TECHNISCHE UNIVERSITÄT DRESDEN

DRESDEN concept

Review on log*ft* values

23rd Technical Meeting of the Nuclear Structure and Decay Data Network

Xavier Mougeot, Balraj Singh, Steffen Turkat, Kai Zuber

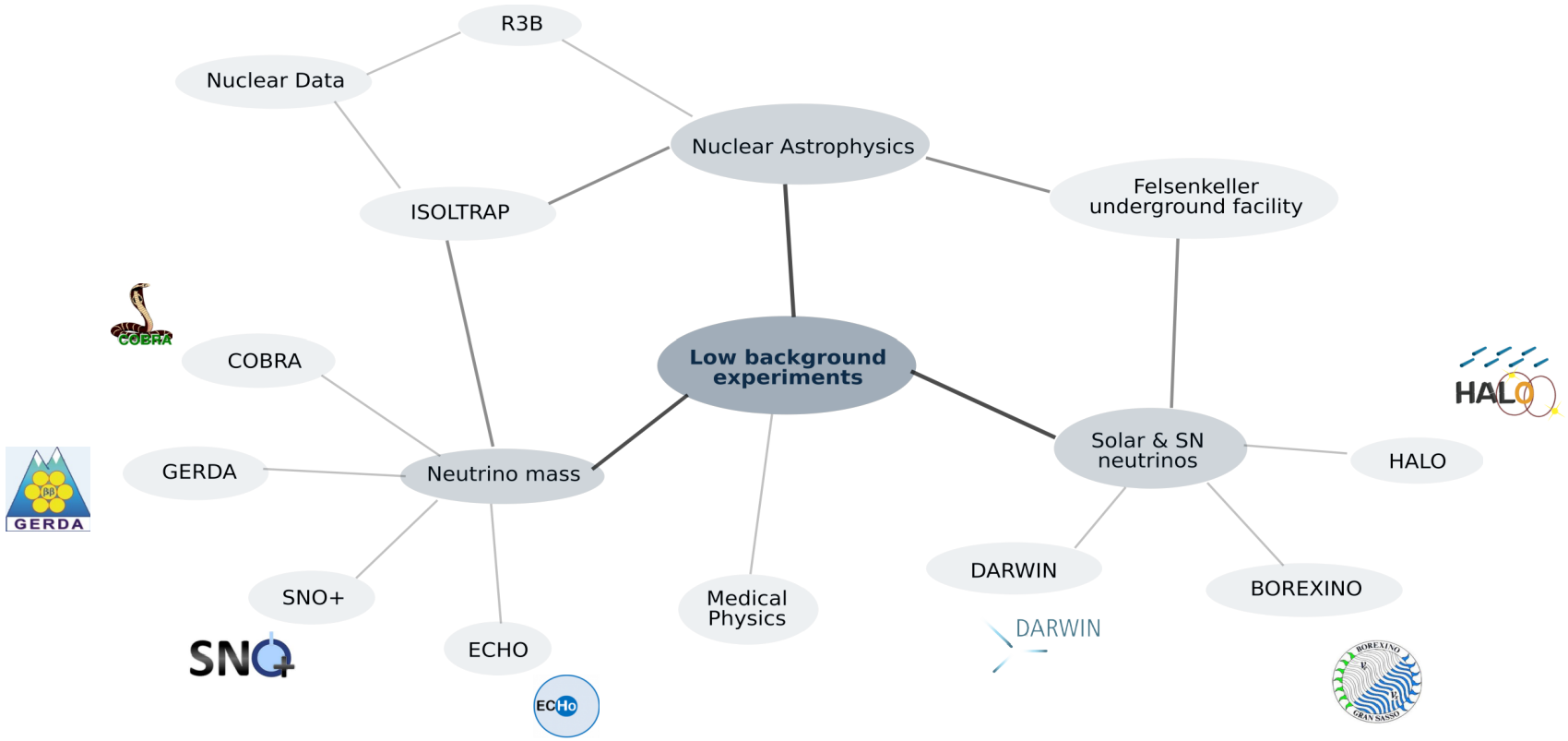
Institute for Nuclear and Particle Physics
TU Dresden

10.04.2019

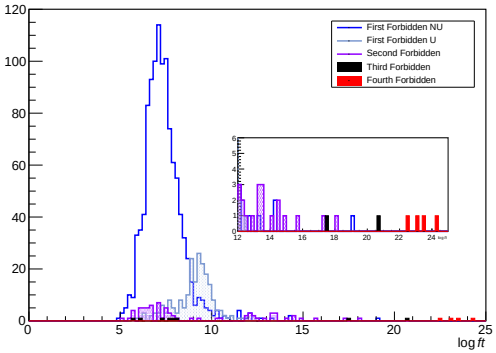
iktp

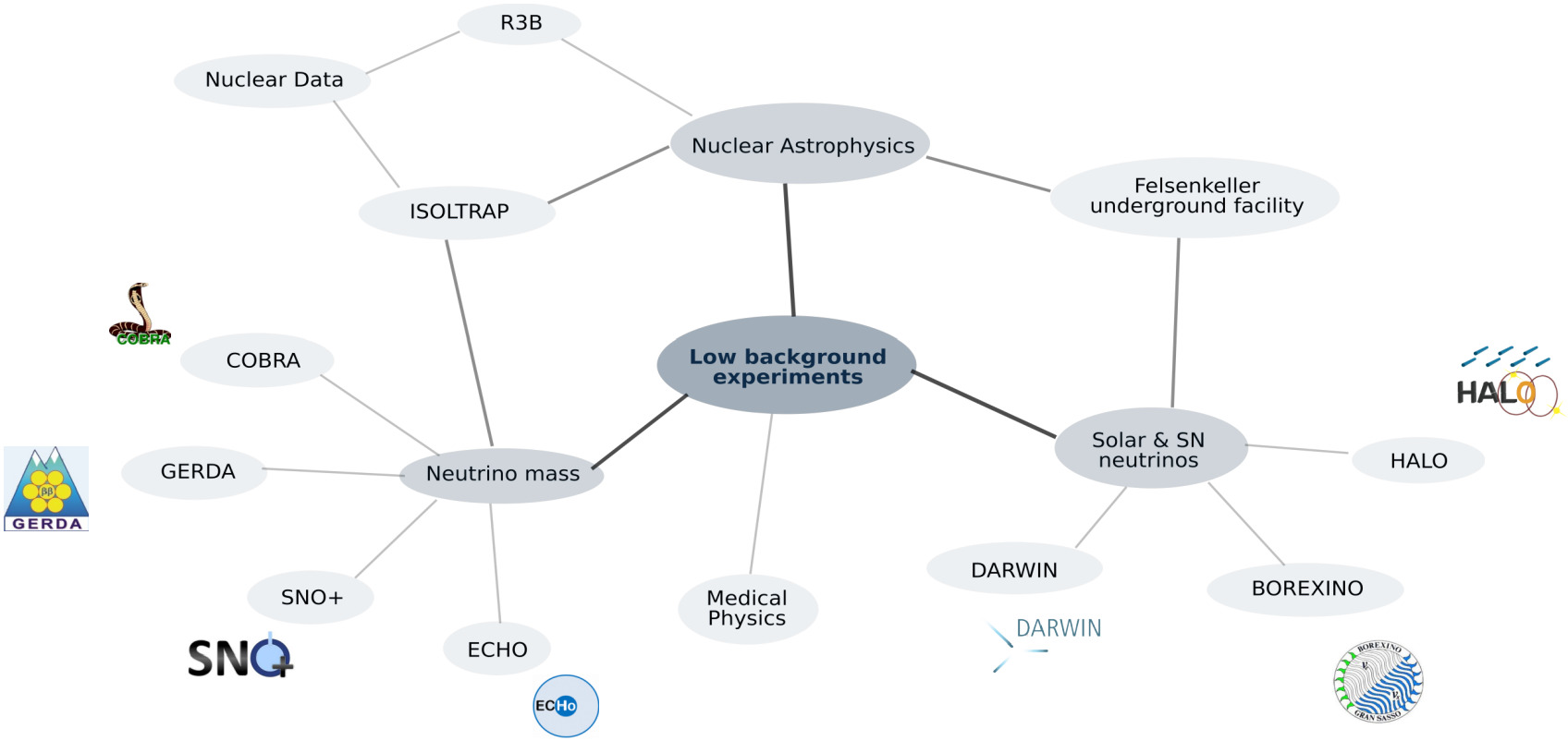
Konrad Adenauer Stiftung

Measuring rare processes at IKTP

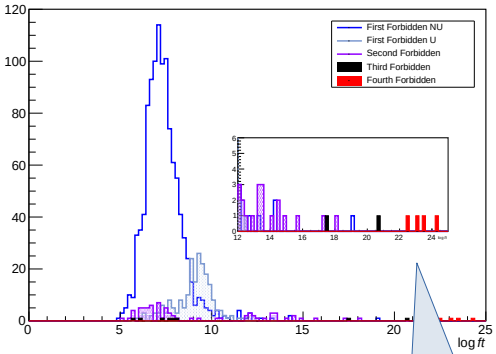


Measuring rare processes at IKTP

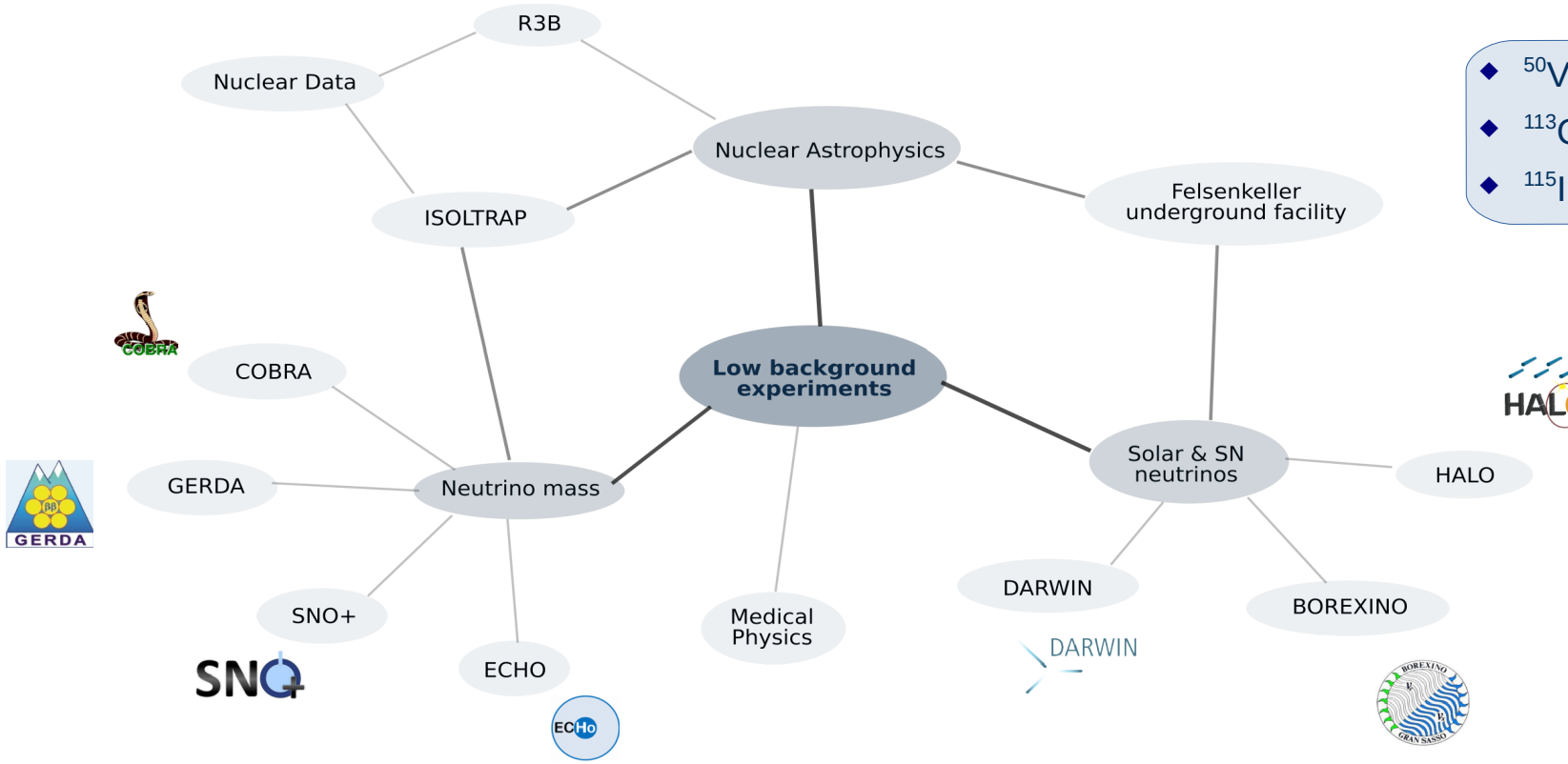




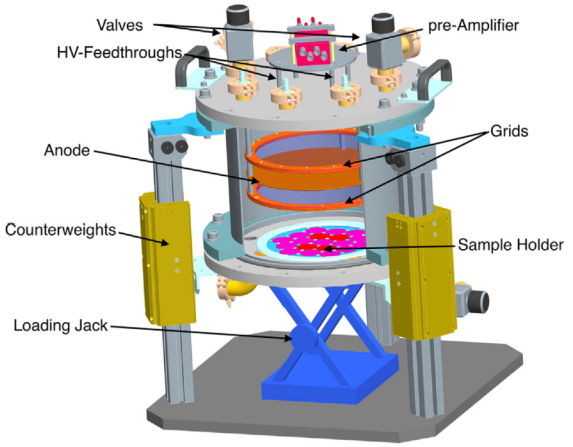
Measuring rare processes at IKTP



- ^{50}V ~ 10^{17} y
- ^{113}Cd ~ 10^{16} y
- ^{115}In ~ 10^{14} y



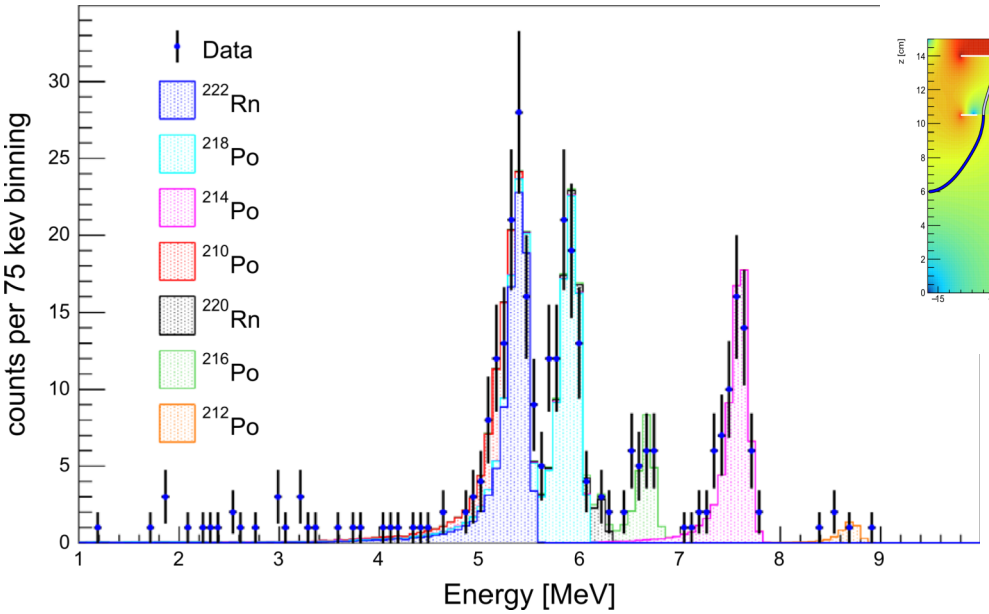
Alphaspectrometry at IKTP

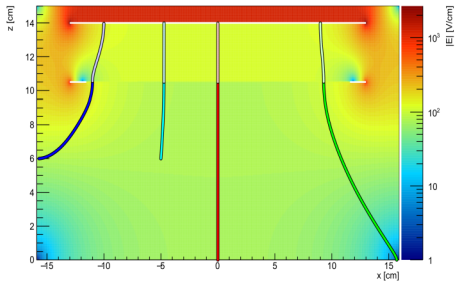


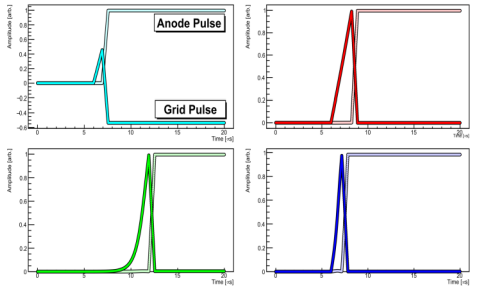
Frisch-grid ionization chamber

→ Record pulse-shapes of grids and anode

→ Pulse-shape discrimination







A. Hartmann et al. NIM A814 (2016) 12 (Heinrich.Wilsenach@tu-dresden.de)

Low-background measurements

→ BG rate: 10.9(6) counts per day

→ Efficiency: 49.3(11)%

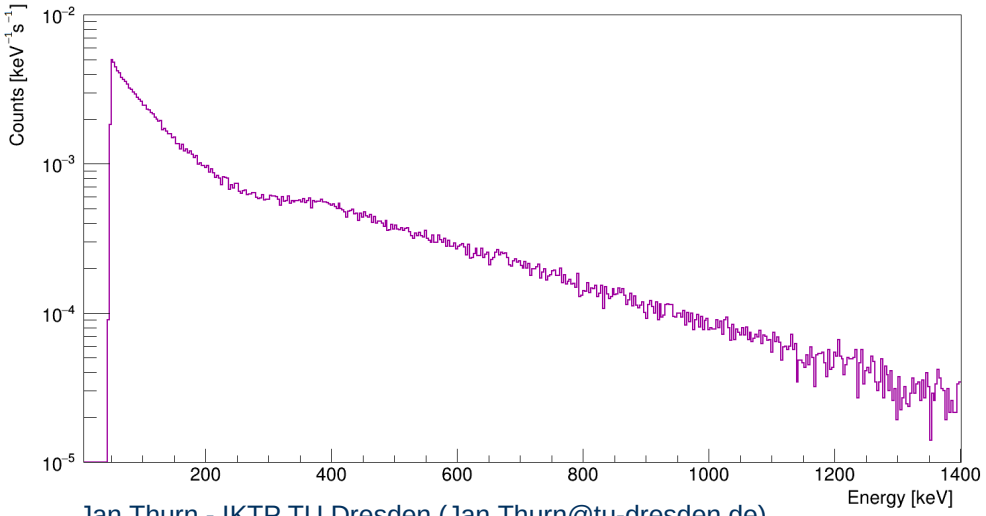
Betaspectrometry at IKTP

Betachamber

→ 6 PIPS-detectors (Passivated Implanted Planar Silicon)

→ Evacuated graded shield

→ Future: Myon veto + Underground facility



Low-background measurements

→ BG rate: <1 count per second

→ Investigations ongoing

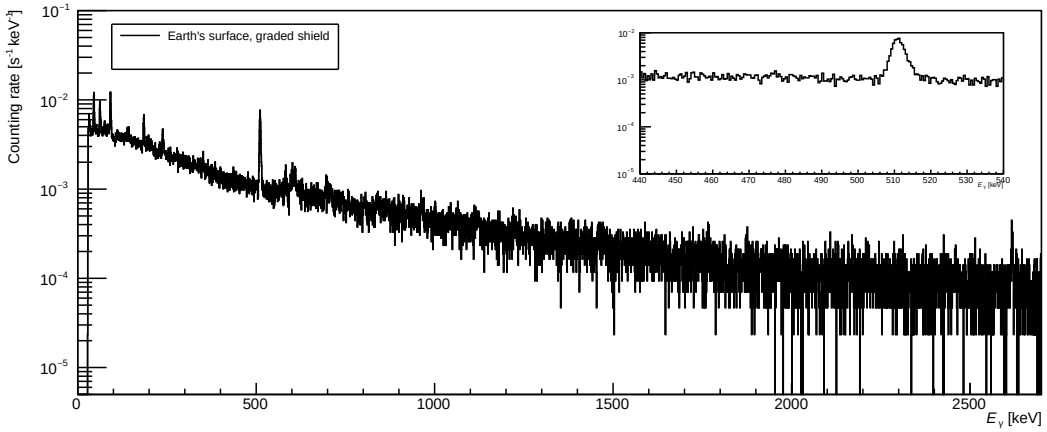
Jan Thurn - IKTP TU Dresden (Jan.Thurn@tu-dresden.de)

Gammaspectrometry at IKTP

Felsenkeller underground laboratory

→ Shallow-underground facility (45m rock overburden)

→ 150% HPGe detector with graded shielding



Gammaspectrometry at IKTP

Felsenkeller underground laboratory

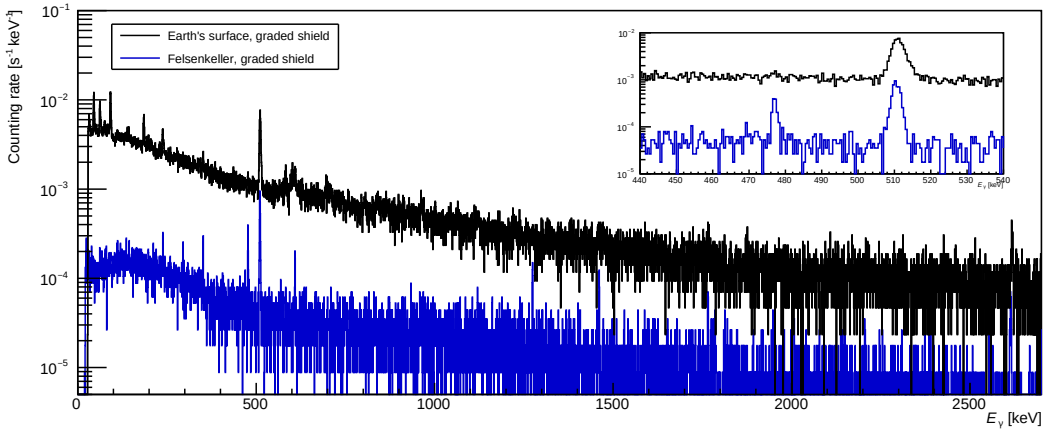
→ Shallow-underground facility (45m rock overburden)

→ 150% HPGe detector with graded shielding

Ultra-low-background γ - spectrometry

→ Activity (^{7}Be) ~ 20mBq → Future: < 1mBq

→ Background rate (40keV-2700keV) ~ 5min^{-1} → Future: <1min^{-1}



Log*ft* values

$$\log ft \begin{cases} \rightarrow f_\beta = \int_1^{W_0} N(W)\mathrm{d}W \\ \rightarrow t = T_{1/2} / I_\beta \end{cases}$$

f_β : Fermi-Integral

$\frac{\mathrm{d}N(W)}{\mathrm{d}W}$: Shape of the β-spectrum

t : Partial half-life

	ΔJ		ΔΠ
Superallowed:	$0^+ \rightarrow 0^+$		no
Allowed:	0,1		no
	Non-unique	**unique**	
1st forbidden	0,1	2	yes
2nd forbidden	2	3	no
3rd forbidden	3	4	yes
4th forbidden	4	5	no

In case of β⁺-transitions:

$$f_{\beta^+/EC} = f_{\beta^+} + f_{EC}$$

X. Mougeot: *Beta-Shape*
Thursday 14:00

Beta-Shape:

→ Includes EC

→ Improved modelling (compared to *Logft*)

→ Q-values from AME2016

Review of log*ft* values (1998)

Database

→ August-1997 ENSDF database

→ ~20000 beta transitions

Criteria

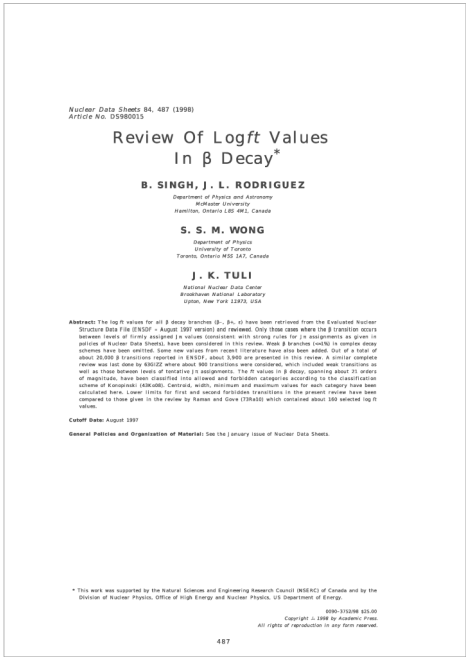
→ Parent & Daugther level have well-known JΠ

→ No weak transitions (<1%) in complex schemes

→ No highly incomplete decay schemes

Paper

→ 3900 published transitions



Nuclear Data Sheets 84, 487 (1998)
Article No. DS980015

Review Of Log*ft* Values
In β Decay*

B. SINGH, J. L. RODRIGUEZ

Department of Physics and Astronomy
McMaster University
Hamilton, Ontario L8S 4M1, Canada

S. S. M. WONG

Department of Physics
University of Toronto
Toronto, Ontario M5S 1A7, Canada

J. K. TULI

National Nuclear Data Center
Brookhaven National Laboratory
Upton, New York 11973, USA

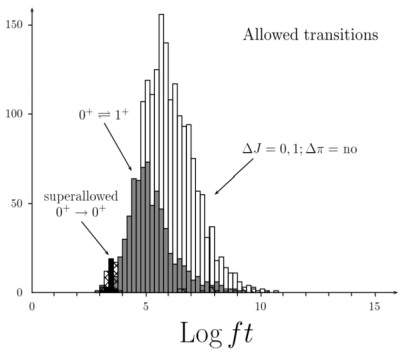
Abstract: The log *ft* values for all β decay branches (β−, β+, ε) have been retrieved from the Evaluated Nuclear Structure Data File (ENSDF – August 1997 version) and reviewed. Only those cases where the β transition occurs between levels of firmly assigned J π values consistent with strong rules for J π assignments as given in policies of Nuclear Data Sheets, have been considered in this review. Weak β branches (<1%) in complex decay schemes have been omitted. Some new values from recent literature have also been added. Out of a total of about 20,000 β transitions reported in ENSDF, about 3,900 are presented in this review. A similar complete review was last done by Gö61DZ where about 900 transitions were considered, which included weak transitions as well as those between levels of tentative J π assignments. The *ft* values in β decay, spanning about 21 orders of magnitude, have been classified into allowed and forbidden categories according to the classification scheme of Konopinski (KON66B). Centroid, width, minimum and maximum values for each category have been calculated here. Lower limits for first and second forbidden transitions in the present review have been compared to those given in the review by Raman and Gove (TIM78JE) which contained about 160 selected log *ft* values.

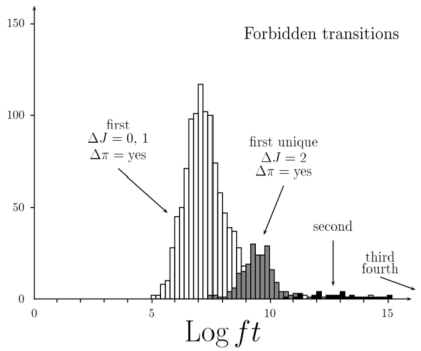
Cutoff Date: August 1997

General Policies and Organization of Material: See the January issue of Nuclear Data Sheets.

* This work was supported by the Natural Sciences and Engineering Research Council (NSERC) of Canada and by the Division of Nuclear Physics, Office of High Energy and Nuclear Physics, US Department of Energy.

0090-3752/98 $25.00





Status of the project

What changed since 1998?

→ Determination of Q-values significantly improved

→ Many half-lives and decay schemes have undergone revisions

→ Consideration of new nuclides or decay schemes

→ New Beta-Shape code from X. Mougeot

Current situation (ENSDF database of January 2019)

→ Total Beta-transitions: **25177**

→ Log*ft* precisely known: **21236**

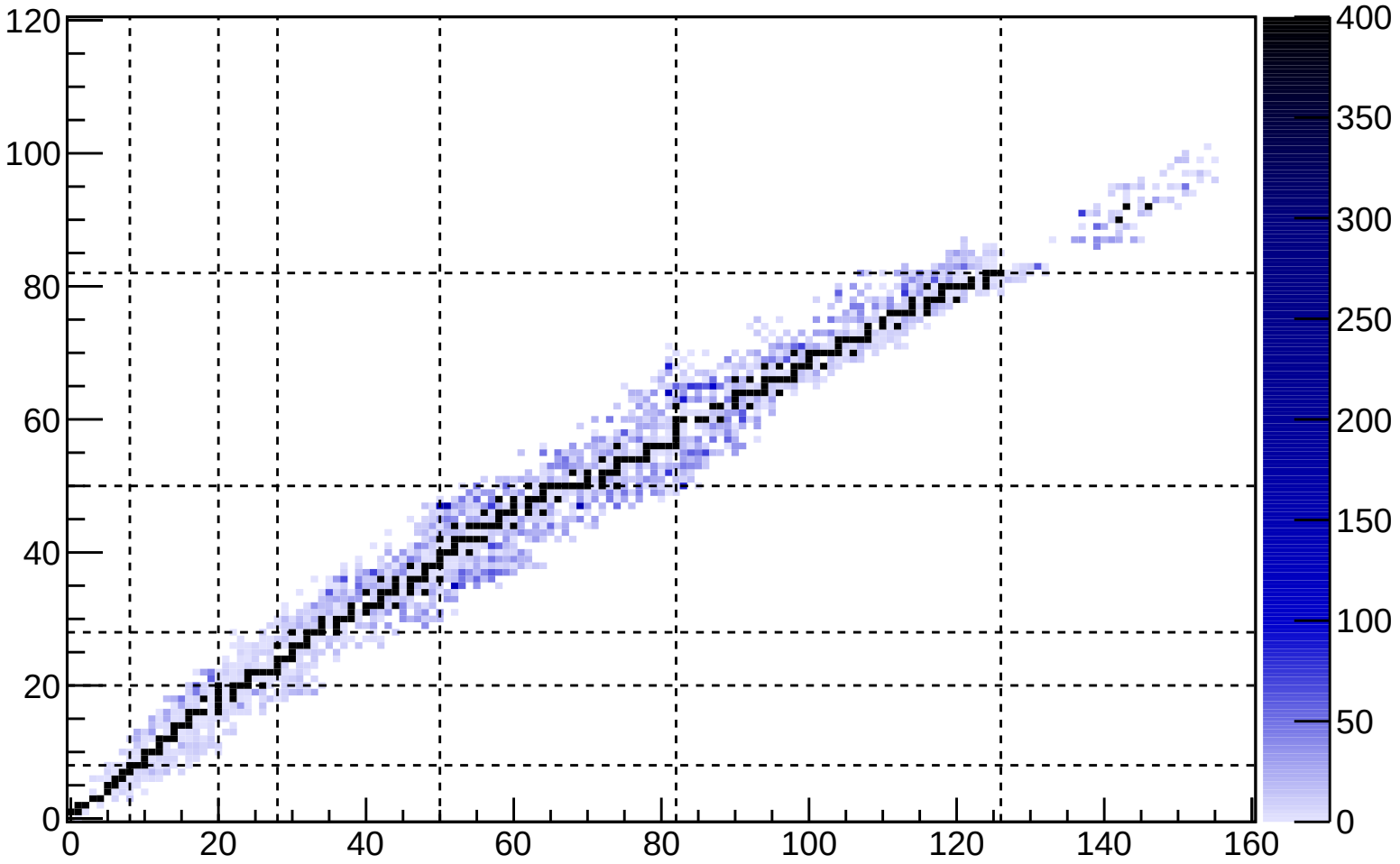
→ Jπ of mother and daughter known: **7051**

→ Allowed transitions: **4308**

→ Forbidden transitions: **2743**

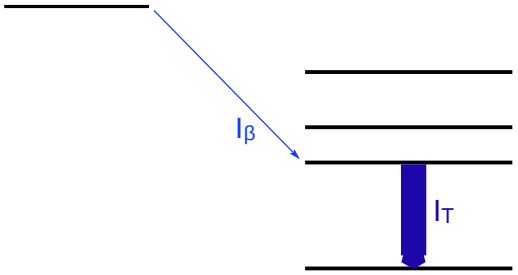
Preliminary final dataset

Status of the project



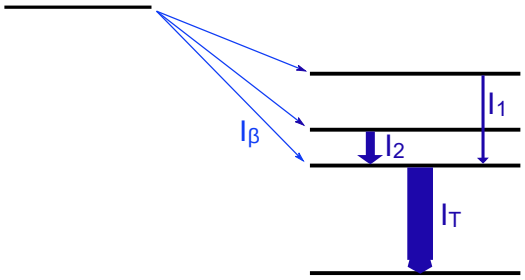
Pandemonium effect

Idealization:



$$I_\beta = I_\mathrm{T}$$

Reality:

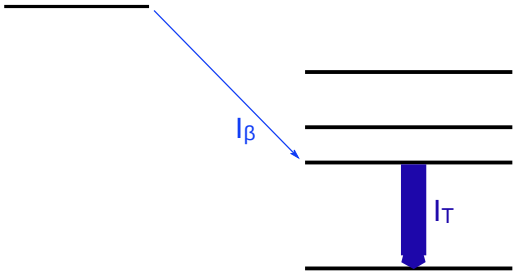


$$\sum I_i = I_1 + I_2 + \ldots$$

$$I_\beta = I_\mathrm{T} - \sum I_i$$

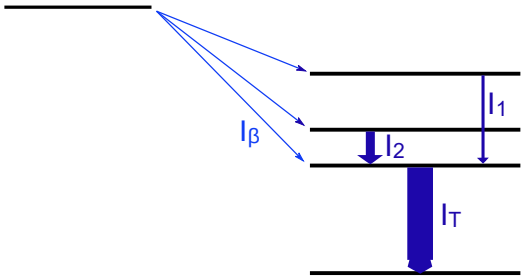
Pandemonium effect

Idealization:



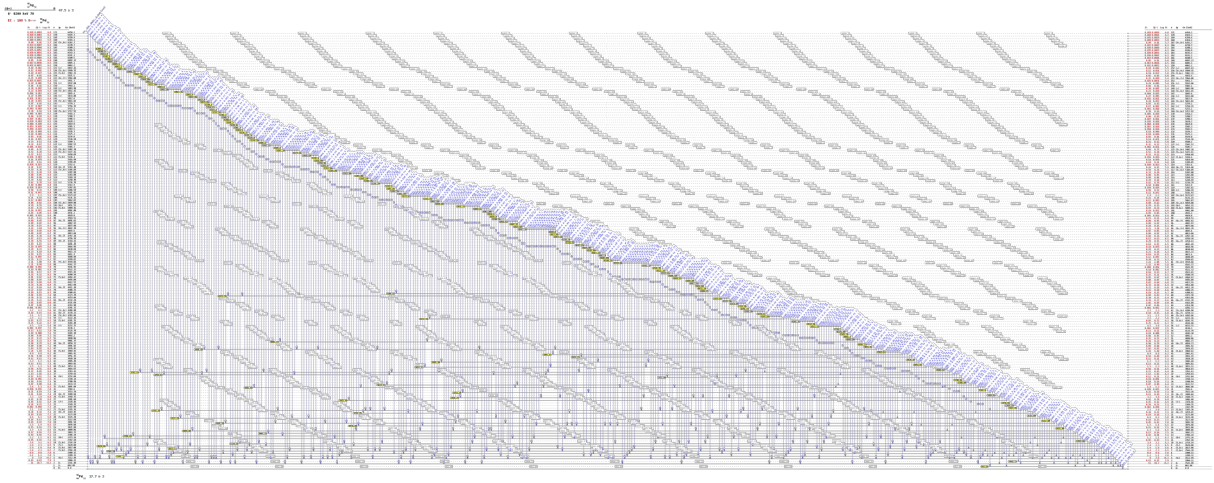
$$I_\beta = I_\mathrm{T}$$

Reality:



$$\sum I_i = I_1 + I_2 + \ldots$$

$$I_\beta = I_\mathrm{T} - \sum I_i$$



B. Singh, Z. Hu, Nucl. Data Sheets 98, 335 (2003) - Plotted with *LiveChart of Nuclides* (IAEA)

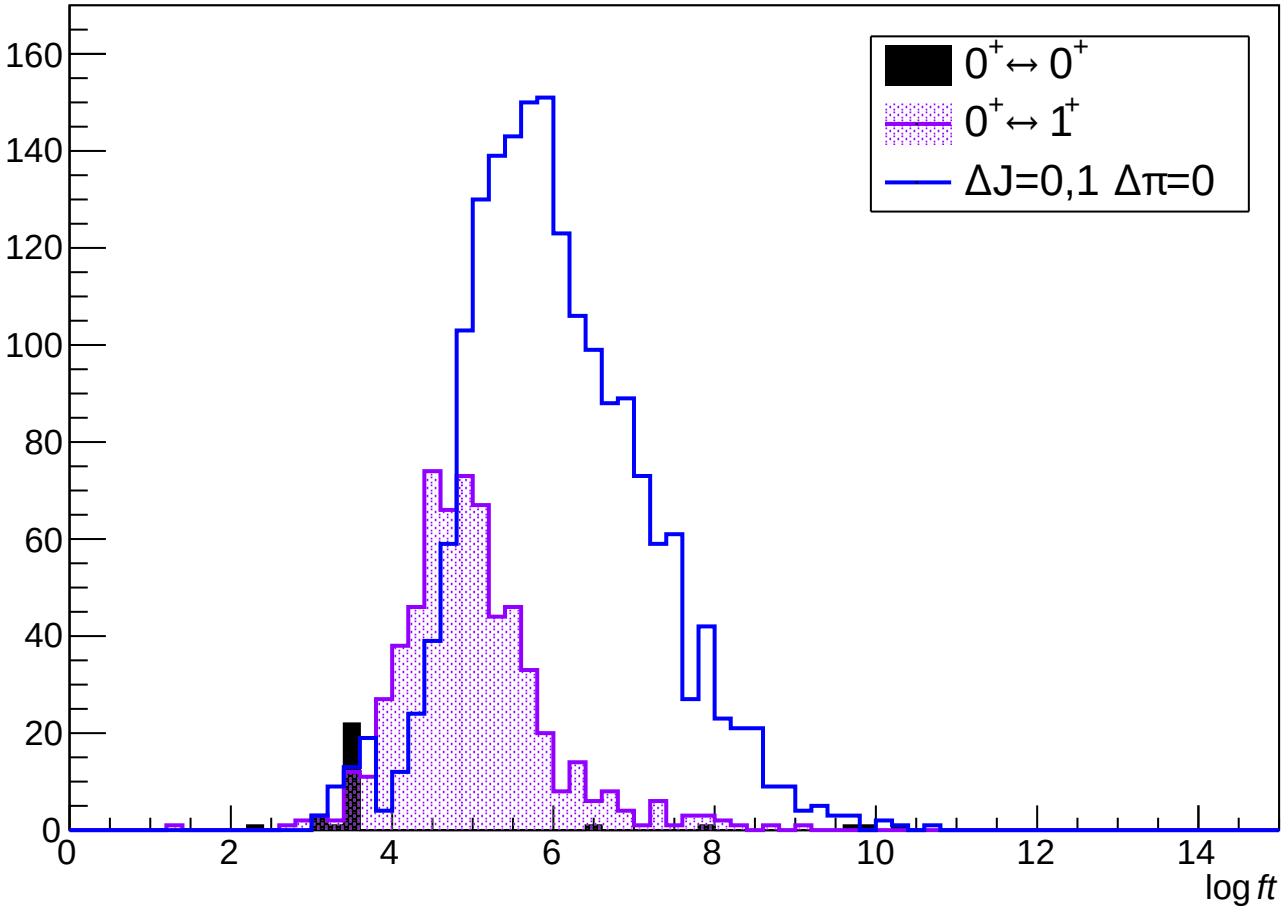
Decay scheme of ^{98}Ag

→ 169 listed transitions

→ 112 fulfil prelim. criteria

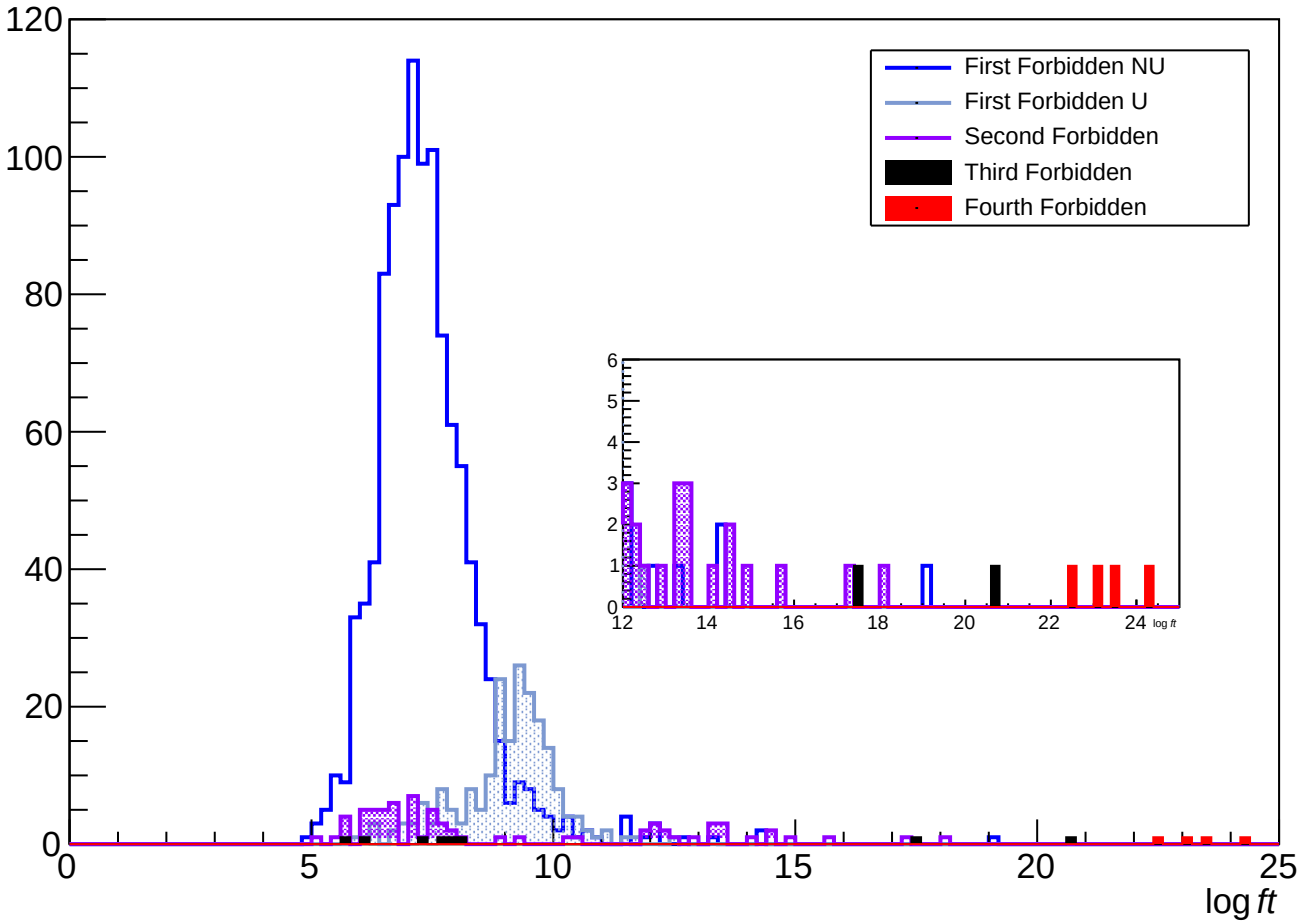
Status of the project

→ Allowed decays (preliminary)

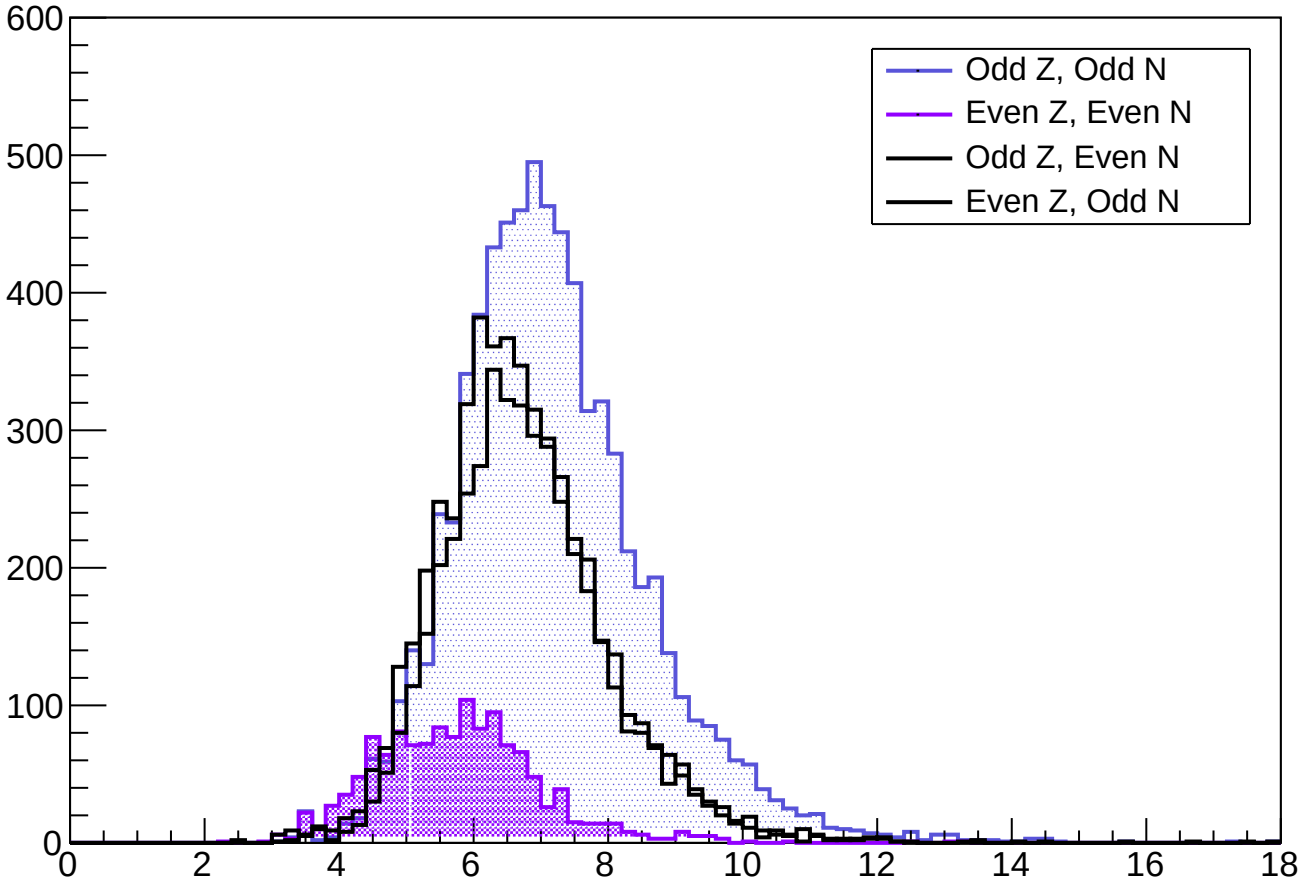


Status of the project

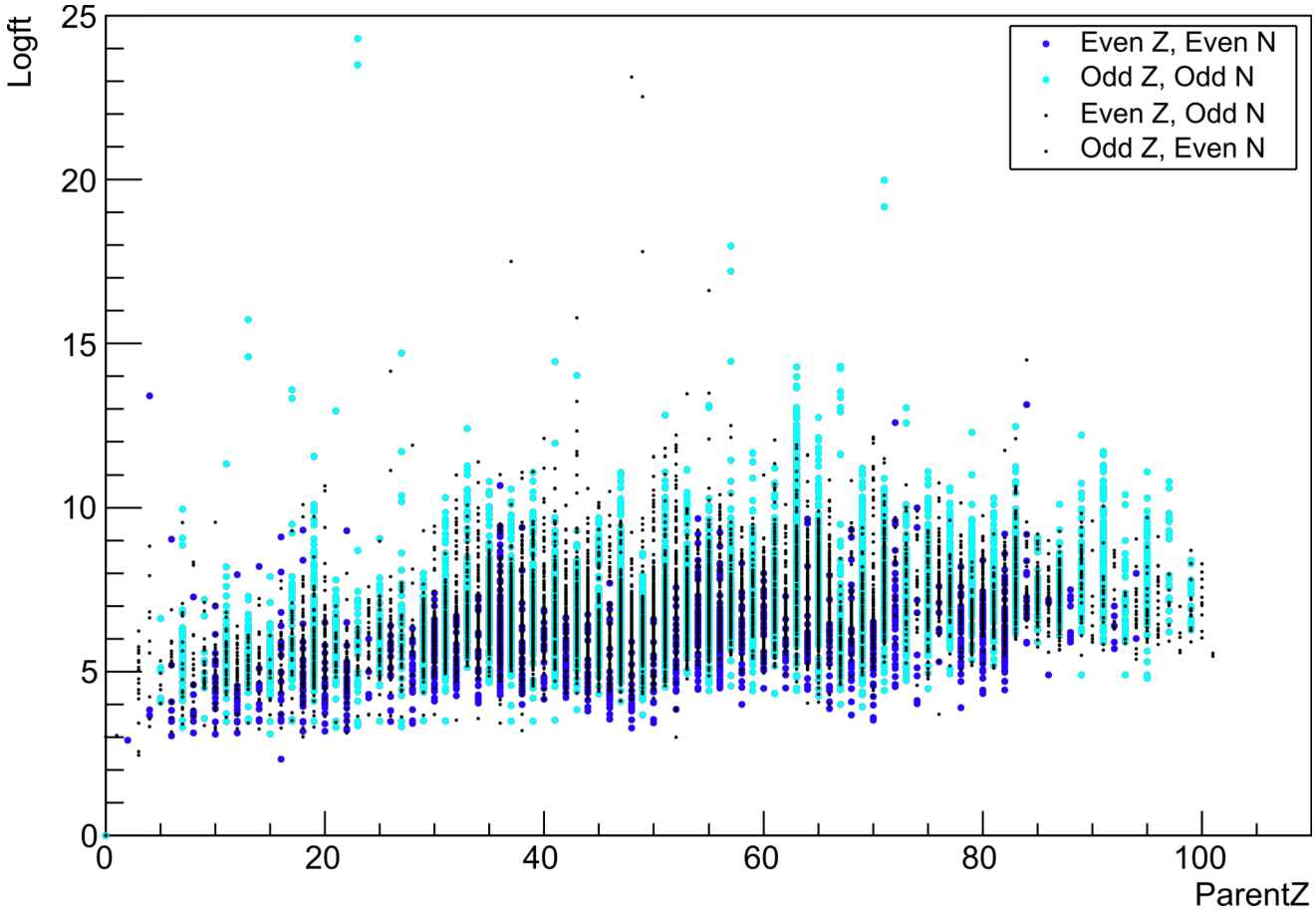
→ Forbidden decays (preliminary)



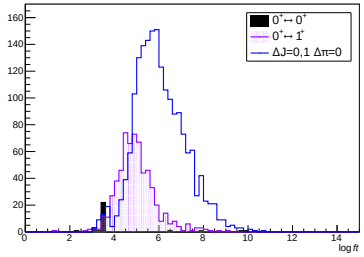
Future and prospects



Future and prospects



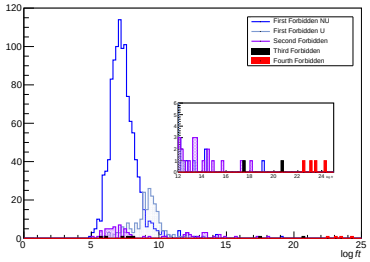
Summary & Outlook



Summary

→ Review of log *ft* values (1998) currently updated

→ Scripts for figures and tables already finished



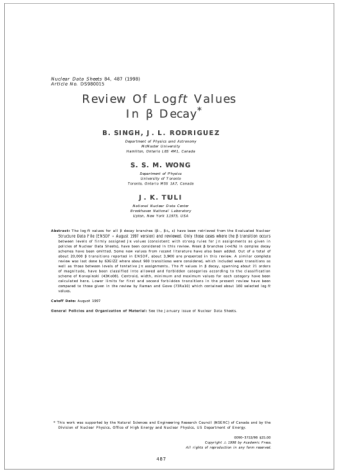
Outlook

→ Update log *ft* values with Xaviers Beta Shape code

→ AME2016

→ Most recent $T_{1/2}$

→ Account for Pandemonium effect



Review Of Log*ft* Values In β Decay*

B. SINGH, J. L. RODRIGUEZ

S. S. M. WONG

J. K. TULI