Argonne Nuclear Data Program

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NE Division

Program Overview (FY13)

- ***Nuclear Data Compilations & Evaluations (90 %)***
  - ✓ nuclear structure & decay data compilations and evaluations for the International NSDD network (ENSDF & XUNDL)
  - ✓ decay data evaluations for IAEA-CRP & other horizontal evaluations (K-isomers, AME & NuBase, medical isotopes)
- ***Complementary ND Research Activities (10 %)***
  - ✓ basic and applied nuclear physics & astrophysics
- ***Effort & Funding:*** ***1.0*** *FTE staff &* ***1.0*** *FTE post-doc (non USNDP funded)*

Compilations & Evaluations

ENSDF

- ✓ completed **A=209** (J. Chen & F.G. Kondev) and **112** (with S. Lalkovski)
- ✓ work in progress: **A=188** (with S. Juutinen, Jyvaskyla University and D. Hartley, US Naval Academy) and a major revision of **A=177**
- ✓ others: **A=174** (with X. Huang, CNDC & T. Kibedi, ANU) and **A=173** (with S. Erturk, Turkey & T. Kibedi, ANU) – it is a very time-consuming process – need a debate and strategy on training of new evaluators – it is a long-lasting process!
- ✓ ported the main ensdf programs to OS X – fmtchk,ruler,ensdat,alphad,logft,pandora, radlst,alphad,gabs,gtol & T.Kibedi (ANU) has done bricc,avetools,briccmixing

XUNDL

- ✓ **28** compilations for XUNDL: PL B, JP G, NP A & NIM A; numerous interactions with the authors
- ✓ J. Chen is working on a new software (python): excel to ensdf translator

- very encouraging feedback from various user communities, especially low-energy PHY
- good citation indices – e.g. A=177 (**49**), A=205 (**31**), etc. … perhaps many more on-line through the NNDC & IAEA web services - there are also papers & libraries, which do not cite properly - lost of traceability (see the presentation of Wednesday morning)

Compilations & Evaluations – cont.

AME2012 & NUBASE2012

http://ribll.impcas.ac.cn/ame/

AMDC Atomic Mass Data Center

IMP 中国科学院近代物理研究所 Institute of Modern Physics, Chinese Academy of Sciences

CSNSM

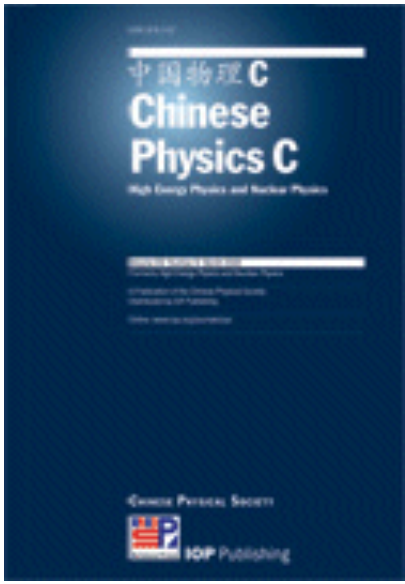
IPN Institut de Physique Nucléaire Orsay

IMP

Max-Planck-Institut für Kernphysik

GSI

Argonne National Laboratory



3711 masses
2416 ground state
232 isomers
1063 extrapolated

significant improvement compared to AME2003 owing to the availability of high-precision Penning trap and storage rings mass measurements

- ✓ extensively used in Atomic and Nuclear Physics, Chemistry, Astrophysics & Applied NP
- ✓ used by the U.S. certifying authority for reference materials of actinide elements (New Brunswick Laboratory)

Compilations & Evaluations – cont.

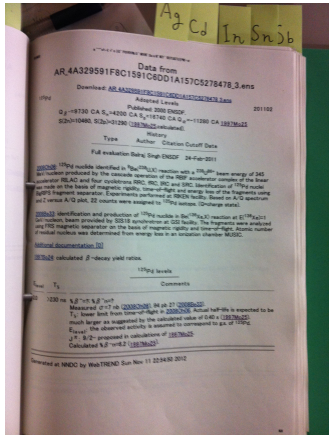
- **IAEA-CRP on "Nuclear data for charged-particle monitor reactions and medical isotope production" – led by R. Capote (IAEA-NDS)**
  - ✓ presentation tomorrow afternoon
- **Horizontal evaluations "Configurations & Hindered Decays of K-Isomers in deformed nuclei with A>100"** – in collaboration with G. Dracoulis and T. Kibedi (ANU) & driven by the LEP user community
  - ✓ available in ENSDF format
  - ✓ implications for ENSDF format development - K quantum number in deformed nuclei - implications for nuclear reactions modeling at low excitation energies (NRF, astrophysics …), e.g. level densities, strength functions, RIPL, etc.
  - ✓ new processing codes development – modification of ruler (a nightmare) & new python code (from scratch) … it is not that complicated …

Nuclear Data Research Activities

- **Nuclear Structure Research:** approved experiments (PI and collaborator) at world's leading NP facilities: **ANL** (ATLAS & CARIBU) with M. Carpenter, C. Chiara, J. Clark, R. Janssens, G. Savard, D. Seweryniak, S. Zhu, **NSCL** (A. Gade & S. Liddick) & **RIKEN** (H. Watanabe)

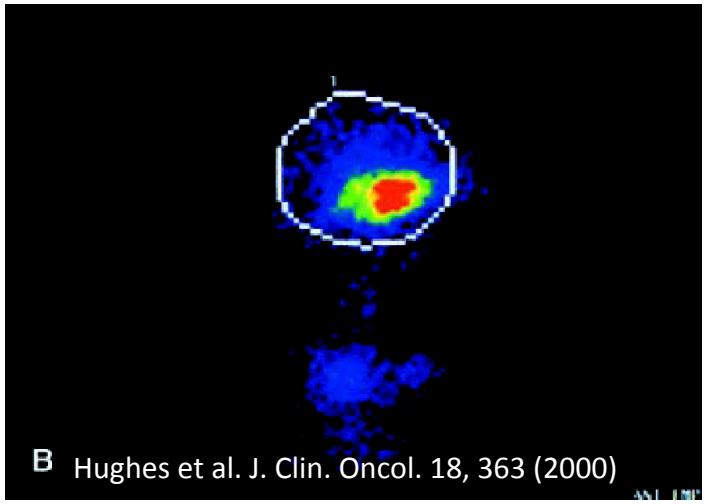
a lot of new data will be available soon! – decay schemes with hundreds of gamma rays and levels!

this is what you can frequently spot in the RIKEN data-collection room



- **Decay studies of actinide nuclei and nuclei relevant to Medical Isotopes applications** with I. Ahmad & J. Greene (ANL-PHY) & T. Kibedi (ANU) – presentations tomorrow afternoon and on Wednesday morning
- **Contribution to the MANTRA project (ARRA funded) – "Measurement and Evaluation of Actinide Neutron Cross Sections Relevant to Advanced Fuel Cycles via Accelerator Mass Spectroscopy"** with R. Pardo (ANL-PHY), G. Youinou, G. Palmiotti & M. Salvatores (INL), G. Imel (ISU)

Improved decay data for ^{67}Cu - impact

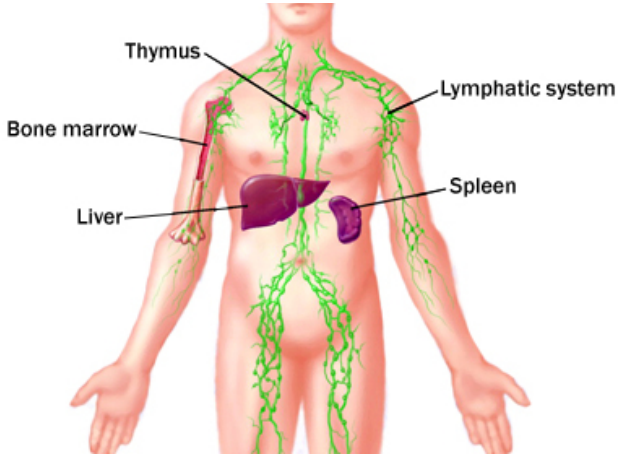


presentations on Wednesday morning

- Excellent properties: E_γ, $E_{\beta-}$ & $T_{1/2}$
  - ✓ therapeutic: $\beta-$ emitter
  - ✓ imaging: 184-keV γ ray
- Limited availability

Deficiencies in Nuclear Data: new exp. data & evaluation by J. Chen et al. : **~7%** overproduction

Non-Hodgkin Lymphoma (NHL): 60740 cases with 19020 deaths
Hodgkin Lymphoma (HL): 9290 cases with 1180 deaths
Bladder Cancers: 72500 cases with 15000 deaths
Colorectal Cancers: 147500 cases with 51000 deaths
Renal Cancers: 65000 cases with 13500 deaths
(National Cancer Institute: www.cancer.gov)



NIDC – DOE/ONP

If 1% are treated with ^{67}Cu:
1 [%] x 264000 [cases] x 260 [mCi per case] x $295 [per mCi] = $200M [per yr]
7% x $200M = $14M [per yr]

I. Novak-Hofer & P. A. Schubiger, Eur.J. Nucl. Med. 29, 821 (2002)

Future (FY14 and beyond) Plans

- **Continue XUNDL & ENSDF activities** – the main collaborative activities within USNDP

- **Continue AME & NuBase collaborative activities** – next distribution 2015

- **Continue IAEA-CRP activities on medical isotopes & improving the ND for Auger emitters**
  - ✓ new development - a proposal has recently been approved by ARC (PI: Stuchberry, Kibedi & Kondev) to address the ND deficiencies

- **Continue research activities** with emphasis on **nuclear structure physics and astrophysics, and their intersection with the applied nuclear physics:**
  - ✓ **ATLAS/CARIBU** – nuclear structure, masses & astrophysics, beta-delayed gammas & neutrons, fission yields …
  - ✓ **GRETINA** at MSU and ANL – nuclear structure & astrophysics
  - ✓ **NSCL (FRIB), RIKEN & TRIUMF** – nuclear structure & astrophysics

Issues - FY14 and beyond

- **Funding – ARRA & LDRD expired - Flat-flat DOE/ONP funding in FY10-FY12 and 8% reduction in FY13**
  - ✓ ANL staff will be funded at **~0.8 FTE (USNDP)** – will need to look for other sponsor/work to fill the gap - not necessarily in the nuclear data area
  - ✓ we won't be able to keep the post-doc beyond April 2014 – a huge lost of investment & talent in nuclear data evaluation – we need to have a common USNDP strategy on how to keep such people into the system

- **Prof. Suresh Kumar (visiting professor at ANL) – 1 year on sabbatical from University of Delhi**
  - ✓ recipient of the prestigious INDO-USA Research fellowship
  - ✓ partially nuclear data evaluation (experienced nuclear physicist - former student of Prof. A. Jain (a quality stamp!) - participated in one of the Trieste workshops)