Astrophysics Task Force

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- Numerous USNDP institutions are pursuing projects that are beneficial for studies in **nuclear astrophysics**

- These activities include work on both nuclear reactions & nuclear structure

USNDP Contributors to this report:

Argonne National Laboratory /TUNL collaboration (F. Kondev /J. Kelley et al.)

National Nuclear Data Center - Brookhaven National Laboratory (B. Pritychenko et al.)

Oak Ridge National Laboratory (M.Smith et al.)

Argonne NATIONAL LABORATORY

TUNL

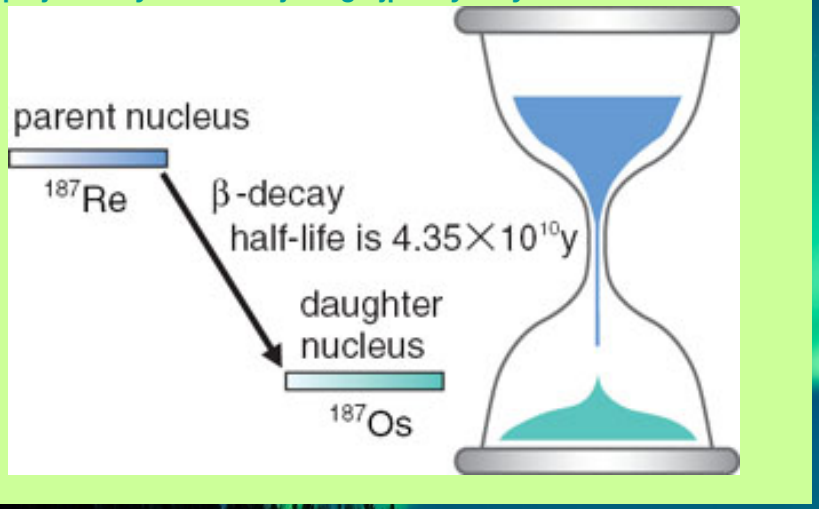
NNDC National Nuclear Data Center BROOKHAVEN NATIONAL LABORATORY

OAK RIDGE National Laboratory

Nucleo - Cosmochronometer:

Tools that measure the elapsed time from a nucleosynthesis event to the present time

http://jolisfukyu.tokai-sc.jaea.go.jp/fukyu/tayu/ACT05E/04/0403.htm



- a parent nucleus is created in a nucleosynthesis event
- parent nucleus decays to daughter at a constant rate
- elapsed time since event determined from abundance ratio of parent to daughter nuclei
- must also account for any ***other*** nucleosynthesis events that can modify this ratio

^{187}Re/^{187}Os cosmochronometer can be used to date the age of the r-process nucleosynthesis

- ^{186}Os produced only by s-process
- ^{187}Re produced only by r-process
- ^{187}Os produced by s-process and by 43.5 Gyr decay of ^{187}Re – cosmochronometer
- However, metastable state in ^{186}Re may provide weak path to make ^{187}Re in s-process
- level structure of ^{186}Re must be understood

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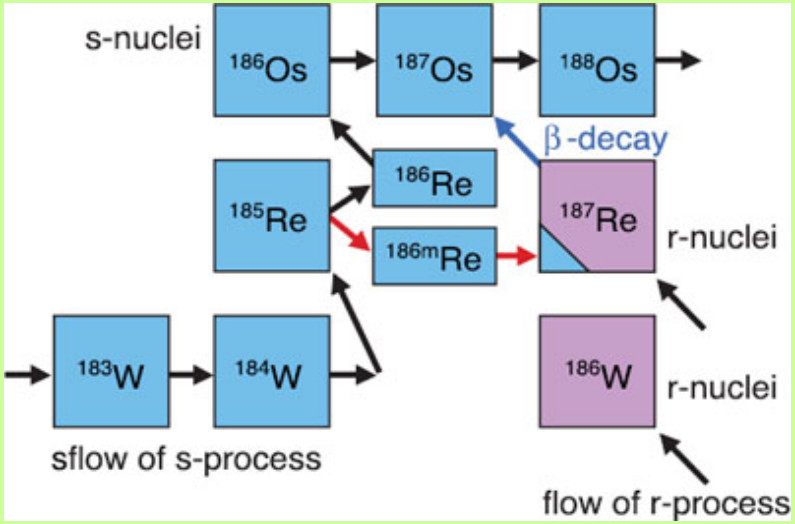
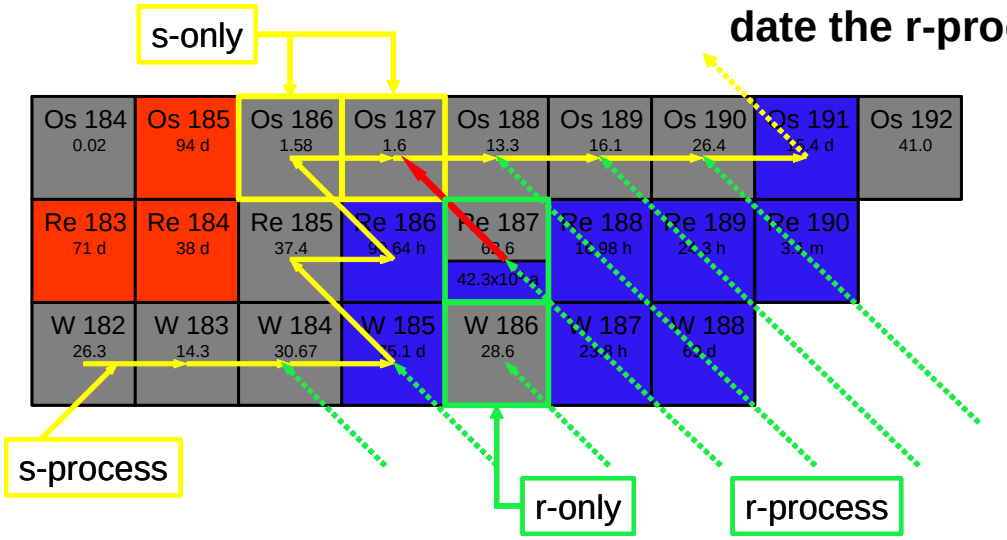


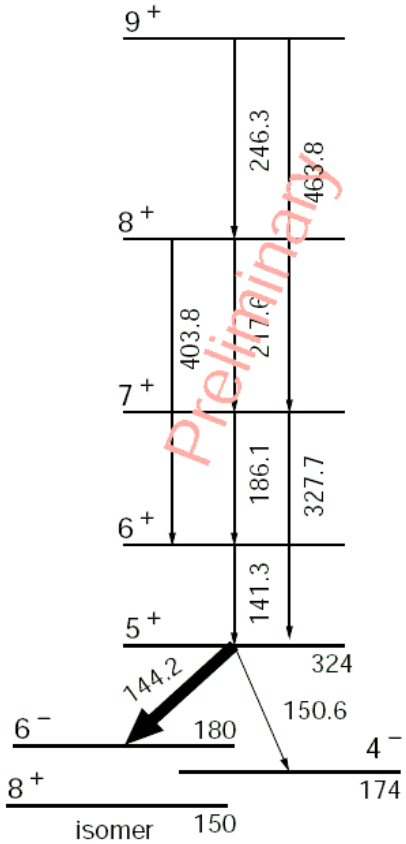
Properties of ^{186m}Re and associated structures

^{187}Re-^{187}Os cosmochronometer can be used to date the r-process

D.D. Clayton, Ap.J. 139 (1964) 637.



Structures above the long-lived isomer in ^{186}Re were discovered and their properties revealed using the ^{186}W(d,2n) reaction at ANU & g-ray coin. technique (CAESAR array – 9 CSS Ge & 2 LEPS)



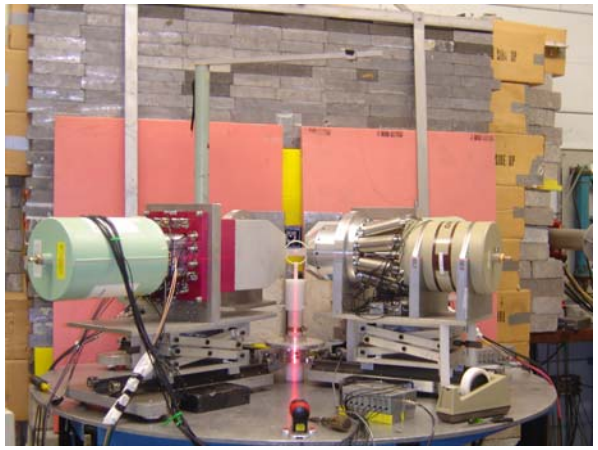
F. Kondev

ANL/TUNL Collaboration (F. Kondev , J. Kelley et al.)

^{187}Re(n,2nγ) cross section measurements at TUNL

Aims

- To confirm the level scheme obtained from the ^{186}W(d,2n) studies
- To observe gamma rays populating the isomer (singles) and deduce partial (n,2nγ) cross sections
- To obtain the total (n,2n) cross section that leads to the population of the isomer using statistical model analysis and the measured partial CS data



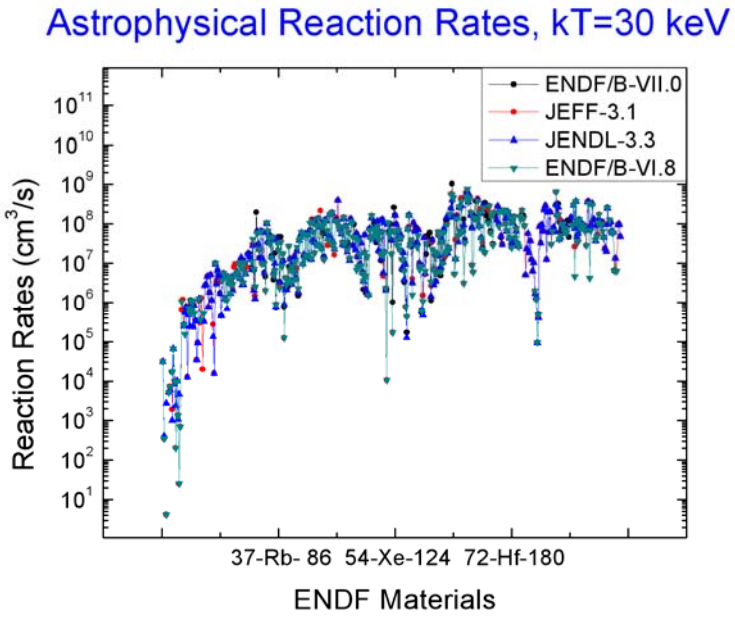
First experimental campaign in August 2007

- ^{187}Re(n, 2nγ)^{186m}Re @ 12 MeV neutrons at TUNL
- array of 2 clovers and 2 LEPS detectors
- ~44 hr of beam time using natural Re target
- data analysis is in process

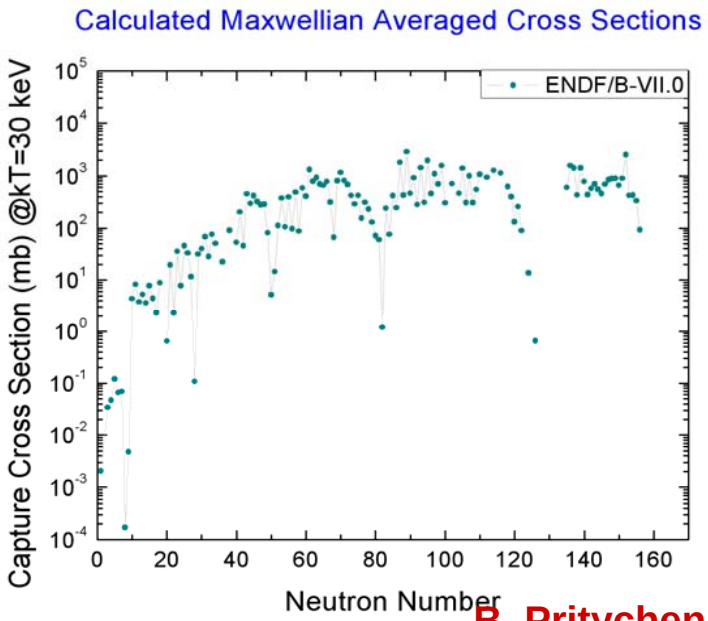
F. Kondev

NNDC - BNL (B. Pritychenko et al.)

Online calculation of Maxwellian Averaged Cross Sections and Reaction Rates using ENDF libraries



B. Pritychenko



B. Pritychenko

More details in the next presentation
"Astrophysics reaction rates" calculation using ENDF libraries" by B. Pritychenko

ORNL – (M. Smith et al.)

Nuclear structure of r-process nuclei

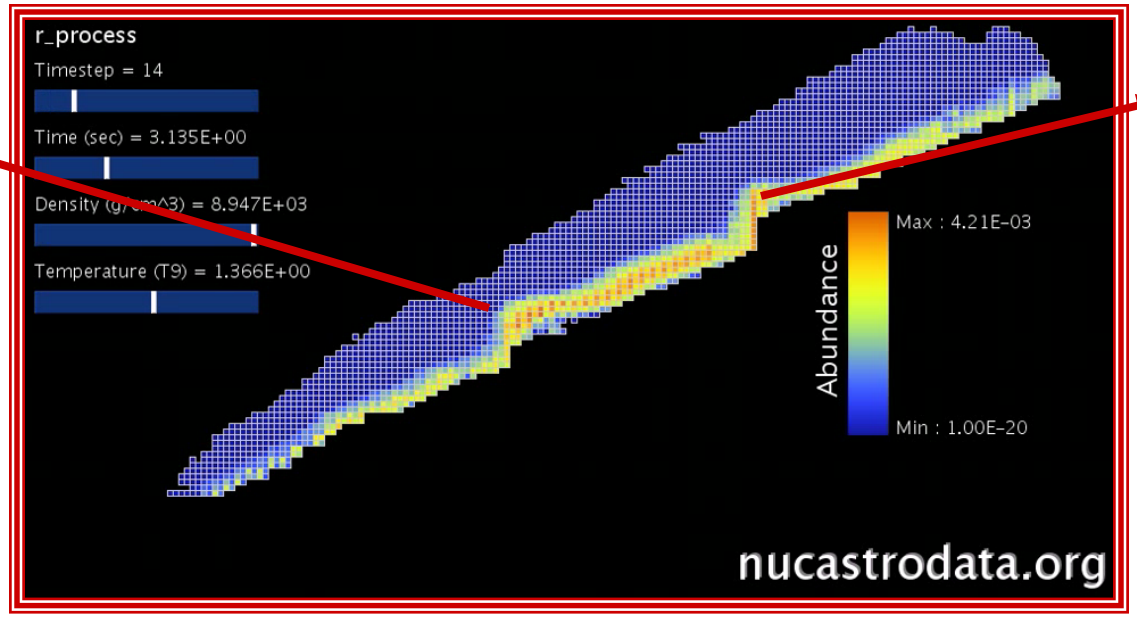
Provide nuclear structure information important for simulating r process nucleosynthesis in supernova explosions

(d,p) transfer experiments made with unique radioactive ^{82}Ge, ^{84}Se, ^{130,132}Sn and ^{134}Te beams

Spectroscopic information for **N=51** isotones; **^{83}Ge** and **^{85}Se** published in

J. S. Thomas et al Phys. Rev. C C 76, 044302 (2007)

J.S. Thomas et al. Phys. Rev. C C71, 021302 (R) (2005).



Analysis and **assessments** in progress to extract energies, spins and spectroscopic factors of single particle levels of **^{131,132}Sn** and **^{135}Te**

ORNL – (M. Smith et al.)

Computational Infrastructure for Nuclear Astrophysics

- New features added to meet request of users in 50 institutes in 18 countries

- Workflow management tools being developed in support of new international collaboration in nuclear astrophysics data

- ORNL will provide **software backbone** for new effort

- Future: Monte Carlo approach to determine impact of reaction rate uncertainties – utilize covariance information