Status Report: McMaster University
April 18, 2015 to May 19, 2017

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IAEA-NSDD-2017
LBNL, Berkeley, May 22-26, 2017

Nuclear Structure and Decay Data

ENSDF evaluations; training; computer codes;
network coordination

XUNDL compilation of current papers, coordination (until Sept 15)

NSR writing keyword abstracts of PR-C papers

Horizontal evaluations and compilations:

B(E2) for first 2+ and 4+ states in e-e nuclei.

Beta-delayed neutron **(BD-N)** emitters: **%Pn, $T_{1/2}$**

Update of Akovali's 1998 **r_0 radius** parameter for α decay

Compilation of **nuclear isomers** of $T_{1/2} \geq 10$ ns

Some participation in collaborative experiments in nuclear structure:

Data for the decay of Y-94 fission fragment: analysis in progress.

ENSDF: NSDD: McMaster Responsibility (17 A-chains)

A=1 (2005)
A=64 (2007)
A=74 (2011)
A=75 (2012)
A=76 (2011)
A=77 (2011)
A=78 (2012)
A=79 (2008)
A=80 (2006)
A=89 (2013)

A=98 (2003; update in progress)
A=100 (2008)
A=149 (2004)
A=151 (2009)
A=164 (2001; post-review stage)
A=188 (2002; update submitted by ANL)
A=190 (2003; update in progress)
A=194 (2006)

April 2015 – May 2017: 9 A-chains published in NDS; 5 A-chains submitted;
9 A chains in progress, in addition to A=266-300 (even A) SHE region.
160 additional nuclide updates for ENSDF.

Involved work on many A-chains and individual nuclides, which are outside McMaster's A-chain responsibility

Network coordination and computer codes for ENSDF

- May 2015 ENSDF 4-day workshop at the IAEA.
- July-August 2016 IAEA-ICTP 2-week training workshop, Trieste.
- IAEA-ENSDF codes workshop: Oct 5-8, 2015: JAVA-NDS, J-GAMUT, V-AVELIB codes (B. Singh and M. Birch).
- Collaboration with S. Singh on the new ALPHA-D and RAD-D codes for alpha decay.
- JAVA-NDS workshop: Oct 5-8, 2015 at TUNL.

XUNDL: compilation of current literature

April 2015 to May 2017

Network coordination (until Sept 30, 2015).

Compiled 450 datasets from 210 publications in 2015-17.

175 datasets from **other centers** were reviewed, and edited as needed

Continued correspondence with the authors.

Coordinated XUNDL compilation activity at July 2016 ICTP workshop

Compilation of **new mass measurements** papers**:**

1. Oct 29, 2015: 17 papers with 83 data points, compared to AME-2012.
2. May 15, 2017: 22 papers with 133 data points, compared to AME-2016.

All files **since 2007** available on Michael Smith's webpage:

www.nuclearmasses.org

NSR: writing keyword abstracts of PRC articles
(April 2015 to May 2017)

PRC issues: Jan 2015 to Feb 2017 (26 months):

Keyword abstracts written for ~1660 articles from

a total of ~2470.

Horizontal evaluations: B(E2) for first 2^+ states in e-e nuclei

NNDC (BNL) + McMaster + Central Michigan Univ. collaboration

B. Pritychenko, J. Choquette, M. Horoi, B. Karamy and B. Singh, An update of B(E2) evaluation for 0_1^+ to 2_1^+ transitions in even-even nuclei near N~Z~28,
ADNDT 98, 798-811 (2012).

B. Pritychenko, M. Birch, B. Singh, and M. Horoi: *Tables of E2 transition probabilities from the first 2^+ states in even-even nuclei*, ADNDT 107, 1-139 (2016): 456 nuclides (326 in Raman)

First reviewer's concern about our weighted averaging procedure (weighting by was addressed in a revised manuscript.

Raman's two statements in fine-print (ADNDT 78, 1 (2001)), often missed by readers:

"*Where several B(E2)↑ values are available for a given nuclide, we have generally used weighting values that are inversely proportional to the quoted uncertainty rather than inversely proportional to the square of the quoted uncertainty, which would be the correct procedure if the uncertainties were purely statistical. We believe that our weighting procedure results in a more reliable average value. We did not, however, adhere religiously to the weighting procedure outlined above in all cases".*

"However, our adopted B(E2)↑ values are based only on the traditional (Coulomb excitation, lifetime measurements, and resonance fluorescence) types of measurements because these are more direct and involve essentially model-independent analyses."

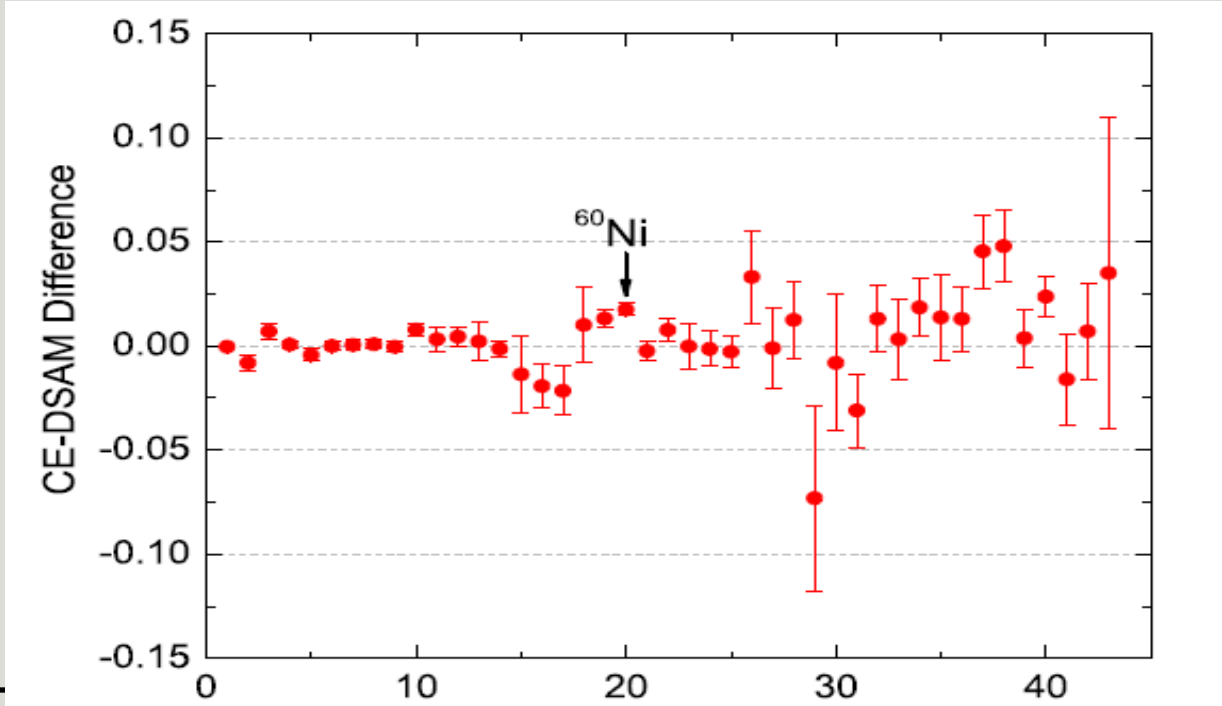
Started compilation and evaluation of B(E2) for first 4+ states.

Using B(E2) database for the first 2+ states: follow-up studies

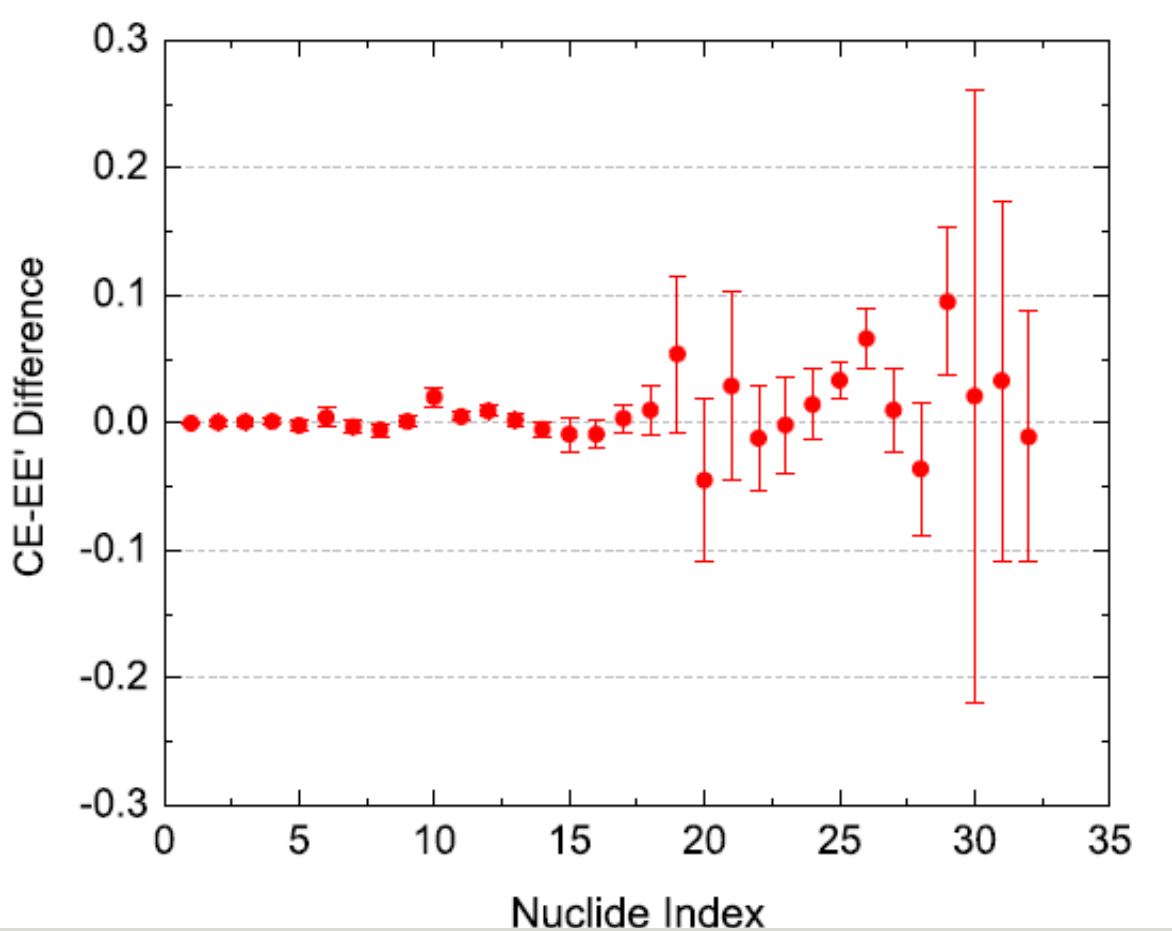
M. Birch, B. Pritychenko, and B. Singh: *On the equivalence of experimental B(E2) values determined by various techniques*, Nucl. Phys. A 955, 145-155 (2016).

Statistical treatment of so-called traditional methods: DC, CE, DSAM, RDDS, NRF; and not so traditional (e,e'). Two independent measurements for each method.

Conclusion: *most commonly used methods used in the measurements of B(E2) are equivalent.*

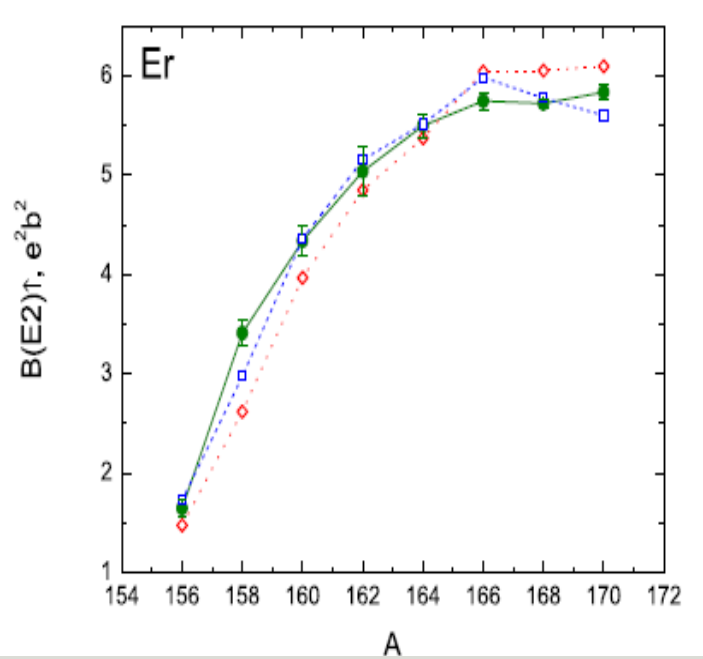


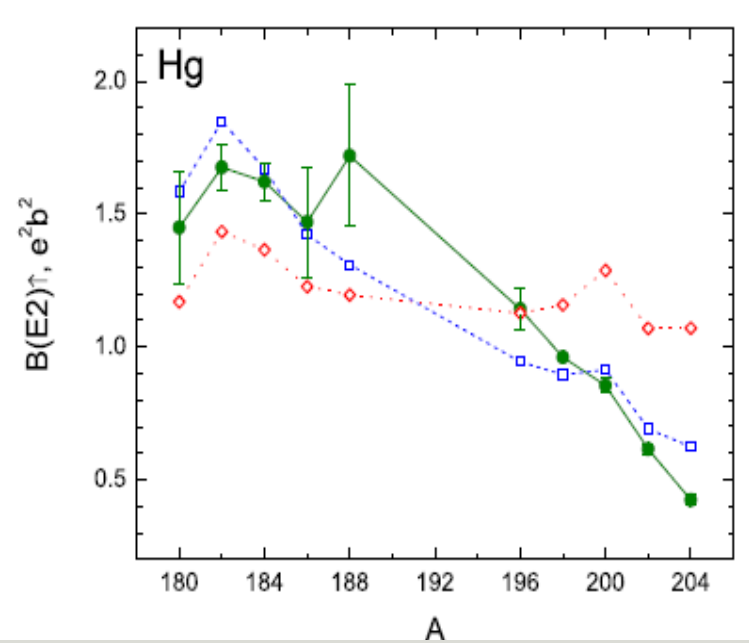
B(E2): follow-up studies: (e,e') method is in general agreement with Coulomb excitation method



B(E2): follow-up studies: Grodzins fits

- B. Pritychenko, M. Birch, and B. Singh: *Revisiting Grodzins systematics of B(E2) values*, Nucl. Phys. A 962, 73-102 (2017). Used Raman (PRC 37, 805 (1988)) and Habs (CERN Proposal INTC-P-1561 (2002)) parametrization approaches.

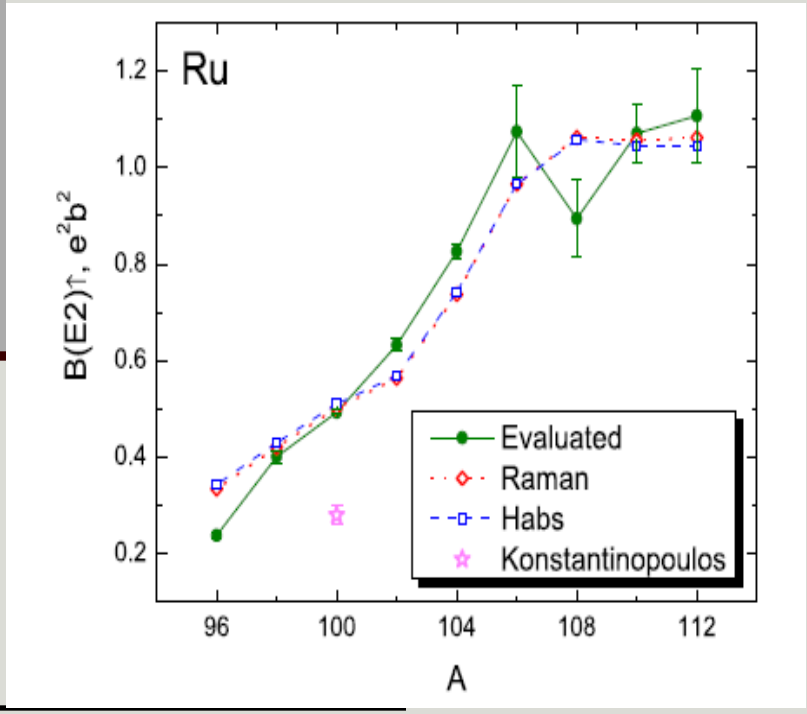


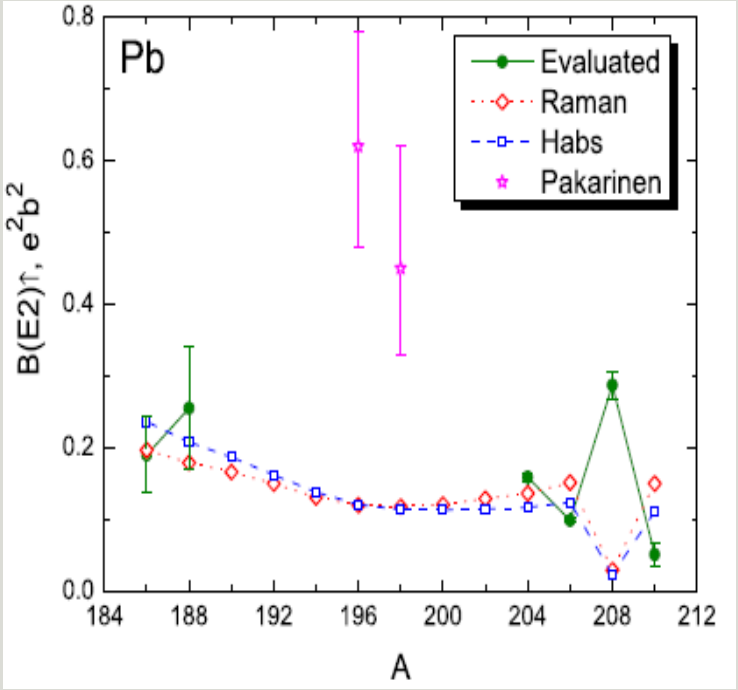


B(E2): follow-up studies: Grodzins fits and comparison with recent data: examples

Ru-100: RDM (Orsay)
PRC 95, 014309 (2017)

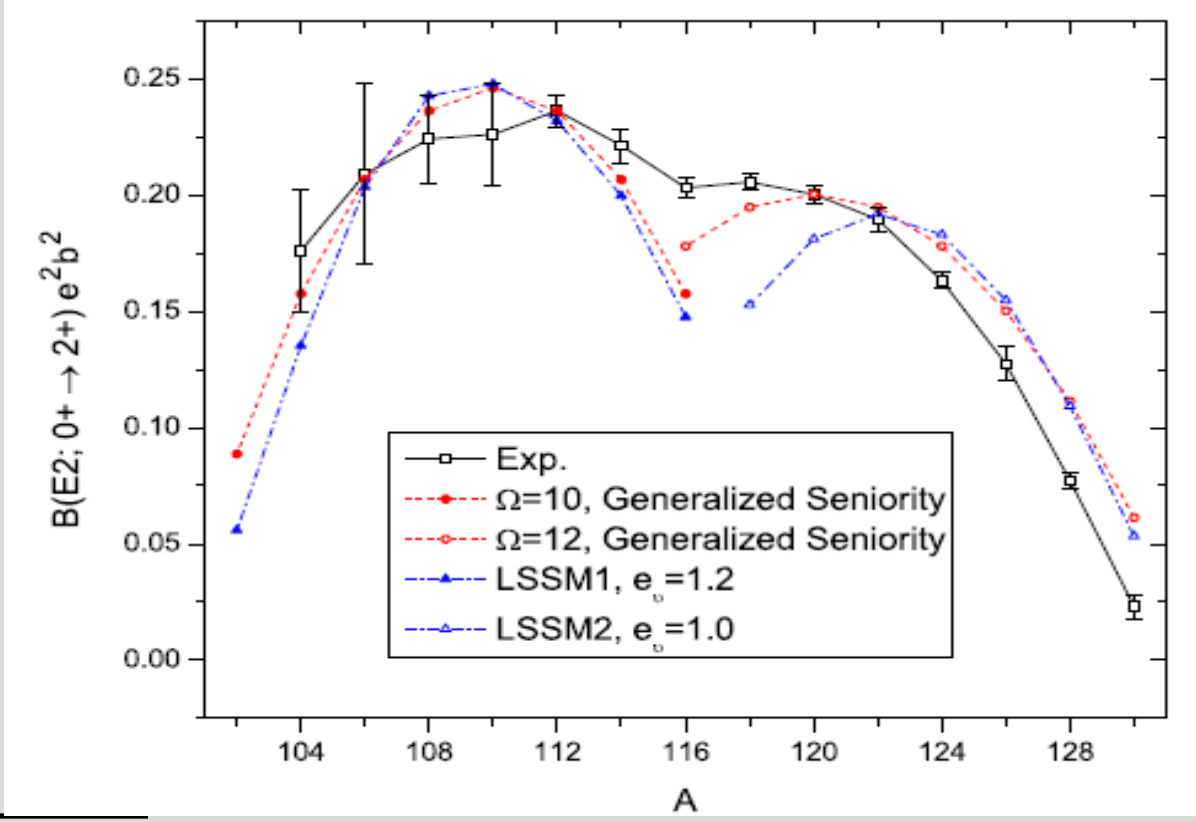
Pb-196, Pb-198: Coul. Ex. (CERN)
JP-G 44, 064009 (2017)





B(E2): theoretical studies: A=104-130 Sn isotopes

- Publication: B. Maheshwari, A.K. Jain, B. Singh, *Asymmetric behavior of the B(E2↑; 0+→2+) values in $^{104-130}$Sn and generalized seniority,* NP-A 952, 62 (2016).



Compilation and evaluation of Pn and half-lives of beta-delayed neutron emitters: IAEA-CRP (2012-2017):

McMaster + TRIUMF + NNDC(BNL) + CIAE (Beijing) + VECC (Kolkata) + CNEA (Buenos Aires) + Valencia (Spain) + Univ. of Warsaw

IAEA-CRP for creating a reference database for microscopic and macroscopic quantities for beta-delayed neutron precursors.

Coordinator of the compilation/evaluation work for the entire mass region: B. Singh

M. Birch, B. Singh, I. Dillmann, D. Abriola, T.D. Johnson, E.A. McCutchan, and A.A. Sonzogni, *Evaluation of Beta-Delayed Neutron Emission Probabilities and Half-Lives for Z = 2-28* , NDS 128, 131-184 (2015). This paper dealt with about 220 B-n emitters.

The Z=2-28 region will be revisited and updated by early 2018 to include data from more recent literature since 2015.

For Z>28 nuclides (about 410 nuclides), semi-final draft of Pn and half-life tables with bibliographic file has been prepared and sent to the IAEA-NDS for setting up a reference database for beta-delayed neutron precursors, first of its kind. The systematics of experimental data are being prepared using Kratz-Herrmann (1973Kr15) formalism, McCutchan et al. (2012Mc04,2014Mc07) based on a novel approach using T1/2 and Pn values, and Miernik's level-density parameterization method (2013Mi23,2014Mi23). Results will be presented at the upcoming 3rd and final RCM of the CRP June 12-16, 2017. A paper based on this work is in preparation and is expected to be submitted to NDS by Fall 2017.

Beta-delayed neutron data: Tables and Data Files (Z>28) sent to IAEA-NDS for reference database

a. Table of recommended half-life and Pn data file with complete bibliography (list of references hyperlinked to the NSR database)

b. Table of nuclides and Q-values for possible P_{1n}, P_{2n}, P_{3n} precursors (based on AME-16)

c. Table of compiled data for P_{1n}, P_{2n} and half-lives with all the available references, including some secondary publications.

d. Supplementary Table of comments for Pn and half-life measurements. (The commentary file fill be made available, but not published)

e. Above data exist in several .excel and .pdf files (Q values for relevant nuclides, recommended Pn and half-lives, compiled data for Pn and half-lives) . These were sent to IAEA-NDS in February 2015 for setup of B-DN database.

f. All the papers used in this work made available on a shared webpage.

Other horizontal compilations/evaluations

- Update of table of r_0 parameter by Y. Akovali (1998Ak03) for alpha decay of e-e nuclei: S. Singh, S. Rathi, B. Singh, A.K, Jain.
  (Presentation by B. Singh, May 26).

- Isomers of $T_{1/2} \geq 10$ ns: A.K. Jain, B. Maheshwari, S. Garg, M. Patial, and B. Singh, *Atlas of Nuclear Isomers*, NDS 128, 1-130 (2015). (Presentation by A.K. Jain)

- Update of 2000Am02 (Amita, A.K. Jain, B. Singh): Table of Magnetic rotational bands: Amita, S. Singh, B. Singh, A.K. Jain (See presentation by A.K. Jain).

- Possible new project: Update of 1998 log *ft* review by B. Singh et al. (1998Si17): Prof. Kai Zuber at Dresden expressed interest in the update of this table, while he visited McMaster for a week in summer 2016. He is visiting McMaster again this summer, and hopefully, in collaboration with Dr. Xavier Mougeot from Saclay, this project can be planned as a Dresden + McMaster + Saclay collaboration.

Financial Support:

ENSDF, XUNDL, NSR: mainly from DOE through a contract from NNDC-BNL.

B-n evaluation: partly from IAEA-NDS. Graduate students support partly from NSERC of Canada.

Codes: J-Gamut, V-Avelib in JAVA: mostly from IAEA-NDS.

Travel support: IAEA-NDS and NNDC-BNL

Infrastructure support: McMaster University.