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Summary Report of an IAEA Technical Meeting

Co-ordination of the International Network of Nuclear Structure and Decay Data Evaluators

Kuwait Foundation for the Advancement of Sciences,
Safat, Kuwait

27 – 31 January 2013

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August 2013

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Abstract

The 20th meeting of the International Network of Nuclear Structure and Decay Data Evaluators was convened at the Kuwait Foundation for the Advancement of Sciences, Safat, Kuwait, from 27 to 31 January 2013 by the IAEA Nuclear Data Section. This meeting was attended by 36 scientists from 17 Member States, plus IAEA staff, concerned with the compilation, evaluation and dissemination of nuclear structure and decay data. A summary of the meeting, data centre reports, various proposals considered, modified and agreed by the participants, and recommendations/conclusions are presented within this document.

August 2013

GLOSSARY

A	Mass Number
ADNDT	Atomic Data and Nuclear Data Tables
AI	Artificial Intelligence
ALPHAD	ENSDF analysis program
AMDC	Atomic Mass Data Centre
AME	Atomic Mass Evaluations
ANL	Argonne National Laboratory, USA
ANU	Australian National University
ATOMKI	Institute of Nuclear Research of the Hungarian Academy of Sciences
A2, A4	Coefficients of Legendre expansion of γ-γ directional correlation
BIPM	Bureau International des Poids et Mesures, France
BMLW	Reduced magnetic transition probability in Weisskopf units (ENSDF)
BNL	Brookhaven National Laboratory, USA
BR	Branching Ratio
BrIcc	Program to calculate Band-Raman ICC
CATAR	Computer code to calculate ICC by Pauli and Raff
CD-ROM	Compact disk with read-only memory
CE	Conversion Electron
CEA	Commissariat à l'Energie Atomique (French Atomic Energy Commission)
CERN	Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)
CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas, Spain
CNDC	China Nuclear Data Center, Institute of Atomic Energy (CIAE)
CRP	Coordinated Research Project (IAEA)
CSNSM	Centre de Spectrométrie Nucléaire et de Spectrométrie de Masse, France
DCO	Directional correlation of γ-rays deexiting oriented states
DDEP	Decay Data Evaluation Project
DDG-NA	Deputy Director General of the Department of Nuclear Sciences and Applications (IAEA)
DELTA	ENSDF analysis program
DICEBOX	Monte Carlo statistical model code (developed by F. Becvar and M. Krticka)
DOE	U.S. Department of Energy
DSAM	Döppler-Shift Attenuation Method
EADL	Evaluated Atomic Data Library
EC	European Commission
EFG	Electric field gradient
EGAF	Evaluated Gamma-ray Activation File
EMPIRE	System of codes for nuclear reaction calculations
ENDF	Evaluated Nuclear Data File
ENSDAT	ENSDF analysis program
ENSDD	European Nuclear Structure and Decay Data Network of Evaluators
ENSDF	Evaluated Nuclear Structure Data File
EQM	Electric quadrupole moment
EU	European Union
EURATOM	European Atomic Energy Community
EXFOR	EXchange FORmat: Computer-based system for the compilation and international exchange of experimental nuclear reaction data
Fm	Femtometer
FMTCHK	ENSDF analysis program
FO	Frozen Orbital
FP7 ENSAR	7^{th} Framework Programme, European Nuclear Science and Applications Research (ENSAR)
FP7 ERA-NET	7^{th} Framework Programme, European Research Area (ERA)

FTE	Full Time Employment
GABS	Gamma ABSolute emission probabilities: ENSDF analysis program
GAMUT	Computer code for gamma-ray energy and intensity analyses of data from ENSDF
GANIL	Grand Accélérateur National d'Ions Lourds, France
GND	General Nuclear Database
GSI	Gesellschaft für Schwerionenforschung mbH, Germany
GTOL	ENSDF analysis program
HF	Hindrance Factor
HFS	Hyperfine structure
HIL	Heavy Ion Laboratory, University of Warsaw, Poland
HSICC	Program to calculate Hager-Seltzer ICC
IAEA	International Atomic Energy Agency
IC	Internal Conversion
ICC	Internal Conversion Coefficients
ICRM	International Committee for Radionuclide Metrology
ICTP	International Centre for Theoretical Physics, Italy
IEP-NAS	Institute of Electron Physics of the National Academy of Sciences of Ukraine
IFIN-HH	Horia Hulubai National Institute of Physics and Nuclear Engineering, Romania
IFJ-PAN	Institute of Nuclear Physics PAN, Poland
IIT	Indian Institute of Technology
IMP	Institute of Modern Physics, Chinese Academy of Sciences, China
INDC	International Nuclear Data Committee
INL	Idaho National Laboratory, USA
INR (Kiev)	Institute for Nuclear Research, Ukraine
INRNE	Institute for Nuclear Research and Nuclear Energy (INRNE), Bulgaria
IP	Isotopes Project at LBNL
IPF	Internal Pair Formation
IUPAC	International Union of Pure and Applied Chemistry
JAEA	Japan Atomic Energy Agency
Jπ/JPI	Spin and Parity
K	Angular momentum projection on the nuclear symmetry axis
KREEP	Geochemical component of some lunar impact rocks
LANL	Los Alamos National Laboratory, USA
LBNL	Lawrence Berkeley National Laboratory, USA
LiveChart	Interactive nuclear structure and decay database (predominantly from ENSDF)
LNHB	Laboratoire National Henri Becquerel, France
LLNL	Lawrence Livermore National Laboratory, USA
LOGFT	ENSDF analysis program
LWM	Limitation of Relative Statistical Weight
M, M$	Transition multipolarity
MDM	Magnetic dipole moment
MPI	Max-Planck-Institut fuer Kernphysik, Germany
MR	Mixing ratio
MSU	Michigan State University, USA
MULT	Multipolarity
MySQL	Relational database engine
NAA	Neutron Activation Analysis
NDP	Nuclear Data Project, Oak Ridge National Laboratory, USA
NDS	Nuclear Data Sheets; journal devoted to ENSDF data
NDS/IAEA	Nuclear Data Section, IAEA
NDWG	Non-Neutron Nuclear Data Working Group (working group of the ICRM)
NEWGTOL	PNPI version of GTOL
NIPNE	National Institute of Physics and Nuclear Engineering, Romania
NIST	National Institute of Standards and Technology, USA

ND	Nuclear Data
NMR	Nuclear Magnetic Resonance
NMR/ON	NMR on Oriented Nuclei
NNDC/BNL	National Nuclear Data Center, Brookhaven National Laboratory, USA
NRM	Normalized Residual Method
NSCL	National Superconducting Cyclotron Laboratory, USA
NSDD	Nuclear Structure and Decay Data network
NSDFLIB	ENSDF analysis program
NSR	Nuclear Science References – bibliographic file
NUBASE	Experimental nuclear properties database
NuDAT	Interactive nuclear structure and decay database (predominantly from ENSDF)
NuPECC	Nuclear Physics European Collaboration Committee
NuPNET	Nuclear Physics Network
NWC	Nuclear Wallet Cards
OECD	Organization for Economic Co-operation and Development
ORNL	Oak Ridge National Laboratory, USA
PAN	Institute of Nuclear Physics PAN, Poland
PANDORA	ENSDF analysis program
PNPI	Petersburg Nuclear Physics Institute of the Russian Academy of Sciences
RADWARE	Software package for interactive graphical analysis of gamma-ray coincidence data (developed at ORNL)
RIPL	Reference Input Parameter Library
RT	Rajeval Technique
RUL	Recommended Upper Limit
RULER	ENSDF analysis program
SHE	Super Heavy Elements
SQL	Structured Query Language
TAEK	Turkish Atomic Energy Authority
TJπ	Proposed theoretical or recommended Jπ
TUNL	Triangle Universities Nuclear Laboratory, USA
USNDP	US Nuclear Data Program
VMI	Variable moment of inertia
WPEC	NEA Working Party on International Evaluation Cooperation
XML	eXtensible Markup Language
XUNDL	Experimental Unevaluated Nuclear Data List
3NDWG	Non-Neutron Nuclear Data Working Group

A-chain evaluation	Mass-chain evaluation: best data for the structure and decay of all nuclides with the same mass number.
Horizontal evaluation	Best values of one or a few selected nuclear parameters for many nuclides irrespective of their mass number.

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FOREWORD

Biennial meetings of the International Network of Nuclear Structure and Decay Data (NSDD) evaluators are held under the auspices of the IAEA. The Network consists of evaluation groups and data service centres in several countries. This Network has the objective of providing up-to-date nuclear structure and decay data for all known nuclides by evaluating all existing experimental data. Data resulting from this international evaluation collaboration are included in the Evaluated Nuclear Structure Data File (ENSDF) and published in the journals *Nuclear Physics A* and *Nuclear Data Sheets* (NDS). The results represent the recommended "best values" for the various nuclear structure and decay data properties. These data and bibliographic details are also available through the World Wide Web, CD-ROM, wall charts of the nuclides, Nuclear Wallet Cards and other such media.

The US efforts are coordinated by the Coordinating Committee of the US Nuclear Data Program. The ENSDF master database is maintained by the US National Nuclear Data Centre at Brookhaven National Laboratory, and these data are also available from other distribution centres including the IAEA Nuclear Data Section.

Biennial meetings of the Network are sponsored by the IAEA Nuclear Data Section, and have the following objectives:

(a) coordination of the work of all centres and groups participating in the compilation, evaluation and dissemination of NSDD;

(b) maintenance of and improvements to the standards and rules governing NSDD evaluations;

(c) review of the development and common use of computerized systems and databases maintained specifically for this activity.

In those meetings detailed studies and discussions are undertaken over a five-day period. This document represents a summary of the Network meeting held at the Kuwait Foundation for the Advancement of Sciences (KFAS), Safat, Kuwait, from 27 to 31 January 2013. Thirty-six nuclear data specialists from seventeen countries attended this meeting to discuss their work as well as problems of common interest, particular with respect to the active membership of the mass chain evaluation team responsible for ENSDF.

The first two days were dedicated to a combination of organisational, administrative, and technical reviews and discussion papers concerning the progress made and problems that have been encountered during the last two years. The last three days of the meeting, specific mass chain activities, horizontal evaluations and technical issues were discussed. Problems are still being experienced in maintaining a suitable number of mass chain evaluators (expressed as FTE – Full Time Employment). The uncertain future of the Network, partly due to the aging of the majority of existing evaluators and partly due to the fact that evaluators are overburdened with many other research activities and duties, was an important issue at the meeting. This makes it rather difficult to maintain the high quality of evaluations that has been achieved over the years by the meticulous work of Network members, Member States are urged to support the continuing efforts of the Network to train new evaluators by providing the proper working environment in their respective institutions. Thanks to IAEA efforts, six evaluators are currently being supported and are actively contributing to the evaluation effort.

The adopted Agenda for the meeting is listed in Annex 1, and the list of participants is given in Annex 3.

NSDD MEETINGS

Place	Date	Report
1. Vienna, Austria	29.04. – 03.05.1974	INDC(NDS)-60
2. Vienna, Austria	03 – 07.05.1976	INDC(NDS)-79
3. Oak Ridge, USA	14 – 18.11.1977	INDC(NDS)-92
4. Vienna, Austria	21 – 25.04.1980	INDC(NDS)-115
5. Zeist, Netherlands	11 – 14.05.1982	INDC(NDS)-133
6. Karlsruhe, Germany	03 – 06.04.1984	INDC(NDS)-157
7. Grenoble, France	02 – 05.06.1986	INDC(NDS)-182
8. Ghent, Belgium	16 – 20.05.1988	INDC(NDS)-206
9. Kuwait, Kuwait	10 – 14.03.1990	INDC(NDS)-250
10. Geel, Belgium	09 – 13.11.1992	INDC(NDS)-296
11. Berkeley, USA	16 – 20.05.1994	INDC(NDS)-307
12. Budapest, Hungary	14 – 18.10.1996	INDC(NDS)-363
13. Vienna, Austria	14 – 17.12.1998	INDC(NDS)-399
14. Vienna, Austria	04 – 07.12.2000	INDC(NDS)-422
15. Vienna, Austria	10 – 14.11.2003	INDC(NDS)-456
16. Hamilton, Canada	06 – 10.06.2005	INDC(NDS)-0476
17. St. Petersburg, Russia	11 – 15.06.2007	INDC(NDS)-0513
18. Vienna, Austria	23 – 27.03.2009	INDC(NDS)-0559
19. Vienna, Austria	04 – 08.04.2011	INDC(NDS)-0595
20. Kuwait City, Kuwait	27 – 31.01.2013	INDC(NDS)-0635

1. INTRODUCTION

The first meeting of the International Network of Nuclear Structure and Decay Data Evaluators took place in Vienna in 1974. Since this time, the network has convened biennially.

The role of the NSDD Network is threefold: first, the compilation, evaluation and dissemination of nuclear structure and decay data; second, the maintenance and improvement of the standards and rules governing nuclear structure and decay data evaluation; and third, monitoring and reviewing the development and use of the computerized systems and databases maintained specifically for such activities. By way of close cooperation within the Network, accurate, freely available data are provided to the user community so as to enhance the quality and reliability of their work. The IAEA Nuclear Data Section takes the role of coordinator of the NSDD network.

The Opening Ceremony of the 20th meeting of the International Network of Nuclear Structure and Decay Data Evaluators was held in the Hamed Al-Essa Auditorium at the Kuwait Foundation for the Advancement of Sciences (KFAS). Dr. Ameenah Farhan, member of the Network and local host, welcomed delegates and distinguished members of KFAS and Kuwait University to the 20th NSDD network meeting.

Dr. Adnan Shihab-Eldin, Director General, KFAS, also welcomed the delegates acknowledging the importance of their work and their coordinated effort. He also gave a brief presentation of the history and role of KFAS in the advancement of sciences in Kuwait.

D. Abriola, representing the IAEA, mentioned its commitment to promoting peaceful applications of nuclear energy, and on behalf of NDS/IAEA thanked the hosts for their support and generous hospitality.

Finally, B. Singh, as one of the initiators of the Kuwait Nuclear Data Project, narrated the history of the Kuwait Data Center's involvement in ENSDF evaluation.

2. SUMMARY

The 20th meeting of the International Network of Nuclear Structure and Decay Data (NSDD) Evaluators was attended by thirty-six participants from seventeen countries, representing the majority of data evaluation centres, new evaluation groups and data dissemination centres (Annex 3).

After conclusion of the official opening ceremony, the Agenda was approved as listed in Annex 1. J.K. Tuli (BNL) was elected as chairman, and P. Dimitriou and E. Ricard-McCutchan were nominated rapporteurs for the meeting. A list of all ENSDF evaluation centres and groups is given in Annex 5, along with their mass-chain evaluation responsibilities as assigned for 2011-2012. Representatives from the individual mass chain evaluation centres presented progress reports on their NSDD studies. These status reports are listed in Annex 6. The technical presentations made by participants are available on the IAEA NSDD website as indicated in Annex 7.

The first two days were mostly devoted to administrative and organisational issues, in particular the discussion of actions from previous meetings, the presentation of reports by evaluation centres, as well as reports on the USA and the IAEA Nuclear Data Programs, and the Network Organisational Review, while the last three days focussed on technical matters. Technical reviews are summarized in Section 3. Meetings, Workshops, Trainings and other new activities are discussed in Section 4, and Data Bases are reviewed in Section 5. Administrative and organizational items are summarized in Section 6, while Activities related

to horizontal evaluations are presented in Section 7. Round-table discussions are contained within Section 8, and recommendations and conclusions are given in Section 9.

Regarding the technical work, participants' discussions covered a wide range of topics, in the course of which recommendations to improve the quality of NSDD evaluations were made. A list of actions was prepared, indicating the expert(s) responsible for implementation over the next two years (see Annex 2). Another major concern, namely that of achieving improved financial and technical support within the Network, was also addressed, and NSDD members prepared recommendations to the IAEA as well as the major evaluation centres that addressed these needs. These recommendations include: i) continued organization of joint ICTP/IAEA and IAEA-based workshops designed to train new NSDD evaluators; ii) support by the major NSDD centres of the evaluation work undertaken by new groups through mentoring; iii) maintenance of horizontal evaluations required by users or covered by on-going activities.

The meeting concluded with the announcement that the next meeting be held in spring 2015, the venue being the IAEA Headquarters, Vienna.

3. TECHNICAL REVIEW

Action items from the last meeting were discussed. First the continuing actions were taken up and those no longer relevant were deleted. See the list of continuing actions (Annex 2). One-time actions were also discussed. Those completed were deleted and those still relevant but requiring further attention were added to the list of new actions which can be found in Annex 2. Some of the items discussed during this session are mentioned in the following.

NSR and library services: It was pointed out that the IAEA is no longer involved in NSR. Currently, NNDC, McMaster University and the Slovak Academy of Sciences, under contract with NNDC, are the only groups involved in scanning literature for NSR.

It was brought to the attention of the Network that certain references used in DDEP evaluations are missing from NSR. An Action was placed on F. Kondev to contact M.-M. Bé at CEA, France, to ask for those references.

With regards to keywords, it was agreed that evaluators may voluntarily help with the preparation of keywords, but that the main responsibility for keywords rests with the NSR manager.

NNDC has digitized most private communications, however, effort should be made to digitize also the hard-to-find references.

There was some discussion whether Google could replace or supplement NSR. Evaluators were advised not to limit their bibliography search to NSR.

It was pointed out that the new 2012 Atomic Mass Evaluation publications should also have associated DOI in NSR.

Quadrupole moments: N. Stone is preparing a new table of electric quadrupole moments, expected to be published at the end of 2013.

An ACTION was placed on NNDC and NDS-IAEA to upload N. Stone's new table of moments on their websites.

Evaluator's Guidelines: E. McCutchan and J. Tuli will revise evaluators' guidelines. These will be discussed with many senior evaluators before finalizing them.

M1 reduced transition probabilities: B. Singh will provide a revised table for reduced transition probabilities to replace the existing one in the NDS introductory pages.

A java-based code producing NDS-like output for ENSDF was written by the McMaster University group and is used by the IAEA in their Interactive Chart of Nuclides (LiveChart).

QCalc, RADLIST, and other relevant codes should be updated to employ new masses.

4. MEETINGS, WORKSHOPS, TRAINING

4.1 IAEA Nuclear Data Programme (D. Abriola)

D. Abriola reviewed the composition of the IAEA-NDS and its activities related to NSDD including:

- Coordinated Research Projects (CRPs)
- ENSDF evaluations
- Financial support for ENSDF and horizontal evaluation/compilation activities
- Coordination of the NSDD Network
- Workshops
- Dissemination

A new CRP on the generation of a database of beta-delayed neutron emission data has been approved by the IAEA and is scheduled to start in August 2013. NDS staff continue to be involved in ENSDF evaluations, in particular D. Abriola is evaluating mass-chain A=144 in collaboration with A. Sonzogni, and together with P. Dimitriou has contributed to mass chain evaluations A=211 and A=215 which were undertaken collectively by participants of the ICTP/IAEA NSDD Workshop in Trieste, 6-17 August 2012, and the ENSDD Workshop in Kolkata, 26-28 November 2012, respectively. The IAEA-NDS supports six mass-chain evaluators and one horizontal evaluation (Table of Nuclear Moments, N. Stone), and has until recently also supported the Atomic Mass Evaluation project (M. Wang). IAEA-NDS continues to coordinate the NSDD Network and organizes workshops to disseminate knowledge of NSDD, such as the Workshop on Nuclear Structure and Decay Data: Theory and Evaluation at ICTP, Trieste, 6 - 17 August 2012. The next ICTP workshop of this series will be held in 2014. With regards to dissemination, IAEA-NDS staff continue to improve the interactive chart of nuclides (LiveChart), with the development of search and plotting capabilities as well as the introduction of new nuclear moments and nuclear radii. LiveChart now includes all nuclear structure and decay data sets from ENSDF with the capability of plotting γ-ray spectra and β-decay spectra obtained from RADLIST. Future plans include extending LiveChart to search the XUNDL files.

4.2 Report on NDS determination of nuclear data needs in nuclear medicine (2008-2012), and CRP on Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (A.L. Nichols)

A. Nichols provided a summary of a recently launched IAEA CRP on"Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production" initiated at the beginning of December 2012 (see INDC(NDS)-0630 (2013)). This particular CRP includes comprehensive evaluations of decay data for just over 20 radionuclides, along with four specific Auger-electron emitters. He also referred to two related CRPs which are described in considerable detail in IAEA technical documents: (a) IAEA TECDOC-1211, Charged Particle Cross-Section Database for Medical Radioisotope Production: Diagnostic Radioisotopes and Monitor Reactions (2001), and (b) IAEA Technical Reports Series No. 473, Nuclear Data for the Production of Therapeutic Radionuclides (2011). A noteworthy consultants' meeting was held on "High-precision Beta-intensity Measurements and Evaluations for Specific PET Radionuclides" in 2008 to assess and review the decay data of about 50 positron-emitting radionuclides, and recommend a number of measurements and re-evaluations (see INDC(NDS)-0535 (2008)). Furthermore, an important related study was also undertaken in August 2011 in the form of an IAEA technical meeting entitled "Intermediate-term Nuclear Data Needs for Medical Applications: Cross Sections and Decay Data" in which significant steps were taken to define the detailed requirements for an extended nuclear medicine database over the course of the next 5 to ~ 15 years (see INDC(NDS)-0596 (2011)).

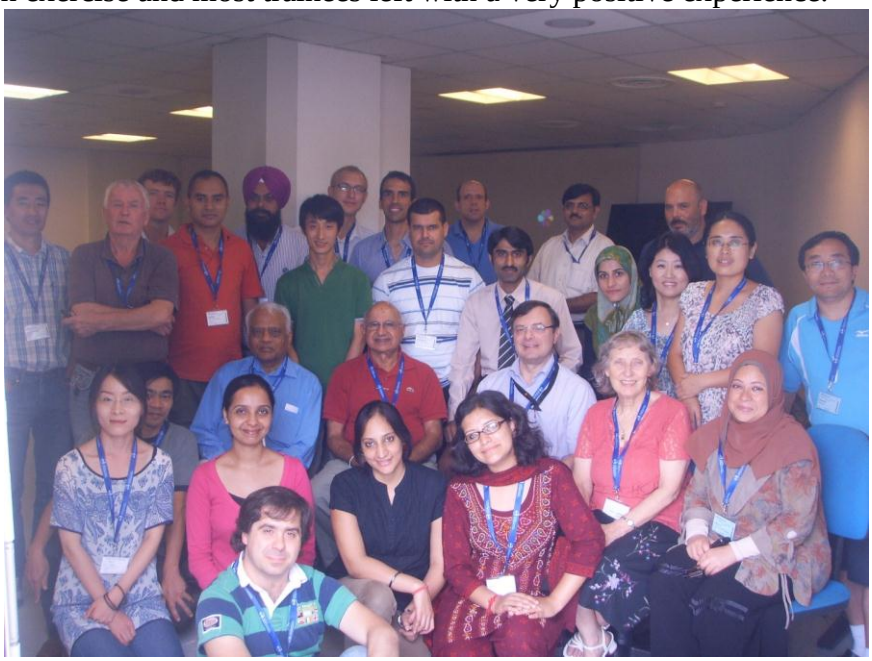
4.3 Data Evaluation Workshops (J. Tuli)

A short summary of the ICTP/IAEA workshop, DDEP workshop, and the ENSDD Kolkata Workshop was presented.

Nuclear Structure and Decay Data: Theory and Evaluation workshop, ICTP, Trieste, 6-17 August, 2012.

This sixth in a series of workshops was held at ICTP for a two-week period in August. About 19 trainees from 14 countries attended the workshop. All lecturers, except Van Isacker of GANIL, France, were NSDD evaluators from the USA, Canada, and the IAEA. Besides

regular lectures in the morning there were hands-on practical sessions in the afternoon. The trainees were divided into six groups, each under the leadership of one or more experienced evaluators. The evaluation of mass chain A=211 was undertaken collectively by the six groups, under overall coordination of B. Singh of McMaster University, Canada. The evaluation work continued after the end of the workshop, and was concluded with the update of the corresponding ENSDF files and a publication in the Nuclear Data Sheets (NDS 114 (2013) 661-749).
It was a successful workshop. Although it is unlikely to produce new evaluators, it was a great outreach exercise and most trainees left with a very positive experience.



Lecturers and participants of the ICTP/IAEA Workshop, Trieste, 2013.

DDEP Workshop, Paris, France, 8-10 October, 2012.
The Decay Data Evaluation Project conducted a workshop in Paris, France in October 2012. Attendance was limited, mostly consisting of local participants and a few NSDD evaluators (F. Kondev, B. Singh, R. Firestone, T. Kibedi, P. Dimitriou, and J.K. Tuli.). Decay data evaluation methodology was discussed.

Workshop on Evaluation of Nuclear Structure and Decay Data (ENSDD), Kolkata, India, 26-29 November, 2012.
The first of its kind, this workshop for evaluation of nuclear structure data was held at the Variable Energy Cyclotron facility of the (Indian) Department of Atomic Energy at Kolkata, India, in November 2012. The workshop was attended by about seventy participants from various Indian universities and national laboratories.
Participants interested in evaluation work, about thirty five in number, were divided into five groups. Collectively these groups undertook evaluation of mass A=215 as practical example as well as actual evaluation under the leadership of experienced evaluators and the overall coordination of B. Singh of McMaster University, Canada.
The work was started at the workshop and continued and completed afterwards.
Most trainees seem very energetic and anxious to learn the process and hopefully will stay involved. The workshop was very well organized and was a great success. Credit goes to the efforts of G. Mukherjee of VECC, Kolkata, India, and his colleagues. It certainly is hoped that NSDD will be able to benefit from the vast human resources that India can offer.

A discussion followed about whether these beginners' workshops need to be followed up with workshops on an expert level. There were suggestions that the initial pool of people needs to be filtered and the good candidates that are singled out should then attend a workshop at a higher level. The IAEA unfortunately cannot fund an entire workshop, it can however assist participants from developing countries attending international workshops. On the other hand, the advantage of the IAEA/ICTP workshops is that they are funded by ICTP, Trieste. However, financial support is provided to participants coming from developing countries only, so that many young scientists from developed countries who may be keen to become evaluators are often not able to attend these workshops. The ICTP/IAEA workshops may thus be seen more as an outreach tool than a means of providing specific training to future evaluators. The mentoring route is probably the best way to pursue a follow-up for people who show promise and interest in evaluation.

4.4 European Effort (D. Balabanski)

There is no funding by the European Union for this activity. Past efforts by members of the network to promote the NSDD evaluation project at the European Nuclear Science and Applications Research (ENSAR) Town Hall meeting in Helsinki, 2007, and at an IAEA meeting with some major EU laboratory heads in 2008, did not succeed in getting EU funds for nuclear data evaluation within the ENSAR project. Other alternatives ought to be looked into, such as the EURATOM project. The JEFF program is funded by national governments so it is not the kind of solution a European NSDD initiative would be looking for, as the NSDD members would first have to convince their national governments to provide the funds. It was agreed that some kind of action should be decided upon prior to the ENSAR2 Town Hall meeting to be held in June 2013. Contacts with people in key decision-making positions would be valuable. The IAEA would support this effort, but financial assistance would have to come from within Europe. The IAEA would also be willing to provide letters of support to individual evaluators to help their effort to get funding at a national level.

5. DATA BASES AND OTHER PRODUCTS

5.1 ENSDF/NDS Status (J. Tuli)

The status of ENSDF/NDS was presented. The benefit of publishing 11 issues a year is that it provides some discipline in finishing evaluations in a timely manner. However, the bottleneck to turning in evaluations is that oversight is missing. The possibility of doing a nuclide evaluation rather than a mass chain evaluation is already there, nevertheless mass chain evaluations are still preferred. It was also mentioned that, as publishing in NPA was time consuming, there was serious consideration of bringing the light mass evaluations in NDS after the "round" of publication in NPA (i.e. through A=16) came to completion.

5.2 Status Report of XUNDL database (B. Singh)

For the period 1April 2011 to 31 January 2013

- Purpose and Scope:
  1.) Provides prompt and convenient web access to current publications in experimental nuclear-structure data through on-line retrieval systems at BNL, RADWARE at ORNL and Isotope-Explorer at LBNL. The aim remains the same as defined in 1998 after deliberations with several researchers at different labs in the U.S. Regular scanning (independent of NSR) of PRL, PR-C, PL-B, EPJ-A, NP-A, JP-G, IJMP-E, CPL, and others.

2.) Complements the ENSDF database since data for many nuclides in ENSDF are quite outdated (i.e. more than 10 years old).
Corrections in existing datasets in ENSDF database are based on compilations. Inclusion of data for newly discovered nuclides and for those nuclides for which excited-state data have become available

3.) Frequent communications with authors of papers to resolve inconsistencies in data, and to obtain additional details of data. Some authors send submissions to XUNDL database for repository of data, which do not appear in their papers, but are referred to XUNDL.

4.) Estimated Evaluator effort: 0.50 FTE (estimated payback to ENSDF > 0.25 FTE).

- **Contributors:** B. Singh, J. Chen, M. Birch, E. Thiagalingam (McMaster); J. Kelley, G. Sheu. J. Purcell (TUNL); F.G. Kondev, J. Chen, J. Modica, W. Murrey (ANL); J.K. Tuli, D. Kulp (BNL).
- **Current contents of XUNDL:** 5064 datasets for 2160 nuclides from about 3250 primary publications between 1998-2013, spread over almost all isobaric mass chains. Also papers submitted to XUNDL database by some authors in support of their main paper in a journal such as PRC, PRL, etc.
- **Work from 1 April 2011 to 31 January, 2013:** 1001 datasets from 350 publications: 796 from McMaster; 42 (McMaster + BNL); 116 from TUNL; 47 from ANL. About 25 datasets were updated for new papers. A computer code was developed by M. Birch to replace temporary key-numbers in XUNDL with permanent ones in NSR database. Communications with original authors continued to resolve inconsistencies or to obtain additional data details.
- **Compilation of mass measurement papers from November 2010 to October 2012:** 41 papers mainly in PRC and PRL were compiled with ~325 data points. These data are available on http://www.nuclearmasses.org webpage at ORNL.
- **Examples:** six examples of current papers were presented where data problems were found and authors contacted in the compilation process.

5.3 LiveChart (D. Abriola)

The latest version of LiveChart was presented. It includes all nuclear structure (adopted data sets) and decay data sets from ENSDF. A plotting program developed at McMaster University has been adopted to produce level schemes similar to Nuclear Data Sheets. New capabilities include γ-ray and β-decay spectra plots using the RADLIST code.
Discussions following the presentation focused on the suggestion that genetic relationships between radioisotopes could be shown in tabular form upon request. Such a feature could also be provided by NUDAT. Overall, LiveChart was acknowledged as a versatile tool that could be enriched with additional features such as fitting capabilities. It was also suggested that it could be further developed to accept modules created by other users or developers. Currently LiveChart is updated with the new ENSDF files every six months.

6. ORGANIZATIONAL REVIEW

6.1 Summary of ENSDF/NDS Status (J. Tuli)

ENSDF Status: (As of 10 January 2013)

Datasets	17638 (17096 in 3/2011)
Nuclides	3174 (3120)
Records	2,522,559 (2384692) +5.8%
	202 Mega Bytes(190.8 MB)
Adopted Datasets	3174 (3135 in 3/11)
Decay Datasets	4110 (4032)
Reactions	9503 (9099)
Decay Type	No. of datasets
B+/EC	1230
B-	1074
A	780
IT	495
SF	214

ENSDF is distributed twice a year, the last distribution was in October 2012.

Nuclear Data Sheets

9 Issues (Jan-Nov): 16 Mass-chain evaluations, 2840 pages
178 pg /A-chain, (previously 137,183, 129, 154, 160,173)
1 Issue (Dec, 2012) 350 pages, non-ENSDF content

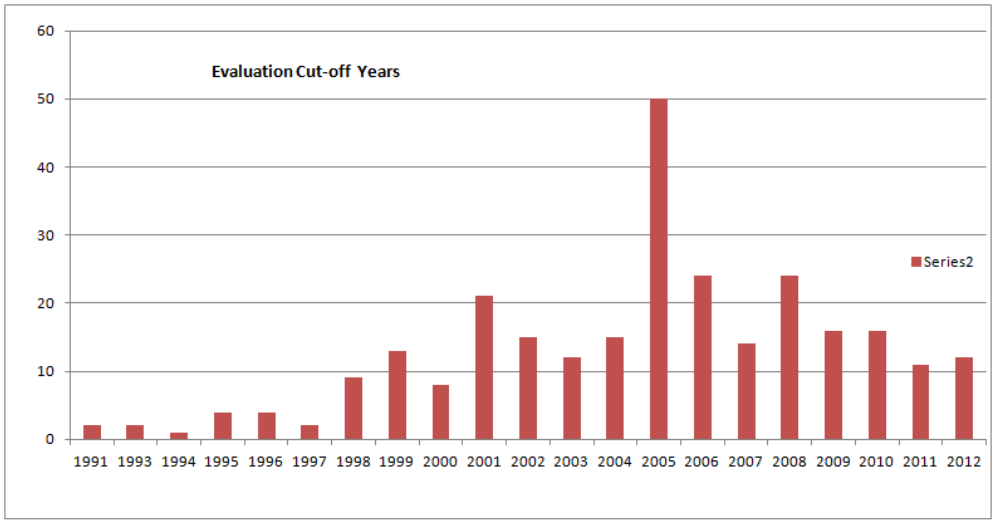


FIG 1. Cut-off years of mass chain evaluations for the past 20 years.

Estimated manpower of each centre for ENSDF evaluations

Changes in FTE effort devoted to ENSDF evaluations by various data centers:

- Change 0.35 FTE for TUNL to 0.45 FTE for TUNL (including XUNDL effort)
- Change 0.25 FTE for India to 0.7 FTE
- Change 0.40 FTE for China to 0.3 FTE
- Change 0.20 FTE for France to 0.1 FTE
- Change 0.5 FTE for Japan to 0.2 FTE

- Change 1.2 FTE for Canada to 0.75 FTE
- Change 0.2 FTE for Australia to 0.1 FTE
- Change 0.2 FTE for Hungary to 0.5 FTE
- LBNL will drop to ~0.7 FTE in the near future.
- Change 0.33 FTE for ORNL to 1.0

Changes in mass-chain assignments
LBNL proposes to reduce its mass-chain responsibility to only A = 21-30. If this happens, then the remainder of their mass chains would be added to NNDC responsibility.
India and Hungary are willing to add additional mass chains. A = 173 will be worked on by S. Erturk (Turkey).

7. HORIZONTAL EVALUATIONS

7.1 Summary of report on update of the Combined Reference Table of Nuclear Magnetic Dipole and Electric Quadrupole Moments and interim report on the new Table of Recommended Electric Quadrupole Moments (N. Stone)

Following the last meeting of the INDC in Vienna in 2011 an updated version of the combined Table of Nuclear Magnetic Dipole and Electric Quadrupole Moments was published in April 2011 and is available on the NDS website. This Report contains a complete list of all measurements of nuclear dipole and quadrupole moments, of nuclear ground states and excited states, with closing date December 2010. Since that date the Table has been kept up to date by adding all new results, with the intention that it should be reissued at regular intervals of a few years. It was agreed that the latest version should also be posted on the Brookhaven NNDC website.
Such a comprehensive list is not ideal for users other than those concerned with the physics of nuclear moments. For broader use a simpler list would be required giving a recommended value for each nuclear moment that has been measured. The preparation of the new form of electric quadrupole moment table, described in more detail below, was started in 2012 and will be completed in 2013. Following completion, a similar list of recommended magnetic dipole moments will be prepared.
The past two years have seen the publication of several papers giving examples of the physics of nuclear moments. Three of these include examples of innovative methods of nuclear moment measurement which are described in a more detailed technical report that is available on the NSDD website (see Annex 7).

7.2 Progress in the isomer project (A.K. Jain)

Isomers can be viewed as a separate class of nuclei and offer interesting possibilities to study the behavior of nuclei under varied conditions of life-time, spin, excitation and particle configuration. A systematic of the nuclear properties of isomers like excitation energy, half-life, spin, abundance etc. was presented. The atlas of nuclear isomers based on different limits on the isomer half-life was shown. Several interesting features of fission isomers were also pointed out, in particular the observation that some fission isomers have half-lives greater than their ground states. This phenomenon is not fully understood and is being investigated.

7.3 Summary: A survey of isobaric analogue states (IAS) in NUBASE2012 (M. MacCormick)

Isobaric analogue states (IAS) can be used to estimate the mass of nuclei belonging to isobars of the same isospin multiplet set. The Atomic Mass Evaluation (AME) had previously evaluated the experimental data used to establish the mass of these isobaric analogue states, however the experimental and Isobaric Multiplet Mass Equation (IMME) estimated IAS data were not published. Given the recognized importance of these states, it was decided to reactivate the AME and NUBASE IAS studies initially instigated by A.H. Wapstra.
NUBASE2012 now includes 107 IAS nuclides, the ground states of each isospin multiplet being naturally included in the *AME2012*. There are also eight isomer states, $^{16}N^{m}$, $^{26}Al^{m}$, $^{34}Cl^{m}$, $^{38}K^{m}$, $^{46}V^{m}$, $^{50}Mn^{m}$, $^{54}Co^{m}$, $^{72}Ga^{m}$ which are also IAS, however the isomer notation (*m*,*n*) has been preferred over the IAS notation in these cases. The overall evaluated IAS mass precision is in the order of 10^{-6}.
A more detailed technical presentation is available on the NSDD website (see Annex 7).

7.4 The AME and NUBASE evaluation: present and future (Wang)

AME2012, the latest version of atomic mass evaluation, was published in December 2012 in the "Chinese Physics C" journal, together with the NUBASE2012 evaluation. The Atomic Mass Evaluation (AME) provides the most reliable source for values of atomic masses and their uncertainties. AME considers all experimental data related to atomic masses extracted from the available literature. After compilation in an appropriate format, they are carefully examined. A least-squares fit method is used to determine the best values for the atomic masses and to quantify their uncertainties. The atomic mass table, main product of AME, is used as the source of the reference values in all mass model development and all mass measurement experiments. The Nubase evaluation combines all basic properties of nuclei in their ground and isomeric states in a consistent way, and in full coordination with AME.
The last complete evaluation of experimental atomic mass data before AME2012, AME2003 was published in 2003. Since then an uncommonly large amount of new, high quality, data has been published in the scientific literature. This is substantiated by the fact that as much as 53% of the data used in the present AME2012 evaluation were not available in 2003.
After publication of AME2012, the coordinator responsibility for the AME evaluation passed from G. Audi of CSNSM, France, to M. Wang of IMP, CAS. The next release of AME mass tables is planned for the end of 2015.
AME2012 was supported in part by the French-Chinese collaboration program PICS, the Chinese Academy of Sciences, the International Atomic Energy Agency and the U.S. Department of Energy, Office of Nuclear Physics.

7.5 Summary: Status of the Evaluated Gamma-ray Activation File (EGAF) (Firestone)

The EGAF database is the result of an IAEA Coordinated Research Project (CRP) to evaluate thermal neutron capture cross sections, σ_{γ}, for all stable elements and selected radioactive nuclides. These data were measured with guided neutron beams at the Budapest Reactor, and no previous comparable measurements had existed. The EGAF database is available at

- Documentation: http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1263_web.pdf
- IAEA website: http://www-nds.iaea.org/pgaa/pgaa7/index.html
- LBNL website: http://ie.lbl.gov/ng.html

After the IAEA CRP, the LBNL Isotopes Project organized an international collaboration to

improve and extend the contents of the EGAF file to include: i) total radiative neutron cross sections (σ_0) derived from EGAF, ii) activation data (P_γ, σ_γ, $t_{1/2}$), iii) neutron separation energies (S_n), iv) Reference Input Parameter Library (RIPL) nuclear structure data, v) average resonance neutron capture γ-ray data (I_γ,σ_γ), vi) photon strengths ($f_{M1,E1,E2}$).

Considerable progress has been made in the evaluation of the EGAF data file during the past 10 years. Cross section evaluations are published in refereed journals. Data for the palladium and potassium isotopes have been published in Physical Review C, and data for yttrium, europium, gadolinium, and tungsten isotopes are near completion. The EGAF database will serve as a source of information for many other databases including ENDF (E_γ, σ_γ, σ_0), DDEP (E_γ, P_γ, $t_{1/2}$, σ_γ, σ_0), AME(S_n), and RIPL (E_{Lev}, P_γ, Mult/MR, icc).

Future plans for EGAF include adding average resonance data from the literature, and extending the database to include γ-ray cross sections for up to 20 MeV neutrons. A new collaboration called TransActinide Nuclear Data Evaluation and Measurement (TANDEM) has been organized to work on measurements of rare actinide targets, and another collaboration was formed, led by the Oslo cyclotron group, in collaboration with the IAEA Nuclear Data Section to compile and evaluate photon strengths extracted from reaction gamma-ray data. We hope to also develop a prompt and delayed fission γ-ray database containing fission yields and Total Absorption Spectrometer (TAS) fission product β-strength data. The EGAF effort also expects to maintain the RIPL file for all (n, γ) product nuclides. A detailed report on the extended work performed for the EGAF project is included in the presentation that is available online (see Annex 7).

7.6 Compilation and evaluation of beta-delayed neutron probabilities and associated half-lives (Collaboration: B. Singh and M. Birch (McMaster), D. Abriola (IAEA), I. Dillmann (GSI), A. Sonzogni, E. McCutchan and T. Johnson (NNDC, BNL))

In April 2011, suggestion for this topic came from I. Dillmann at GSI, as a result of communication between B. Singh and C. Sheidenberger. In June 2011, B. Singh visited IAEA-NDS and suggested to D. Abriola to consider this activity for a possible IAEA Coordinated Research Project (CRP). This was followed by B. Singh's visit to GSI to confer with I. Dillmann about a possible CRP. In October 2011, a Consultants' meeting at IAEA for a reference database of %P(n) values for beta-delayed neutron emitters was organized by D. Abriola. A Summary report was published by D. Abriola, B. Singh and I. Dillmann: (INDC(NDS)-0599 (Dec 2011)). In May 2012, McMaster hosted a follow-up meeting with 15 participants from IAEA, GSI, Valencia, BNL, ORNL, RIKEN, LLNL, Guelph (TRIUMF) with interest in experimental and evaluation work of beta-delayed neutron emitters. An IAEA CRP was finally approved in September 2012. A first draft of evaluation of %P(n) and $T_{1/2}$ for non-fission region (A<72) nuclei has been prepared as a McMaster, IAEA, NNDC and GSI collaboration. This draft is going through detailed checking by the group members. We hope to publish this work by the end of 2013. In the meantime, NNDC has published a systematics paper on this topic [1].
The start of the evaluation of the fission region is planned for summer 2013. Furthermore, there are plans to participate in the first Research Coordination Meeting (RCM) to be held under this CRP on 26-30 August 2013 at IAEA in Vienna.

7.7 Evaluation of B(E2) values for first 2+ states in even-even nuclei (Collaboration: BNL, McMaster Univ., Central Michigan Univ.)

The project aims at updating Raman's 2001 evaluation of B(E2) values for first 2+ states in

even-even nuclei [2]. Since the 2001 evaluation, a large number of measurements have been made in many mass regions, but especially in the nuclei far from the stability line which are now accessible by RIB facilities at some major accelerator labs. This project started in 2010 with a pilot program of data evaluations of nuclei around N=Z=28, specifically for Cr, Fe, Ni and Zn nuclei. This work was published in 2012 to seek feedback from the user community [3].

This update is based on all published data prior to April 2011 and includes new experimental B(E2) values for 33 out of 38 nuclei. It extends evaluated data in the N~Z ~28 region from 20 to 38 nuclei. These results are compared with large-scale shell-model calculations. Evaluations of quadrupole collectivities for all nuclides, grouped by the Z region, will follow, accommodating user feedback based on this paper. Since then, B(E2) data for Z=2-22, Z>32 have been evaluated. An article for the Z=2-22 region is being prepared for submission to Atomic Data Nuclear Data Tables. See also: arXiv:1302.6881v1 (2013). Hopefully this project can be completed by the end of 2013.

References:

[1] E.A. McCutchan, A.A. Sonzogni, T.D. Johnson, D. Abriola, M. Birch, B. Singh, Improving systematic predictions of β-delayed neutron emission probabilities, Phys. Rev. C **86** (2012) 041305(R).

[2] S. Raman, C.W. Nestor, P. Tikkanen, Transition Probability from the Ground to the First-Excited 2^+ State of Even-Even Nuclides, At. Data Nucl. Data Tables **78** (2001) 1.

[3] B. Pritychenko, J. Choquette, M. Horoi, B. Karamy, B. Singh, An update of the B(E2) evaluation for $0^+_1 \rightarrow 2^+_1$ transitions in even-even nuclei near N ~ Z ~ 28, At. Data Nucl. Data Tables **98** (2012) 798.

8. ROUNDTABLE/TECHNICAL DISCUSSIONS

The following technical items were discussed at the meeting and decisions were taken to formulate specific actions.

1.) Charged-particle and neutron resonance data (B. Singh)

It was decided that the General Policies would be modified to take into account the decisions taken in previous USNDP and NSDD meetings regarding coverage of charged-particle and neutron resonance data.

2.) Guidelines for evaluation of half-lives for ground states and isomeric states (B. Singh)

Following an action item from the previous meeting, B. Singh and A. Nichols had prepared a draft that was distributed to the network members for comments.

The importance of half-life data for applications and the necessity of putting in place procedures to be followed by evaluators was once again underlined.

An action was placed on B. Singh and A. Nichols to revise the existing draft and submit it to the network for adoption. The final version should also be made available on the NSDD network webpage. A possible extension to include decay data was not adopted.

3.) BR=NP in the normalization record for particle decays should be removed (B. Singh)

An Action was placed on T. Johnson to modify the FMTCHK code accordingly.

An extensive discussion on the issue of computer programs was triggered by F. Kondev who suggested that analysis codes should be updated in the future. J. Tuli stressed that the maintenance of the computer programs was of high priority. M. Herman suggested that an effort to rewrite these codes in a more modern programming language should be undertaken, to enable programmers and those in charge of maintenance to have better understanding of how the codes work, and therefore make sure that they run smoothly and are maintained properly. However, J. Tuli pointed out that not all the computer programs were problematic and that the effort should focus on those which were known to have problems, such as RADLIST and RULER. As a result of this discussion,

an Action was placed on J. Tuli, F. Kondev and M. Herman to continue the discussions on the issue of codes.

4.) Quality of ENSDF evaluations (F. Kondev)

F. Kondev remarked that although ENSDF evaluations are generally of good quality, there exist many which do not meet the desired standards, an unfortunate situation that cannot solely attributed to the shortfall of available evaluators. The quality of an evaluation depends on the quality of the available analysis codes and also on the existing evaluation policies, and the extent to which they are implemented. Although many good evaluation policies exist, they are often difficult to find as they do not appear in the regular NDS editions.

J. Tuli re-iterated his decision to revise the Evaluation Guidelines together with E. McCutchan with a view to present a final draft at the November 2013 USNDP meeting. With regards to the quality of evaluations and evaluators, at the current rate of completion of mass chain evaluations, he acknowledged that it was not possible to reject neither evaluators nor mass chain evaluations.

A. Nichols intervened to point out that the good quality of ENSDF evaluations is not only a matter of updating evaluation policies but of ensuring that, where necessary, there exist specific procedures that evaluators have to follow in all cases. He then presented two examples of ENSDF evaluations, one on half-lives and the other involving the γ rays, where the choice of data adopted was based solely on the most recent year of publication, without any

consideration of the various measurement procedures, data quality, and adoption of accepted evaluation procedures. J. Tuli agreed that an action should be taken to supplement the general guidelines with suggestions on specific procedures that need to be followed in certain cases.
The discussion moved on to the reviewing procedure, and how it could be speeded up and made more efficient. R. Firestone suggested that checking codes should be developed to check evaluations for obvious errors before they are forwarded to the reviewer. B. Singh added that codes should be able to check the physics contents as well as formats. J. Tuli stressed the importance of having ENSDF evaluators performing the reviews and encouraged experienced evaluators such as C. Baglin and B. Singh to continue their efforts in reviewing mass chain evaluations.

5.) The arbitrary rule of 25 for uncertainties was discussed and it was decided that an Action should be placed to relax it.

6.) An Action was placed on NNDC to modify the NDSPUB/HTML translator in order to provide more than 25 XREF symbols.

7.) Meeting RIPL needs in ENSDF (R. Firestone)
The issue of spin assignment was raised by R. Firestone who suggested that in cases where more than one possible value of J^{π} exists, evaluators should include their best-guess value or most probable values in the 2L record, in the order of maximum likelihood.

8.) Adopted relative intensities for unique γ transitions (J. Tuli)
The participants discussed the issue of relative intensities when no numerical data are given by experimentalists. J. Tuli suggested that a General Policy declaration be made, that when there is only one γ ray measured from a given level, then by definition the relative intensity (RI) in the Adopted data set should be RI=100 and that this should be accepted as a General Policy. B. Singh mentioned the two examples of high-spin level schemes and Super Deformed bands where the available experimental information is too incomplete to allow for a definite assignment of RI=100. He urged the network to continue discussions on this topic before a final decision was taken. R. Firestone added that what is actually used in nuclear reaction codes are total transition intensities rather than relative photon intensities, so that the record TI should be set to 100 rather than RI.

However, following discussions held after the meeting, participants felt that the wording that was initially was too general to be practical, and that a modified action was required to supersede the original one (see Action 65).

9.) Assignment of multipolarities (B. Singh)
B. Singh has observed inconsistencies in the assignment of multipolarities, especially for high-spin data. Specific rules exist but are not being applied. J. Tuli mentioned that there is confusion as to what should be included in the multipolarity record when E or M have not been measured. Some evaluators include D or Q whereas others are of the view that since Q is E they should include E. It was agreed that Rule 37 which deals with these issues should be revisited
An Action was placed on B. Singh and F. Kondev to revisit Rule 37, and another Action was placed on E. McCutchan and J. Tuli to include a separate section on multipolarities in the revised General Policies.

10.) Prompt particle decays from short-lived excited states (B. Singh)
Although there are many nuclides with excited states that decay by proton or α-particles, ENSDF does not provide a format to handle such cases. A suggestion to create separate data

sets for each decaying state was thought to be impractical especially for cases where there are many of these decaying states.
An Action was placed on J. Kelley and J. Tuli to look into this issue in more detail.

11.) The future of XUNDL (J. Kelley)

The importance of XUNDL in view of the effort and persons involved in its maintenance was discussed at large. It was suggested that more groups should get involved in the survey and compilation of experimental data to keep it up-to-date. Although B. Singh will continue to work on XUNDL for the next two years at least, the question of continuity and the future of the data library need to be addressed and resolved. C. Nesaraja proposed that mass-chain evaluators undertake the compilation of experimental data that fall in their mass region of interest However, as J. Tuli pointed out, this procedure could slow down the whole process of data compilation whereas the main asset of XUNDL was promptness. R. Firestone volunteered to take up part of the XUNDL work and to get his students involved, at which point J. Tuli suggested that all network members with direct access to university students, such as A. Farhan, R. Firestone, M. Gupta, A. Jain, S. Lalkovski, should explore the possibility of having their students contribute to XUNDL. B. Singh would continue to coordinate this joint activity which, for practical reasons, should involve at most two to three groups.

An Action was placed on A. Farhan, R. Firestone, M. Gupta, A. Jain, S. Lalkovski, to explore possibilities of undertaking XUNDL work with their university groups.

12.) Integrating XUNDL into ENSDF – new formats for ENSDF (R. Firestone)

J. Tuli commented that it would be very useful to have a new ENSDF file sample as basis of discussion and comment on new formats. There was general consensus that adopted levels have great importance and should be included in a new ENSDF file. However, since there are different views on what else is important and should be included, it was agreed that anyone with an opinion on this issue should distribute a sample file to the community of evaluators for discussion.
An Action was placed on R. Firestone to prepare his suggestions for the new ENSDF format and present them at USNDP meeting in November 2013.

13.) Emerging need for greater detail (and accuracy) in the derivation of Auger-electron data in nuclear medicine (A.L. Nichols)

A.L. Nichols stressed the need to evaluate the atomic and nuclear decay data of appropriate radioisotopes that possess significant Auger-electron emissions, and made reference to the Powerpoint images he had prepared for this purpose which are uploaded on the IAEA NSDD website. In these Powerpoint images he included relevant references on Auger electron data and an IAEA Report on emerging needs for nuclear medicine. He listed some of the important nuclides that either need to be re-measured or/and re-evaluated. He urged the network to consider how these atomic radiation data could be evaluated and incorporated in ENSDF.
J. Tuli explained that currently, X-ray data and Auger electrons are only included in the Comments section in ENSDF, but that there was no uniform policy on how detailed information on atomic radiation data can be provided. However, the data produced by T. Kibedi's improved atomic radiation program should be included in an easily retrievable format.

An Action was placed on A. Nichols, T. Kibedi and F. Kondev to investigate possible ways how X-ray and Auger electron data could be included in ENSDF in a retrievable format, and also how they should be evaluated and given as recommended data.

In relation to decay data in ENSDF, F. Kondev made the remark that the decay data user community often requires absolute numbers rather than relative numbers provided by ENSDF. J. Tuli replied that E. Browne had developed a program that automatically includes absolute intensities in the continuation record. F. Kondev added that RADLIST does these calculations and could be used to incorporate them in ENSDF.
An Action was placed on J. Tuli to look into possible ways of using E. Browne's program in ENSDF.

14.) Information on genetic feeding in ENSDF (R. Firestone)
R. Firestone proposed that the relative intensities of genetic feeding of isomeric states with respect to ground states should be calculated by looking at level balancing and then incorporated in the decay data set. G. Audi mentioned that they had incorporated these feedings into a prior NUBASE version and that this information could possibly be retrieved.

An ACTION was placed on R. Firestone to investigate possible ways to include this information in ENSDF.

15.) New ENSDF formats (XML) (D. Abriola)
D. Abriola pointed out that two groups need to get involved in the discussions about new formats and codes for ENSDF, namely expert programmers and experienced evaluators, to ensure both that the new proposed formats will accommodate all the detailed experimental and evaluation information stored in ENSDF in a convenient and user-friendly way and that the transition from old to new format will be smooth. R. Firestone mentioned that there is a contract with LLNL to work on this project, and that both BNL and IAEA should participate in this effort. M. Herman remarked that the Network should take advantage of the experience of the ENDF community and suggested a coordinated effort of both ENDF and ENSDF communities to ensure a transition to more generic and open data libraries with emphasis not only on the language but also on the structure. The aim should not be a mere translation of current format into XML, but an expansion of usability and flexibility. B. Singh expressed his concerns whether moving to a new format would also require changing the analysis codes. In reply, M. Herman mentioned that interface programs reading and translating information from ENDF/ENSDF to XML format and vice versa would be developed in the beginning to ensure a smooth transition. R. Firestone added that LLNL had a greater plan to combine both ENDF and ENSDF files into a new XML file. A. Nichols advised that if that were indeed the case, WPEC/CSEWG should first finalize their proposals and recommendations before the IAEA and/or BNL followed-up with specific actions.
An Action was placed on R. Firestone to contact LLNL and report back to the network on the status of this project. IAEA and BNL should be involved in this.

16.) NSDD Evaluation in Europe: what should be done (A.L. Nichols)
A. Nichols pointed out that it would be to the network's benefit if the IAEA could assist the European members in meeting with key players in EU funding policies to determine the best way to get EU funding.
An Action was placed on D. Balabanski and NDS-IAEA to explore possible ways of acquiring EU funds for NSDD evaluation.

17.) Need for a separate database for Radioactive Isotopes derived from ENSDF for the benefit of applied users/researchers (B. Singh)
The need of a separate database for Radioactivity data that would be easy to find and retrieve, and not as overloaded with information as ENSDF, NUDAT or LiveChart, was proposed by B. Singh. Participants discussed whether this was only a matter of adapting the retrieval system and making several options available for dealing with radioactive isotopes, or whether

a separate database was really needed. It was pointed out that a new database would require maintenance and concerns were expressed whether a new simpler database would be actually used.
An Action was placed on NNDC and NDS-IAEA to explore whether retrieval of decay only data could be made simpler in NuDat and LiveChart. It was also proposed that LiveChart be updated on a more frequent schedule.

18.) Data on photon strengths and need for an evaluated database (R. Firestone, S. Siem)

The importance of photon strength functions for different applications combined with the emergence of high-quality data measured at different laboratories and with different methods suggests the need of generating a reference database of measured and evaluated data. This conclusion was drawn from the lengthy discussions and it was agreed that a consultant's meeting should be held at the IAEA to discuss the details of such a joint effort.
An Action was placed on R. Firestone, S. Siem and the NDS-IAEA to hold a CM to discuss the generation of a database for γ-ray data, and to report to the network in two years.

19.) Analysis codes (J. Tuli)

J. Tuli presented Tables 1 and 2 with the various analysis/utility codes and their present status. T. Johnson has added a column to indicate whether the codes run on MACINTOSH platform as well.

TABLE 1. PRESENT STATUS OF ANALYSIS CODES

Analysis Codes									
Code	**Function**		**Version No./Date**	**FORTRAN**					**Documentation**
				ANS[a]	**DVF**[b]	**MacOS**[f]	**UNX**[d]		
							Linux	**UNIX**	
ALPHAD	Calculates α R_0's, HF's and theoretical $T_{½}(\alpha)$'s		2.0a 20061106	X	X		X		No (See "Read Me" file)
BrIcc	Calculates internal conversion coefficients, internal electron-positron pair formation coefficients, and E0 electronic form factors.		2.3 20130628		X[e]	X[eg]	X[ef]	X[eg]	Yes
DELTA	Analyzes angular correlation data.		1.01 19930415	X	X		X[h]		LUNFD/(NFFR-3048) 1-27
GABS	Calculates absolute ΔI_γ's.		9.2 20010207	X	X		X[h]		Yes
GTOL	Determines level energies from a least-squares fit to E_γ's & feedings.		7.2h 20130524	X	X		X		BNL-NCS-23375/R LUNFD/(NFFR-3049) 1-27
HSICC	Interpolates internal conversion coefficients		11.13f 20011009	X	X		X[h]		Nucl. Data A4, 1 Nucl. Data Tables A6, 235 Nucl. Data Tables A9, 119 BNL-NCS-23375/R (1977)
LOGFT	Calculates log *ft*.		7.2a 20010220	X	X		X[h]		Nucl. Data Tables A10, 206 BNL-NCS-23375/R (1977)
NSDFLIB	Support subprograms for many codes	FORTRAN77	1.5d 19990628	-					No
		FORTRAN95	1.7a 20120612	-	X		X		Yes
PANDORA	Physics check of ENSDF data sets. Aids with adopted gammas & XREF.		7.1 20120517		X		X		Yes
RadList	Calculates atomic & nuclear radiations. Checks energy balance.		5.5 19881005	X	X				BNL-NCS-52142
RULER	Calculates reduced transition probabilities.		3.2a 20070806	X	X		X		Yes

a ANSI-standard FORTRAN 95, except as noted
b Compaq/Digital Visual Fortran (Win9x/ME/NT/2000/XP)
c OpenVMS Fortran, except as noted
d Lahey/Fujitsu FORTRAN 95, except as noted

e Only executables are available

f INTEL FORTRAN 90
g Digital FORTRAN 90
h Linux GNU f77 Fortran

TABLE 2. PRESENT STATUS OF UTILITY CODES

Utility Codes							
Code	**Function**	**Version No./Date**	**FORTRAN**				**Documentation**
			ANS[a]	**DVF**[b]	**MacOS**	**UNX**[d]	
ADDGAM	Adds gammas to adopted data set.	1.4 20010207	X[e]	X		X[f]	No (See "Read Me" file)
COMTRANS	Converts the text comments of an ENSDF dataset to a "rich text format"	7.1 20031124		X[g]		X[g]	No (See "Read Me" file)
ENSDAT	Produces tables and drawings	12.19 20070501		X[g]		X[g]	No (See "Read Me" file)
FMTCHK	ENSDF format checking	10.4a 20130628	X	X		X	No (See "Read Me" PDF or "Read Me" in HTML)
NSDFLIB	Support subprograms for many codes	See above					
TREND	Tabular display of ENSDF data.	8.3 20010207	X[e]	X		X[f]	No (See "Read Me" file)

a ANSI-standard FORTRAN 95, except as noted
b Compaq/Digital Visual Fortran (Win9x/ME/NT/2000/XP)
c OpenVMS Fortran
d Lahey/Fujitsu FORTRAN 95, except as noted
e ANSI-standard FORTRAN 77
f Linux GNU f77 Fortran
g Only the executables are available

B. Singh pointed out that some ENSDF and XUNDL files had problems in the html translation. Further discussion on the need to update the analysis codes followed. It was also mentioned that the EVP editor (A. Sonzogni) was available upon request whereas the AVERAGING program (I. Mitropolski) was no longer available on the NNDC website as it was incompatible with platforms commonly used by NSDD evaluators. Finally it was remarked that as there were plans to move to an XML format, the analysis codes would have to be revisited eventually.

20.) Tracking history of ENSDF evaluations

There was discussion on how to make known ENSDF file updates that do not get published in Nuclear Data Sheets. J. Kelley proposed publishing a one page abstract about the update in NDS, which was however, not adopted amid concerns that the reader would get confused when looking for published data and finding only an abstract. The alternative of putting the pre-publication version of the evaluation on the web was also not accepted.

An Action was placed on J. Tuli to consult with Elsevier on whether to put ENSDF index on their website.

9. RECOMMENDATIONS AND CONCLUSIONS

The twentieth meeting of the IAEA network of Nuclear Structure and Decay Data evaluators, held in Kuwait City, Kuwait, was graciously hosted by the Kuwait Foundation for the Advancement of Sciences and the Physics Department, University of Kuwait. The meeting was attended by 36 participants from 17 countries, and was devoted to a wide range of administrative and technical issues. All ENSDF data centers presented status reports on their relevant activities, and a few additional guests not part of the NSDD network also presented information related to their research interests.

It was re-emphasized that keeping ENSDF up to date was the main task and the top priority for this network. The ENSDF database and its derivatives serve its users adequately only if they are kept reasonably current. A recycle time of up to ten years for the file would be recommendable. In order to achieve that it was estimated that at the very least about 25 mass-chain evaluations should be renewed in a year. This would require a minimum of about dozen (FTE) evaluators.

Although there is important contribution from European and Asian countries, mostly the evaluation responsibility is shouldered by the US and, soon to be terminated, Canadian efforts. The IAEA is supporting evaluation activities in developing countries. In view of the limited budget, it is unlikely that new evaluators will be recruited, therefore existing evaluators were urged to contribute more towards updating ENSDF.

Recent publication of latest atomic mass adjustments under leadership of G. Audi was appreciated.

Further steps to assure the quality and completeness of the databases were taken and a detailed list of actions was produced covering the time up to the next Network meeting in 2015. Technical improvements to facilitate the work of evaluators were discussed with special emphasis on improving and maintaining the analysis codes. The need to provide evaluators with updated guidelines was recognized and E. McCutchan and J. Tuli were assigned the task of revising the current guidelines.

The dedicated biennial IAEA/ICTP workshops held at ICTP, Trieste, Italy, were acknowledged to be useful. However, it was also recognized that there is an emerging need for specialized refresher workshops for improving existing evaluators' skills and techniques.

The 21st Technical Meeting of the International Network of Nuclear Structure and Decay Data Evaluators will be held at the IAEA Headquarters in Vienna, Austria in spring 2015.

ANNEXES

20th Meeting of the Nuclear Structure and Decay Data (NSDD) Network
27 – 31 January 2013
Kuwait Foundation for the Advancement of Sciences (KFAS)
Safat, Kuwait

ADOPTED AGENDA

Sunday, 27 January

10:00-12:00 **Opening of the 20th IAEA NSDD Meeting, Welcome and Introduction (Hamed Al-Essa Auditorium at KFAS)**

- Dr. Ameenah Farhan, Kuwait University/KFAS
- Dr. Adnan Shihab-Eldin, Director General, KFAS
- Dr. Daniel Abriola, IAEA-NDS
- Dr. Balraj Singh, McMaster Univ.: Brief history of Kuwait Nuclear Data Project

REFRESHMENT BREAK (Ground Floor Lobby)

NOTE: ALL MEETING SESSIONS BELOW WILL BE HELD IN THE **KUWAIT HALL** – **2nd FlOOR.**
Lunches and Coffee Breaks will be on 2nd Floor Lobby.

12:00-12:30 **Chairman Election and Agenda**

- Election of Chairman and Rapporteur
- Adoption of Agenda (Chairman)

12:30-14:00 *Lunch*

14:00-15:30 **Actions from Previous NSDD Meetings**

- List of Actions (carry over from NSDD-2011)
- Others

15:30-16:15 **Reports by Evaluation Centers about NSDD activities**
(all centers – 10-mins each)

NNDC, USA
IAEA-NDS
ORNL, USA
LBNL, USA

16:15-16:30 *Coffee Break*

16:30-17:45 **Reports by Evaluation Centers (cont'd)**

TUNL, USA
ANL, USA
McMaster, Canada
JAEA, Japan
Jilin University, China

Monday, 28 January

09:00-10:45 **Reports by Evaluation Centers (cont'd)**

IIT, Roorkee, India
Manipal University, India
ANU, Australia
Nuclear Data Project, Kuwait
Nuclear Physics Institute, Hungary
CEN, France

10:45-11:00 *Coffee Break*

11:00-12:30 **Meetings, Workshops, Trainings and Other Activities**

- Report on the IAEA Nuclear Data Programme (Abriola)
  - ICTP-IAEA workshop on NSDD, 6-17 August 2012
- Report on NDS Determination of Nuclear Data Needs in Nuclear Medicine (2008-2012), and CRP on Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production (Nichols)
- New evaluation centers/new evaluators (Tuli)
  - Status of new evaluation centers/new evaluators
  - European effort (Balabanski)
- New groups
  - Tandem collaboration to measure and evaluate actinide capture γ-ray data (Rossbach)

12:30-14:00 *Lunch*

14:00-16:15 **Data Bases**

- ENSDF Status (Tuli)
- XUNDL (Singh)
- LiveChart (Abriola)

16:15-16:30 *Coffee Break*

16:30-17:30 **Organisational Review (Tuli)**

- Activities, priorities and manpower
  - Summary of ENSDF evaluations status and activities 2011-2012
  - Revision of NSDD membership
  - Estimated manpower of each centre for ENSDF evaluations
  - Future evaluations: priorities
- Re-definition of responsibilities of current groups
- Preliminary mass assignments to new groups
- Network computer programs

Tuesday, 29 January

09:00-10:45 Technical presentations (~ 20 min each)

1. β-n decay probability systematic (McCutchan)
2. Report of Jordanian Nuclear Program (AbuSaleem)
3. ^{119m}Sn - A difficult experimental case to test internal-conversion theory (Nica)
4. Development of the new code to evaluate atomic radiations in nuclear decay to incorporate atomic data into ENSDF (Kibedi)
5. Nuclear data for level density and photon strengths (Siem)

10:45-11:00 *Coffee Break*

11:00-12:30 Technical presentations (cont'd)

6. TAG measurements at VECC (Mukherjee)
7. Anti-neutrino spectrum from nuclear reactors (McCutchan)
8. ^{139}Ba decay: precise half-life measurement and gamma spectroscopy at BARC (Joshi)

12:30-14:00 *Lunch*

14:00-16:15 Technical presentations (cont'd)

9. The RoSphere array at the Tandem accelerator of IFIN-HH (Negret)
10. Test of the visual average program (Blachot)
11. A survey of isobaric analogue states in NUBASE2012 (MacCormick)
12. Progress in the isomer project (Jain)

16:15-16:30 *Coffee Break*

16**:30-17:30 Horizontal Evaluations, including Needs and Plans (~ 20 min each, if not indicated otherwise)**

13. Report on update of the Combined Reference Table of Nuclear Magnetic Dipole and Electric Quadrupole Moments and interim Report on the new Table of Recommended Electric Quadrupole Moments (Stone,45 min.)
14. The AME and Nubase evaluation: present and future (Wang)

18:30-20:30 VISIT TO THE SCIENTIFIC CENTER KUWAIT (TSCK)

Wednesday, 30 January

09:00-10:45 Horizontal Evaluations, including Needs and Plans (cont'd)

15. Status of EGAF evaluation (Firestone)
16. Beta-delayed neutrons: McMaster +IAEA + BNL + GSI (Singh)
17. B(E2) for first 2+ states in e-e nuclei: BNL + McMaster + Central Michigan (Singh)

10:45-11:00 *Coffee Break*

11:00-12:30 Round Table: Technical Discussions

12:30-14:00 *Lunch*

14:00-16:15 Round Table: Technical Discussions (Cont'd)

16:15-16:30 *Coffee Break*

16:15-17:30 Recommendations and Actions: round table discussion (cont'd)

19:30 COMMON DINNER at the ASSAHA (Lebanese Traditional Village)

Thursday, 31 January

09:00-10:45 Recommendations and Actions: drafting of list

- Adoption of recommendations and actions

10:45-11:00 *Coffee Break*

11:00-13:00 Recommendations and Actions: drafting of list (contd.)

- Adoption of recommendations and actions (contd.)
- NSDD chairman
- Next meeting
- Adjournment

ANNEX 2

LIST OF CONTINUOUS, NEW AND COMPLETED ACTIONS

As of 31/01/2013

CONTINUOUS / ONGOING / PENDING			
No.	**Responsible**	**Reason**	**Action**
1 (1)	Tuli, BNL/NNDC and all Network participants	Keep horizontal evaluations in separate repository, to be used by evaluators.	Task for all: inform Tuli who will maintain a list of horizontal evaluations on NNDC-NSDD Web site. **Continuous**
2 (2)	BNL/NNDC	ENSDF analysis and checking codes need to remain up to date with respect to formats, physics requirements, and the needs of the community.	Update codes for approved format changes. **Continuous**
3 (3)	All Network participants	Highly-relevant information and data from some conferences, meetings and laboratory reports are not always available to NSR compilers in NNDC.	Assist NNDC in obtaining conference proceedings, meeting and laboratory reports for NSR. Copy of unpublished conference reports containing significant NSDD contribution should be sent to NNDC. **Continuous**
4 (4)	NDS-IAEA	Maintain up to date information on the Network.	Review, modify and correct the contents of INDC(NDS)-421. **Continuous**
5 (5)	BNL/NNDC	Published versions of ENSDF are required.	Continue journal "publication" of the mass chain evaluations. **Continuous**
6 (6)	All Network participants	Misprints and errors found in NSR and ENSDF.	Report errors detected in NSR, XUNDL and ENSDF to NNDC. **Continuous**
7 (7)	All ENSDF evaluators	Accelerate the review process.	Each ENSDF evaluator should be willing to do two mass-chains equivalent reviews per FTE-year. Reviewing process for one mass chain should not be longer than three months. **Continuous**
8 (8)	All network participants	Bring NSDD evaluation work to the attention of the nuclear community.	Present network activities at different conferences and meetings. **Continuous**
9 (9)	All Network participants	Avoid duplication of work.	Participants should inform the NNDC about any development of software related to NSDD. **Continuous**
10 (10)	Evaluators	Young scientists to evaluate mass chains.	Encourage participation in research/evaluation of nuclear structure data. **Continuous**

N.B.: In the first column, numbers in brackets indicate the previous action number (see INDC(NDS)-595).

CONTINUOUS / ONGOING / PENDING (Cont'd)			
No.	**Responsible**	**Reason**	**Action**
11 (11)	All Network participants	Improve NSR	Send comments and suggestions on NSR improvements (indexing) to NNDC. **Continuous**
12 (12)	All ENSDF evaluators	Check validity of the rules.	Inform NNDC when experimental results appear to contradict the rules. **Continuous**
13 (13)	All Network participants	Improve quality of evaluations.	Solicit potential non-network evaluation reviewers, and send names to ENSDF manager (NNDC). **Continuous**
14 (14)	NSDD Network	Support new ENSDF evaluators.	Provide local support and mentoring to new ENSDF evaluators of mass chain evaluations. **Continuous**
15 (16)	BNL/NNDC; IAEA-NDS	Outreach	Continue to pursue initiatives to improve the international contributions to the ENSDF mass chain evaluations. **Continuous**
16 (17)	All Network participants	Outreach	Formulate and expand contributions to mass chain evaluations within their own countries. **Continuous**
17 (18)	IAEA-NDS	Keep links with horizontal evaluations.	Invite representatives of atomic mass and other horizontal evaluations to next meeting. **Continuous**
18 (19)	NSDD evaluators	Quality Assurance *Recommendation*	Consider updating the evaluation cut-off date when no or little experimentally significant new data are available. **Continuous**
19 (20)	Tuli, BNL/NNDC	Facilitate evaluators' work.	Analyze Nica's proposal to modify PANDORA. **Ongoing**
20 (23)	All evaluators	Evaluations in progress *Recommendation*	Inform J. Tuli about mass chain evaluations in progress to be included in monthly processing report
21 (24)	NSR manager	Assignment of key numbers	Evaluators will be required to immediately send the relevant reference/article to NNDC. **Continuous**
22 (25)	NSR manager	Assignment of key numbers *Recommendation*	The keyword requirement for evaluators should be optional, however, it should be encouraged as it is valuable information. **Continuous**
23 (26)	BNL/NNDC	Hard-to-get references	Investigate digitizing of secondary references which are hard to get. Private communications are already scanned. **Continuous**

N.B.: In the first column, numbers in brackets indicate the previous action number (see INDC(NDS)-595).

CONTINUOUS / ONGOING / PENDING (Cont'd)			
No.	**Responsible**	**Reason**	**Action**
24 (28)	Firestone	ENSDF into XML	Look into possibilities of working with LLNL and report to network. (see Action 57) **Continuous**
25 (30)	Kibedi	Mixing ratio for E0, E2, M1.	Suggest changes to format in order to define mixing ratios. **In progress**
26 (31)	Sonzogni	Improve data that quantify continuum beta spectra.	Develop and recommend analysis codes to provide more detailed presentations of continuum beta spectra. **In progress**
27 (31)	Kibedi	Improve data that quantify Auger electrons.	Develop and recommend analysis codes to provide more detailed presentations of Auger electrons. **In progress**
28 (41)	Singh, Baglin, Browne, Kondev, Timor, Sonzogni, Tuli, Abriola	Guidelines	Revise evaluators' guidelines. **To be continued by Tuli and McCutchan in consultation with Murray Martin and other evaluators.**
29 (42)	Network	Policies	Point out to NNDC discrepancies in the current policies and propose changes and additions. **Continuous**
30 (43)	NNDC	Analysis codes	Notify Network of new versions. **Continuous**
31 (47)	NNDC	General policy pages in NDS.	Modify them as needed. **Continuous**
32 (48)	Firestone	Thermal neutron capture gammas.	Suggest procedure for inclusion of capture gamma intensities in adopted levels. **Ongoing**
33 (50)	NDS-IAEA	Training of evaluators	Explore if there is need for additional training workshops. **Continuous**

N.B.: In the first column, numbers in brackets indicate the previous action number (see INDC(NDS)-595).

NEW 2013			
No.	**Responsible**	**Reason**	**Action**
34	NDS-IAEA/NNDC	Keep all information relevant to ENSDF available to network members	Keep network website updated-make talks available **Continuous**
35	NDS-IAEA/NNDC	Make newly evaluated nuclear moments (2011) available to all evaluators	Make updated evaluated nuclear moments file available on network website. **Continuous**
36	NNDC	Maintain up-to-date information on Network	Update website with the new group responsibilities
37	Sonzogni	Update codes	Incorporate AME 2012 into QCALC
38	Kondev	Update NSR with missing references on decay data	Contact M.-M. Bé and ask for list of references for nuclides that are included in the DDEP database but are not in NSR
39	NNDC	Maintain analysis codes up to date	Update all analysis codes that use masses to include AME 2012
40	All Evaluators/ Kibedi	Determination of mixing ratios from available experimental information/Improve calculations of mixing ratios	In cases where penetration effect plays a role recalculate mixing ratios from experimental information rather than Bricc Conversion Coefficients. In cases where mixing ratios in the file were based on HSICC those should be recalculated using BRICC. A new version of BRICC code for mixing ratio calculations is in works by Kibedi who will also look into how penetration effects can be incorporated, where relevant.
41	NDS-IAEA	Russian and Chinese Data Centers reports	D. Abriola should contact NSDD representatives of Russia and the Chinese Nuclear Data Center to clarify status of evaluation effort and participation in next meeting
42	All evaluators	Assignment of spin	In cases of uncertain JP, evaluators should assign up to three values in order of preference or should insert best-guess or theoretical spin value in 2L record
43	NNDC/ Johnson	Implementation of action 42 in FMTCHK	Modify FMTCHK to read continuation record containing JP estimates
44	Singh, Nichols	Evaluation of half-lives	Revise and distribute the final version of guidelines for evaluation of half-lives for ground states and long-lived isomers

NEW 2013 (Cont'd)			
No.	**Responsible**	**Reason**	**Action**
45	NNDC/ Johnson	Policy implementation	Modify FMTCHK to take into account new policy that BR=NP is not needed
46	NNDC/ Johnson	Format	Update list of element names
47	Kondev, Herman, Tuli	Maintaining and updating codes	Evaluate status of analysis codes and determine priorities as to which codes should be re-written or corrected.
48	BNL-NNDC	Format	Look into modifying NDSPUB/HTML translator for cases with >26 XREF symbols
49	Singh, Kondev, Tuli	Policy	Revisit Rule 37
50	NNDC/ Tuli, McCutchan	General Guidelines	Include separate section on multipolarity assignment in the guidelines
51	Kelley, Tuli	Prompt particle decays from short-lived excited states	Explore method and format to include particle decays from excited states in ENSDF
52	Network	Ensure sustainability of XUNDL effort	Network participants with direct access to undergraduate students should explore possible ways of getting involved in the XUNDL effort and contact B. Singh
53	Singh	Facilitate conversion of published data tables to ENSDF format	Provide NNDC with procedure and computer code to translate tabular text to ENSDF format
54	Kibedi, Nichols, Kondev	Emerging need for inclusion of X-ray and other atomic data in decay datasets	Suggest possible ways to include atomic radiation data in ENSDF so that they are easily retrievable
55	NNDC/Tuli	Absolute intensities	Look into E. Browne's absolute intensity program and possible ways to incorporate it into ENSDF
56	Firestone	ENSDF	Suggest way of introducing genetic feeding in decay data into ENSDF
57	Firestone	ENSDF format	Prepare suggestions for new ENSDF format; liaise with IAEA
58	Balabanski/ NDS-IAEA	European Evaluators	Explore ways to acquire funding from the EU with the assistance of NDS-IAEA
59	NNDC-IAEA	Applied users/researchers are interested in retrieving decay data sets only	Look into making decay-only retrieval mode user friendly

NEW 2013 (Cont'd)			
No.	**Responsible**	**Reason**	**Action**
60	Firestone-Univ.Oslo-NDS-IAEA	Database of γ-ray data	Hold a Consultant's Meeting to explore need for database of photon strength functions and report in two years
61	BNL-NNDC/ Tuli	Make status of updates in mass chain evaluations readily available	Request ELSEVIER and NNDC to include a copy of Nuclear Data Sheets Index page on their website every month
62	NDS-IAEA	Improve Tools	Include the possibility of displaying genetic relationships in LiveChart (already present in graphical form) in tabular form. Keep improving LiveChart.
63	All Evaluators	To keep ENSDF up-to-date *Recommendation*	Check NNDC monthly report for nuclides added to ENSDF by others that are in your mass-chain responsibility.
64	All Evaluators	*Recommendation*	Rule 25 should be used optionally
65	All Evaluators	Blank records in particular for unique gamma transitions intensity record problematic for ENSDF users	Unique γ transitions are to be assigned intensity of 100% However, following discussions held after the meeting, participants felt that the above wording was too general to be practical, and suggested the following action, to supersede the original one: For a low-lying and generally low-spin level depopulated by a single definite gamma transition, give 100 for relative photon branching ratio (in RI field of Gamma record) in ENSDF Adopted dataset; total conversion coefficient for such a transition should be given if expected to be significant together with known or assumed multipolarity and mixing ratio. Low-lying levels are implied as typically first 30 or so for even-even, and first 15 or so for odd-even and odd-odd nuclei. Exceptions to this rule must be clearly noted and explained.
66	NSR Manager	To ensure consistency of keynumber assignments in NSR database	Keynumber for AME 2012 publication is 2012Wa38. DOI numbers should be provided in NSR database.

COMPLETED			
No.	**Responsible**	**Reason**	**Action**
1 (15)	Shulyak, PNPI	To facilitate evaluators' work.	Provide copy of PNPI Editor, when finished to the Network to evaluate. **Withdrawn**
2 (21)	Tuli, BNL/NNDC	Improve ENSDF to make useful to RIPL community.	Analyze Firestone proposal to include theoretical Jπ in square brackets in Jπ field or a continuation record. Advise evaluators in cases where more than one Jπ value in brackets – preferred value should be listed first (as requested by RIPL community). **Partly withdrawn (see Action 42 and 43)**
3 (22)	NNDC	Set Priority	Consider New criteria based on XUNDL, NSR to create priority list. **Redundant/Withdrawn**
4 (24)	NSR manager	Assignment of key numbers	Evaluators should be able to create key numbers remotely. **Withdrawn**
5 (27)	NNDC	XUNDL compilation date	Expand XUNDL index to show compilation date by nuclide. **Completed**
6 (29)	Kibedi	Calculate conversion coefficients. *Recommendation*	Mixing ratio default to be determined statistically or by evaluator, in either case comments should appear. **Completed**
7 (32)	Network	New production code for Nuclear Data Sheets.	Provide comments to B. Singh based on two mass chains (A=40, A=182) put on the web soon. **Completed**
8 (33)	NNDC	Checking code *Recommendation*	Download Mitropolski's code and incorporate into FMTCHK. **Withdrawn**
9 (34)	All evaluators	Atomic masses *Recommendation*	Use 2011AuZZ masses and quote 2003Au03 in a comment. **Completed**
10 (35)	Audi	Atomic masses	Provide 2011 evaluation to NNDC by end of April 2011. **Completed**
11 (36)	Evaluators	BE2 compilation	Comments and feedback on the presentation and the paper attached to B. Prytichenko. **Completed**
12 (37)	All	Masses *Recommendation*	To get masses for new nuclides communicate directly with AMDC. **Withdrawn**
13 (38)	Evaluators	Moments *Recommendation*	Use N. Stone's 2011 evaluation after key number is assigned. **Completed**

N.B.: In the first column, numbers in brackets indicate the previous action number (see INDC(NDS)-595).

COMPLETED (Cont'd)			
No.	**Responsible**	**Reason**	**Action**
14 (39)	All	Half-life evaluations of ground state and isomers.	Provide comments on the draft recommendations by Sept 2011 to B. Singh. **Withdrawn**
15 (40)	NNDC/IAEA	Remote access	Develop a web interface for ENSDF utility codes to be run remotely. **Completed**
16 (44)	Evaluators	Isomer definition *Recommendation*	Isomer half-life limit is changed to greater than 100 ns. **Completed**
17 (45)	Evaluators	Charged-particle resonance data *Recommendation*	Adopt new policies and guidelines. **Completed**
18 (46)	Evaluators	Neutron capture gammas *Recommendation*	Include primary gammas in adopted levels. **Completed**
19 (49)	Network	ND 2013	Consider attending and presentation of your work. **Completed**
20 (51)	NDS/Abriola	Improvement of dissemination tools.	Continue to improve tools. Stage **Completed (for new work see Action 62)**

N.B.: In the first column, numbers in brackets indicate the previous action number (see INDC(NDS)-595).

20th Meeting of the *International Network of Nuclear Structure and Decay Data Evaluators*

27 – 31 January 2013
Kuwait Foundation for the Advancement of Sciences (KFAS),
Safat, Kuwait

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4. GROUP PICTURE

EVALUATION RESPONSIBILITIES: ENSDF DATA EVALUATION CENTRES

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A-Chain Evaluation Responsibility 2011-1012

Center	Mass Chains
a. US/NNDC (ex83),	45-50,57,58, 60-73(ex 62-64, 67),82-88 94-97,99,118,119,136-148,150, 152-165 (ex 164), 180-183, 185, 189, 230-240,>249
b. US/NDP	241-249
c. US/LBNL	21-30,59,81,83,90-93,166-171,184,186,187, 191-193,210-217
d. US/TUNL	2-20
e. US/ANL	106-112,176-179,199-209
f. India	218-229
g. Russia/StP	130-135,146
h. PRC	51-56,62,63,67, 195-198
i. France	113-117
j. Japan	120-129
k. Kuwait	74-80
l. Canada	1,31-44,64,89,98,100,149, 151,164,188,190,194
m. Australia	172-175
n. Hungary	101-105

ANNEX 6

STATUS REPORTS OF EVALUATION CENTRES

REPORT ON THE NNDC (BNL) AND US NUCLEAR DATA PROGRAM

(M. Herman)

The USNDP consists of seven national laboratories (ANL, BNL, LANL, LLNL, LBNL, NIST and ORNL) and McMaster University, and TUNL. The USNDP program includes nuclear structure and decay data (ANL, BNL, LBNL, ORNL, McMaster University, and TUNL) as well as nuclear reactions (BNL, LANL, LLNL, and NIST). The present report focuses on the structure part of the NNDC and USNDP activities.

While approaching retirements and recruiting new qualified staff was a primary concern over recent years the major challenge for future will be funding. The staff situation, at the moment, is quite satisfactory in all Labs. The NNDC has successfully completed generation turnover and is well positioned for new challenges in both areas (structure and reactions). This passage is still ahead for LBNL, while the situation has stabilized at ORNL. In summary, although a few retirements are expected, the continuity of the expertise in the field of structure and decay data evaluation does not seem to be endangered by lack of young evaluators. Financial situation of NNDC and USNDP in fiscal year 2013 does not raise major concerns due to the ARRA funding that supported the program during recent three years. In fiscal year 2014, however, funding will not be sufficient to cover the current scope of the program and serious cuts might be unavoidable.

A slight decline in the number of nuclear data retrievals from the USNDP servers was recorded. While the decrease is modest, it was for the first time the increasing tendency was reversed. There are objective reasons that could be invoked to explain the decrease but one cannot exclude the possibility that current Web services are in need of structural upgrade.

Compilation activities of the USNDP were very stable over last three years with ~3800 NSR entries per year (about 2/3 key-worded). The NNDC ENSDF evaluations in the reported period include 14 mass chains (168 nuclides), including 2 mass chains evaluated in collaboration.

Several important nuclear reaction highlights should be reported in FY2012: (i) release of ENDF/B-VII.1 (Dec. 2011) with the new decay data sub-library based on ENSDF, (ii) release of covariance library COMMARA-2.0 extensively using the EMPIRE code, (iii) release of the EMPIRE-3.1 (Rivoli) with massive use of ENSDF, (iv) proposed new XML data structure to replace ENDF-6 format that opens a possibility of closer integration of reaction and structure libraries. It is remarkable that all these advancements include substantial contribution from ENSDF.

The NNDC has undertaken a state of the art modeling of antineutrino spectra, which represents direct use of ENSDF in fundamental physics experiment (neutrino oscillations). The NNDC staff had proposed and took part in nuclear data measurements performed at CARIBU and MSU. This is the important novelty in the NNDC operation, which brings evaluators into direct contact with the experiment allowing to carry out measurements in direct support of the evaluation.

NNDC continues to publish the Nuclear Data Sheets, with December issues dedicated to nuclear reactions. Although formally 12 issues were published each year some issues were integrated into a single volume reflecting the decreased amount of mass chains submitted for publication.

The new version of Wallet Cards has been released in 2012. The related Android application, the first modern mobile app produced by the USNDP, was developed at the NNDC.

The NNDC has been preparing the ND2013 Conference to be held in New York City 4-8 March 2013. Herman reported on the status of the preparations and presented statistics of the registrations. It shows strong overall interest (660 registrations). Particularly, numerous registrations come from the European Union (230) and Asia (160) with the Americas (150) being in the third position.

IAEA STATUS REPORT, 2011-2012

(D. Abriola)

Three staff members are engaged in activities related to NSDD: M. Verpelli is in charge of creating tools to search and visualize ENSDF data, D. Abriola is in charge of developing NSDD-related databases and Coordinated Research Projects, organizing training workshops and doing mass chain evaluations and, since mid-2012, P. Dimitriou has also been involved in mass chain evaluations and CRP organization.

Tools to search and visualize ENSDF

The software tool LiveChart parses and transforms the ENSDF adopted levels and gamma datasets into a relational database. During the 2011-2012 period the decay datasets were also included. Plotting capabilities were expanded. For the next period the XUNDL files will be processed as well.

ENSDF mass chain evaluations

D. Abriola: update of most neutron deficient nuclides of A=148 (collaboration with B. Singh).
Mass chain A=211 as an exercise of the IAEA-ICTP ENSDF workshop.
Mass chain A=215 as an exercise of the VECC (Kolkata) ENSDD-2012 workshop.
D. Abriola: Mass chain A=144 (collaboration with A. Sonzogni) to be submitted for review.

Training

Joint IAEA-ICTP Workshop "Nuclear Structure and Decay Data: Theory and Evaluation", ICTP, Trieste, 6-17 August 2012, Directors: J.K. Tuli, D. Abriola.
ENSDD-2012 Workshop, VECC, Kolkata, 26-29 November 2012.

STATUS REPORT OF NUCLEAR DATA ACTIVITIES AT OAK RIDGE NATIONAL LABORATORY

(M. Smith/C. Nesaraja)

1. Members

The Nuclear Data Group consists of M. Smith (Group Leader of Experimental Astrophysics & Nuclear Data Program), C. Nesaraja (ENSDF evaluator), M. Martin (ENSDF evaluator and consultant) and E. Lingerfelt (Software Developer).

2. Activities

i) Nuclear Structure Data

This activity consists of the mass chain evaluations, and our responsibility is in the actinide region A=241-249. Currently the literature cutoff dates for mass chain A=241-249 are listed below:

Mass Chain and Literature cut of dates from ENSDF database
241 M.J. Martin. NDS 106, 89 (2005) (Lit cut-off June, 2005)
242 Y. A. Akovali. NDS 96, 177 (2002) (Lit cut-off Sept., 2001)
243 Y. A. Akovali. NDS 103, 515 (2004) (Lit cut-off March, 2004)
244 Y. A. Akovali. NDS 99, 197 (2003) (Lit cut-off June, 2002)
245 E. Browne & J.K. Tuli . NDS 112,447 (2011) (Lit cut-off June, 2011)
246 E. Browne & J.K. Tuli. NDS 112,447 (2011)(Lit cut off Jan 2011)
247 Y. A. Akovali. NDS 102, 515 (2004) Lit cut-off August, 2003)
248 Y. A. Akovali. NDS 87, 249 (1998) (Lit cut-off July, 1998)
249 Khalifeh Abusalem. NDS 112, 2129 (2011) (Lit cut-off Dec, 1998)

Since the last NSDD meeting in 2011, several mass chains are being evaluated and are in their various stages of evaluation process as shown below.

Mass Chain	Evaluator	#Nuclides	#Pages	Status
152	Martin	17	373	Post Review
69	Nesaraja	12	172	Post Review
248	Martin	7	?	Under Evaluation
247	Nesaraja	8	40	Pre Review

Both M. Martin and C. Nesaraja are also reviewing mass chains as requested by the National Nuclear Data Center.

ii) Nuclear Astrophysics Data

The astrophysics data research is closely coupled with our program of measurements of reactions with unstable and stable nuclei. One recent example of such work, Shisheng Zhang, a guest visitor from Beihang Univ. in Beijing collaborated with Michael Smith and others to calculate the single-particle bound and resonant levels for ^{131,133}Sn. Zhang used the analytical continuation of the coupling constant (ACCC) method based on a relativistic mean field (RMF) theory with BCS pairing approximation for these calculations. The RMF+ACCC+BCS model successfully reproduced observed single-particle bound levels in 131,133Sn and self-consistently predicts single-particle resonant levels with densities too low for widely used traditional statistical model treatments of neutron capture cross sections on 130,132Sn employing Fermi gas level density formulations. For more information on the work please refer to "Structures of exotic 131,133Sn isotopes and effect on r-process nucleosynthesis", Shi-Sheng Zhang, M. S. Smith, G. Arbanas, R. L. Kozub, Phys. Rev. C 86 (2012) 032802(R).

iii) Online Software Systems

Our nuclear astrophysics data activity also includes software work to improve and expand the functionality of the Computational Infrastructure for Nuclear Astrophysics (CINA). This suite enables users to make the connection between laboratory nuclear physics results -- and USNDP data bases -- and astrophysical simulations with just a few mouse clicks. Researchers from over ##institutions in ##countries use this software system for their research. A related tool at nuclearmasses.org is also periodically updated with the latest mass measurements as compiled by McMaster Univ., as well as with the latest theoretical mass models.

3. Future Activities

Future mass chains will be evaluated within the range A=241-249 the range assigned to ORNL, as well as others assigned by USNDP / NNDC.

NSDD LBNL ISOTOPES PROJECT COLLABORATION REPORT

(R.B. Firestone)
Isotopes Project, Lawrence Berkeley National Laboratory, Berkeley, CA

Group summary: The Isotopes Project group currently consists of five scientists and a postdoctoral student. It also leads the Evaluated Gamma-ray Activation File (EGAF) collaboration consisting of over 20 scientists at ten universities and laboratories. The group is responsible for the evaluation of mass chains in the region 21-30.

Mass chain evaluation: During the calendar years the Isotopes Project evaluated the following mass chains.

1. A=27, *Nuclear Data Sheets* **112**, 1875-1948 (2011)
2. A=29, *Nuclear Data Sheets* **113**, 909-972 (2012)
3. A=92, *Nuclear Data Sheets* **113**, 2187-2389 (2012)
4. A=93, *Nuclear Data Sheets* **112**, 1163-1389 (2011)
5. A=99, *Nuclear Data Sheets* **112**, 275-446 (2011)*
6. A=143, *Nuclear Data Sheets* **113**, 715-908 (2012)*
7. A=192, *Nuclear Data Sheets* **113**, 1871-2111 (2012)
8. A=220, *Nuclear Data Sheets* **112**, 1115-1161 (2011)*
9. A=230, *Nuclear Data Sheets* **113**, 2113-2185 (2012)*
10. A=245, *Nuclear Data Sheets* **112**, 447-494 (2011)*
11. A=246, *Nuclear Data Sheets* **112**, 1833-1873 (2011)*

*Evaluations supported by the NNDC

EGAF evaluations: The Isotope Project's primary effort is to measure and evaluate neutron capture γ-ray cross section data for all stable and selected radioactive isotopes. These data include prompt and delayed γ-ray cross sections, σ_γ, total thermal radiative neutron cross sections, σ_0, and neutron separation energies, S_n. The first EGAF elemental γ-ray cross section library was published as the result of an IAEA CRP [1] and the neutron separation energies were supplied to the Atomic Mass Evaluation project for inclusion in their most recent evaluation [2].

EGAF is being updated with new experiments on enriched isotopes using the Budapest and Munich FRM II guided neutron beam facilities. New measurements have been performed on the isotopes ^{151,153}Eu, ^{155,157}Gd, ^{180,182,183,184,186}W, ^{237}Np, ^{240}Pu, and ^{241}Am. Additional measurements have been approved for 2013 on ^{70,72,73,74,76}Ge, ^{90,91,92,94,96}Zr, and ^{238}U.

The EGAF data are being evaluated to determine precise total neutron radiative cross sections, σ_0. For light nuclei with Z≤19 the EGAF level schemes are complete and σ_0 can be determined directly from the level scheme where $\sigma_0=\Sigma\sigma_\gamma(GS)=\Sigma\sigma_\gamma(CS)$ for γ-rays feeding the ground state (GS) or de-exciting the capture state (CS). For heavier elements the contribution to σ_0 from unresolved continuum γ-rays becomes significant and must be accounted for. We make these corrections using statistical model calculations with the Prague Monte Carlo code DICEBOX [3]. DICEBOX uses the capture decay scheme data for levels below energy E_{crit}, where the level scheme is presumed to be complete, from the Reference Input Parameter Library (RIPL) [4] and primary γ-rays feeding levels below E_{crit} are taken from experiment. DICEBOX then creates a simulated level scheme for higher lying levels based on statistical models of level density and photon strength assuming a Porter-Thomas [5] distribution of level widths and transition probabilities. The simulations are normalized with population/depopulation plots comparing the calculated population feeding each level below E_{crit} to the experimental cross section de-exciting those levels. In principle the population/depopulation of each level should be balanced and deviations are usually due to errors in the decay scheme below E_{crit}. An example of a population/depopulation plot for ^{105}Pd(n,γ)^{106}Pd is shown in Fig. 1.

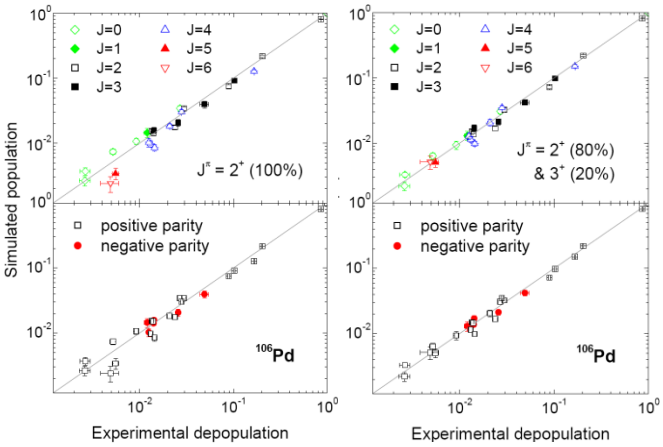

FIG. 1. Population/depopulation plot for ^{106}Pd. In the figure on the left a capture state that is 100% $J^\pi=2^+$ is assumed and in the figure on the right 80% 2^+, 20% 3^+ gives a much better fit to the data. The upper curves show the data labeled by spin and the lower curve by parity. Note that an excellent fit between population and depopulation is attained over a region of three orders of magnitude in intensity.

Recent EGAF results: We have published the total radiative neutron cross sections for the isotopes ^{102,104,105,106,108,110}Pd [6] and ^{39,40,41}K [7]. Data for the isotopes ^{151,153}Eu, ^{155,157}Gd and ^{180,182,183,184,186}W have been evaluated and draft papers are written. Earlier results for the ^{12}C cross section [8] determined a new cross section $\sigma_0(^{12}C)=3.89(6)$ b that disagreed with the recommended cross section [9] $\sigma_0(^{12}C)=3.53(7)$ b. The new EGAF measurements have now been verified [10] and entered in the ENDF carbon evaluation.

The EGAF project also evaluates an activation file based on decay γ-ray cross section measurements with guided neutron beams, activation k_0 values from the IUPAC evaluations [11], and other data from the scientific literature. For ^{41}K(n,γ) we determined $\sigma_0=1.62(3)$ b from prompt γ-ray measurements [7], which is significantly larger than all previous measurements including the recommended value [9] of $\sigma_0=1.46(3)$ b. However, our measurement of the decay γ-ray cross section $\sigma_\gamma(1525)=0.263(2)$ b, in the same experiment, agreed with three previous measurements. This indicated that the precise value of $P_\gamma(1525)=0.1808(9)$ used in ENSDF [12] is incorrect. Our new result is $P_\gamma(1525)=0.164(3)$. The cause of this discrepancy is believed to be the failure of previous authors to correct for self-absorption in the source in their 4πβ–γ experiments.

EGAF statistical model studies: Statistical model calculations are an important aspect of the EGAF evaluation effort. Statistical photon strength models are largely based on data from the giant dipole resonance region, near 15 MeV, and little experimental data exists below the neutron separation energy. We have developed a method of extraction photon strength information directly from the EGAF primary γ-ray cross section data, as shown in Eq. 1 where

$$f(E_\gamma) = \sigma_\gamma \Gamma_\gamma / (\sigma_0 \cdot d_0 \cdot E_\gamma^3) \qquad (1)$$

and E_γ is the primary γ-ray energy (MeV), Γ_γ is the capture state width (eV), σ_γ is the primary γ-ray cross section (b), σ_0 is the total radiative neutron cross section (b) and d_0 is the average level spacing at S_n (eV). Data for E_γ and σ_γ are from EGAF while data for Γ_γ, σ_0 and d_0 are available in the Atlas of Neutron Resonance [9]. The thermal primary γ-ray photon strength for ^{187}W is shown in Fig. 2 where good agreement is seen with Brink-Axel predictions. These data will also be used to test Porter-Thomas [5] fluctuations. We have expanded these calculations to determine average photon strengths from average resonance capture data compiled in ENSDF, as shown for ^{187}W in Fig. 3. In these cases the normalization of the primary resonance capture g-rays can be determined using DICEBOX calculations.

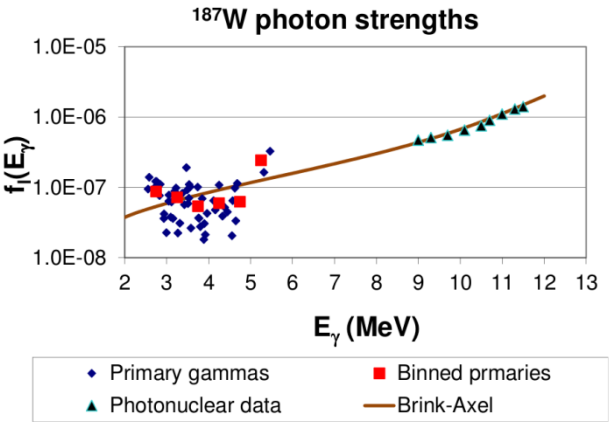

FIG. 2. Comparison of primary γ-ray photon strengths in ^{187}W with Brink-Axel theory.

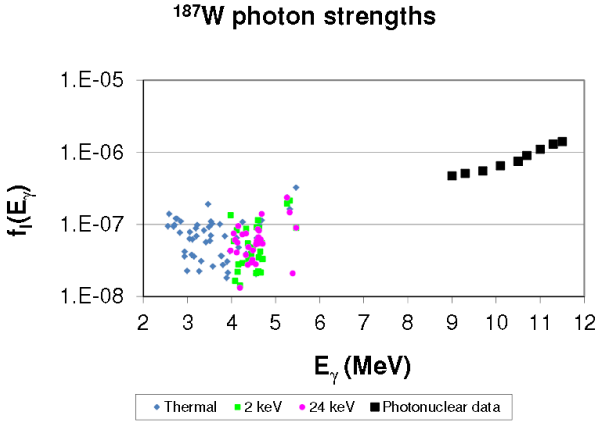

FIG. 3. Comparison of average resonance γ-ray photon strengths in ^{187}W with Brink-Axel theory.

Future evaluation plans: The Isotopes Project will continue to evaluate data for A=21-30. New thermal capture γ-ray measurements will be performed on all available isotopically enriched targets. Total radiative thermal neutron cross section evaluations will be published in refereed journals. The EGAF activation data will be evaluated in collaboration with the Decay Data Evaluation Project (DDEP) and the *Table of Radionuclides*. Neutron separation energies will be evaluated in greater detail for the Atomic Mass Evaluation project.

A byproduct of the DICEBOX calculations will be new, improved RIPL data files. Currently RIPL data are taken directly from ENSDF, although that file is not evaluated for applications. The Isotopes Project will work with the IAEA to provide RIPL files benchmarked by DICEBOX calculations and supplemented to include primary γ-ray cross sections and improved spin/parity and transition intensity information.

The Isotopes Project, in collaboration with the Oslo University cyclotron group, is initiating a new project to evaluate reaction data from the continuum near the neutron separation energy. This evaluation would update the IAEA photonuclear data files and add additional surrogate reaction data such as that measured with the CACTUS NaI(Tl) array in Oslo. Initial discussions of the scope and structure of the evaluation will be discussed at the IAEA in 2013.

We have also entered into a memorandum of understanding with the TransActinide Nuclear Data Evaluation and Measurement (TANDEM) collaboration, including scientists from the Budapest Neutron Centre, FZ-Jülich GmbH, Munich FRM II, and LLNL to produce exotic actinide targets for measuring g-ray cross sections.

Extension of EGAF to 20 MeV: Currently the EGAF effort has been limited to measuring and evaluating thermal γ-ray cross section data. We are planning to extend this effort to 20 MeV neutrons in collaboration with Lawrence Livermore National Laboratory (LLNL). A Berkeley Area Neutron Group (BANG) has been organized to develop new experimental facilities on the UC Berkeley campus, at the LBNL cyclotron laboratory, and with the LLNL National Ignition Facility.

1. **UC Berkeley Neutron Generator Laboratory** – A 5×10^{11} n/s D+D neutron generator (Fig. 4) is being installed at Etcheverry Hall on the UC Berkeley campus. This facility will produce 10^{10} n/cm^{2}s at the target area and was built for Ar-Ar dating. It will be available for ≤2.5 MeV cross section measurements.

FIG. 4. The UC Berkeley neutron generator expected to be running in the summer of 2013.

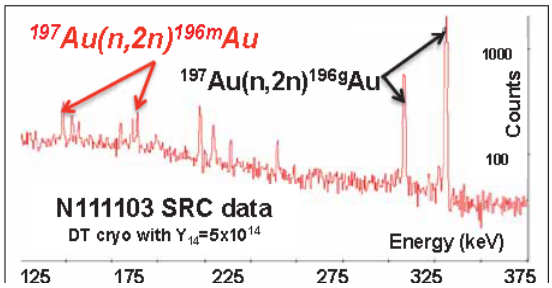

FIG. 5. Decay of debris following NIF shots shows the relative production of the $^{196}Au^{m+g}$ isomer and ground state. Initial data suggest that this ratio varies with plasma density suggesting electron capture on excited nuclear states.

2. **LLNL National Ignition Facility (NIF) –** NIF (Fig. 5) consists of 192 beams of laser light that converge to deliver 500 terawatts of peak power and 1.85 megajoules of ultraviolet laser light within a few picoseconds. It can produce instantaneous neutron fluxes of $10^{27\text{-}33}$ n/cm^{2}s. This facility creates conditions comparable to those during a supernova explosion and may be used to measure cross section on targets with as few as 10^{10} atoms.

3. **LBNL 88" Cyclotron** – This facility can supply tunable, monoenergetic neutron beams in the range of 8-33 MeV with up to more than 10^8 n/cm^{2}s, produced by deuteron break up. There is a 5-10 m flight path and TOF to better than 1 ns.

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TUNL CONTRIBUTIONS IN THE US NUCLEAR DATA PROGRAM AND NSDD

J.H. Kelley, Jim Purcell, and G. Sheu

Responsibilities:

- We are responsible for nuclear structure evaluation in the A=2-20 mass region
  - Energy Levels of Light Nuclei reviews published in Nuclear Physics A
  - ENSDF files for A=2-20
  - XUNDL from A=2-20
- Web interface for A=3-20 Information

Recent evaluation activities:

- Published "Energy Levels of Light Nuclei A=11"
- Added A=11 ENSDF data set
- Updated 7 b-n data sets (more to come)
- Other work in progress:
  - A=12 Evaluation for "Energy Levels" (Kelley)
  - A=13 Evaluation for "Energy Levels" (Purcell)
  - Preparing A=12 ENSDF file

Recent compilation activities for A=2-20:

- Committed to XUNDL (A=3-20)
  - 63 data sets 2012 (5-6/month)
- Compilation of ground state decay & β-decay references and data
- Compilation of (p,X) and (α,X) excitation functions
- TUNL Dissertations
  - http://www.tunl.duke.edu/~gsheu/Theses/TUNL_Theses.shtml

PROGRESS REPORT OF CEN, FRANCE
(J. BLACHOT)

Blachot remarked that he had been a Member of the NSDD network since the beginning in 1978 (35 years) and has more than 45 publications in Nuclear Data sheets.

Status since the last meeting (2011)

Mass	NDS	**Dat--ENSDF**	**Comments**
113	NDS 111, 1471(2010)	**201006**	
114	NDS 113, 515 (2012)	**201203**	
115	NDS 113,2391 (2012)	**201210**	
116	NDS 111, 717 (2010)	**201004**	**Mo (10)**
117	NDS 95, 679 (2002)	**201101**	
	ENSDF (2011)		

Participation in NUBASE

CPC (HEP & NP), 2012, 36(12): 1157–1286 Chinese Physics C Vol. 36, No. 12, Dec., 2012.

The NUBASE2012

G. Audi, F.G. Kondev, M. Wang, B. Pfeiffer, X. Sun, J. Blachot, and M. MacCormick

Abstract: This paper presents the NUBASE2012 evaluation that contains the recommended values for nuclear and decay properties of nuclides in their ground and excited isomeric (T1=2_100 ns) states. All nuclides for which some experimental information is known are considered. NUBASE2012 covers all up to date experimental data published in primary (journal articles) and secondary (mainly laboratory reports and conference proceedings) references, together with the corresponding bibliographical information. During the development of NUBASE2012, the data available in the "Evaluated Nuclear Structure Data File" (ENSDF) database were consulted, and critically assessed of their validity and completeness. Furthermore, a large amount of new and somewhat older experimental results that were missing in ENSDF were compiled, evaluated and included in NUBASE2012. The atomic mass values were taken from the "Atomic Mass Evaluation" (AME2012, second and third parts of the present issue). In cases where no experimental data were available for a particular nuclide, trends in the behaviour of specific properties in neighbouring nuclei (TNN) were examined. This approach allowed us to estimate, whenever possible, values for a range of properties, which are labeled in NUBASE2012 as "non-experimental" (flagged "#"). Evaluation procedures and policies that

were used during the development of this database are presented, together with a detailed table of recommended values and their uncertainties.

AMDC: http://amdc.in2p3.fr and http://amdc.impcas.ac.cn

Table I. The NUBASE2012 table (continued, Explanation of Table on page 1176)

Nuclide	Mass excess (keV)		Excitation energy (keV)		Half-life			J^π	Ens	Reference		Year of discovery	Decay modes and intensities (%)	
^{113}Nb	−40510#	400#			20#	ms	(>300 ns)	5/2+#	10	97Be70	I	1997	β^- ?; β^-n ?; β^-2n ?	
^{113}Mo	−52770#	300#			79	ms	6	3/2+#	10	11Ni01	TD	1994	β^-=100; β^-n ?	*
^{113}Tc	−62812	3			169	ms	18	5/2+#	10	09Pe06	T	1992	β^-=100; β^-n=2.1 3	*
^{113}Tc^m	−62698	3	114.4	0.5	527	ns	16	(5/2−)		12KaB	ET	2010	IT=100	*
^{113}Ru	−71870	40			800	ms	50	(1/2+)	10			1988	β^-=100	
^{113}Ru^m	−71740	40	130	18	510	ms	30	(7/2−)	10	98Ku17	E	1998	IT=?; β^-=?	*
^{113}Rh	−78768	7			2.80	s	0.12	(7/2+)	10	93Pe11	J	1971	β^-=100	
^{113}Pd	−83591	7			93	s	5	(5/2+)	10			1954	β^-=100	
^{113}Pd^m	−83510	7	81.1	0.3	300	ms	100	(9/2−)	10			1993	IT=100	
^{113}Ag	−87027	17			5.37	h	0.05	1/2−	10			1949	β^-=100	
^{113}Ag^m	−86984	17	43.50	0.10	68.7	s	1.6	7/2+	10			1958	IT=64 7; β^-=36 7	
^{113}Cd	−89043.3	0.4			8.04	Py	0.05	1/2+	10			1925	IS=12.22 12; β^-=100	*
^{113}Cd^m	−88779.8	0.4	263.54	0.03	13.89	y	0.11	11/2−	10	11Ko01	TD	1965	β^-=99.9036 19; IT=0.0964 19	*
^{113}In	−89365.8	0.9			STABLE			9/2+	10			1934	IS=4.29 5	
^{113}In^m	−88974.1	0.9	391.699	0.003	1.6579	h	0.0004	1/2−	10			1939	IT=100	*
^{113}Sn	−88328.2	1.6			115.09	d	0.03	1/2+	10			1939	β^+=100	
^{113}Sn^m	−88250.8	1.6	77.389	0.019	21.4	m	0.4	7/2+	10			1961	IT=91.1 23; β^+=8.9 23	
^{113}Sb	−84417	17			6.67	m	0.07	5/2+	10			1958	β^+=100	
^{113}Te	−78347	28			1.7	m	0.2	(7/2+)	10			1974	β^+=100	
^{113}I	−71120	8			6.6	s	0.2	5/2+#	10			1977	β^+=100; α=3.310e−7; …	*
^{113}Xe	−62204	7			2.74	s	0.08	5/2+#	10			1973	$\beta^+\approx$100; $\alpha\approx$0.011; …	*
^{113}Cs	−51764	9			16.7	μs	0.7	(3/2+)	10			1984	p=100	
*^{113}Mo	T : symmetrized from 11Ni01=78(+6−5)													**
*^{113}Tc	T : average 09Pe06=160(+50−40) 99Wa09=170(20) J : 07Ku23 > 5/2													**
*^{113}Tc^m	T : other recent 10Br15=500(100) E : other 10Br15=114(1)													**
*^{113}Ru^m	E : above the 99 keV level and below 160 keV													**
*^{113}Cd	T : from 07Be61=8.037(0.005)(0.05 systematics);													**
*^{113}Cd	T : other 09Da09=8.00(0.11)(syst 0.24) outweighed													**
*^{113}Cd^m	T : average 11Ko01=13.97(0.13) 72Wa11=14.6(0.5) 65Fl02=13.6(0.2)													**
*^{113}In^m	T : 99.476 m 23													**
*^{113}I	D : … ; $\beta^+\alpha$?													**
*^{113}Xe	D : … ; β^+p=7 4; $\beta^+\alpha\approx$0.007 4													**
*^{113}Xe	D : α=0.0024-0.0204 % from estimated limit for the reduced width, see 85Ti02													**
*^{113}Xe	D : β^+p and $\beta^+\alpha$ derived from β^+p/α=605(35) and β^+p/$\beta^+\alpha$=500-1500 in 85Ti02													**

ARGONNE NUCLEAR DATA PROGRAM

Member of the US Nuclear Data Program,
supported by the Office of NP, U.S. DOE/SC
(F. Kondev)

Nuclear Data Compilations & Evaluations

- **Nuclear structure and decay data compilations & evaluations for the International NSDD** network (ENSDF & XUNDL);
- AME12 & NuBase12 – in collaboration with G. Audi & M. MacCormick, CSNSM (Orsay), M. Wang, IMP (Lanzhou) and B. Pfeiffer, GSI (Darmstadt) – presentation by M. Wang;
- DDEP coordinator – completed;
- Horizontal nuclear data evaluation activities –IAEA CRP's, Isomers, Medical Isotopes;

Complementary ND research Activities

- CARIBU, FRIB and other RIB facilities, Gretina, IAEA-CRP –emphasis on nuclear structure physics and astrophysics, and their intersection with applied nuclear physics programs.

Effort & Funding

1.0 staff & 1-2 post-docs (non USNDP)

ANL Region of Responsibility

- 21 mass chains permanently assigned to ANL – the goal is to keep them up to date – expansion is unlikely given the current staff level.

Mass Chain	NDS Publication	Evaluator	Current Status
176	NDS **107** (2006) 791	Basunia	completed/**LBNL**
177	NDS **98** (2003) 801	Kondev	completed/**under revision**
178	NDS 110 (2009) 1473	Browne	completed / Argentina
179	NDS 110 (2009) 265	Baglin	completed/**LBNL**
199	NDS 108 (2007) 79	Singh	completed **/ McMaster**
200	NDS **108** (2007) 1471	Kondev& Lalkovski	completed
201	NDS **108** (2007) 365	Kondev	completed
202	NDS **109** (2008) 699	Zhu & Kondev	completed
203	NDS **105** (2005) 1	Kondev	completed
204	NDS **111** (2010) 141	Chiara & Kondev	completed
205	NDS **101** (2004) 521	Kondev	completed
206	NDS **109** (2008) 1527	Kondev	completed
207	NDS **112** (2011) 707	Kondev& Lalkovski	completed
208	NDS **108** (2007) 1583	Martin	completed/**ORNL**
209	NDS **63** (1991) 723	Martin	**being evaluated/J.Chen**

ANL Region of Responsibility – cont.

New region of responsibility – closely related to our research interest at ANL

Mass Chain	NDS Publication	Evaluator	Current Status
106	NDS **109** (2008) 943	De Frenne & Negret	completed
107	NDS **109** (2008) 1383	Blachot	completed
108	updated online 2008	Blachot	completed
109	NDS **107** (2006) 355	Blachot	completed
110	NDS **113** (2012) 1315	Gurdal & Kondev	completed
111	NDS **110** (2009) 1239	Blachot	completed

112 NDS **79** (1996) 639 De Frenne & Jacobs **being evaluated/****
** In collaboration with S. Lalkovski, Univ. Sofia

A=133 was published in collaboration with St. Petersburg group & work is continuing on A=188 (with S. Juutinen, Jyvaskyla and D. Hartley, USNA) and A=174 (with T. Kibedi, ANU and H. Xiaolong, CNDC) – it is a time consuming effort, **is it worth it?**

XUNDL Compilations

Contributing since 2009 – in collaboration with B. Singh (McMaster Univ.) & J. Kelley (TUNL)

- Covering Phys.Lett. **B**, J. Phys. **G,** Nucl. Phys. **A** & Nucl. Instrum. & Methods **A** & **B** – numerous interactions with the authors---(presentation by B.Singh)
- ANL follows the very successful McMaster model–established contacts with local Universities – DePaul Univ. (*Prof. S. Fisher*) –undergraduate students involvement in compilation activities: W. Murray (currently PhD in NE at Georgia Tech) and J. Modica; possibility to involve graduate students from Univ. of Chicago (*Prof. G. Savard*)
- Collaboration with *Prof. D. Hartley* (USNA)– faculty (tenured) member – visited ANL for a week (together with B. Singh) and trained---spent two months on sabbatical at ANL in the summer of FY11 (one month leveraged by USNA funding)

Nuclear Data Research Activities

Complement the evaluation activities at ANL;

Nuclear Structure physics and Astrophysics and their intersection with the applied Nuclear Physics;

- At **ANL** – using Gammasphere & FMA – nuclei far from stability, spectroscopy of heavy and super-heavy nuclei, K-isomers, beta-delayed spectroscopy, surrogate reactions…. Decay spectroscopy of actinide nuclei and nuclei of importance to applications of medical isotopes and metrology
    - At ATLAS & CARIBU – we have 3 approved proposals –two priority I and one priority II
    - Possibility to establish a new program at APS – Auger emissions spectroscopy – collaboration with ANU (T. Kibedi) and U. Surrey (A. Nichols).
- At **MSU** (Coulex & decay spectroscopy), TRIUMF (decay spectroscopy) 7 RIKEN (in-beam spectroscopy) – properties of neutron-rich nuclei far from the line of stability.
- At **ANU** (isomers, astrophysics & medical isotopes physics) and Jyvaskyla University (spectroscopy of SHE).
- At **IAEA** – new CRP on "nuclear Data for charged-particle Monitor Reactions & Medical Isotope Production" – both data evaluation and measurements.

Statistics 2011 -2012

- 37 journal publications
- 5 refereed publications & 28 published abstracts in conference proceedings & workshops
- 11 invited presentations at international conferences & workshops; 10+ contributed talks
- 4 invited seminars & colloquiums

Active Collaborations

ANU, IIT Roorkee, U. Sofia, U. Surrey, McMaster U. TUNL/NC State, NNDC, Iaea, CSNSM & INP-Orsay, IMP-Lanzhou, ANL, LBNL, ORNL & UT, INL, MSU, FSU, USNA, UML, U. of Notre Dame, M.State U., U. Maryland, RIKEN, Jyvaskyla U., IPJ Krakow, U. Manchester.

STATUS REPORT OF NUCLEAR DATA PROJECT
AT McMASTER UNIVERSITY
(April 1, 2011 to January 31, 2013)
(B. Singh)

I. ENSDF evaluations and training workshops:

Current status of A-chains with permanent responsibility:
A= 1 (2005), 31(1998,galley stage), 32(2011), 33(2011), 34(2012)*, 35(2011), 36(2011)*, 37(2012)*, 38(2008), 39(2006), 40(2004), 41(2001), 42(2001,s), 43(2001, post-review stage), 44(2011), 64(2007), 89(2013), 98(2003), 100(2008), 149(2004), 151(2009), 164(2001,s), 188(2002,w at another center), 190(2003,w), 194(2006).
* In collaboration with Ninel Nica. w: work in progress, s: revision submitted

Mass chains/nuclides submitted from April 1, 2011 to Jan 31, 2013:
A=44 and 62, submitted May 2011 and Sept 2011; published in 2012.
A=75, A. Negret and B. Singh, NDS (submitted July 2011, post-review stage).
A=43, B. Singh and J. Chen, NDS (submitted Sept 2011, post-review stage).
A=42, J. Chen and B. Singh, NDS (submitted Sept 2012, pre-review stage).
A=164, B. Singh and J. Chen, NDS (submitted Sept 2012, pre-review stage).
A=211, IAEA-ICTP-2012 workshop, NDS (submitted Sept 2012, post-review stage).
(This work is being coordinated by B. Singh.)
Another **80 nuclides**, many were either new nuclides in ENSDF or nuclides for which excited-state data became available for the first time.
A table of half-lives of bare and/or highly-charged ionic nuclei together with complete bibliography was prepared by Y. Litvinov (GSI) and B. Singh, and published as an appendix in 2011 Wallet Cards.

Review work: 1 full-length A-chain, **6 nuclides.**

Mass chains published from April 1, 2011 to Jan 31, 2013:
A=33: J. Chen and B. Singh, NDS 112, 1393-1511 (2011).
A=32: C. Ouellet and B. Singh, NDS 112, 2199-2355 (2011).
A=44: J. Chen, B. Singh and J.A. Cameron: NDS 112, 2357-2495 (2011).
A=35: J. Chen, J. Cameron and B. Singh: NDS 112, 2715-2850 (2011).
A=36: N. Nica, J.A. Cameron and B. Singh, NDS 113, 1-155 (2012).
A=37: J.A. Cameron, J. Chen, B. Singh and N. Nica, NDS 113, 365-514 (2012).
A=62: A.L. Nichols, B. Singh and J.K. Tuli, NDS 113, 973-1114 (2012).
A=77: B. Singh and N. Nica, NDS 113, 1115-1314 (2012).
A=34: N. Nica and B. Singh, NDS 113, 1563-1733 (2012).
A=89: B. Singh, NDS 114, 1-208 (2013).

Work in Progress as of Jan 31, 2013:
A=31, 85, 61, 129: at different stages in pipeline, will be completed during 2013 for final publication in NDS.
A=57: with K. Zuber (Krakow). (previous: 1999).
A=130: with A. Rodionov and Yu. Khazov (PNPI, Russia). (previous: 2001).
A=86: with A. Negret (Bucharest). (previous: 1999).
A=76: with A. Farhan (Kuwait U). (previous: 1994).
A=139: with P. Joshi (TIFR, Mumbai) (previous: 2001).
A=189, 190 with T. Johnson (NNDC. BNL) (previous 2003).

Collaborations and International coordination:
A. Negret from Bucharest visited McMaster in July 2011 for 2 weeks for A=75 evaluation and training**.**

IAEA-NSDD workshop at ICTP, Trieste, 6-17 Aug 2012: lectures and coordinated evaluation of A=211 nuclides. This work is at post-review stage.

ENSDF workshop Nov 26-29, 2012 at VECC, Kolkata, India. B. Singh participated as lecturer and coordinator of A=215 evaluation. This work is in progress. First draft of this mass chain is expected by the end of March 2013.

ENSDF database: corrections for I_γ values for single-gamma levels:
In response to comments from R. Capote (NDS-IAEA) about missing gamma-ray branching ratios for single-gamma levels for some of the nuclei in Adopted datasets, corrections were sent to NNDC for 21 nuclides for which data were searched. This work will continue until all the corrections are done.

ENSDF related computer codes:
A working version of JAVA-NDS code primarily developed at McMaster was delivered to NNDC in Oct 2011. For several years this code has been routinely used to produce color band drawings in NDS publications. In Aug 2012, this code was also sent to M. Verpelli at IAEA-NDS for use in LIVECHART of nuclides, and possibly for XUNDL datasets.

Michael Birch developed a general purpose code AVELIB which has a library of different averaging procedures including outlier techniques. This code handles asymmetric uncertainties as well. The code is now available through NNDC webpage.

II. XUNDL compilation, including mass measurements:

Since April 1, 2011, **796** compiled datasets and **25** updated (for new papers from the same groups, errata or replies from authors to enquiries) datasets from about 280 recent (from April 2011 onwards) publications have been prepared at McMaster and included in XUNDL database. 42 datasets were compiled with Dr. D. Kulp, contractor with NNDC.
Additional **163** datasets with other center: **116** datasets from **TUNL**; **47** from **ANL**; **10** from **LBNL** were checked and edited.
Continued frequent correspondence with the original authors is a regular feature of this activity.
Compilation of papers on **new mass measurements since AME-2003.** Nov 2010 –Oct 2012: 41 primary papers (~ 325 data points); on an ORNL webpage: www.nuclearmasses.org

III. NSR key-wording (March 2011 to Sept 2012 issues) – 1880 PRC articles:

prepared keywords for ~1220. This activity continues with the help of undergraduate students: J. Choquette, M. Birch and E. Thiagalingam.

IV. Topical evaluations:

B(E2) update of Raman's 2001 evaluation: one paper has been published in 2012. Draft of other mass regions is complete and we expect to complete this work in 2013.
Beta-delayed Neutron decays: this work was initiated at McMaster in 2011 with the first consultant's meeting at IAEA-NDS in October 2011 (IAEA report INDC(NDS)-0599 (2011)). This was followed up by a workshop at McMaster in May 2012. First draft of evaluation of %P(n) and $T_{1/2}$ values has been prepared and going through cross checks. This is McMaster + IAEA + GSI + NNDC collaboration.

V. Other related publications (April 2011 to Jan 2013):

1. B. Pritychenko, E. Betak, M.A. Kellett, B. Singh and J. Totans, The Nuclear Science References (NSR) database and Web Retrieval System, Nucl. Instrum. Methods Phys. Research A **640**, (2011) 213.
2. J. Chen, S.D. Geraedts, C. Ouellet and B. Singh, Evaluation of half-life of ^{198}Au., Appl. Radiat. Isotopes **69** (2011) 1064.
3. D.Abriola**,** B.Singh and I. Dillmann, Summary Report of Consultants' Meeting of Beta-delayed neutron emission evaluation, IAEA report INDC(NDS)-0599 (Dec 2011).

4. B. Pritychenko, J. Choquette, M. Horoi, B. Karamy, B. Singh, An Update of B(E2) Evaluation for $0_1+ \rightarrow 2_1+$ Transitions in Even-Even Nuclei near N∼Z∼28. At. Data Nucl. Data Tables **98** (2012) 798.
5. E.A. McCutchan, A.A. Sonzogni, T.D. Johnson, D. Abriola, M. Birch, B. Singh, Improving systematic predictions of β-delayed neutron emission probabilities, Phys. Rev. C **86** (2012) 041305(R).
6. L.S. Danu, P.K. Joshi, D.C. Biswas, S. Mukhopadhyay, A. Goswami, P.N. Prashanth, L.A. Kinage, R.K. Choudhury, B. Singh, Revisiting the decay scheme and half-life of ^{139}Ba; Eur. Phys. J. A **48** (Dec 2012) 186.
7. P.C. Sood, M. Sainath, R. Gowrishankar, B. Singh, Level structures in ^{156}Pm from ^{156}Nd β− decay, Eur. Phys. J. A **48** (2012) 136.
8. A. Chakraborty, E.E. Peters, B.P. Crider, C. Andreoiu, et al., Collective Structures in ^{94}Zr and Subshell Effects in Shape Coexistence, Phys. Rev. Lett. **110** (2013) 022504.

Experiment at TRIUMF-ISAC September 2011:
Phonon-Coupled Excitations and Mixed-Symmetry States in Zr-94.
(Through the study of Y-94 decay to Zr-94 at TRIUMF-ISAC facility: using radioactive ion beam and 8π gamma-detector array): B. Singh participated in this experiment. See above section for a paper from this work. Analysis is in progress. Drs. Chakraborty and Yates are scheduled to visit McMaster in May-June 2013 in connection with this work.

VI. Personnel:

Alan Chen: Assoc. Professor, Head of the Project
Jim Waddington: Emeritus Professor: Co-PI of the project
John Cameron: Emeritus Professor (volunteer work for ENSDF work 1998-2012 for A=31-44 mass region)
Balraj Singh: Senior Research Scientist
Jun Chen: Post-doctoral fellow: June 2009 –Mar 2012

Undergraduate Students (part-time):
Jeremie Choquette: March 2011 – Nov 2012
Michael Birch: Since March 2011
Ervine Thiagalingam: Since March 2012

VII. Support: Main source of funding during April 2011 to Jan 2013 was Office of Science, Department of Energy of U.S.A.

STATUS REPORT OF JAPANESE ACTIVITIES FOR NUCLEAR STRUCTURE AND DECAY DATA EVALUATION

Hideki Iimura
Nuclear Data Center
Japan Atomic Energy Agency

1. Members

The Japanese group has a meeting once a year usually in January or February, to exchange information on each member's progress in evaluation. Present members of our group are A. Hashizume, H. Iimura, M. Kanbe, J. Katakura, K. Kitao, S. Ohya, and Y. Tendow. Last April, Katakura moved from JAEA to Nagaoka University of Technology. Although he continues the evaluation at the university, the contact person of Japanese group was changed from Katakura to Iimura.

2. Mass chain evaluation

The mass chain evaluation for which the Japanese group has responsibility is A=120-129. Other than these mass chains, evaluation of A=118 is continued by Kitao and Kanbe. However, it has already been accepted by the Network that the responsibility of A=118 will be transferred to another group after the Japanese group finishes the present revision.

Status of Mass Chain Evaluation

Mass	Last NDS publication		Status
	Year	Evaluators	
118	1995	Kitao	Evaluating (Kitao, Kanbe)
120	2002	Kitao, Tendow, Hashizume	Evaluating (Hashizume)
121	2010	Ohya	
122	2007	Tamura	
123	2004	Ohya	
124	2008	Katakura, Wu	
125	2011	Katakura	
126	2002	Katakura, Kitao	Evaluating (Iimura, Katakura, Ohya)
127	2011	Hashizume	

As listed in the table, A=127 (Hashizume) was published in 2011. We have started the evaluation of A=120 (Hashizume) and 126 (Iimura, Katakura, Ohya), for which the publication year of NDS is relatively old. As to A=128 and 129, we agreed to the proposal by NNDC that the evaluation of these mass chains are temporally made by the Hungarian group. This agreement is only for the present revision, and we will undertake the responsibility of A=128 and 129 in the next revision.

3. Chart of the nuclides

The Japanese Nuclear Data Committee and Nuclear Data Center, JAEA publish chart of the nuclides every 4 years. A particular point of this chart is that the beta-decay half-lives being estimated by using the gross theory are listed for nuclides not yet synthesized. The latest version of this chart is 2010, which was compiled by Tachibana, Koura, and Katakura. The new version is planned to be published in 2014. The web chart is also available at http://wwwndc.jaea.go.jp/CN10/index.html, which includes data not given in the printed chart, such as neutron cross-sections and fission yields taken from JENDL-4.0.

4. JENDL FP decay data file 2011

Katakura compiled the decay data of fission products as JENDL FP Decay Data File 2011 (http://wwwndc.jaea.go.jp/ftpnd/jendl/jendl-fpd-2011.html). This file is the revision of the compilation in 2000, and is reflecting the data measured during this decade, such as new TAGS

data. The file contains the decay data of 1284 FP nuclides. In order to confirm the validity of this file and newly compiled fission yields file, the decay heat calculation for various kinds of fissioning nuclides were performed. The calculated results showed good agreement with the measured data.

5. Estimation of beta-decay properties

A table of beta-decay properties being estimated by using the gross theory of beta decay has been recently added at http://wwwndc.jaea.go.jp/nucldata/beta-decay-properties.pdf. Estimated beta-decay half-lives, average beta-ray energies, average gamma-ray energies, and delayed neutron emission probabilities are listed for nuclei ranging from Li-8 to 130-330.

STATUS REPORT JILIN UNIVERSITY

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Status of mass chain evaluation

Jilin University (JLU) group is responsible for nuclear structure and decay data evaluation of mass chains: A=52, 53, 54, 55, 56, and 63.

(1) Status of publication in Nuclear Data Sheets (NDS)

A	Publication
52	NDS, 106, 773 (2007)
53	NDS, 110, 2689 (2009)
54	NDS, 107, 1393 (2006)
55	NDS, 109, 787 (2008)
56	NDS, 112, 1513 (2011)
63	NDS, 92, 147 (2001)
	ENSDF (2009)

(2) Evaluation since last meeting (2011)
A=54 in review
(since 26-Dec-2012)
A=52 evaluating
A=63 evaluating

(3) Other Activity
NSR (Nuclear Structure References)
Looked up a journal of High-Energy Physics and Nuclear Physics (in Chinese)
From 1977 to 1983
Found 12 experimental papers on NSDD
Wrote keywords of the papers.

For example:
1982ZhAA High-Energy Physics and Nuclear Physics (in Chinese), 6, 255 (1982)
Zhao Zhizheng, Sun Xijun, R. B. Piercey, J. D. H. Hamilton, C, F. Maguire, A. V. Ramayya, R. L. Robinson, H. J. Kim, J. C. Wells.
Lifetime measurement of excited states in ^{76}Kr.
NUCLEAR REACTION ^{66}Zn(^{12}C,2nγ), E=39 MeV, measured lifetime of excited states in ^{76}Kr, DSAM.

NUCLEAR DATA ACTITIVITIES AT I.I.T. ROORKEE

Period 2011-13

(A.K. Jain)

1. Work has been done to evaluate and update the mass chain A=211, 222 and 224. The present status of the work is as follows:
   (a) The **A=211** mass chain has been submitted for review. The students from NDC, IIT Roorkee and MMU Mullana contributed in this mass chain. The comments from the referee have been received and the final version will be submitted within few days.
   (b) In mass chain A=215, two nuclides namely ^{215}Ac and ^{215}Fr are being updated. This work will be completed before 01.03.2013.
   (c) This A=222 mass chain has been published [S. Singh *et al.,* Nucl. Data Sheets **112** (2011) 2715].
   (a) In the A=224 mass chain, there are total 10 nuclides and three nuclides namely ^{224}At, ^{224}Bi, ^{224}Th have been updated. Out of these three nuclides ^{224}At has been included in the ENSDF database so that the updated information for this nuclide will be incorporated in the upcoming evaluation by Audi *et al.* 2011AuZZ. The evaluation of ^{224}Po and ^{224}Pa is on-going. We are planning to submit this evaluation by the end of July-2013. Evaluation of ^{224}U is also going on which will soon be ready for submission.

   This work is being done in collaboration with S. Singh (Maharishi Markandeshwar Univ., India) and J.K. Tuli (BNL).

2. Work has been done to evaluate and update the mass chain A=139. The present status of the work is as follows:
   (a) There are a total of 16 nuclides in this mass chain and 10 nuclides namely ^{139}Nd, ^{139}Sb, ^{139}Te, ^{139}Xe, ^{139}I, ^{139}Dy, ^{139}Tb, ^{139}Gd, ^{139}Eu and ^{139}Sm have been up updated.
   (b) For ^{139}Cs, the individual data sets and adopted data set have been updated. The results of Pandora are being studied for fine tuning the adopted data set.
   (c) The evaluation of ^{139}Ba is also in progress and data from the latest experiment held at BARC is awaited for being included.
   (d) The data on ^{139}Pm have been evaluated and a final checking of the evaluation is presently going on.

   This work is being done in collaboration with P. Joshi, S. Singh and B. Singh.

3. A systematic study of Nuclear Isomers has been done based on which an Atlas of Nuclear Isomers has been prepared (a horizontal evaluation). Details of this study are as follows:

We have prepared an Atlas of all the known nuclear isomers for all the neutron and proton numbers, to highlight the extent of information in this promising and highly interesting field. The total number of nuclear isomers for the complete mass region has been found to be about 2252 including 507 nuclei having only one known isomer and 559 nuclei having isomers between 2 and 5. Nuclear isomers have been found all over the nuclear chart, the largest number being near the magic numbers and gap. It was interesting to find ^{180}Ta to have the largest number (13) of isomeric states. ^{179,177}Ta, ^{152}Eu, ^{214}Rn were found to have 10 isomeric states each. A theoretical estimation of the half-lives of transitions was made using the Weisskopff single particle

estimates which were then compared to the experimental half-lives. The number of isomers is found to be highest in the range 1 ns-100 ns. The number falls gradually with the increase in half-life of the isomeric states up to 0.1s and then a small rise being observed at 10s-10^3s. The detailed results and findings have been presented in the conferences listed below.

(1) Atlas of Nuclear Isomers & their Systematics, A.K. Jain, Talk delivered at Argonne National Lab, USA during a visit in August 2012.
(2) Atlas of Nuclear Isomers and Spin Systematics, A.K. Jain, Invited talk in the BRNS workshop on Evaluation of Nuclear Structure and Decay Data, November 26-29, 2012, VECC, Kolkata.

We have studied/developed a global systematics of the spins (total angular momentum) of nuclear isomeric states for nuclei in the whole mass region from A=1 to 240. Systematics of spins have been made region wise for a) Z(28-50) and N(28-50), b) Z(50-82) and N(50-82), and c) Z(50-82) and N(82-126). We observe that nuclear isomers having half-integer spins are more in number as compared to nuclei having integral spins for spins less than 6 to 6.5 ħ. This pattern changes its signature after 6.5 ħ where we find integral spins lying at the peaks between 6 to 10.5 ħ. Also, the high spin isomers are more likely in even-even or, in odd-odd nuclei which probably happens because higher spin excitations lie closer to the ground state in these nuclei. A maximum number of high spin isomers was observed at spin values 5.5, 6, 7 and 10ħ.

A further up-gradation of the Atlas of isomers is being carried out to include the newly identified isomers and other new information.

While updating the data from ENSDF and NUBASE 2012, we found some isomeric states which are having a longer half-life than their corresponding ground state in this region particular in higher mass neutron rich region. The chart of nuclear isomers based on the experimental data shows a significant gap in this region which motivates us to visit this region for the search of new isomers. We plan to study the following in the actinide region and beyond:

(a) Fission isomers having half-life greater than 100ns
(b) Rest of isomers having half-life greater than 100 ns
(c) Fission isomers having half-life in the range of 1 ns- 100 ns

List of Publications:

(A) Papers published in cited Journals (SCI):

1. **Nuclear Data Sheets for A=222,** Sukhjeet Singh, **A.K. Jain**, and J.K. Tuli. Nucl. Data Sheets **112** (2011) 2715.
2. **Effects of Coriolis and residual n–p interactions in the proton emission from ^{130}Eu**
   M. Patial, P. Arumugam, **A.K. Jain**, E. Maglione, L.S. Ferreira,
   Phys. Lett. B **718** (2013) 979.
3. **Structure of Dipole Bands in ^{112}In: Through Lifetime Measurement,**
   T. Trivedi, R. Palit, **A.K. Jain**, D. Choudhury, D. Negi, et al.,
   Journal of Physics: Conference Series **381** (2012) 012061.
4. **Small quadrupole deformation for the dipole bands in ^{112}In,**
   T. Trivedi, R. Palit, J. Sethi, S. Saha, S. Kumar, Z. Naik, A.K. Jain, D. Choudhury, et al.,
   Phys. Rev. C **85** (2012) 014327.
5. **Shape Evolution in Odd-A ^{137}Pm**
   A. Dhal, R.K. Sinha**, A.K. Jain**, et al., Eur. Phys. J. A **48** (2012) 28.

(B) Papers published in Conference Proceedings etc.

1. **Atlas of nuclear isomers & their Systematics**, **A.K. Jain**, Talk delivered at ANL, USA during a visit in August 2012.
2. **Atlas of nuclear isomers & their Systematics**, A.K. Jain, Invited talk in the workshop BRNS workshop on Evaluation of Nuclear Structure and Decay Data, November 26-29, 2012, VECC, Kolkata.
3. **Nuclear Theory for the Experimentalists and the Evaluators**, A.K. Jain, Invited talk in the workshop BRNS workshop on Evaluation of Nuclear Structure and Decay Data, November 26-29, 2012, VECC, Kolkata.
4. **NCAP: Atlas of Nuclear Isomers and Spin Systematics**, M. Patial, B. Maheshwari, M. Dhibar, **A. K. Jain,** P. Arumugam and B. Singh, Presented in the National Conference on Advances in Physics, 2012.
5. **Nonadiabatic quasiparticle description of proton emission from the odd-odd nucleus 130Eu**, M. Patial, P. Arumugam, **A. K. Jain**, E. Maglione, L. S. Ferreira, Proceeding of DAE Symp. Nucl. Phys. 57,214 (2012).
6. **Role of Newby Shift of K=0 in K=1 band of 180Ta**, Alpana Goel, **A. K. Jain**, M. Patial, K. Kaur, Proceeding of DAE Symp. Nucl. Phys. 57,260 (2012).
7. **Coriolis interactions in odd-odd proton emitters**, Monika Patial, P. Arumugam, **A. K. Jain**, E. Maglione, L.S. Ferreira, International Conference of Nuclear Structure 2012, Argonne National Laboratory, USA, Aug. 13-17, 2012.
8. **Theoretical description of proton decay by Non-adiabatic approach**, M. Patial, P. Arumugam, **A. K. Jain**, E. Maglione and L.S. Ferreira, Proceeding of the National Conference on Advances in Physics 105-106, 2012.
9. **Non-adiabatic approach for odd-odd proton emitters**, M. Patial, P. Arumugam, **A. K. Jain**, E. Maglione, and L.S. Ferreira, presented in Joint ICTP-IAEA Workshop on Nuclear Structure Decay Data: Theory and Evaluation, Trieste-Italy, 2012.
10. **Theoretical description of proton emission by nonadiabatic approac,** M. Patial, P. Arumugam, **A. K. Jain**, E. Maglione, and L.S. Ferreira, to be published in AIP Conf. proceedings of ICRTNP 2012.
11. **Empirical rule for pair break mechanism in three-quasiparticle rotational bands**, S. Singh, S. Kumar, **A.K. Jain**, J.K. Sharma, Proceeding of DAE Symp. Nucl. Phys. 56, 374 (2011).
12. **Nonadiabatic effects in odd-odd deformed proton emitters**, M. Patial, P. Arumugam, **A. K. Jain**, E. Maglione and L.S. Ferreira, AIP Conference Proceedings 2011, 111(1).
13. **Isospin conservation in neutron-rich fission fragments from thermal neutron induced fission, A.K. Jain** and D. Choudhury, Proceeding of DAE Symposium on Nuclear Physics, Vol. 56 (2011) 208.
14. **Search for twin shears mechanism in odd-A ^{107}Cd,** D. Choudhury, **A.K. Jain**, et al., Proceedings of DAE Symposium on Nuclear Physics, Vol. 56 (2011) 210.
15. **Small axially symmetric deformation for the dipole band in ^{112}In,** T. Trivedi, R. Palit, **A.K. Jain**, et al., Proceedings of DAE Symposium on Nuclear Physics, Vol. 56, (2011) 226.
16. **Chiral partner bands in ^{98}Tc**, R K Sinha, A Dhal, D Negi, D. Choudhury, **A. K. Jain**, et al., Proceedings of DAE Symposium on Nuclear Physics, Vol. 56, (2011) 244.
17. **Polarization asymmetry measurements for the yrast band of ^{85}Rb,** S Kumar, V Kumar, D. Choudhury, **A.K. Jain**, et al., Proceedings of DAE Symposium on Nuclear Physics, Vol. 56, (2011) 322.
18. **Band moment of inertia in Signature partner and Identical SD bands in A = 190 mass region,** Neha Sharma, H, M, Mittal, **A. K. Jain**, Proceedings of DAE Symposium on Nuclear Physics, Vol. 56 (2011) 332.
19. **Influence of band interaction on super deformed rotational bands,** H.M. Mittal, Neha Sharma, **A. K. Jain**, Proceedings of DAE Symposium on Nuclear Physics, Vol. 56, (2011) 334.

20. **Negative Parity States in ^{86}Sr,** S Kumar, V Kumar, D Choudhary, **A.K. Jain**, et al., Proceedings of DAE Symposium on Nuclear Physics, Vol. 56 (2011) 400.
21. **Complexity of energy levels of light nuclei,** Sushil Kumar, S. R. Jain, S. S. Dhindsa **, A.K. Jain,** Proceedings of DAE Symposium on Nuclear Physics, Vol. 56 (2011) 408.
22. **Multiple anti-magnetic rotation bands in odd-A ^{107}Cd,** D. Choudhury, **A.K. Jain**, et al., Frontiers in Gamma-Ray Spectroscopy 2012, IUAC, New Delhi, (March 5-7, 2012).
23. **Anti-magnetic rotation in odd-A Cd isotopes,** D. Choudhury and **A.K. Jain**, Poster presentation in the National Conference on "Advances in Physics", Dept. of Physics, I.I.T. Roorkee, Feb. 25-26, (2012).
24. **Isotopic Enrichment of Water during Evaporation under Reducing and Constant Volume Conditions,** P. Devi, **A.K. Jain** and M.S. Rao, Poster presentation in the National Conference on Advances in Physics at I.I.T. Roorkee, India, February 25-26, 2012.
25. **Investigation of Temperature and Salinity induced Water Mixing using Oxygen Isotopes,** P. Devi, M.S. Rao, **A.K. Jain** and B. Kumar, National seminar on Applications of Isotopes and Radiation Technology for Societal Benefits, Bangalore University, during 21-23 June, 2012.
26. **Search for anti-magnetic rotation in odd-A ^{107}Cd,** D. Choudhury, **A.K. Jain**, G.A. Kumar, S. Kumar, S. Singh, et al., Poster presentation in the International Conference on "Nuclear Structure 2012", Argonne National Laboratory, USA, 2012.
27. **Novel band structure of odd-A ^{107}Cd**, Deepika Choudhury, **A.K. Jain**, G. Anil Kumar, Suresh Kumar, Sukhjeet Singh, et al., accepted for presentation in DAE Symposium on Nuclear Physics, 2012.

STATUS REPORT OF THE NUCLEAR STRUCTURE AND DECAY DATA EVALUATION ACTIVITIESAT THE AUSTRALIAN NATIONAL UNIVERSITY IN 2011-2013 (T. KIBEDI**)**

A major part of the activity focused on improving the theoretical calculations of Internal Conversion Coefficients and incorporating them in updated versions of the BrIcc code. These include

- New calculations of theoretical DF atomic binding energies with semi-empirical corrections: the Breit electron interaction was used with QED corrections (ADNDT 98 (2012) 313-335; 2012Ki04). The new tables will be incorporated into BrIcc V3.0.
- BrIcc – v2.3 (2-Oct-2012):
  - Different default MR values are available when no MR is given (with B. Singh, McMaster)
  - MR=1.0 for E2/M1 and E3/M2; MR=0.1 for the rest
  - MERGE operation and documentation improved
  - Windows/Linux/Machintosh supported
- BrIccMixing – v2.3 (2-Oct-2012)
  - Windows/Linux/Machintosh using GNUPLOT
  - MR values deduced from subshell CE intensity ratios need to be reviewed since with BrIcc theoretical ICC`s often change
  - Comments and suggestions are welcome
- Electronic factors for E0 transitions (with G. Gosselin, V. Meot, and M. Pascal, CEA, Saclay)
  - Z=10-95, E=1-600 keV tables compiled and tested
  - Ω_{CE}(E0) values and ratios are compared previous calculations (1969Ha61, 1970Be87, 1986PaZM)
  - New horizontal evaluation of ratios of experimental Ω_{CE}(E0)
  - ADNDT publication & ND2013 presentation

Other activites include:

- **Mass chain evaluations**

  The ANU has primary responsibilities for A=172-175:
  - A172 with C. Baglin (evaluation continued)
  - A174 with F.G. Kondev (ANL) and H. Xiaolong (CIAE, China) (evaluation started)
- **Tables of Prolate Deformed Nuclear K-**Isomers (with F.K. Kondev, ANL and G.D. Dracoulis, ANU)

  Adopted spectroscopic information on K-forbidden transitions depopulating high-K isomeric states in nuclei ranging from A>100 has been deduced by critical evaluation of the available experimental data. Values of f_n, the reduced hindrance factor per degree of K-forbiddenness, have been determined. The work was continued to collect primary experimental information from published works, conference proceedings and other sources. The evaluated information is stored in ENSDF format and BrIcc and a modified version of the RULER code is used for the analysis. The ANU responsible for the Z=74-75 isotopes.

  New model to evaluate atomic radiation in nuclear decay (with A.E. Stuchbery, B.Q. Lee, K. Robinson (ANU), F.G. Kondev (ANL))

  Stemming from urgent needs for reliable updated data on Auger electrons for medical applications (see IAEA report INDC-NDS-0596).

  Publication: Lee, Kibedi, Stuchbery and Robertson, Comp. Math. Methods in Medicine, Vol. 2012, Article ID 651475 (doi: 10.1153/2012/651475).

  Presentation at Int. Conf. for Nuclear Data in Science and Technology ND2013.

Participation in IAEA Coordinated Research Project on "Nuclear data for charged-particle monitor reactions and medical isotope production".

- **Presentations at workshops and meetings**
  - "Frontiers of Nuclear Data Physics and Related Applications", Faculty of Science, King Abdulaziz University (KAU), Jeddah, Saudi Arabia, September 10-12, 2011.
  - DDEP workshop 8th – Weds 10th October 2012, Paris.

Our future plans are as follows:

- **BrIcc**
  - Z=5 -126 using ICC with "Frozen Orbitals" approximation
  - Z=10-95 Electronic factors for E0
  - Correct treatment of mixed E0+E2+M1 transitions
- **Atomic radiations**
  - Ab initio calculation of transition rates and energies
  - Develop a tool for evaluators

STATUS REPORT KUWAIT NUCLEAR DATA PROJECT

Physics Department, **Kuwait University**
(A. Farhan)

This report covers the Kuwaiti group's activities for the period April 2011 – January 2013;

- A. Farhan (KU) and B. Singh (McMaster University) are currently working on A = 76 (expected completion in March 2013).
- A. Farhan is still working as a part-time researcher for the project.
- The Kuwait Group will continue its collaboration with B. Singh in order to fulfill its commitments.

The Kuwait Nuclear Data Project has permanent responsibility for evaluating and updating ENSDF for A = 74 -80. The status of the mass chains is:

- A = 74 (2006)
- A = 75 (1999) √
- A = 76 (1995) √
- A = 77 (2012)
- A = 78 (2009)
- A = 79 (2002)
- A = 80 (2005)

PROGRESS REPORT ON NUCLEAR STRUCTURE AND DECAY DATA ACTIVITIES AT MTA ATOMKI

(J. Timár and Z. Elekes)

1. About the Debrecen evaluation center

The center at the Institute for Nuclear Research (MTA Atomki) consists of two evaluators: János Timár and Zoltán Elekes, who devote altogether 0.5 FTE to mass-chain evaluation work. We have been working on mass-chain evaluation since 2009. Until now we have been working on mass chains that were temporarily assigned to us. Now we have permanent responsibilities, which are the A=101-105 mass chains. Our evaluation work is funded mainly by MTA Atomki, but we have also received considerable financial support from IAEA through Research Contract No. 15902/R0, and from the McMaster University. Besides financial supports, we received great help from Balraj Singh to start and build up our evaluation work.

2. Mass-chain evaluation in the 2011-2012 period

In the covered period, we evaluated the A=128, A=129 and A=46 mass chains.

1) The evaluation of the A=129 mass chain had started in the previous period, however due to appearance of new important published and unpublished data after the review of the NDS manuscript, we decided to include them into the new evaluation. It is in post review status.
2) The evaluation of the A=128 mass chain has been finished, and it has been submitted to NNDC. It is in pre review status.
3) The evaluation of the A=46 mass chain is still in progress, but it is close to be finished and to be submitted to NNDC.

3. Plans for the next period

The group plans to continue the mass-chain evaluation on a basis of about one mass chain per year. For the next period we plan to finish and publish the A=129, 128 and 46 mass chains. Also, as the mass chains of A=105 and A=101, from our permanently assigned mass chains, has been updated last in 2004 and 2006, respectively, we plan to evaluate these two mass chains starting with A=105.

NUCLEAR DATA EVALUATIONS AT MANIPAL UNIVERSITY: A=260-265

Status Report: March 31, 2011 to March 31, 2013

(M. Gupta, Manipal University, T.W. Burrows, NNDC)

A=260-265

The evaluation methodology developed in 2005Gu33 (A=266-294) has been applied to the mass region A=260-265. While the evaluation technique is based on 1992Ba77, additional evaluation tools include using the approximations of 1984Sc13 for estimates of half-lives and an updated parameter set for the Viola-Seaborg phenomenology (1966Vi04).

The nuclides which form the subject matter of the present evaluation were covered in 1999Ar21, 1999Ak02, and 2001Ak11 and 2000Fi12 (^{265}Rf). New data are available and an update is due. Also, some of the α-decay mass chains from heavier nuclei (A≥266) end in this region and it was felt that the same evaluation methodology adopted for (distant) ancestors could be usefully extended to descendants within a given α-decay chain for consistency and uniformity of treatment. In instances where no new data are available, a re-evaluation of existing data within this internally consistent framework also yields useful information.

The current evaluation spans about 9 elements comprising about ≈31 observed nuclides. Approximately 40% of these nuclides have been experimentally studied using chemical techniques which often provide increased statistics and could be used for independent verification of the data.

Relevant experimental quantities such as information on cross-sections and atomic properties derived from chemical studies are also provided.

Future Plans:

It is intended that data evaluations for the mass region A≥260 will be continued.

References:

1966Vi04: J. Inorg. Nucl. Chem. **28** (1966) 741, V.E. Viola, Jr., G.T. Seaborg; Nuclear Systematics of the Heavy Elements - II. Lifetimes for Alpha, Beta and Spontaneous Fission Decay.

1984Sc13: Z. Phys. A **316** (1984) 19; K.-H. Schmidt, C.-C. Sahm, K. Pielenz, H.-G. Clerc, Some Remarks on the Error Analysis in the Case of Poor Statistics.

1992Ba77: Prog. Part. Nucl. Phys. **29** (1992) 453; R.C. Barber, N.N. Greenwood, Z. Hrynkiewicz, Y.P. Jeannin, M. Lefort, M. Sakai, I. Ulehla, A.H. Wapstra, D.H. Wilkinson; Discovery of the Transfermium Elements.

1999Ar21: Nucl. Data Sheets **88** (1999) 155, A . Artna-Cohen; Nuclear Data Sheets for A = 249-265 (odd).

1999Ak02: Nucl. Data Sheets **87** (1999) 249, Y.A. Akovali, Nuclear Data Sheets for A = 248, 252, 256, 260, 264.

2000Fi12: Nucl. Data Sheets **90** (2000) 391, R. B. Firestone, J. Gilat, Nuclear Data Sheets for A = 267-293.

2001Ak11: Nucl. Data Sheets **94** (2001) 131, Y.A. Akovali, Nuclear Data Sheets for A = 250, 254, 258, 262, 266.

2005Gu33: Nucl. Data Sheets **106** (2005) 251; Erratum Nucl. Data Sheets **107** (2006) 789; M. Gupta, T.W. Burrows; Nuclear Data Sheets for A = 266-294.

ANNEX 7

TECHNICAL PRESENTATIONS

Name	Technical Presentations	Link
M. Rossbach (Julich)	Sample Preparation for (n,γ) Cross Section Measurements of Actinides	PPT
E. McCutchan (BNL)	B-n decay probability systematic	PPT
N. Nica (Texas A&M)	119mSn-A difficult experimental case to test internal-conversion theory	PPT
T. Kibedi (ANU)	New code to evaluate atomic radiations in nuclear decay	PPT
S. Siem (Univ. Oslo)	Nuclear data for level density and photon strengths	PDF
G. Mukherjee (VECC)	TAG measurements at VECC	PPT
A.Sonzogni (BNL)	Anti-neutrino spectrum from nuclear reactors	PPT
P. Joshi (TIFR)	139-Ba decay:precise half-life measurement and gamma spectroscopy at BARC	PPT
A.Negret (HH-IFNF)	The RoSphere array at the Tandem accelerator of IFIN-HH	PPT
J. Blachot (CEN)	Test of the visual average program	PDF
	Horizontal Evaluations	
N. Stone (Oxford Univ.)	Report on update of Tables of Nuclear Magnetic Dipole and Electric Quadrupole Moments	PPT
A. Jain (IIT)	Horizontal evaluations-Nuclear Isomers	PDF
M. Wang (CAS-Lanzhou)	The AME and Nubase evaluation: present and future	PPT
M. MacCormick (IPNO-Orsay)	A survey of isobaric analogue states in NUBASE2012	PDF
R. Firestone (LBNL)	Status of EGAF evaluation	PPT

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