Argonne Nuclear Data Program

Filip G. Kondev
NE Division

Member of the US Nuclear Data Program

Program Overview (FY10)

- ***Nuclear Data Compilations & Evaluations (90 %)***
  - ✓ nuclear structure & decay data compilations & evaluations for the International NSDD network (ENSDF & XUNDL)
  - ✓ decay data evaluations for DDEP
- ***Complementary ND Research Activities (10 %)***
  - ✓ basic and applied nuclear physics & astrophysics
- ***Effort & Funding:*** ***1.0*** *FTE staff &* ***1.0*** *FTE post-doc (ARRA)*

Compilations & Evaluations

ENSDF & XUNDL

- ✓ completed **A=207** (with S. Lalkovski, Univ. Sofia); submitted to NNDC for review
- ✓ work in progress: **110** (G. Gurdal – post-doc), **112** (with S. Lalkovski, Univ. Sofia), **209** (with G. Mukherjee, India), **188** (with S. Juutinen, Jyvaskyla Univ.), **174** (with T. Kibedi, ANU and X. Huang, CNDC) and **133** (with A. Radionov and Y. Khazov – follow up on a review)
- ✓ compilations for XUNDL: Phys. Lett. B & J. Phys. G (FGK), Nucl. Phys. A & Nucl. Instrum. & Methods (G. Gurdal) - **38** submitted during FY10 – numerous interactions with the authors - very useful both ways - *"… I think the next time we publish a paper we should ask YOU first to check the data..."*

Evaluations & Reviews for the DDEP collaboration

- ✓ **^{207}Tl** & **^{215}Bi** (with A. Nichols);**^{209}Tl and ^{209,211}Pb** (work in progress)
- ✓ DDEP coordinator since June 2010 – currently overseeing the review process for 20 nuclides (presentation at the WG meeting)

Nuclear Data Research Activities

❑ **Nuclear Structure studies using Gammasphere & FMA at ANL – several presentations at the DNP meeting** (with M. Carpenter, S. Zhu & R. Janssens, ANL-PHY)

✓properties of ^{180}**Tl** relevant to studying beta-delayed fission probabilities of nuclei far from the line of stability (**C. Nair** – an ARRA funded post-doc)
✓properties of the proton-rich ^{175}**Pt** nuclide – establish for the first time the ground-state and excited level structures (**G. Gurdal** – an ARRA funded post-doc)
✓decay studies of ^{177m}**Lu** – a project that started ~10 years ago with irradiation at the Univ. Mass.-Lowell reactor - a few years of cooling completed with a source preparation at ANL after radiochemical separation – interesting physics related to the hindered decay of K-isomers; calibration standard for gamma-ray tracking detectors; impurity in the production of the medical isotope ^{177}Lu; relevance to the interpretation of the capture and super-elastic neutron cross section data (*Bruyeres le Chatel*)

❑ **Decay studies of selected actinide nuclei** (with I. Ahmad & J. Greene, ANL-PHY)

✓completed studies of ^{233}**Pa** – solved the issues related to the reported larger absolute emission probability for the 311 keV gamma-ray by Harada et al. - related to measurements of ^{237}Np(n,γ) and ^{237}Np(n,f) cross-sections – a paper is accepted for publication in Nucl. Instrum. & Methods

MANTRA (Measurement of Actinide Neutronic Transmutation Rates with Accelerator mass spectrometry)

G. Youinou, G. Palmiotti & M. Salvatores — R. Pardo & F.G. Kondev — G. Imel

ARRA funded project

The **main aim**: to obtain integral information on neutron-induced cross sections for very high mass actinides in a reactor environment. The project involves **three major steps**:

1) **Preparation and irradiation** of pure actinide samples in the Advanced Test Reactor (ATR) at the Idaho National Laboratory (^{232}Th, ^{235}U, ^{236}U, ^{238}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu, ^{241}Am, ^{243}Am and ^{248}Cm)
2) **Measurements** of the atom densities of different isotopes produced in the irradiated samples at Argonne National Laboratory using the novel Accelerator Mass Spectrometry (AMS) technique
3) **Derivation** of (n, γ), and (n,2n) cross sections and their uncertainties for the target and transmutation-produced isotopes

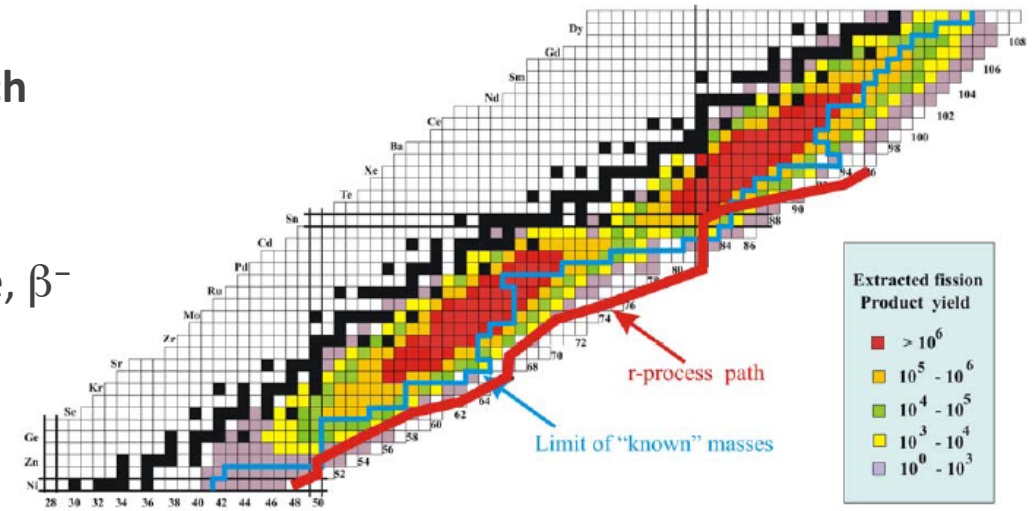
recent developments at ANL

- **design of automated sample changer:** better characterization of the isotope transmission between the ion source and the detector system at the FMA focal plane, which would enable higher precision of the AMS measurements
- **laser ablation:** controlled release of laser-produced ions into the ECR plasma will eliminate a significant material buildup often associated with the sputtering ion-extraction technique and will reduce cross-talk between various samples

AFC Decay Data studies @ CARIBU

- **CA**lifornium **R**are **I**on **B**reeder **U**pgrade (**CARIBU**) of ATLAS – 1 Ci ^{252}Cf spontaneous fission source (~20% of total activity extracted as ions) - gas catcher and isobar separator (with or without post acceleration) – large improvement over existing ISOL-based facilities

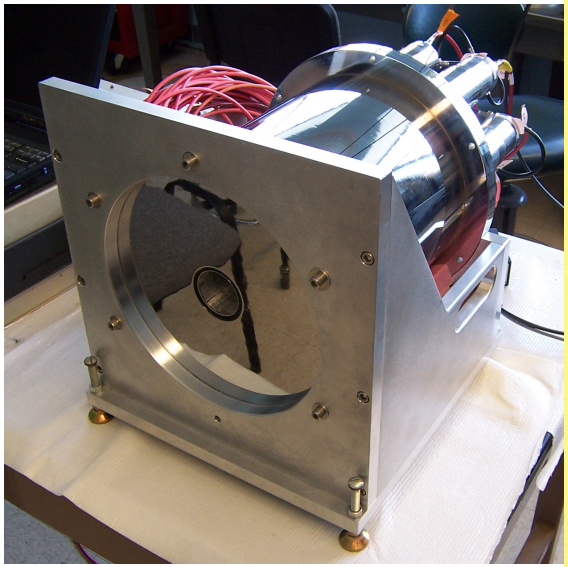
- **modification of nuclear structure in n-rich systems**
- **r-process path (astrophysics)**
  - ✓ ground-state information – mass, lifetime, β^- n
  - ✓ neutron capture rate
- **applications of nuclear science**
  - ✓ FP decay data for Decay Heat reactor applications – short cooling times
  - ✓ FP neutron capture rates – surrogate method in inverse kinematics

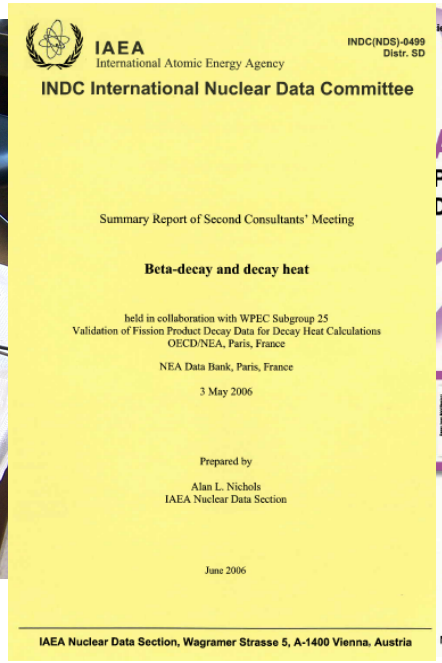


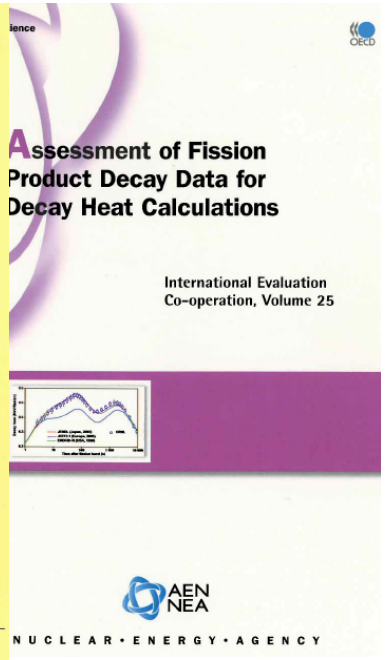
ARRA funded project

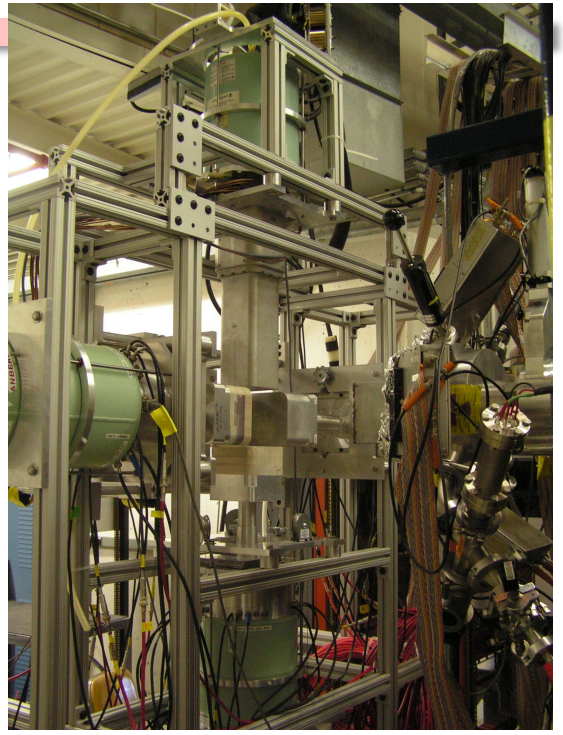
collaboration ANL-PHY, ANL-NE & Univ. Mass. Lowell

Decay Counting Station at CARIBU







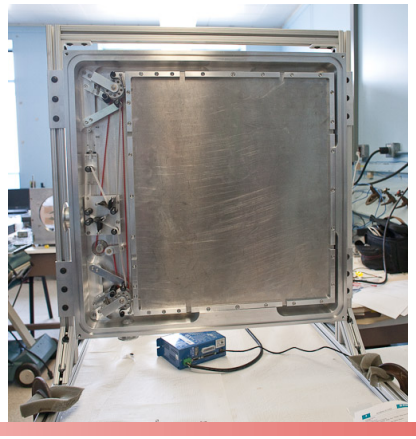


TAGS

NaI from INL (*Greenwood et al.*)

Tape System

adopted from LSU, but designed with increased tape-advance rate (~2m in 0.1s)



X-array

One “Super-Clover” & four 70 X 70 mm crystals - a pack with ~275% efficiency relative to a 3” x 3” NaI

Plastic scintillators LaBr3(Ce)

ANL Nuclear Data Workforce

on request by the USNDP Chair

Scientific Permanent staff: **1** head & **1.0** FTE
Scientific Temporary staff (post-docs, long term visitors):
1 head & **1.0** FTE (ARRA-DOE/ONP funded under Nuclear Data Program Initiative)
1 head & **1.0** FTE (ARRA-DOE/ONP funded under Applications of Nuclear Science & Technology)
Scientific External collaborators (longer than 6 mo): **none**
Technical/Support staff: **none**

New hires:
✓Dr. Gulhan Guradal (PhD in Physics from Clark Univ.), 11/30/2009, 1.0 FTE (ARRA-DOE/ONP funded under Nuclear Data Program Initiative)
✓Dr. Chithra Nair (PhD in Physics from FZ Dresden-Rossendorf, 03/1/2010, 1.0 FTE (ARRA-DOE/ONP funded under Applications of Nuclear Science & Technology)

Resigned/Retired: **none**