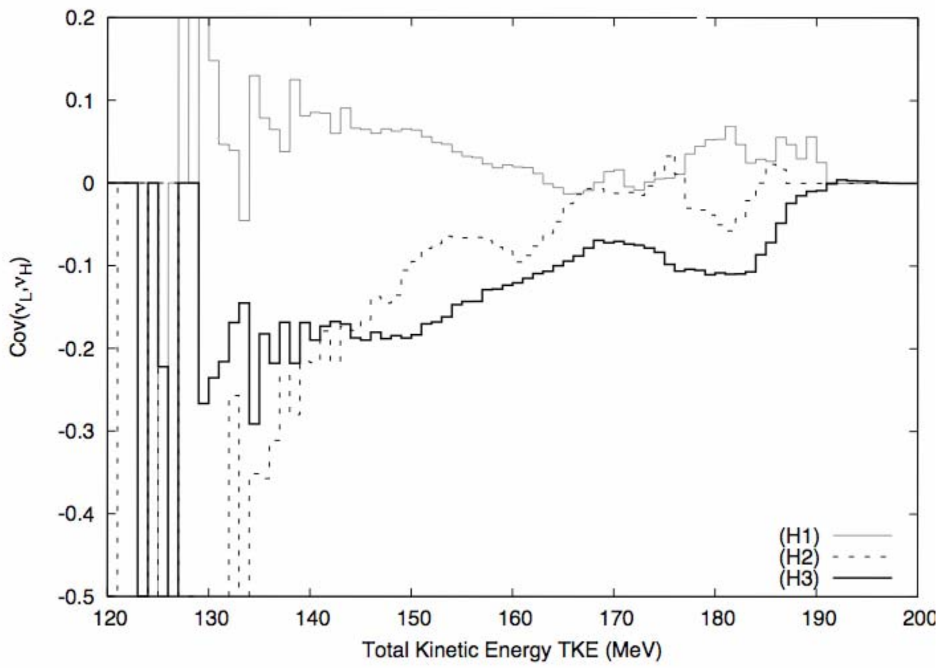
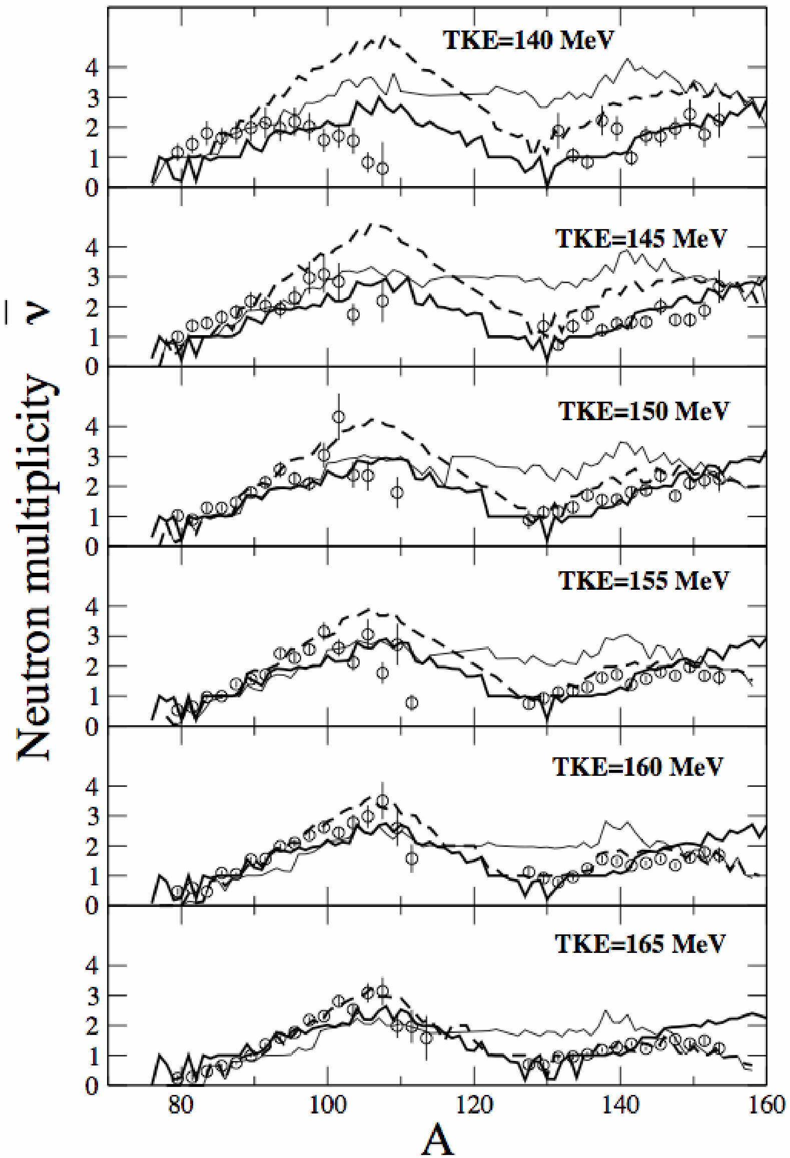


P_ν(A,TKE) and Cov(ν_l,ν_h)





Final comments

- We have a functioning Monte Carlo code
- Several directions for improvement:
  - Full Hauser-Feshbach prescription for the de-excitation process, to treat spin-dependent decay and γ-ray-neutron emission competition properly
  - Theoretical predictions for the fission fragments yields, as a function of mass and TKE
  - Better understanding of the physics at scission
- What about ENDF… new formats for $P(\nu)$ and other observables?