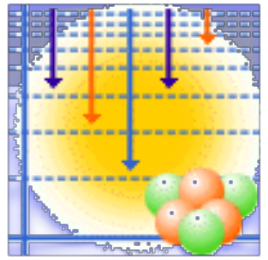
Argonne NATIONAL LABORATORY

Member of the US Nuclear Data Program



Argonne Nuclear Data Program

- ANL-NDP resides in ANL-PHY - part of the LE NP research group
- Nuclear Data **Compilations** & **Evaluations**
  - ✓ nuclear structure compilations and evaluations - **ENSDF & XUNDL**
  - ✓ evaluation of atomic masses and nuclear properties - **AME & NuBase**
  - ✓ decay data evaluations in support of IAEA-led projects & other horizontal evaluations (nuclear isomers, medical isotopes, nuclear moments, etc.)
- Complementary ND **Research** Activities
  - ✓ intersections between basic and applied nuclear physics & astrophysics- via collaborative agreements with a little or no cost to USNDP
  - ✓ contributions to DOE/NP FOA's - 2 funded at the FY17 call

Evaluations & Compilations

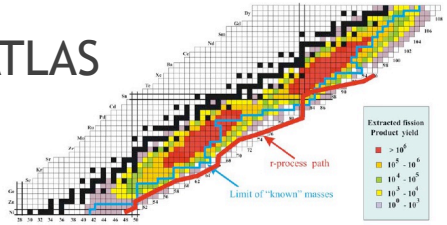
- **A=188** was completed and published in NDS (in collaboration with S. Juutinen (Jyvaskyla U) & D. Hartley (USNA)
- **A=177** was completed, submitted to NNDC, reviewed & being prepared for publication
- working on **A=205** - ENSDF priority list (2018)
- reviewed mass chains, as requested by NNDC

A	NDS	Evaluator
109	NDS **137** (2016)	S. Kumar, J. Chen & F.G. Kondev
110	NDS **113** (2012)	G. Gurdal & F.G. Kondev
176	NDS **107** (2006)	M.S. Basunia
177	NDS **98** (2003)	F.G. Kondev
178	NDS **110** (2009)	E. Browne
179	NDS **110** (2009)	C.M. Baglin
199	NDS **108** (2007)	B. Singh
200	NDS **108** (2007)	F.G. Kondev & S. Lalkovski
201	NDS **108** (2007)	F.G. Kondev
202	NDS **109** (2008)	S. Zhu & F.G. Kondev
203	NDS **105** (2005)	F.G. Kondev
204	NDS **111** (2010)	C.J. Chiara & F.G. Kondev
205	NDS **101** (2004)	F.G. Kondev
206	NDS **109** (2008)	F.G. Kondev
207	NDS **112** (2011)	F.G. Kondev & S. Lalkovski
208	NDS **108** (2007)	M. Martin
209	NDS **126** (2015)	J. Chen & F.G. Kondev

- 17 mass chains; one to ORNL
- **goal:** current within 10 years

aligned well with the ANL research effort

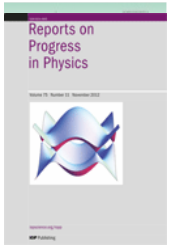
CARIBU & ATLAS



Atomic Data and Nuclear Data Tables 103–104 (2015) 50–105

Configurations and hindered decays of K isomers in deformed nuclei with $A > 100$

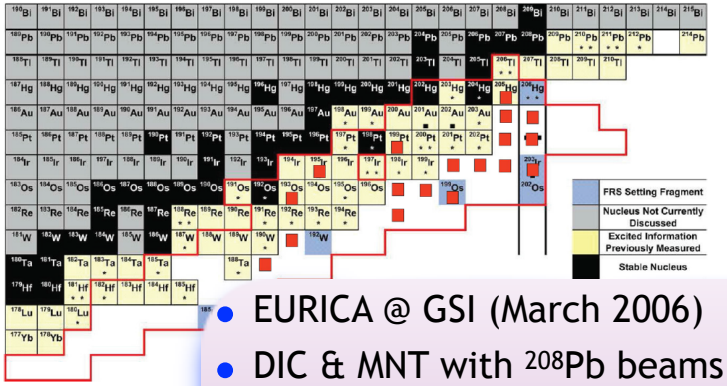
F.G. Kondev[a,*], G.D. Dracoulis[b,1], T. Kibédi[b]



IOP Publishing — Reports on Progress in Physics

Review of metastable states in heavy nuclei

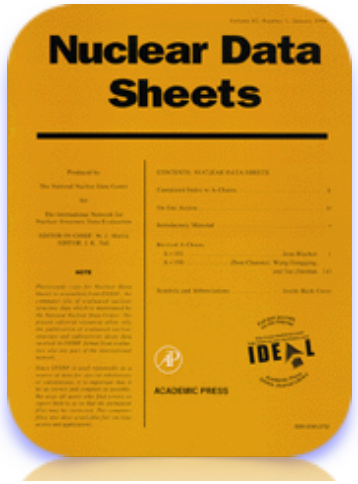
G D Dracoulis[1,4], P M Walker[2] and F G Kondev[3]



- EURICA @ GSI (March 2006)
- DIC & MNT with ^{208}Pb beams or targets & Gammasphere
- new RIKEN project near N=126
- N=126 factory at ANL

Evaluations & Compilations - cont.

XUNDL



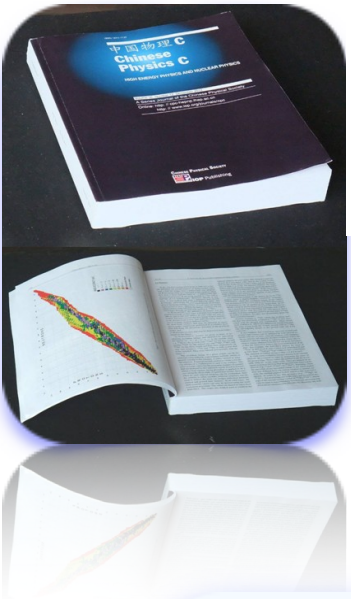
- compiled what we were asked by the DB manager
- collaboration with Y. Ichikawa (RIKEN) - compilation of RIKEN papers

PHYSICAL REVIEW C 97, 019901(E) (2018)

Erratum: Properties of γ-decaying isomers and isomeric ratios in the ^{100}Sn region [Phys. Rev. C 96, 044311 (2017)]

In Table I on p. 3, the Weisskopf unit (W.u.) calculation for the 1067-keV $M2$ transition strength of the 11^- isomer in ^{90}Nb was incorrect; the exponent on the mass number A should have been 2/3 (instead of 4/3, which is correct for $E2$). The correct $B(M2)$ value is $1.72(13) \times 10^{-3}$ W.u., where 1 W.u. for an $M2$ transition in ^{90}Nb is 33.14 μ_N fm^2. The updated $B(M2)$ value is 20 times greater than the one reported in the original manuscript. No other results in the paper are affected.

We thank F. G. Kondev and Y. Ichikawa, who are compiling the results of this article for the XUNDL database at the National Nuclear Data Center (NNDC), for bringing this error to our attention.



AME & NUBASE

- continued compilation & evaluation activities in collaboration with IMP, CSNSM & RIKEN

IAEA-NDS collaborations

- CRP on Medical Isotopes; TM on TAGS; consultation(s) on LiveChart; TM on ENSDF codes (benchmarking & code development)

Nuclear Data Research Activities

relatively small effort (0.1 FTE) - complements and benefits the evaluation activities – sought after collaborator with little or no cost to USNDP

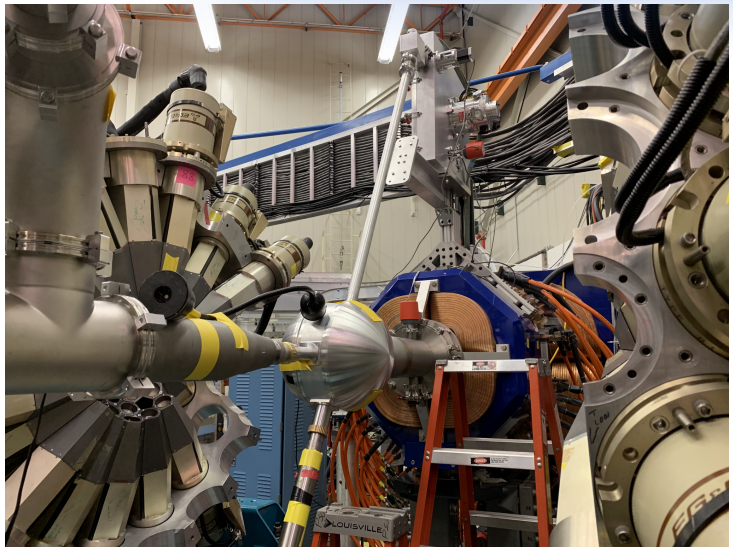
- at **ANL** - nuclei far from stability; spectroscopy of heavy and super-heavy nuclei; K-isomers, beta-decay spectroscopy & mass measurements in the FP region; precise ***decay spectroscopy*** of actinide nuclei and nuclei of importance to applications of medical isotopes and metrology
  - ✓ **CARIBU** – properties of neutron-rich nuclei (nuclear structure & masses, astrophysics & applications)-DOE Nuclear Data **FOA's** funded projects
  - ✓ Near-future directions - using the ***neutron generator*** and ***N=126 Factory*** at ANL

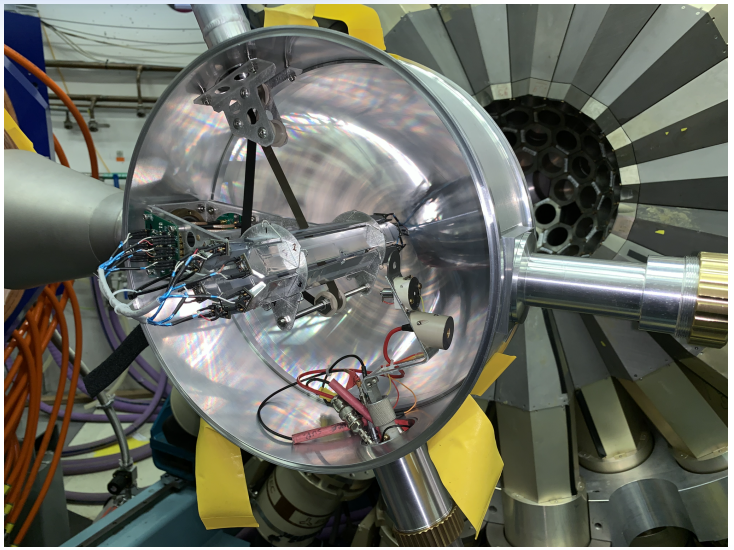
- at **MSU** (Coulex & decay spectroscopy), **TRIUMF** (decay spectroscopy) & **RIKEN** (decay spectroscopy) – nuclear structure properties of neutron-rich nuclei and nuclear astrophysics

Decay Spectroscopy with Gammasphere

Combine **GAMMASPHERE** the **most powerful** gamma-ray spectrometer in the WORLD with the unique **beam capabilities of CARIBU** (all fission products are available as high purity beams - no stopovers for refractory elements)

DOE/NP and DOE/NNSA/NA-22 funded project

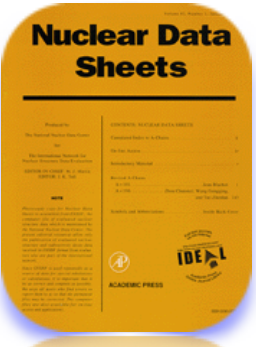




Advantages

- **discrete & calorimetry** γ-ray spectroscopy techniques within a single device
- **high granularity** & **resolving power** ($\Delta E\gamma$=2 keV, P/T~60% and ε_γ~85%) - ability to resolve week γ-ray cascades (10^{-5}-10^{-6} %) - unprecedented sensitivity!
- **establish complete decay schemes** - angular correlations for transition multipolarities & Jπ assignments - end-game in nuclear spectroscopy

First results - spectroscopy of ^{144,146g,m}La



^{146,146m}La

(6^-) 0.0+X

(2^-) 0.0

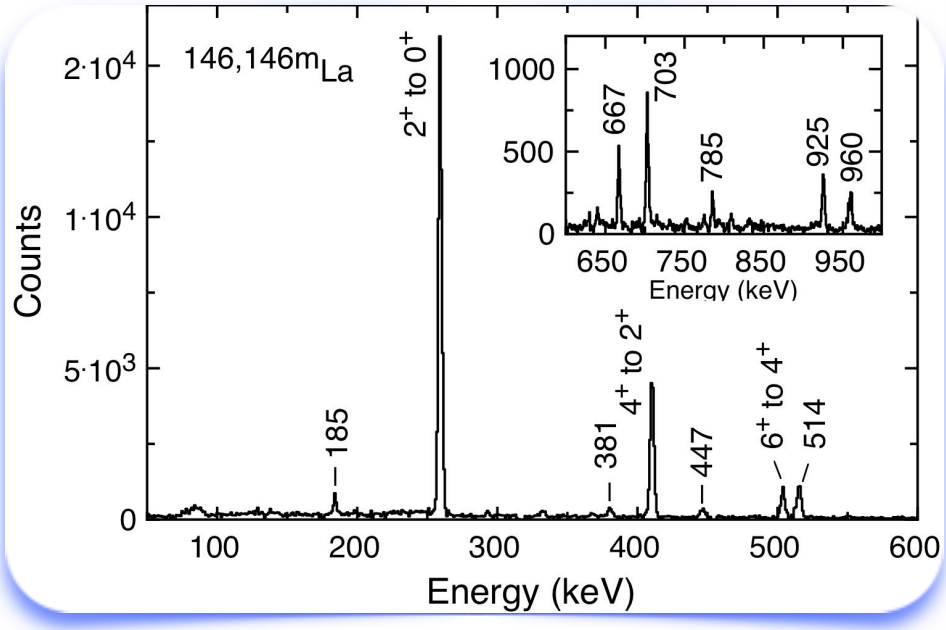
(1^-) 0.0+X

(5^-) 0.0

Y. Khazov et al., NDS **136** (2016) 163

transitional region
deformation changes

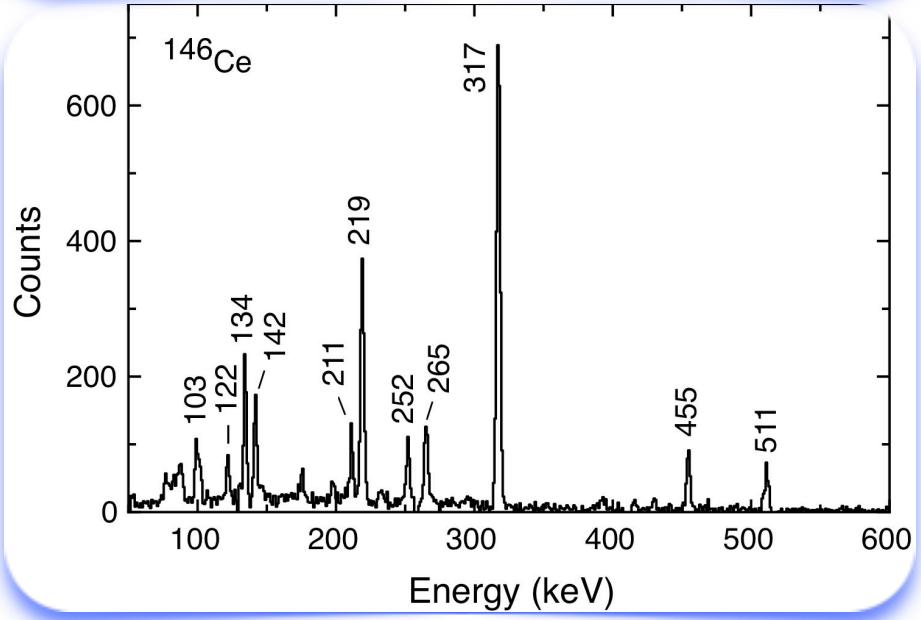
π5/2+[413] ν5/2[523]
Nilsson assignment



^{146}Ce β- decay

- differs significantly from previous TAGS (calorimetric) studies

R.C. Greenwood et al. NIM **A390** (1997) 95



What Next?

a list of ~30 nuclides, based on recent recommendations by IAEA-NDS

IAEA
International Atomic Energy Agency

INDC(NDS)-0676
Distr. EN, ND

INDC International Nuclear Data Committee

Technical Meeting on "Nuclear Data for Anti-neutrino Spectra Calculations and Their Applications", April 2019

- 10 days allocated in April 2019 - $^{100,100m;101;102,102m;104,104m}$Nb & ^{100,100m}Y
  - ✓ role played by deformation
- new proposal approved by the ATLAS-PAC for campaigns in FY19 & FY20
- Decay Data Factory (LOI endorsed by the PAC) - user's workshop soon