

s-process modeling

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Cross Section Evaluation Working Group meeting

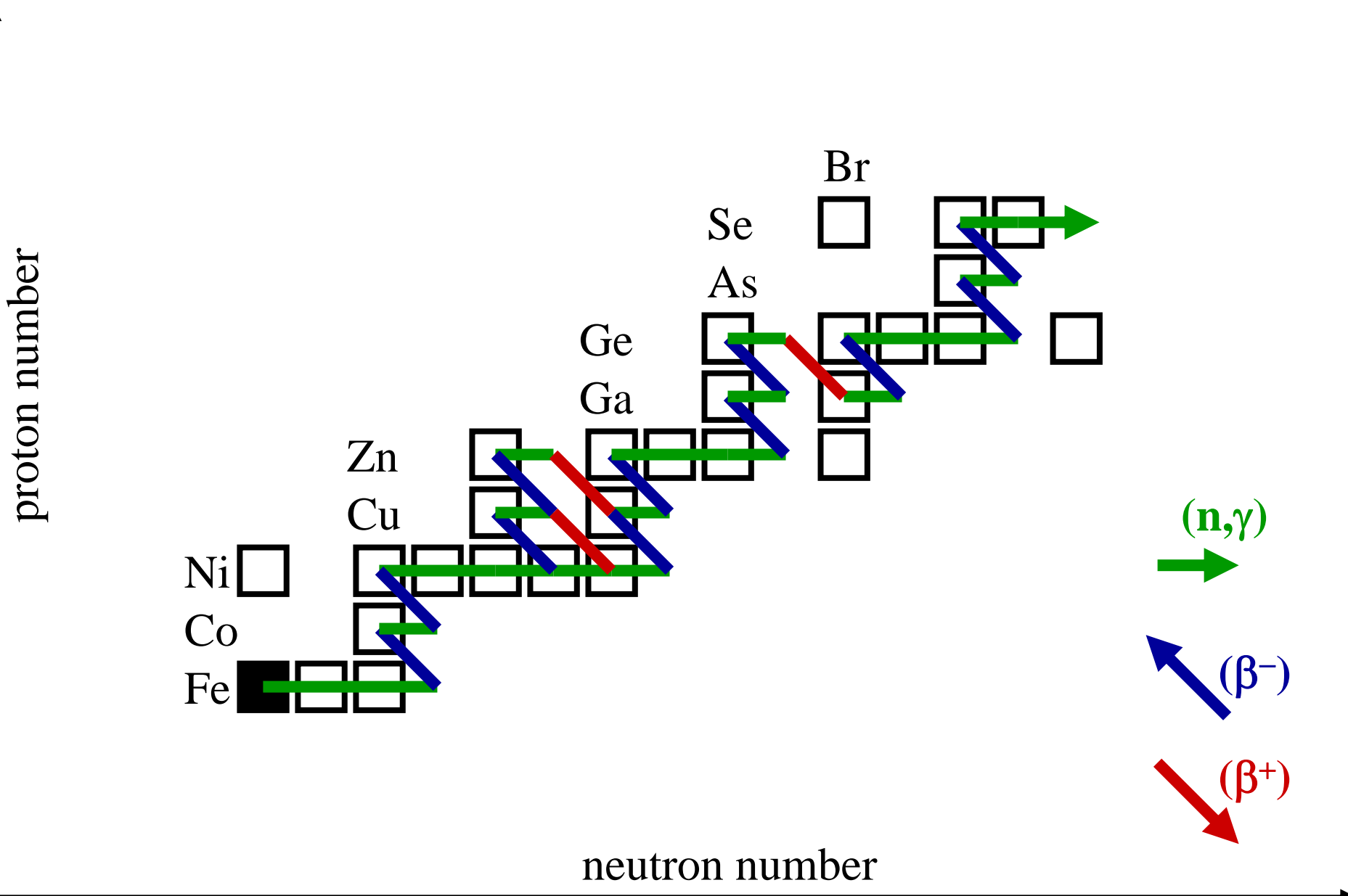
National Nuclear Data Center, Brookhaven National Laboratory,
November 8 - 10, 2005



Collaborators

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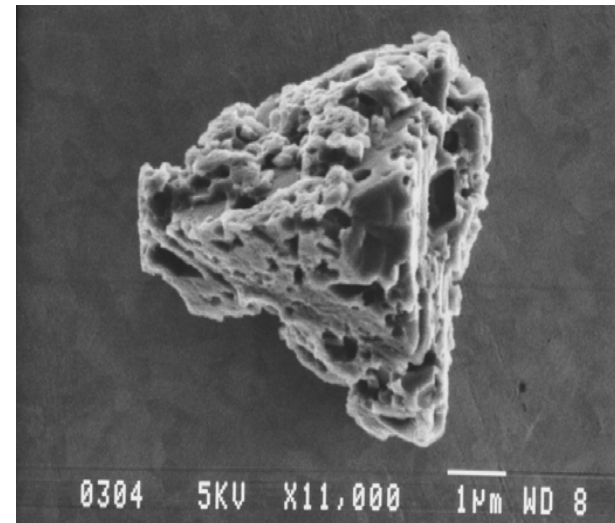
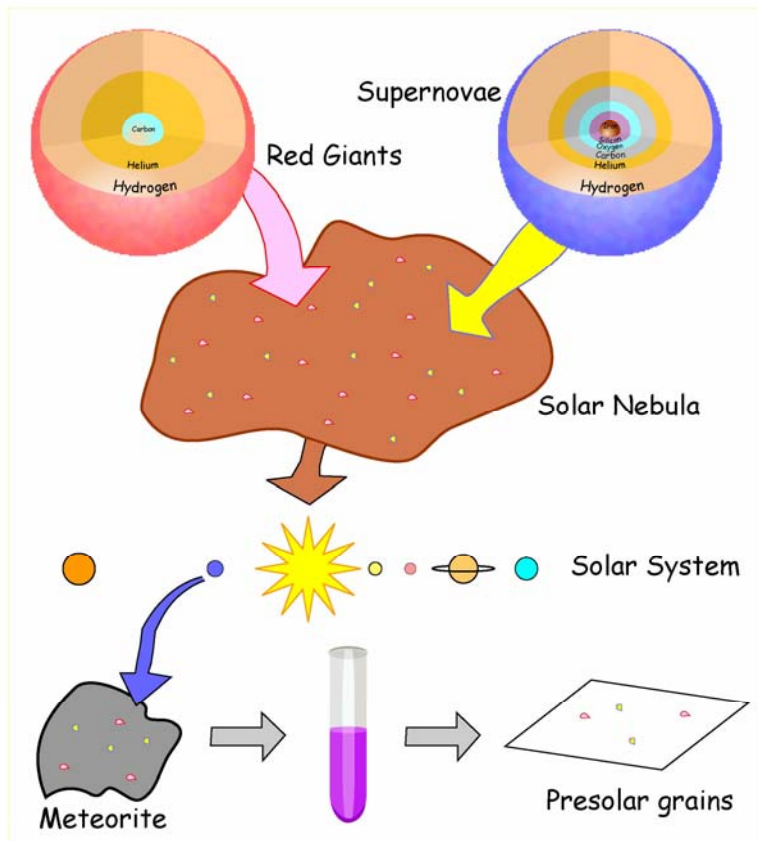
the s-process



The observable: Stardust from meteorites

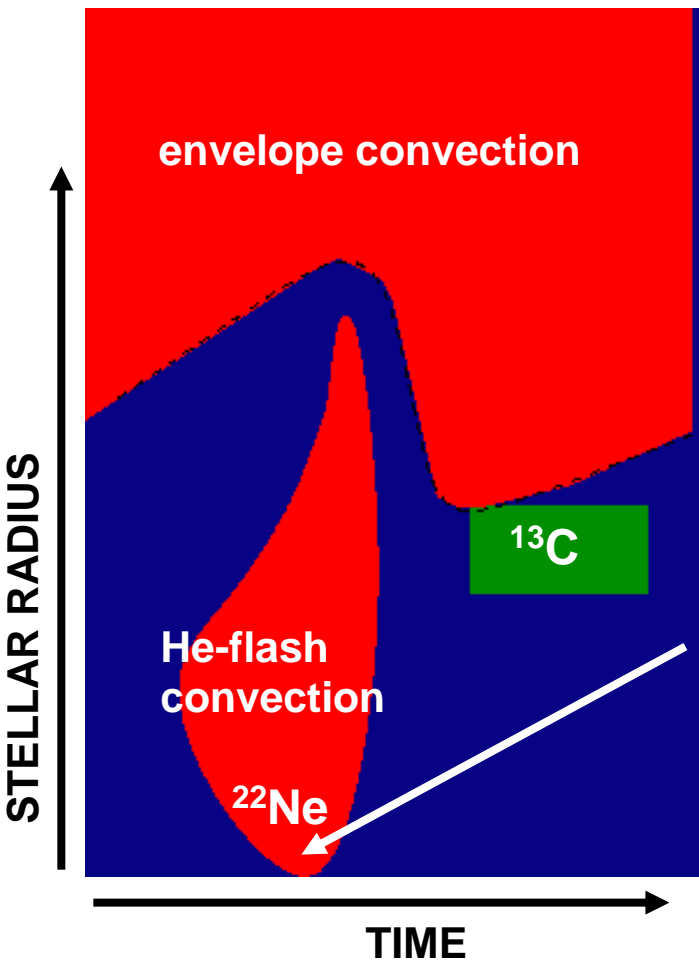
Dust forms in the cool mass outflows of s-process generating stars.

Individual dust grains extracted from primitive meteorites can be associated with their individual site of origin around one star ... tracing that star's individual isotopic signature.

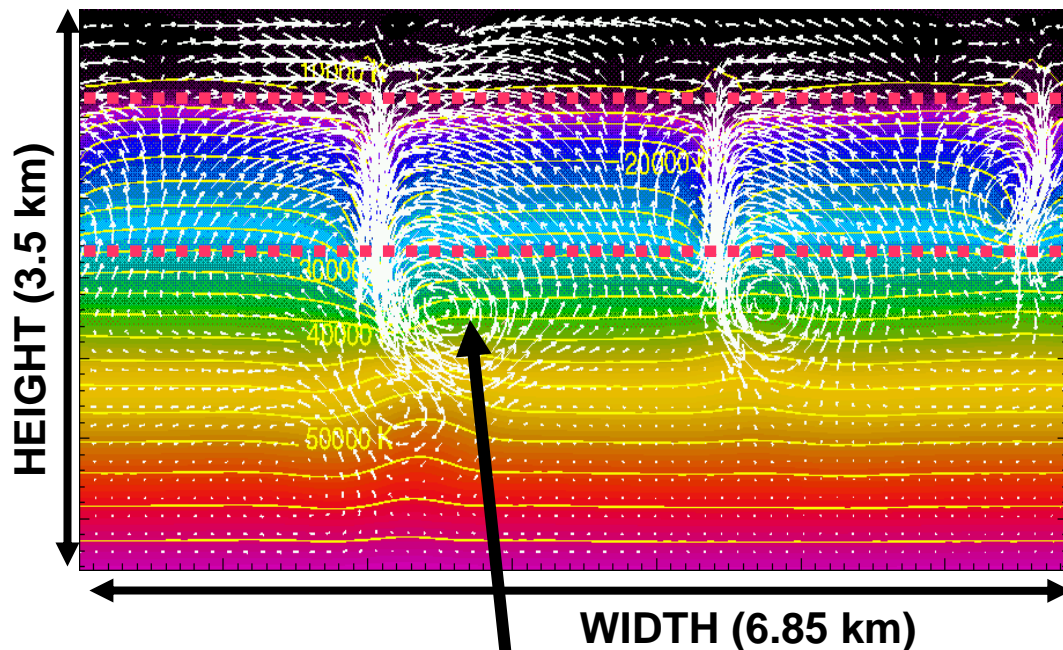


Astrophysics theory of convection

Schematic of He-shell flash



2D-model of White Dwarf convection zone

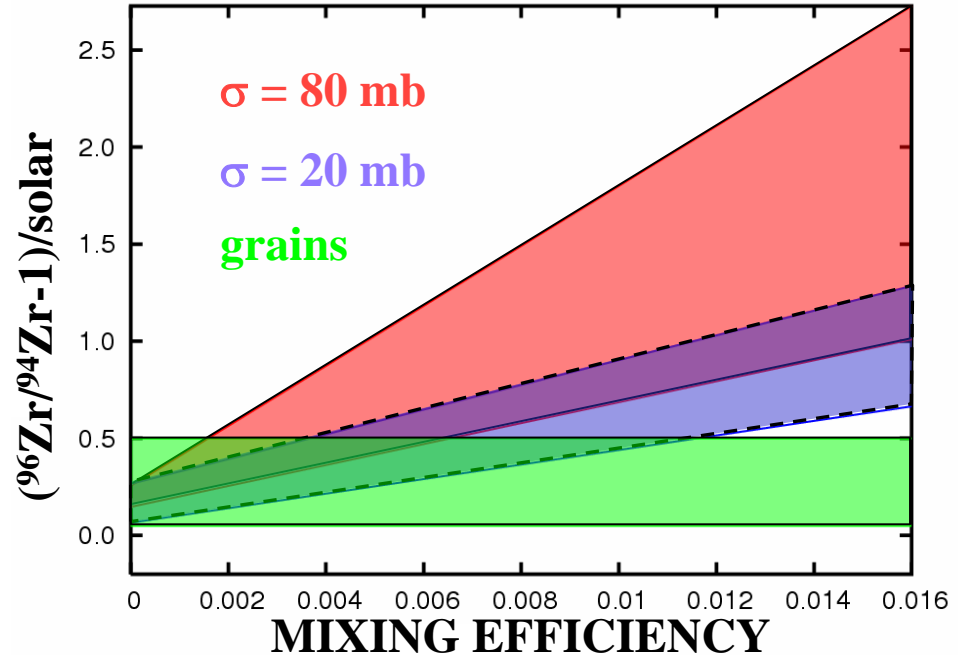
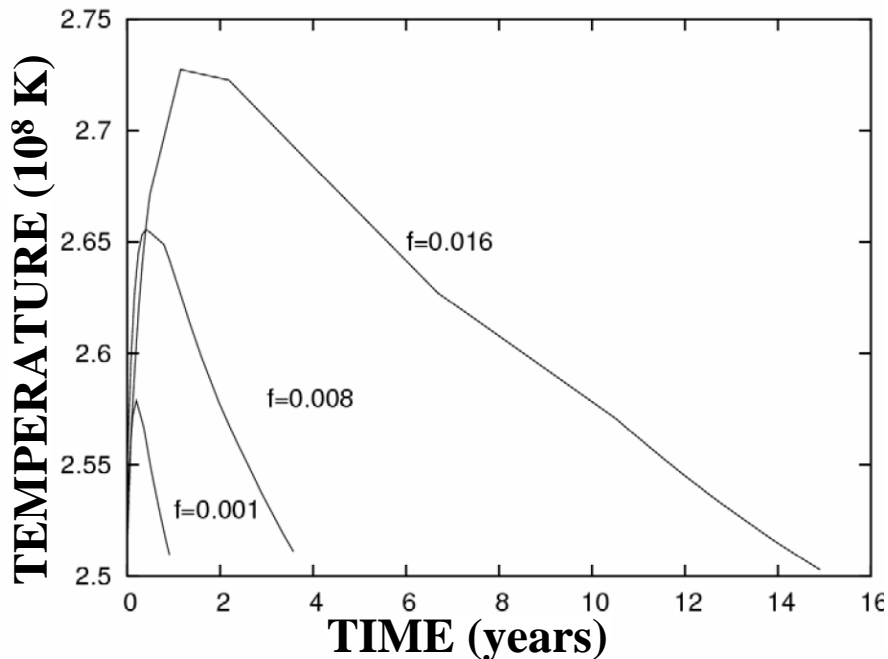
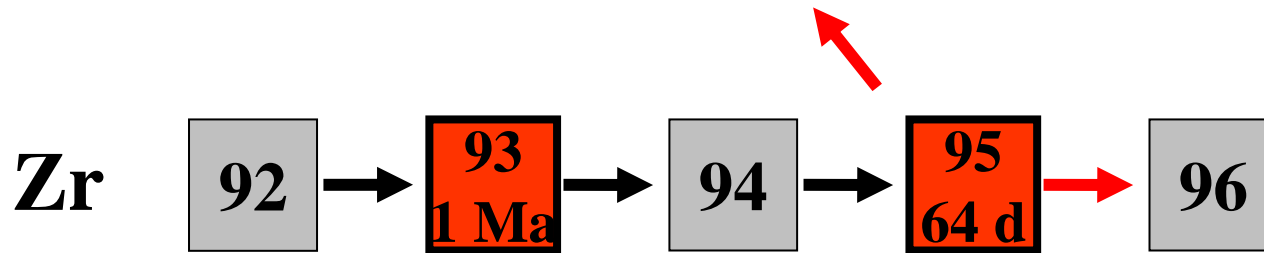


How efficient is *extra mixing* in deep stellar interior?

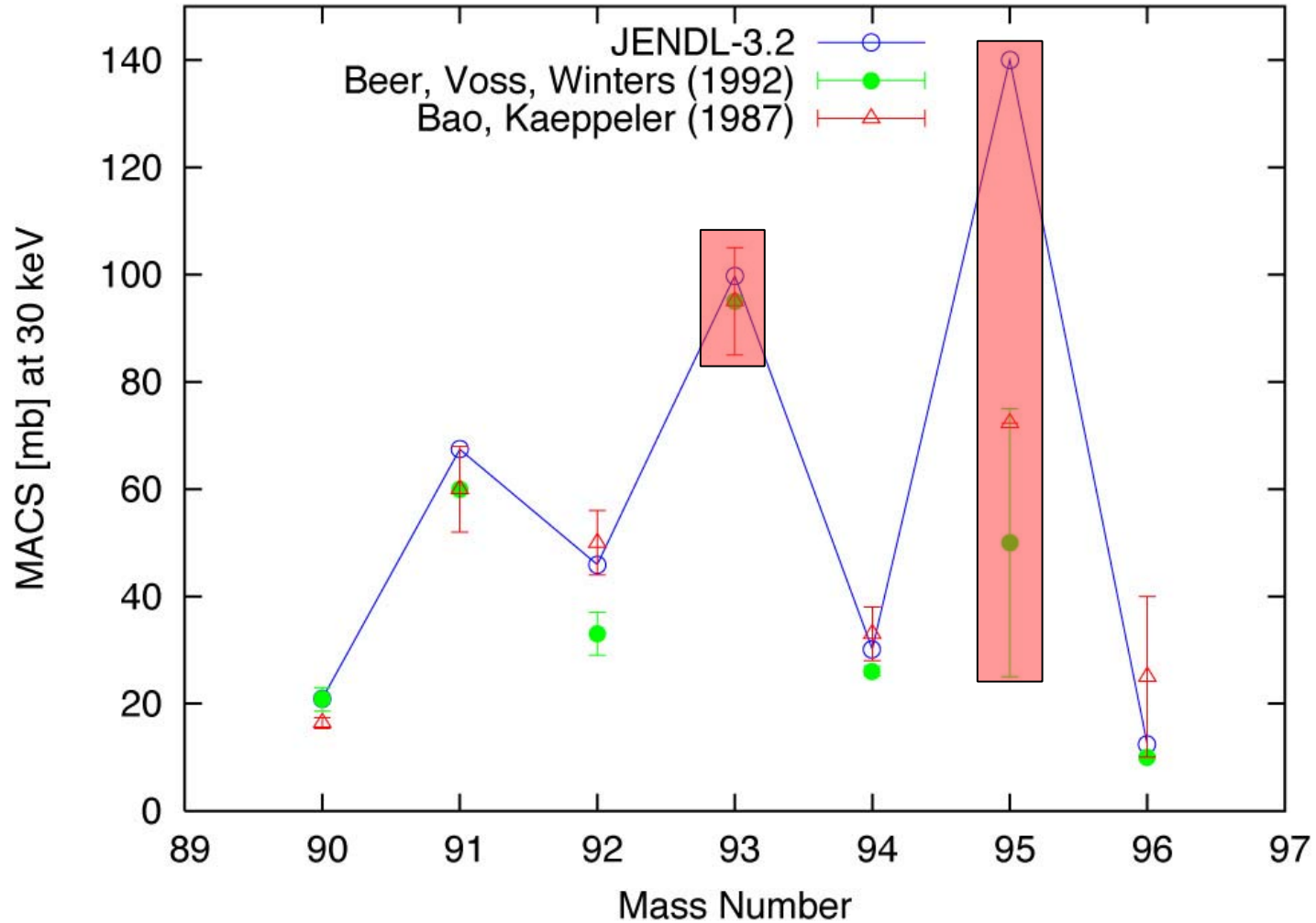
Mixing extends into stable layers -> *extra mixing*.

Test with 1D exponential diffusion approximation, efficiency parameter f .

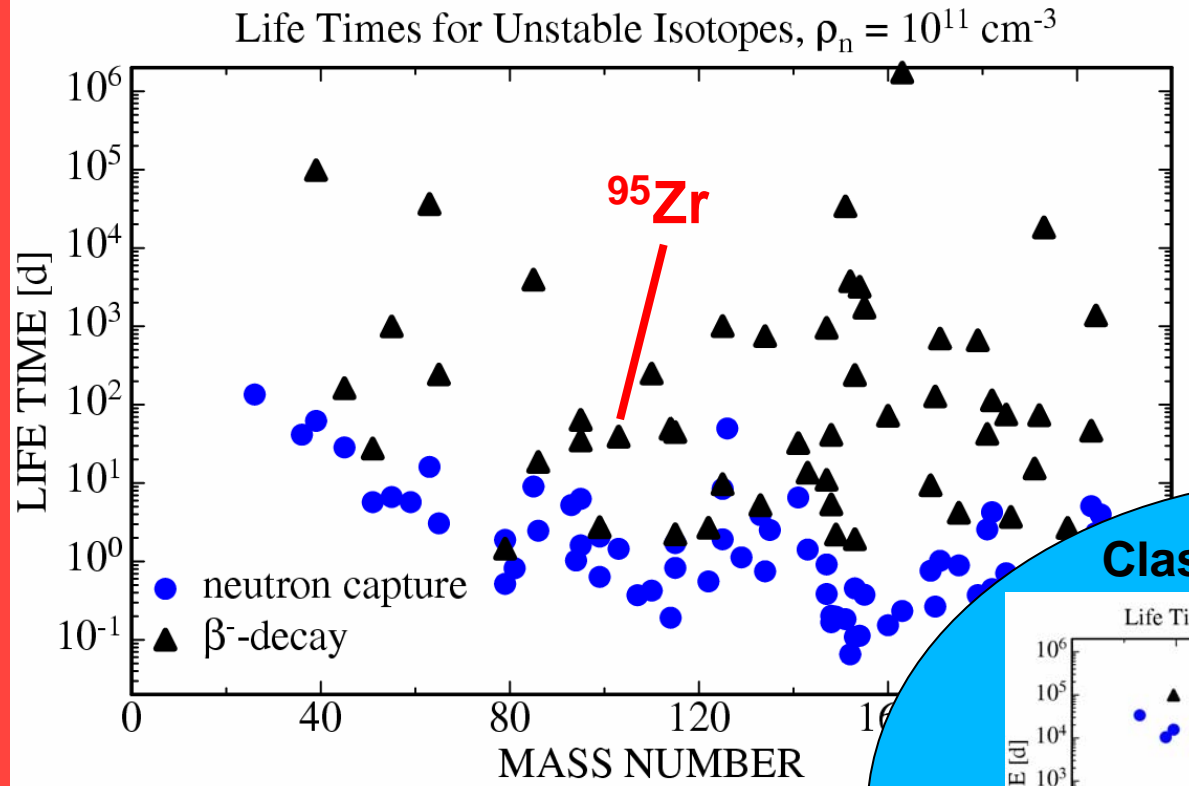
Probing efficiency of mixing with the s-process and grains



Cross Sections of Radioactive Isotopes?

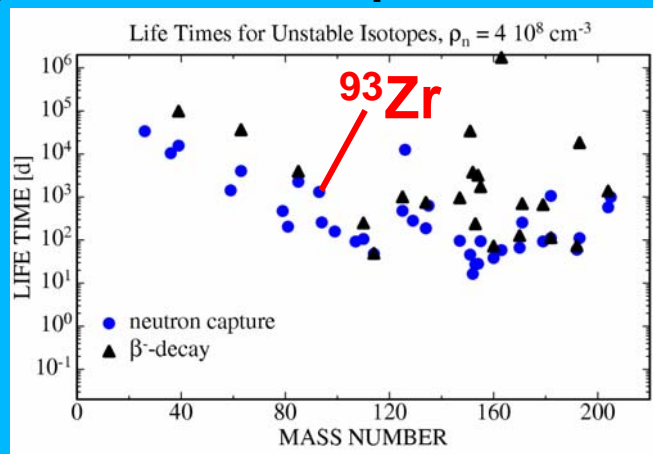


Connection between theory and experiment



**Modern
s-process
models
(AGB stars)**

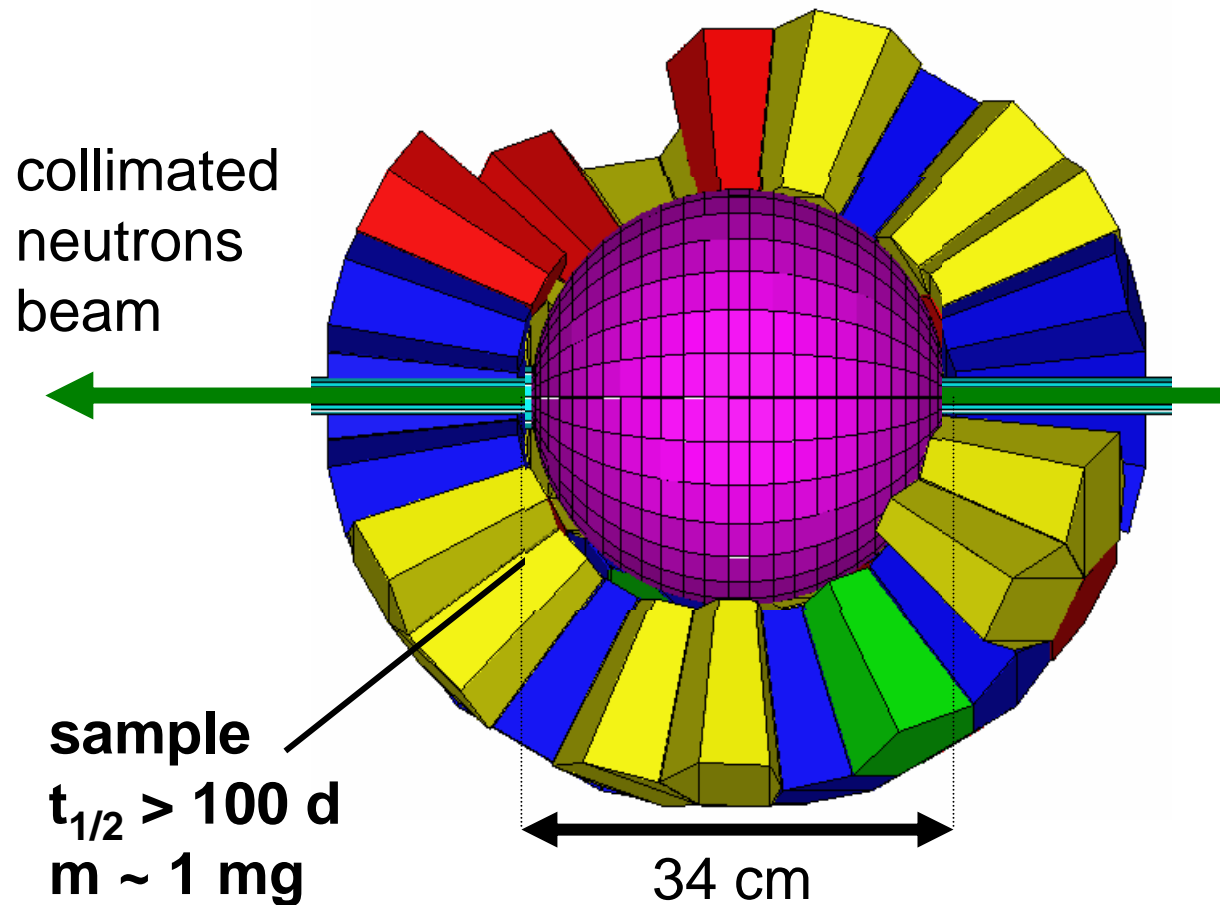
Classical s-process



**DANCE + n-facility
@ RIA**

DANCE @ LANL

Detector for Advanced Neutron Capture Experiments



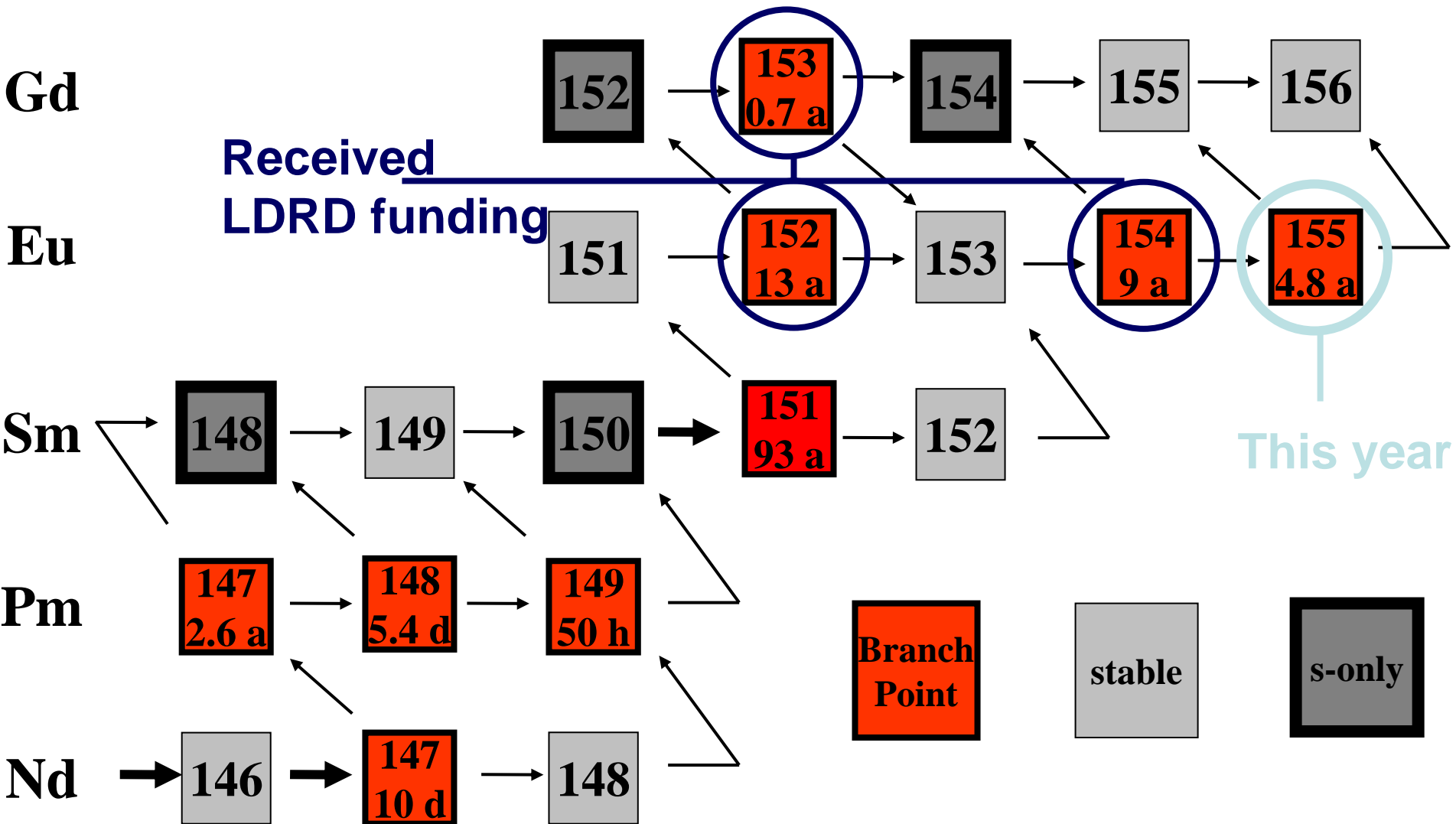
neutrons:

- spallation source
- thermal .. 500 keV
- 20 m flight path
- $3 \cdot 10^5 \text{ n/s/cm}^2/\text{decade}$

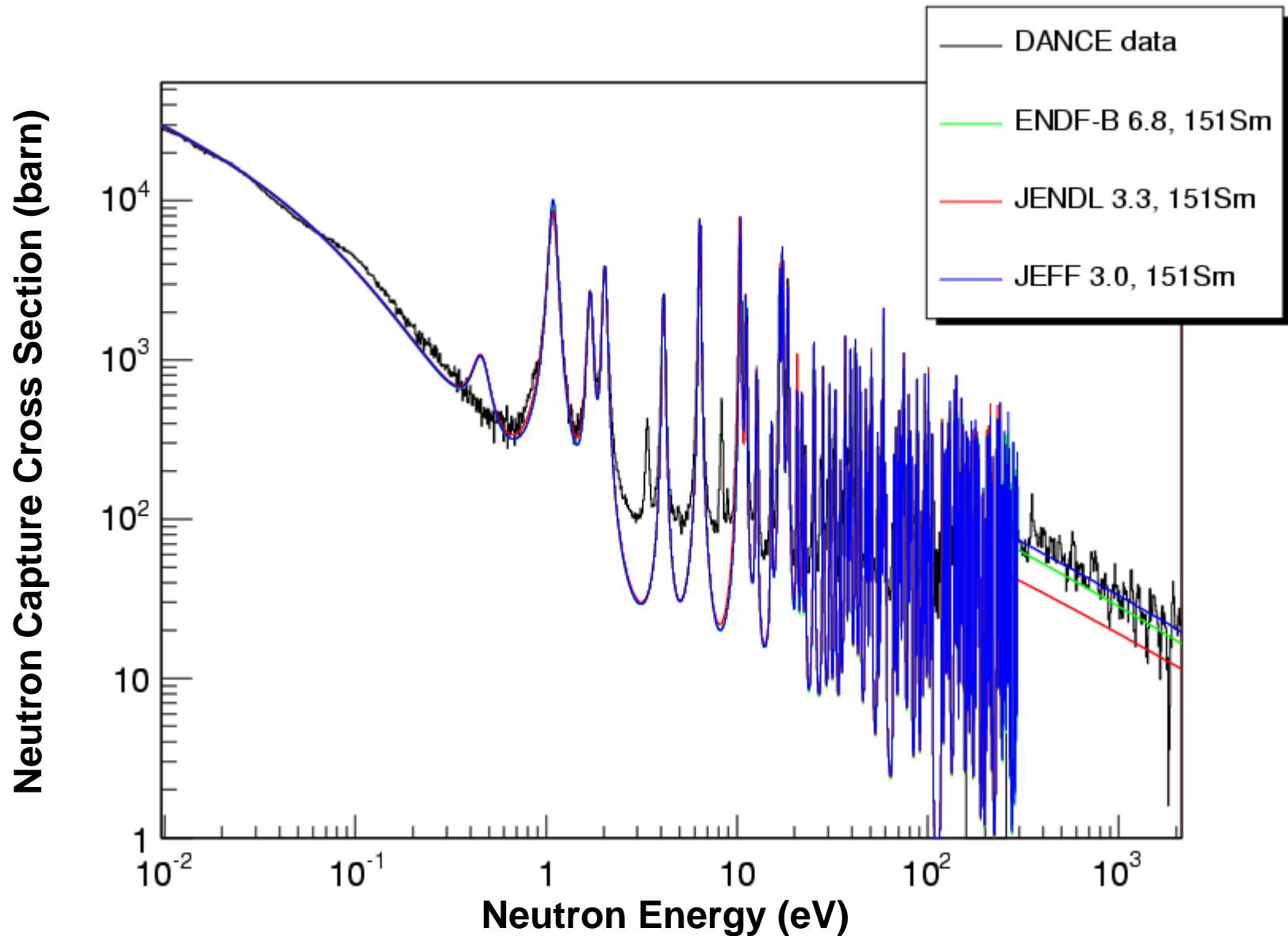
γ -Detector:

- 160 BaF_2 crystals
- 4 different shapes
- $R_i=17 \text{ cm}$, $R_a=32 \text{ cm}$
- 7 cm ${}^6\text{LiH}$ inside
- $\epsilon_\gamma \approx 90 \%$
- $\epsilon_{\text{casc}} \approx 98 \%$

^{151}Sm combining to decoupled branching regions



0.5 mg of $^{151}\text{Sm}(n,\gamma)$ – TOF, $t_{1/2} = 100$ yr



Summary

- (n,γ) data on radioactive isotopes are extremely important for modern astrophysics
- DANCE contributes in the half live time range above a few hundred days
- ^{152}Eu , ^{154}Eu , ^{153}Gd is planned and funded
- Many can be measured now, more will have to wait for future facilities