

Nuclear Data Project McMaster University

Status Report: Oct. 1, 2004-Sept. 30, 2005

October 31, 2005

(USNDP-2005 meeting, Nov. 9-11, 2005)

Part 1: Nuclear Structure and Decay Data

Prepared by: B. Singh

ENSDF Work

■ Permanent Responsibility:

A=1 (1999,s), 31-37 (1999),
39 (1999,s), 38 (1999,w)
40 (2004),
41 (2001), 42 (2000),
43 (2001), 44 (1999),
64 (1996,w), 89 (1998),
98 (2003), 100 (1997,w),
149 (2004), 151 (1997),
164 (2001), 188 (2002),
190 (2003), 194 (1996,s)

- Note: The number in parentheses gives the year of last revision in ENSDF database
- w: work in progress
- s: revision submitted

- During FY-2005, work was mostly done on other priority A-chains and nuclides, which are outside McMaster's A-chain responsibility

Mass-chain Evaluations Published or Submitted Since October 2004

- **A=199:** B. Singh, NDS (submitted September 2005, at pre-review stage)
- **A=1:** B. Singh, NDS (submitted September 2005, at pre-review stage)
- **A=74:** B. Singh and A.R. Farhan, NDS (submitted September 2005, at review stage)
- **A=218:** A.K. Jain and B. Singh, NDS (submitted June 2005, at review stage)
- **A=165:** A.K. Jain, A. Ghosh and B. Singh, NDS (submitted March 2005, at review stage)
- **A=39:** B. Singh and J.A. Cameron, NDS (submitted January 2005, at post-review stage)
- **A=194:** B. Singh, NDS (submitted September 2004, at post-review stage)
- **A=80:** B. Singh, NDS 105, 223-418 (2005)
- **A=233:** B. Singh and J.K. Tuli, NDS 105, 109-222 (2005)
- **A=132:** Yu. Khazov, A. Rodionov, S. Sakharov and B. Singh, NDS 104, 497-790 (2005)
- **A=240:** F. Chukreev and B. Singh, NDS 103, 325-388 (2004)

Nuclide & Superdeformed Structure updates

The following nuclides have been updated for ENSDF:

^{84}Zr and ^{163}Lu (by B. Singh)

- SD Data from primary publications during 2004-2005 included in ENSDF (by B. Singh) for the following nuclides:

^{131}Ce , ^{132}Ce , ^{138}Nd , ^{140}Nd , ^{161}Lu , ^{167}Lu , ^{173}Hf , ^{174}Hf , ^{190}Pb , ^{191}Hg ,
 ^{192}Pb , ^{195}Pb , ^{196}Bi , ^{198}Po

- As of October 31, 2005, we are current on the coverage of SD band data in ENSDF, except for a paper on ^{196}Pb published this week.
- Continuous updates will be done as new papers appear

XUNDL work

Compilation of Data from Current Literature

- Since October 1, 2004, 300 compiled (but checked for level-scheme and data consistency) datasets prepared by McMaster group have been included in the XUNDL database.
- 15 datasets in XUNDL were revised/updated to incorporate newer papers from the same groups
- Frequently scan web pages of primary nuclear physics journals:
(PR-C, PRL, NP-A, PL-B, EPJ-A, JP-G)
- Almost up-to-date on the coverage of data from current papers, with the exception of ~20 papers which have appeared in journal web pages in the last few weeks.
- Major portion of compilation work since October 2004, performed by undergraduate student, Joel Roediger.
- Datasets checked thoroughly by B. Singh, before submission to NNDC for inclusion in XUNDL
- Communication with authors actively pursued to resolve data-related inconsistencies and/or to request additional data details.

Review of A-chains from other centers

- A=22: by J.A. Cameron
- A=122 (first report), 193: by B. Singh
- A=153: review of complete A chain, addition of several new datasets based on papers published in 2005, and update of “adopted” datasets for ^{153}Sm and ^{153}Eu since the original submission of A=153 in October 2004. This work is still continuing, expected completion in November 2005: by B. Singh and D.G. Burke.

Work in Progress

(as of October 1, 2005)

- A=38.** Complete all ENSDF style datasets for all reactions and adopted properties. Except for ^{38}Ar and ^{38}K , all nuclides of A=38 have been completed.
- A=64, 100.** Work continues to update all nuclides in these A-chains. Since the previous (1997) update of A=100, there has been a large number of primary publications for this mass chain.
- A=182.** Work started in late summer 2005 to update all nuclides of this mass chain.

Mentoring and Training

of New Data Evaluators through Collaborative work

- **A=165, 218:** Work in collaboration with new team of evaluators at Department of Physics, Indian Institute of Technology, Roorkee, India. This work was submitted in 2005. Dr. Jain from India visited McMaster group second time for a month in June 2005. This collaboration will continue until the two mass chains are published and included in ENSDF.
- **A=132:** This collaborative work, with the team of new evaluators at Petersburg Nuclear Physics Institute, Russia, started in 2003 and was brought to completion in February 2005 with the publication of A=132 in the March 2005 issue of NDS and subsequent inclusion in ENSDF database.

Other Related Activities

- **IAEA-NSDD-2005 Meeting:**

The 16th biennial meeting of the IAEA's international Nuclear Structure and Decay Data network (NSDD) was hosted by McMaster group from June 6-10, 2005 at McMaster University campus. All the necessary arrangements and administrative matters, including meeting website were handled by the McMaster data group. See website:

www.physics.mcmaster.ca/~balraj/nsdd2005/ for details.

- **Three-quasiparticle structures in deformed region:**

A compilation of all the known 3-quasiparticle structures in the deformed region has been prepared, covering all the literature up to July 2005. This work is a collaboration between B. Singh and Dr. A.K. Jain's theory group in India. The paper has been accepted for publication in Atomic Data and Nuclear Data Tables. A preprint is available on NNDC website.

Other related activities *contd.*

- **Magnetic-dipole rotational (MR) bands:**

Compilation of magnetic-dipole rotational structures is continuing in collaboration with Dr. Jain's theory group in India. A complete update of our previous publication in the year 2000 has been prepared and is expected to be submitted for publication to the Atomic Data and Nuclear Data Tables. A preprint will be made available on NNDC website.

- **Review of Shape (Fission) Isomers in Actinide Nuclei:**

At the suggestion of B. Singh, review of shape isomers in actinides is being prepared by Stephan Oberstedt (Neutron Physics Unit, European Commission, Geel). According to a recent e-mail from Dr. Oberstedt, the literature phase and preparatory work for this review is expected to be finished by the end of 2005, thereafter, writing will start. He has also conducted recent experiments on search for shape isomers in ^{239}U , the results of which will be included in the review.

Personnel and Funding (Nuclear structure and decay data)

- J.C. Waddington (Professor, Head of the data group at McMaster)
 - J.A. Cameron (Emeritus-Professor)
 - B. Singh (Research Scientist/Nuclear Data Evaluator)
 - J. Roediger (Undergraduate Student)
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- One FTE support from DOE, USA + NSERC, Canada
 - Partial support for undergraduate students

Part 2: Astrophysics Data

Prepared by: A. Chen

Evaluation of Data for Astrophysics

- Personnel: A. Chen (McMaster faculty)
J. Pearson (postdoc, part-time)
- Reactions evaluated: $^{25}\text{Al}(p,\gamma)^{26}\text{Si}$ and $^{13}\text{N}(p,\gamma)^{14}\text{O}$
 - Additional ongoing evaluations: $^{21}\text{Na}(p,\gamma)^{22}\text{Mg}$ and $^{18}\text{Ne}(\alpha,p)^{21}\text{Na}$
 - Planned evaluations: $^{26}\text{Al}(p,\gamma)^{27}\text{Si}$ (new data in 2005 from TRIUMF-ISAC)
 $^{40}\text{Ca}(\alpha,\gamma)^{44}\text{Ti}$ (new data in 2005 from TRIUMF-ISAC)
 - New reaction rates will be disseminated through the new ORNL computational infrastructure at www.nucastrodata.org.

Evaluation of the $^{25}\text{Al}(p,\gamma)^{26}\text{Si}$ reaction rate

- Critical rate in the production of galactic ^{26}Al in nova explosions.
- Incorporated recent data from various transfer reaction studies (e.g., (p,t) at ORNL, (^3He , ^6He) at Yale University, and (^3He ,n) at Ohio University).
- Evaluation will continue as new results on this reaction become available from TRIUMF-ISAC and other laboratories, including a planned direct measurement of the cross section at ISAC.

Evaluation of the $^{13}\text{N}(p,\gamma)^{14}\text{O}$ reaction rate

- Important in the breakout from the CNO cycles to the Hot-CNO cycles in novae and X-ray bursts.
- Incorporated all data on this reaction to date.
- New direct measurement of the reaction rate is planned at TRIUMF-ISAC.