Trieste05

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Trieste05

- Introduction
- History of Evaluation
- NSDD network
- Workshop Aims

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Introduction

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.

Introduction-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!!

Introduction-cont

In last couple decades we have seen advent of:

Fax

Internet

Cellular phone

(liquid crystals, GPS technology)

Soon to come: Nanotechnology

Evaluation History

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".

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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)
- J. M. Hollander, I. Perlman, and G. T. Seaborg, ibid., 25, 469 (1953)
- D. Strominger, J.M. Hollander, G.T. Seaborg, ibid., 30, 585 (1958)

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

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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

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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.

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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

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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

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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

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Nuclear Structure and Decay Data Network –Cont.

WHAT DO WE DO?

Primary mission:

Evaluate (or compile) structure & decay data, A=1-293, for inclusion in ENSDF (or XUNDL) database.

Other responsibilities:

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

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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

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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

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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

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Workshop - General

Databases currently in use

ENSDF

XUNDL

Workshop - General

Evaluation Methods and Policies

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Workshop - General

Hands-on exercises

Evaluated nuclear Structure Data Base

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ENSDF

- Source For
  Table of Isotopes
  Nuclear Data Sheets
  Nuclear Wallet Cards
  NUDAT
- Update – continuous
- Distributed – six monthly

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General

- Evaluated results of a single experiment or combined results of a number of experiments yielding basically the same kind of information, e.g., (HI,xng), or Coulomb Excitations. The collection is called a Data Set.
- The adopted Properties of the nucleus.

GS Properties

- Q(beta-)
- N-Separation Energy
- P-Separation Energy
- Alpha-Decay Q value
- Half-life
- Spin-parity
- Decay Modes
- Static Moments

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Level Properties

- Spin-parity
- Half-life
- Angular Momentum transfer
- Spectroscopic Factor
- Decay braching
- Static Moments
- Configuration
- Experiments in which level is seen

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Level Properties –Special Cases

- Configuration assignments
- Band Assignments, Parameters
- Isomer Shifts, isotope shifts
- Charge distribution og gs, often only a reference
- Deformation parameters of gs (model dependent)
- Excitation Probabilities (BEL, BML) when the T1/2 and ga branching are not known

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Radiation Properties

- Placement in level scheme
- Energy
- Intensity –Relative and Absolute through Normalization. Per 100 decay modes for Alphas.

  Transition Intensity. EC, B+ decay (theory).

  Partial EC probabilities.
- Multipolarity and Mixing Ratios
- Total internal Conversion Coefficients
- Logft values/ Hindrance Factors
- Reduced Transition Probability-down –W.u.

ENSDF Content

- Collection of Data Sets by A and Z

  Abstract (Comments)

  Adopted Levels, Gammas

  Experimental Data Sets
  -Radiactive Decay
  -Nuclear Reactions

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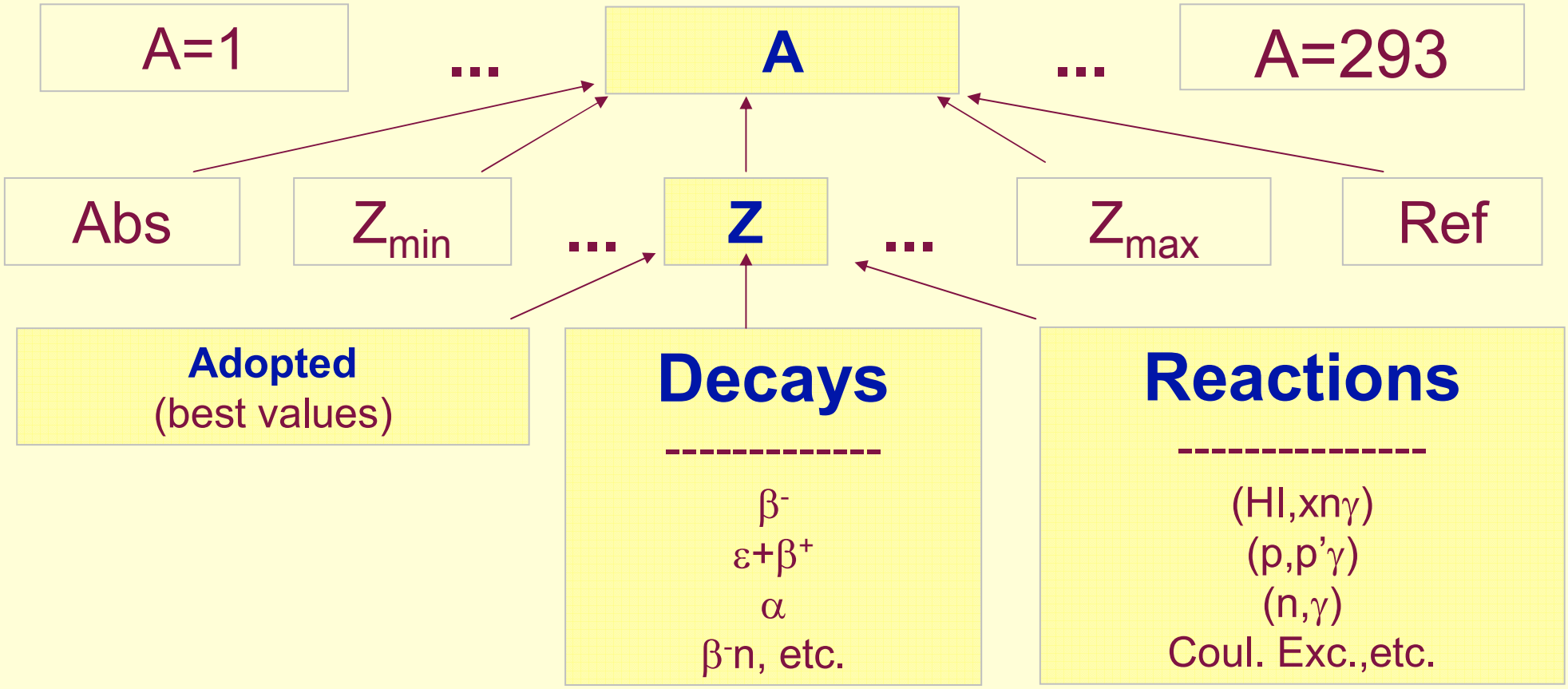
ENSDF Schematic



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Record Types

ID	LEVEL
History	BETA
XREF	EC
Comments	ALPHA
Q-value	PARTICLE
Parent	GAMMA
Normalization	END

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Identification Record

Required for all data sets.Must precede all other records.

Field (Col.)	**Name**
1-5	NUCID
10-39	DSID
40-65	DSREF
66-74	PUB
75-80	DATE (year/month)

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The History Record

Field (Col.)	Name
1-5	NUCID
6	Blank
7	Blank
8	H
9	Blank
10-80	History

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The Q-value Record

Field (Col.)	Name		
1-5	NUCID		
8	Q	Letter ‘Q’ is required	
10-19	Q^-	20-21	DQ^-
22-29	SN	30-31	DSN
32-39	SP	40-41	DSP
42-49	QA	50-55	DQA
56-80	QREF		

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The Cross-Reference Record

Field (Col.)	Name	
1-5	NUCID	
8	X	Letter ‘X’ is required
9	DSSYM	Any ASCII character
10-39	DSID	*Must* exactly match one of ID’s

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The Comment Record

Field (Col.)	Name	
1-5	NUCID	
7	Letter ‘C’, ‘D’, or ‘T’ is required	
8	RTYPE	Blank or record type
9	PSYM	Blank, or symbol
10-80	CTEXT	Text of the comment.

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The Parent Record

Field	Name	
1-5	NUCID	
8	P (required)	
9	Blank or integer	
10-19	E Energy	20-21 DE
22-39	JPI	
40-49	T	50-55 DT
65-74	QP	75-76 DQP
77-80	Ionization State	

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The Normalization Record

Field	Name	
8	N (required)	
10-19	NR	20-21 DNR
22-29	NT	30-31 DNT
32-39	BR	40-41 DBR
42-49	NB	50-55 DNB
56-62	NP	63-64 DNP

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The Prod Normalization Record

Field	Name	
8	N (required)	
10-19	NR*BR	20-21 DNR
22-29	NT*BR	30-31 DNT
42-49	NB*BR	50-55 DNB
56-62	NP	63-64 DNP
77	Blank or C	78 Opt (1-7)

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The Level Record

Field	Name	
1-5	NUCID	
8	L (required)	
10-19	E Energy	20-21 DE
22-39	JPI	
40-49	T	50-55 DT
56-64	L (angular momentum transfer)	
65-74	S (spect at)	75-76 DS
77	Flag	78-79 MS 80 Q

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The Beta Record

Field	Name		
1-5	NUCID		
8	B (required)		
10-19	E Energy	20-21 DE	
22-29	IB Intensity	30-31 DIB	
42-49	Logft	50-55 DFT	
77	Flag		
78-79	Forbiddenness	80 Q	

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The EC Record

Field	Name		
1-5	NUCID		
8	E (required)		
10-19	E Energy	20-21 DE	
22-29	IB Intensity	30-31 DIB	
32-39	IE Intensity	40-41 DIE	
42-49	Logft	50-55 DFT	
65-74	TI	75-76 DTI	77 Flag
78-79	Forbiddenness	80 Q	

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The Alpha Record

Field	Name	
1-5	NUCID	
8	A (required)	
10-19	E Energy	20-21 DE
22-29	IA Intensity	30-31 DIA
32-39	HF	40-41 DHF
77	Flag	
80	Q	

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The Gamma Record

Field	Name			
8	G (required)			
10-19	E Energy	20-21 DE		
22-29	RI rel Intensity	30-31 DRI		
32-41	M multipolarity			
42-49	MR mix ratio	50-55 DMR		
56-62	CC total CC	63-64 DCC		
65-74	TI	75-76 DTI		
77	Flag	78 COIN	80	Q

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The (Delayed-) Particle Record

Field	Name		
8	D (for delayed)	9	particle (N,P,..)
10-19	E Energy	20-21	DE
22-29	IP % Intensity	30-31	DIP
32-39	El lev en int nuc		
40-49	T Width	50-55	DT
56-64	L angular momentum transfer		
77	Flag	78 COIN	80 Q

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Purpose/Philosopy

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Purpose/Philosopy

- Present set of critically evaluated properties of nuclides based on best known experimental information to date
- Present best data available for each type of experiment
- Present best info for each nuclide
- Concise, consistent, and well-documented

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Minimum Standards

- A-Chain completeness – All nuclides
- Nuclide Completeness – All data sets
- Data Set Completeness – ID to END record

  Decay Data Sets: Parent record

  Adopted sets: Q record

  etc.

  Uncertainty, units, documentation

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Physical Properties

- Adopted Properties

  General – Q, History, XREF, Comments

  Levels-E,Jpi,T1/2,branching,static mom

  Gammas-E,branching,mult,cc,BLW

- Decay Properties
- Nuclear Reaction Properties

Guidelines-extraction of data

- Quote authors' measured quantities
- Document any deviations
- Note authors' assumptions
- Check for missed references
- Check authors' quoted older values

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Guidelines-presentation of data-1

- Order of Comments
- E= not needed for reaction
- Target JPI should be given
- Keyno: measured, etc.
- Do not combine different kind of data sets
- Specify source of data

Guidelines-presentation-2

- Gammas order by increasing Eg
- Significant digits
- Uncertainty limited to 25
- Multiplets
- Xsection,Analyzing-power,A2,A4 not given
- BEL up for levels, down for gammas
- Delayed gammas-give as IT decay

Guidelines-presentation-3

- Normalization condition should be given
- Parent record, all fields should be given
- Replace `/' by `:' for multiple ratios
- Unresolved discrepancies should be pointed out
- Uncertainty not error
- E(ec),E(b-) only when accurate, measured

Guidelines-Systematics

- LogT1/2(alpha) vs Log E(alpha) is linear
- Takahashi's gross beta decay theory reliable to better than a factor of 3
- Alpha Decay HF
- Certain pairs of conf lead to isomeric transitions
- GS feeding from local systematics
- Mass syst from Audi

Guideline-Style

- APS style adopted
- Accepted abbreviations
- Key no. is plural. Space after `,’

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