McMaster University Nuclear Data Project

Report of completed and on-going work from May 2017-April 2019
(IAEA-NSDD meeting, Vienna, Austria. April 8-12, 2019)

ENSDF: evaluations, training, computer codes, network coordination**.**
XUNDL: compilation of current papers, communication with authors.
NSR: writing key-word abstracts of papers in PR-C journal.

Horizontal evaluations and compilations:

Beta-delayed neutron (BD-N) emitters: %Pn, $T_{1/2}$ for all potential β-n emitters (IAEA-CRP)
B(E2) for first 2^+ and first 4^+ states in e-e nuclei.
Compilation of nuclear isomers of $T_{1/2} \geq 10$ ns (may include 1-10 ns)
Table of r_0 parameters for even-even alpha emitters.
Review of Log ft values in β decay.
Table of magnetic-dipole rotational (shears) bands.

ENSDF evaluation work (May 2017 to April 2019):

Mass Chain publications in NDS

A=254: B. Singh, NDS **156**, 1-69 (February 2019)
A=266,270,274,278,282,286,290,294,298,302: B. Singh, NDS **156**, 70-147 (February 2019)
A=268,272,276,280,284,288,292,296,300: B. Singh, NDS **156**, 148-212 (February 2019)
A=164: B. Singh and J. Chen, **147**, 1-381 (January 2018)
A=217: F.G. Kondev, E.A. McCutchan, and B. Singh et al., NDS **147**, 382-458 (January 2018): IAEA-ICTP-2016 workshop
A=258: B. Singh, NDS **144**, 297-322 (September-October 2017)
A=189: T.D. Johnson and B. Singh, NDS **142**, 1-330 (May-June 2017)

Additional ENSDF updates of 21 nuclides.

Review work: one mass chain for ENSDF / NDS.
One article on horizontal compilation for ADNDT journal

Mass chains submitted / in pipeline for ENSDF / NDS

A=218: B. Singh, M.S. Basunia, M.J. Martin, E.A. McCutchan et al.: submitted March 28, 2019. IAEA-ICTP-2018 workshop; work coordinated by B. Singh: in review.
A=190: B. Singh and J. Chen: submitted March 3, 2019: in review.
A=50: J. Chen and B. Singh: submitted Sept 30, 2018: final version submitted March 26, 2019.
A=219: B. Singh, G. Mukherjee, S.K. Basu et al.: submitted Oct 2, 2018: in review.
A=100: B. Singh and J. Chen: submitted Sept 19, 2018: post-review.
A=130: S. Pascu, B. Singh, A. Rodionov and G. Shulyak: submitted Sept 18, 2018: in review.
A=98: J. Chen and B. Singh: submitted June 18, 2018: in review
A=73: B. Singh and J. Chen: submitted Feb 1, 2018: post-review.

A=172: B. Singh and T. Kibedi: submitted May 2017: post-review.
A=57: A. Negret, B. Singh and R.B. Firestone: submitted April 2017: post-review.
A=76: B. Singh and A.R. Farhan: submitted April 2016: post-review: waiting for results of experiment by E.A. McCutchan et al. for ^{76}Br to ^{76}Se decay using Gammasphere array.

Mass chains in Progress:

A=149
A=194 (with J. Chen, MSU)
A=64 (with J. Chen, MSU)
A=132 (with A. Rodionov and G. Shulyak, PNPI)
A=58 (with C. Nesaraja, ORNL)

Mass chains planned in the next 1-2 years:

A=240, 165, 74, 80, 134 (some in collaboration with other centers)

XUNDL compilation work (May 2017 to April 2019):

Compiled: **518** datasets from **182** papers, includes **14** papers for which data-check reports were submitted together with compiled datasets for PRC-submitted papers.

Assisted with training in XUNDL compilation work at the 2018 IAEA-ICTP workshop

Compilation of current papers on Atomic Mass measurements:

1. November 2, 2018: **32** paper with 202 data points, compared to data in AME-2016.
2. May 15, 2017: **22** papers with 133 data points, compared to AME-2016 data.

Both files are available on Michael Smith's nuclearmasses.org webpage at ORNL**,** where our compiled Atomic mass data since 2008 has been made available from a total of about **222** primary publications. Note that these papers are not covered in the XUNDL database.

NSR key-wording of papers (May 2017 to April 2019):

1957 articles in March 2017-January 2019 issues of **PR-C** were consulted, and keyword abstracts were written for **1392** papers. These were submitted to NNDC, for the NSR database, after checking the keyword file by the NSRPREP compilation code. In addition, keyword abstracts were written for **52** papers from INPC-2007 conference proceedings.

Horizontal evaluations and compilations:

1. **B(E2) for the first 2^+ and 4^+ states in e-e nuclei (NNDC, BNL + McMaster):** NNDC + McMaster collaboration continues for a compilation and evaluation of B(E2) (and B(E4)) for the first 4+ states in e-e nuclei, systematic of BE2(4+ to 2+)/BE2(2+ to 0+) and E(first 4+)/E(first 2+), etc. Also update of B(E2) values continues for the first 2+ states, as this topic is very active in current experimental structure work, and many new publications have appeared since the publication of our B(E2) article 2016Pr01: At. Data Nucl. Data Tables **107**, 1 (2016)

2. **Beta-delayed neutron emission probabilities (Pn) and half-lives for Z>28 n-rich nuclei (McMaster + TRIUMF + NNDC-BNL + CIAE-Beijing + VECC-Kolkata + Valencia + CNEA-Argentina + Warsaw): IAEA-CRP 2012-2017:**
   For Z>28 nuclides (~410 nuclides): paper by J. Liang, B. Singh, E.A. McCutchan, I Dillmann, M. Birch, A.A. Sonzogni, X. Huang, M. Kang, J. Wang, G. Mukherjee, K. Banerjee, D. Abriola, A. Algora, A.A. Chen, T.D. Johnson, and K. Miernik was submitted for publication May 17, 2018. We received review comments March 25, 2019. Hopefully a final version will be submitted in June 2019, incorporating response to Reviewers' comments as well as updating for papers since the submission in 2018.

   Z<28 region (~**220 nuclides**): Since the publication of 2015Bi05: NDS **128**, 131-184 (2015), for this region, tables are being updated to include data from papers in this Z region that have appeared after the 2015 publication.

3. **Compilation of nuclear isomers of half-life 10 ns or greater: (Amity Univ, Noida, India; Akal Univ, India; McMaster Univ.):** presentation by Ashok K. Jain at this meeting. Many new papers on isomers have appeared since the publication of the Atlas of Nuclear Isomers in NDS **128**, 1 (2015).

4. **Update of 1998Ak04 Table of radius (r0) parameters for alpha-decay hindrance factors (Akal Univ., India; McMaster Univ.; Amity Univ., Noida, India):** presentation by Sukhjeet Singh at this meeting for ALPHAD-RadD code and updated 2019 r_0 table. Significant new data for new alpha-decaying isotopes, half-lives and branching ratios have become available since the 1998Ak04: NDS **84**, 1 (1998). A paper on updated r_0 parameters by S. Singh, S. Kumar, B. Singh and A.K. Jain was submitted in July 2018. We received review comments November 2018. Revised version, with a thorough

checking of various tables and inclusion of newer data, was submitted Feb 28, 2019. Apparently, it has not yet been sent for review (to a different reviewer).

5. **Update of 1998Si17**: NDS **84,** 487 (1998**): Log *ft* review: Dresden Univ. (**Kai Zuber, Steffen Turkat); **Saclay** (Xavier Mougeot) and **McMaster** (B. Singh): presentation by Steffen Turkat at this meeting. We plan to use BetaShape code for Log *ft* values.

6. **Update of 2000Am02:** At. Data Nucl. Data Tables **74,** 283 (2000), also 2006-update on NNDC webpage: **Table of magnetic-rotational dipole (shears) bands**: **(Akal Univ., India; Amity Univ., Noida, India; McMaster Univ.):** see center report by Ashok Jain. Many new papers have appeared since the previous publication in 2000.

Network Coordination:

1. Participated in IAEA-ENSDF codes meeting December 2018: presented Alphad-radD code, J-GAMUT code, and update of r_0 parameters for even-even alpha emitters.
2. Participated in October 2018 IAEA-ICTP ENSDF two-week workshop in Trieste: lectures and hands-on training in ENSDF formats, XUNDL compilations, and ENSDF evaluation of A=218.
3. Participated in the 3rd RCM of the CRP for Beta-delayed neutron project, June 2017.
4. Dr. Sorin Pascu from Bucharest center visited McMaster for 2 weeks in Sept 2017, and for another 2 weeks in July 2018 for consultations on ENSDF matters, and work on A=130 mass chain.

Analysis of experimental data for ^{94}Y decay to ^{94}Zr:

The experiment was performed in 2011 at TRIUMF using the 4π HPGe detector array, with S. Yates as the spokesperson. I participated in the experiment run for a week. The data have been analyzed by Dr. Anagha Chakraborty and his student at Visva Bharati University in India, in consultation with me. About 240 gamma rays have been identified from singles and γγ-coin data, and placed amongst 110 levels in ^{94}Zr with the lowest intensity of 0.001%, a major improvement in the decay characteristics of ^{94}Y isotope (neutron-rich fission fragment), over the last study by B. Singh et al., Jour. Phys. G **2**, 397 (1976), where only 54 gamma rays were found with the lowest intensity of ~0.01%, and placed amongst 22 levels. Current data in the ENSDF database for this decay is from the 1976 publication. A paper from the 2011 experiment was published in Phys. Rev. Lett. **110**, 022504 (2013), while a detailed paper is expected to be submitted for publication in about a year's time.

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