The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

1939-8

Joint ICTP-IAEA Workshop on Nuclear Structure and Decay Data: Theory and Evaluation

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Introduction

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Trieste-08: Workshop on Nuclear Structure and Decay Data

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BROOKHAVEN NATIONAL LABORATORY

Trieste08

1. Aims of the workshop
2. Short History of Evaluations
3. Nuclear Structure and Decay Data Network

Workshop Aims

International Evaluation Activity in Nuclear Structure Physics

Nuclear Structure and Decay Data Network

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Workshop Aims

Get new evaluators into the system

Technical Assistance

Workshop - General

Databases currently in use

NSR

ENSDF

XUNDL

Workshop - General

Evaluation Methods and Policies

Workshop - General

Hands-on exercises

Evaluations
A Very Informal History

- How did we get here

  from there or

  from no where?

Evaluation History-cont

The first American Nobel Laureate, Albert A. Michelson, in an 1894 speech at U of Chicago lamented that

"The most important fundamental laws and facts of physical science have all been discovered.

Evaluation History-cont

- These are now so firmly established that the possibility of their ever being supplanted in consequence of new discoveries is exceedingly remote. Our future discoveries must be looked for in the sixth place of decimals.”
- Within three years of this speech, x-rays, the electron,and the radioactivity were discovered!!

Evaluation History-cont

- In last couple decades we have seen advent of:
- Fax
- Internet
- Cellular phone
- (liquid crystals, GPS technology)
- Soon to come: Nanotechnology

Evaluation History-cont

- Webster's Dictionary defines to compile as

"to put together, in a new form, out of materials already existing"

In scientific fields it involves to compact and serve as a convenient source of detailed information.

Evaluate as "to appraise; to determine value"

A good "compilation" always involves "evaluation".

Evaluation History-cont

- First Compilation of known nuclides was published by Giorgio Fea in 1935:

  Tabelle Riassunitive E Bibliografia delle Transmutazioni Artificiali,

  Nuovo Cimento 6, 1 (1935)

Evaluation History-cont

- First Evaluation as Table of Isotopes published

  by J.J. Livingwood and G. T. Seaborg –

  Rev Mod Phys 12, 30 (1940)
- Evaluation Limited to Artificially Produced Nuclear Species – Immediate use in identification and radiotracers

Evaluation History - cont

The subsequent editions of Table of Isotopes included all nuclear species:

- G.T. Seaborg, Rev Mod Physics 16, 1 (1944)
- G.T. Seaborg, I. Perlman, *ibid*. 20, 585 (1948)
- D. Strominger, J.M. Hollander, G.T. Seaborg, *ibid.*, 30, 585 (1958)
- J. M. Hollander, I. Perlman, and G. T. Seaborg, *ibid*., 25, 469 (1953)

Evaluation History - cont

The subsequent editions of Table of Isotopes

Published by John Wiley:

6th Edition: C. M. Lederer, J. M. Hollander, and I. Perlman

7th Edition: Editors: C. M. Lederer, V. S. Shirley;

Principal Authors: E. Browne, J.M. Dairiki, andR.E. Doebler;

Authors: A.A. Shihab-Eldin, L.J. Jardine, J.K. Tuli, and A.B. Buyrn

Evaluation History - cont

The 8th, and the last, edition of Table of Isotopes was also published by John Wiley in two volumes, ~3000 pages+ CD ROM:

Editors: R.B. Firestone, V.S. Shirley

Assistant Editors: C.M. Baglin, S.Y. Chu, J. Zipkin

Unlike previous editions, it is derived, and not an independent evaluation

Evaluation History - cont

In 1941 an Editor of Table of Isotopes observed

"The rate at which radioactivities are discovered may be reduced very considerably and the table would itself become stable."

That clearly did not happen!

Evaluation History - cont

There were other parallel evaluation efforts:

Some of these were:

T. Lauritsen (and later F. Ajzenberg-Selove) (1948-on)

B.S. Dzhelepov (and later with L. Peker and others) in USSR (1950-on)

P. M. Endt (and later with C. van der Leun) (1954 – on)

Evaluation History - cont

Wall Chart

Emilio Segre, as part of Enrico Fermi's group, introduced first chart, with Z along the x-axis and N along the Y axis.

Segre's chart was published in 5/1945 as Los Alamos report with classified data omitted!

In 1948 G. Friedlander and M. Perlman, at GE Research Lab, created the first GE chart with Z and N reversed. Sixteen editions have since been published by Knolls Atomic Power Lab

Evaluation History - cont

Nuclear Data Sheets

Katherine Way as part of Manhattan Project working at Clinton Lab (later renamed ORNL) began collecting nuclear data.

In 1948 Way headed the Nuclear Data Project at US National Bureau of Standards (later renamed US National Inst of Standards and Technology (NIST)

Evaluation History - cont

A “Nuclear Data” report was published in 1950.

The data included measured values, with references, of: isotopic abundances, methods of production, n cross sections, half-lives, decay modes, energies and intensities of radiations, conversion coefficients and some reaction data and some decay schemes. There were no recommended values or uncertainties given.

Evaluation History - cont

In 1953, the Nuclear Data Project, moved under the US National Academy of Sciences-National Research Council in Washington, DC

The published data, as AEC reports, now also included coin, mass assignments, n-, p- separation energies, total disintegration energies, spins, magnetic and electric moments. Uncertainties were given with a single decay scheme for all isobars for given A.

The data were in form of loose-leaf pages called the "NUCLEAR DATA SHEETS"

Evaluation History - cont

In 1964, the Nuclear Data Project, under the leadership of Katherine Way moved back to Oak Ridge National Lab, where her effort had originally started in 1948.

The Nuclear Data Sheets were once again to be published in a book form by the Academic Press, rather than the single sheets of data.

Evaluation History - cont

Nuclear Data Sheets-Journal

In February 1966, Nuclear Data Sheets started as the section B of the journal Nuclear Data, and later as simply Nuclear Data Sheets, published by the Academic Press

The section A of Nuclear Data was started in December 1965 as Atomic Data Tables.

In August 1973 Two journals Atomic Data and Atomic Data A merged as Atomic and Nuclear Data Tables with K. Way as the Editor

Evaluation History - cont

Evaluations limited to NDP-ORNL effort

Time lag in evaluations (1970-71)

Employment situation was not good for Ph.D.'s

NSF/NAS joined to make evaluations more current.

Created three-year NIRA program. Recruited two sets of 12 young Ph.D's for two-year terms. Some stayed in evaluation business at the end of the program.(1971-74)

Evaluation History - cont

Hand-written data sheets. Draftsman drawn drawings.

Bruce Ewbank at ORNL was instrumental in

Computerization of recent references (NSR)

Computerization of drawings

Common input format for tables and drawing

Evaluated Nuclear Structure Data File

Evaluation History - cont

Subsequent to the completion of NIRA program, it was proposed in 1975 that the evaluation activity be decentralized with international involvement under the auspice of IAEA, Nuclear Data Section. The evaluation responsibility was divided amongst various data centers within and outside the US. The NNDC at BNL coordinated the national and the international effort for the US/DOE. But the lead role in editing and processing of evaluation continued at the NDP/ORNL.

Evaluation History - cont

Change of production responsibility to NNDC, however, came about in 1980 when ORNL management support for the activity dropped considerably.

The NNDC took over production of Nuclear Data sheets in 1981 and completely computerized the process. Photo-ready copy of the journal has since been supplied to the publisher.

Evaluation History - cont

The ORNL and NNDC jointly edited the journal until June, 1998 when Murray Martin, who started evaluation work with Katherine Way and served as the Editor-in-Chief of the journal while working at the Nuclear Data Project at ORNL, retired. With Murray's retirement the editing responsibility completely shifted to the National Nuclear Data Center.

Evaluation History - cont

Nuclear Data Sheets:

1966-1968	Editor: K. Way
	Asstt: A. Artna, N.B. Gove, W.B. Ewbank
1969-1976	Editor: D. Horen
	Asstt. Editor: W.B. Ewbank
1976-1980	Editor: W.B. Ewbank
1981-1998	Editor-in-Chief: M. J. Martin
	Editor: J.K. Tuli
1999-	Editor: J.K. Tuli

Nuclear Structure and Decay Data Network

Created in 1975 under auspice of the IAEA, Nuclear Data Section.

1. IAEA coordinates international groups
2. Meets every two years
3. Discuss Responsibilities
4. Cooperate in evaluation and program development

Nuclear Structure and Decay Data Network

US Network (~ 6 FTE)

BNL

INEEL

LBNL

McMaster, Canada

ORNL

TUNL

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Nuclear Structure and Decay Data Network –Cont.

Non-US Contributors

Argentina
Australia
Belgium
Bulgaria
Canada
China
France
Japan
Kuwait
Russia

Nuclear Structure and Decay Data Network –Cont.

WHAT DO WE DO?

Primary mission:

Evaluate (or compile) structure & decay data, A=1-294, for inclusion in ENSDF (or XUNDL) database.

Other responsibilities:

- Maintenance of checking & evaluation software
- Peer review of evaluations
- Dissemination of the data

Nuclear Structure and Decay Data Network –Cont.

OUR PRINCIPAL DATABASES

(Web accessible from NNDC or mirror sites;
http://www.nndc.bnl.gov links you to them).

- **NSR** - Nuclear Science References
- **ENSDF** - Evaluated Nuclear Structure Data File
- **XUNDL** - Unevaluated data compiled from recently published literature

Nuclear Structure and Decay Data Network –Cont.

Analysis Programs

Services to community and evaluators

Web access, from NNDC or its mirror sites;
http://www.nndc.bnl.gov links to all

Publications: NDS, TOI, WC