
Nuclear Data Project

McMaster University

Status Report: Oct. 1, 2006-Sept. 30, 2007

(November 5, 2007)

USNDP: November 7-9, 2007

Part 1: Nuclear Structure and Decay Data Evaluation

Prepared by: B. Singh

ENSDF Work

■ Permanent Responsibility:

A=1 (2005), **31** (1999,w),
32-35 (1999), **36** (1999,w)
37 (1999,w), **38** (2007)
39 (2006), **40** (2004),
41 (2001), **42** (2000),
43 (2001), **44** (1999),
64 (2006), **89** (1998,w),
98 (2003), **100** (2007),
149 (2004), **151** (1997,s),
164 (2001), **188** (2002),
190 (2003), **194** (2006)

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

- During FY-2007, work was also done on other A-chains and nuclides, which are outside McMaster's A-chain responsibility

Mass-chain Evaluations Published or Submitted Since October 1, 2006

- **A=151:** B. Singh (submitted September 2007)
 - **A=182:** B. Singh and J. Roediger (submitted September 2007)
 - **A=58:** C. Nesaraja, S. Geraedts and B. Singh (submitted September 2007)
 - **A=38:** J.A. Cameron and B. Singh, NDS (submitted Sept 2006, in ENSDF, waiting pub.)
 - **A=135:** B. Singh, Yu. Khazov and A. Rodionov, NDS (submitted Sept 2006, in ENSDF, waiting pub.)
 - **A=100:** B. Singh (submitted September 2006, in ENSDF, waiting pub.)
 - **A=64,** B. Singh, NDS **108**, 197-364 (2007)
 - **A=199,** B. Singh, NDS **108**, 79-195 (2007)
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Nuclide updates

Nuclide evaluations (56 total) during Oct 1, 2006 - Sept 30, 2007 for ENSDF

(Most are **New Nuclides** and nuclides for which **excited state and/or gamma-ray data** became available for the first time; Cf. proposals at 2006-US-NDP and 2007-NSDD meetings): (by Singh)

^{24}Si , ^{24}N , ^{28}S , ^{30}Ne , ^{31}F , ^{31}Ne , ^{31}Na , ^{31}Ar , ^{32}Ar , ^{33}Ne , ^{33}Mg , ^{33}Al , ^{33}Ar , ^{33}Si , ^{34}Ne , ^{36}Na , ^{36}Mg , ^{36}Ca , ^{37}Na , ^{40}Si , ^{41}Cl , ^{41}P , ^{42}Si , ^{43}P , ^{43}Si , ^{43}Cl , ^{44}S , ^{44}P , ^{44}Si , ^{89}Ru , ^{90}Se , ^{105}Te , ^{109}Xe , ^{118}Ba , ^{118}Ru , ^{118}Rh , ^{118}Pd , ^{118}Tc , ^{120}Rh , ^{121}Rh , ^{149}La , ^{158}W , ^{159}Re , ^{163}Tm (*), ^{164}Lu (*), ^{164}Eu , ^{164}Gd , ^{164}Ir , ^{188}W , ^{189}Po , ^{193}Rn , ^{194}Rn , ^{194}Re , ^{251}No , ^{255}Rf , ^{264}Sg ,

(*) : also SD band update

- SD Data from primary publications during Oct 1, 2006 – Sept 30, 2007 included in ENSDF (by Singh) for the following nuclides: ^{157}Er , ^{158}Er . As of November 5, 2007, we are current on the coverage of SD band data in ENSDF.
- Review work: $A=24$ (by Cameron), 124 (by Singh) for ENSDF; six radioisotopes in ^{226}Ra chain for DDEP (by Singh)

XUNDL work

Compilation of Data from Current Literature

- Between October 1, 2006 and September 30, 2007, **368** compiled (checked for internal level-scheme and data consistency) datasets prepared by McMaster group have been included in XUNDL.
 - **25** datasets in XUNDL were revised/updated to incorporate newer related papers from the same groups.
 - Represent about 200 primary publications in experimental nuclear structure.
 - Frequent scanning of web pages of primary nuclear physics journals: (PR-C, PRL, NP-A, PL-B, EPJ-A, JP-G, IJMP-E, Chinese Phys Lett)
 - As of Nov. 5 we are up-to-date on the coverage of structure data from current papers in above journals; 5 papers published in PR-C and PRL, Oct. 30 - Nov 5 are currently being compiled.
 - Major participation in this effort by undergraduate students: Maxim Mitchell until April 2007, and Scott Geraedts since March 2007. Scott received training during March-April in the XUNDL compilation work and basics of nuclear physics and spectroscopy, translation and ENSDF codes.
 - Datasets checked and edited 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; about 40 communications this year.
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Work in Progress

(as of October 1, 2007)

A=31. Complete all ENSDF style datasets for all reactions and adopted properties. Work on this started in September 2007.

A=37. Complete all ENSDF style datasets for all reactions and adopted properties. Expected submission in early 2008

A=78. This work is in collaboration with Dr. Farhan of Kuwait group. This mass chain is near completion and will be submitted in November 2007. The last evaluation dates to 1990, almost the oldest mass chain in the system.

A=85. Work is actively going on to update all nuclides in these A-chains. The previous evaluation was published in 1997.

A=89. Work has just started on this mass chain to update all nuclides of this mass chain. The last evaluation dates to 1998.

Mentoring and Training

of New Data Evaluators through Collaborative work

- **A=31:** Dr. Christian Ouellet joined our group as post-doctoral fellow in September 2007. Chris is working on A=31 evaluation according to ENSDF procedures. The ^{31}Na and ^{31}Mg nuclides, which are relevant to “island of inversion” have already been submitted to NNDC.
 - **A=58:** Work in collaboration with Dr. Caroline Nesaraja at ORNL. She visited McMaster for three weeks in May 2007. The mass chain has recently been submitted to NNDC and is currently at pre-review stage.
 - **A=71:** This collaborative work is at a preliminary stage with Dr. A.K. Bhati, Professor in Physics at Panjab University, Chandigarh, India. He is involved with experiments at RHIC and CERN, but is also engaged in nuclear moment measurements and has expressed interest in ENSDF work. He intends applying for the ICTP-IAEA workshop for ENSDF training scheduled in April 2008 at Trieste.
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Other Related Activities

- **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 publication in 1999 was prepared in Dec 2006 and a table of such structures made available on NNDC website. A manuscript is under preparation to be submitted to Atomic Data and Nuclear Data Tables.

- **Review of transition probabilities in ENSDF:** Review of M1 transitions was started in April 2007 based on a request by Professor Henryk Mach at Notre Dame and Studsvik.

Scott Geraedts is heavily involved in this work e.g. writing a code to extract relevant values from ENSDF database, checking unusually (and unrealistically) high values in the ENSDF database.

In many cases these have been found to be mistakes as a result of use (**mainly misuse**) of the RULER code, e.g. ascribing width of an unbound level to only the electromagnetic transitions and not taking into account particle-decay modes.

We have found other types of subtle mistakes e.g. incorrect extraction of level half-lives from experimental BE2 values in Coul. Ex.

RULER code has since been modified by Tom Burrows to remedy some of the mistakes and give warnings in cases where values are higher than current RUL.

We are planning a limited review of all the multipolarities and check all the RUL assigned about 20 years back.

Personnel and Funding

- A. Chen: Assoc. Professor, Principal Investigator of Data Project.
 - J. C. Waddington: Emeritus-Professor, Co-PI of Data Project.
 - J. A. Cameron: Emeritus-Professor: **Volunteer work** since 1999 on ENSDF evaluation of Endt's A=31-44 region: A=38-44 published; A=36, 37 currently being evaluated.
 - B. Singh: Research Scientist/Nuclear Data Evaluator.
 - C. Ouellet: Post-doctoral Fellow: **since September 2007**
 - M. Mitchell: Undergraduate Student; until April 2007.
 - S. Geraedts: Undergraduate Student; since March 2007.

 - Support from DOE, USA and from NSERC, Canada.
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Part 2: Astrophysics Data

Prepared by: A. Chen

Evaluation of Data for Astrophysics

- Personnel: A. Chen (McMaster faculty)
C. Ouellet (Post-doctoral Fellow, McMaster)
- Evaluation closely coupled to experimental program of McMaster team (e.g., TRIUMF-ISAC)

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Work planned for 2007-2008

- The nuclear astrophysics component of our data project efforts resumed in July 2007, after a one-year hiatus.

We will continue to compile and evaluate nuclear data relevant to stellar reaction cross sections, and determine the best reaction rates to be adopted in standard reaction-rate libraries.

- Focus on two key reactions for which recent experiments have been done by McMaster team, namely, $^{40}\text{Ca}(\alpha,\gamma)^{44}\text{Ti}$ (Chris Ouellet's thesis project, completed in 2007) and the $^{25}\text{Al}(p,\gamma)^{26}\text{Si}$ (experimental work on-going). In the light of new data from our experiments, we will be updating the evaluation of stellar rates for these reactions.
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