Isotopes Project

LAWRENCE BERKELEY NATIONAL LABORATORY

E.B. Norman (Project Leader)

NUCLEAR STRUCTURE AND DECAY ACTIVITIES
April 1998 - April 1999

Report prepared for the Nuclear Structure and Decay Working Group, USNDP Annual Meeting, April 26-28, 1999 at Brookhaven National Laboratory.

This report refers exclusively to the data evaluation/compilation component of the Isotopes Project's activities; for the group's Data Dissemination activities, please see the Isotopes Project's report to the Dissemination Working Group.

MASS CHAIN RESPONSIBILITY, STATUS (41 chains)

A = 59, 81, 83, 90-93, 166-187, 189, 191-193, 206, 210-212, 215, 219, 223, 227

Excluding chains that are under revision this year, the average age of the above chains is 4.7 y based on the literature cutoff date for the oldest nuclide in each chain. It should be noted, however, that several mass chain evaluations include at least one nuclide which has been fully revised much more recently, or for which high-spin data alone have been updated.

PERSONNEL

Isotopes Project personnel involved in data evaluation/compilation are as follows:

C. Baglin	0.5 FTE
E. Browne	1.0 FTE
R. Firestone	0.5 FTE

In addition, two guests have spent sabbatical leave with the Isotopes Project: Professor Jacob Gilat (Israel) (through August '98) and Professor Alice Wu (Taiwan) (since July '98). Both were interested in spending part of their time on evaluation. Dr. Wu (0.5 FTE) has already prepared ^{57}Ni and ^{60}Fe decay evaluations, and Dr. Gilat evaluated the A≥266 chains.

Ongoing international collaborations exist with Gabor Molnar, Hungary (preparation of evaluated (n,γ) data), and with French, German, British, US and Russian scientists participating in a radioactive decay data evaluation project.

The group is indebted to Jean Zipkin (also a guest of LBNL) for the preparation of many high-spin and (n,γ) data sets.

EVALUATION ACCOMPLISHMENTS (since April 1998 Meeting)

- **Mass Chain Evaluations**

  Submitted: 167, 174, 206, A>265 (8 chains, 11 nuclides)
  Published: 89 (75% LBNL), 91, 135 (75% LBNL), 176, 192

- **Complete Nuclide Evaluations**

  Evaluations for 8 'priority nuclides' have been incorporated in complete mass chains listed above. Additional nuclide evaluations (listed below) were prompted by the existence of significant, newly-published information which could be expeditiously included in ENSDF (thus improving the timeliness of the file), and also by a need to revise α-decay parent or daughter information (for internal consistency of the file), or by the fact that no evaluation for the nuclide had previously been published.

  - Published:
    ^{170}Ta, ^{170}Lu, ^{170}Pt, ^{179}Ir, ^{186}W.
  - Unpublished (reviewed and added to ENSDF):
    ^{81}Y, ^{81}Sr, ^{92}Tc, ^{92}Ru, ^{92}Rh, ^{170}Yb, ^{170}W, ^{170}Os, ^{171}Os, ^{171}Ir, ^{171}Pt, ^{171}Au, ^{186}Hf
  - Submitted:
    ^{183}Au.

- **Data Sets**

  Decay Data Evaluation Project (DDEP) Nuclides of Astrophysical Interest:
  - ^{57}Ni (submitted to BNL for inclusion in ENSDF).
  - ^{44}Ti, ^{44}Sc (both submitted to McMaster for inclusion in A=44).
  - ^{60}Fe (in review).

- **Reviews of Evaluations**

  Mass Chains:
  A = 109, 115.
  Decay Data Evaluation Project Nuclides:
  ^{3}H, ^{7}Be, ^{14}C, ^{35}S, ^{36}Cl, ^{111}In, ^{153}Sm, ^{153}Gd, ^{207}Bi.

COMPILATION

High-Spin Data sets for XUNDL:
During 1996-1997, in response to high-spin researchers' desire for more timely access to data sets from recent publications, 242 high-spin data sets (208 nuclides) were compiled in ENSDF format by Jean Zipkin, and promptly posted on the Web. These data sets, along with 111 high-spin data sets (108 accessible on-line from NNDC) compiled in 1995 by F. Chu and others in conjunction with the preparation of the 8th Edition of the *Table of Isotopes*, have been transmitted to Balraj Singh (McMaster University) for his consideration for inclusion in the new XUNDL database (which contains compiled (i.e., unevaluated) data). A number of these data sets provide information that has not yet been evaluated and added to ENSDF. After being edited at McMaster, more than 110 of these data sets have now been incorporated in the XUNDL database.

PC SOFTWARE FOR EVALUATION

With the demise of the laboratory's central VAX VMS computers, PC (Windows 95/NT, Fortran) versions of five programs originally written for use on that system have been created and also made available on the Web. These are BALANCE 2.0, ENDIT 2.0 (ENSDF-file line editor), Betas 2.0, XICC 2.0 and LogFT 2.0 (interactive calculation of Log*ft* and EC/B+ values). Preparation of a PC version of the program GAMUT has been commenced.

EVALUATION/COMPILATION PLANS FOR 1999

The Isotopes Project will continue its commitment to providing an ENSDF database that is as current, accurate and appropriate to its users' needs as possible. Our plans for 1999 include a mix of individual nuclide and complete mass chain evaluations. In addition, participation in two international collaborations will continue; these are concerned with evaluation of radioactive decay data (with emphasis on decays having specific astrophysical interest), and a systematic evaluation of nuclear structure aspects of (thermal n,γ) data. Each is a response to current research community needs. Our proposed plans for 1999 are as follows:

- **Mass Chain Evaluation:**
  A = 46, 92, 215, 219, 223, 227

- **Individual Nuclide Evaluation:**
  ^{168}Er#, ^{169}Ta#, ^{179}Ta, ^{181}Au, ^{183}Au (already submitted), ^{191}Bi.
  # Priority nuclide

- **Continuation of (thermal n,γ) Horizontal Evaluation:**
  Ongoing US-Hungary Capture Gamma Collaboration (with G. Molnar (Hungary)). Evaluated (thermal n,γ) data sets already have been prepared for 43 nuclides with A<50; these are currently being checked by Dr. Molnar. Subsequently, they will be submitted for inclusion in ENSDF.

- **Continuation of DDEP Nuclide Evaluation:**
  Emphasis will be placed on nuclide decays that are of astrophysical interest.

- **ENSDF Coding of non-US Evaluations:**

  DDEP Nuclides:
  ^{68}Ge, ^{68}Ga, ^{125}I, ^{141}Ce
  (Decay and Adopted data sets are being prepared for inclusion in ENSDF.)

  A=21-39 (Endt; 1998 Update):
  For A=21-23, reaction data sets based on the 1990 publication by Endt already have been coded and combined with the decay and adopted data sets already existent in ENSDF, and data from Endt's 1998 update are currently being incorporated in those chains. Ultimately, revised chains will be submitted to BNL for inclusion in ENSDF.

PUBLICATIONS (since April '98 Meeting)

Nuclear Data Evaluation

Nuclear Data Sheets for A=135, Yu.V. Sergeenkov and B. Singh, Nuclear Data Sheets **84**,115 (1998).

Nuclear Data Sheets for ^{170}Ta, Coral M. Baglin, Nuclear Data Sheets **84**, 323 (1998).

Nuclear Data Sheets for A=176, E. Browne and J. Huo, Nuclear Data Sheets **84**, 337 (1998).

Nuclear Data Sheets for A=192, Coral M. Baglin, Nuclear Data Sheets **84**, 717 (1998).

Nuclear Data Sheets for A=89, B. Singh, Nuclear Data Sheets **85**, 1 (1998).

Nuclear Data Sheets for ^{170}Lu, Coral M. Baglin, Nuclear Data Sheets **85**, 575 (1998).

Nuclear Data Sheets for ^{179}Ir, Coral M. Baglin, Nuclear Data Sheets **85**, 595 (1998).

Nuclear Data Sheets for A=91, Coral M. Baglin, Nuclear Data Sheets **86**, 1 (1999).

Nuclear Data Sheets for ^{170}Pt, Coral M. Baglin, Nuclear Data Sheets **86**, 449 (1999).

Nuclear Data Sheets for ^{186}W, Coral M. Baglin, Nuclear Data Sheets **86**, 455 (1999).

Nuclear Data Sheets for ^{187}Tl, Coral M. Baglin, Nuclear Data Sheets **86**, 487 (1999).

"Table de Radionucléides", M.-M. Bé, N. Coursol, B. Duchemin, J. Lamé, C. Morillon, F. Piton, E. Browne, V. Chechev, R. Helmer and E. Schönfeld, Document CEA-ISBN 2 7272 0200 8 (1999); CD-ROM "Nucléide", the computerized form of "Table de Radionucléides", version: 1-98, 19/12/98, CEA Laboratoire Primaire des Rayonnements Ionisants.

Nuclear Structure and Nuclear Astrophysics Research:

Identification of New Negative-Parity Levels in ^{152,154}Nd, X.Q. Zhang, J.H. Hamilton, ... , J. Gilat, *et al.*, Phys. Rev. **C57**, 2040 (1998).

Cross Sections for the ^{17}O(n,p)^{17}N and ^{17}O(n,d)^{16}N Reactions at 14 MeV, E.B. Norman and B. Sur, Phys. Rev. **C57**, 2043 (1998).

Cosmic-Ray Half-Life of ^{144}Pm, K. Zaerpoor, Y.D. Chan, ... , E.B. Norman, S.J. Robinson, Phys. Rev. **C57**, 2046 (1998).

Identification of the γ Transitions in Tc and Cs Products of ^{252}Cf Fission and Possible (7/2)+[413] Bands in $^{105\text{-}109}$Tc Isotopes, J.K. Hwang, A.V. Ramayya, ... , J. Gilat, ... , S.Y. Chu, *et al.*, Phys. Rev. **C57**, 2250 (1998).

Cold (Neutronless) α Ternary Fission of ^{252}Cf, A.V. Ramayya, J.H. Hamilton, ... , S.Y. Chu, *et al*., Phys. Rev. **C57**, 2370 (1998).

Closed Doublet Structures in ^{103}Mo, ^{109,111}Ru and Neighbours: Rotation-alignment for the Half-filled h11/2 subshell (Question), J.K. Hwang, A.V. Ramayya, ... , S.Y. Chu, ... , J. Gilat, *et al.*, J. Phys. (London) **G24**, L9 (1998).

Electron Capture Decay of ^{116}In and Nuclear Double Beta Decays, M. Bhattacharya, A. Garcia, M.M. Hindi, E.B. Norman, C.E. Ortiz, N.I. Kaloskamis, C.N. Davids, O. Civitarese, J. Suhonen, Phys. Rev. **C58**, 1247 (1998).

Collective Band Structures in Neutron-Rich ^{107,109}Ru Nuclei, S.-Z. Zhu, C.-Y. Gan, …, S.Y. Chu, *et al.*, Chin. Phys. Lett. **15**, 793 (1998).

Octupole Correlations in Neutron-Rich ^{145,147}La Nuclei: Coriolis-limit-coupling bands with aligned h11/2 Proton, S.Z. Zhu, J.H. Hamilton, …, J. Gilat, …, S.Y. Chu, *et al.*, Phys. Rev. **C59**, 1316 (1999).