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JAVA-NDS program

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NSCL/MSU
2015 USNDP

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What is JAVA-NDS

A Java program to produce a reader-friendly (or publish-ready) PDF output from an ENSDF-format file.

- Written in Java
- Convert ENSDF to LaTeX
- Use Latex table and figure environments
- Use MetaPost to generate figures

Why JAVA-NDS

- Similar layout as that of the NDS-PUB.
- Times New Roman used as the standard font, as in most journals
- Final level and JPI added for each γ-transition, making it convenient for user to consult the level scheme.
- Better level-scheme and band drawing function than NDS-PUB.
- Easy maintenance of the program: the code is easy to read, understand and modify.
- User-friendly graphical interface makes it very easy to use.

History of development and application

- In *2007*, it was initiated by Balraj Singh and started with a contract from NNDC, BNL to Roy Zywina and regular consultations with Balraj.
- In *January 2008*, a code was supplied by Roy but not operational; Roy quit after half-time of contract term.
- In *2008-2011*, Scott Geraedts and Jeremie Choquette worked on this code to produce band drawings and complete tables and level/decay drawings. A workable version was presented at NSDD2009 and NSDD2011 meetings.
- From *2009-2014*, Marion Blennau at NNDC used this code to generate band drawings for several A-chains published in NDS, until quite recently.
- Since *2013*, Marco Verpelli at IAEA-NDS is using this code for some level-scheme drawings.
- In *April 2015*, Jun Chen at NSCL/MSU took over and started working on the 2011 version of this code : restructured the program, implemented missing functions, added features for auto-adjustment of table layout (instead of manual settings using a control file), added graphical user interface.

By the end of 2015 November, a beta version will be available for testing by the NSDD network evaluators.

Structure of JAVA-NDS code

- **JAVA-NDS**
  - **ensdf** — parsing ENSDF records to objects based on record types – Level, Gamma, Beta, …
  - **nds**
    - **ensdf** — Wrap of an ENSDF dataset with all settings
    - **chart** — Making figures for level schemes and band drawings
    - **latex** — Making LaTeX tables and Writing everything to a LaTeX file
    - **control** — all settings for individual tables and figures
    - **config** — global configuration
    - **ui** — user interface
    - **util** — utility functions

How it worked previously (demo in 04/2015)

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Steps:

1. One ran the program to read a ENSDF file and produce a PDF output with default settings
2. One looked through the PDF file and marked down things that need to be changed, like table orientation, table break, and so on.
3. One modified the settings in the default control file generated by the program based on the checking in previous step.
4. One re-ran the program with the modified control file to produce the final PDF file.

Drawbacks:

✓ step 2 and 3 are very time-consuming (a few hours to 1 day) and probably frustrating, especially when the PDF file is a-few-hundred-page long.

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How it works now

Steps:

1. One runs the program to read a ENSDF file and produce a final PDF output with automatic table-orientation and table-break.

Only one step is needed

Comments:

- ✓ settings are made automatically by the program based on table positions and dimensions. The whole procedure takes seconds to minutes depending on the size of the input ENSDF file.
- ✓ Still keep the option for manual setting with a control file for fine-tuning of the layout of individual dataset

What have been changed

Some major changes (other than structure change)

Page Breaks:

Before: Page-breaks of a long table are handled by the LaTeX long-table environment and the program has no control of it.

Now: A long table is divided to sub-tables that only show in one page based on table position and page size; page-breaks are inserted into the output LaTeX file by the program.

Table Orientation:

Before: Manually set in the control file (one had to read through the PDF output with default settings to decide which tables should be in orientation modes)

Now: Automatically set by the program based on estimated physical table-width to be in the PDF output.

Table Splitting (for long and narrow tables that can be split to sub-tables side-by-side):

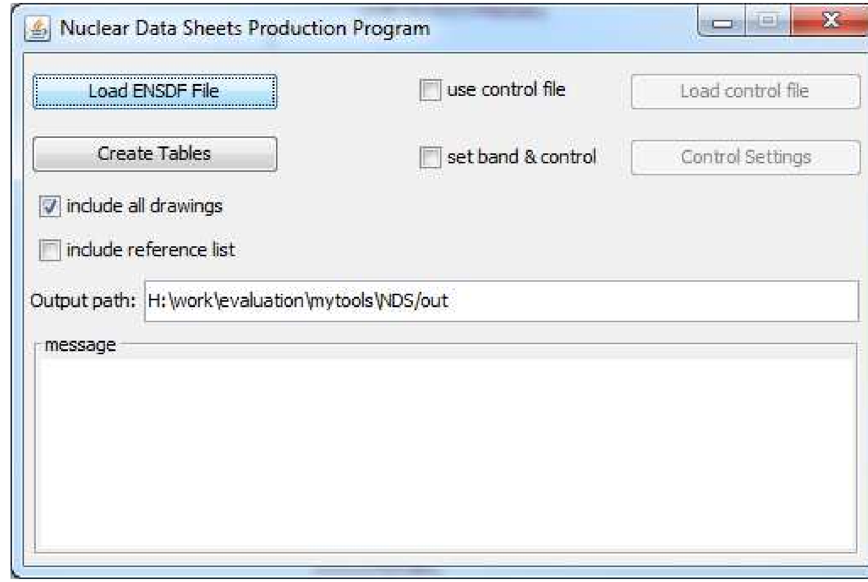
Before: Break points (level energy or gamma energy) were manually set in control file (similar to table orientation, one has to find out which tables can be split and where to break the table)

Now: Break points are determined automatically by the program based on table position, table size, and/or page size . The program scans the whole table and estimates the physical table-size that could be in the PDF output.

How to use it

Three options:

- Automatic mode
- Manual mode using a control file
- Manual mode with customized settings using a graphical user interface



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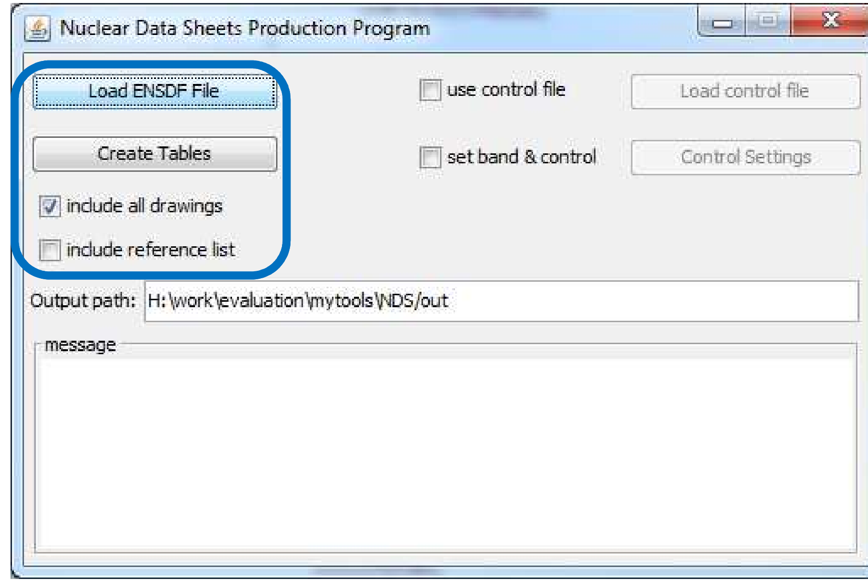

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Three options:

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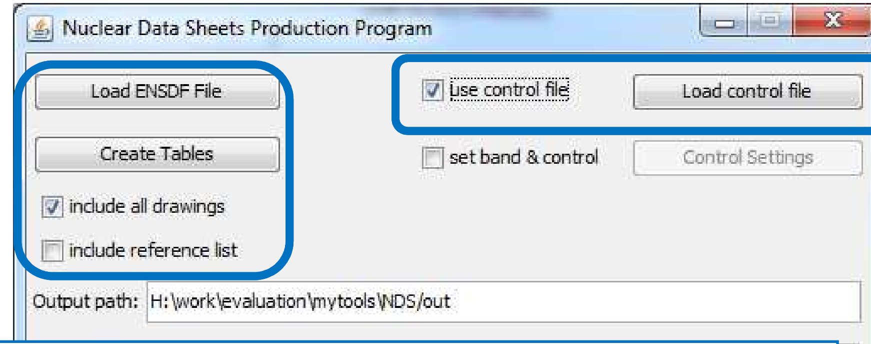

part of a sample control file

```
REVIEW
ABSTRACT/V:xx/Y:****/R:****
SKELETON
INDEX/B:
 40MG     ADOPTED LEVELS
LEVEL/D:E,J,T,COMM/W:14.2/M:
PAGE
REORDER
XREF 0
 40AL     ADOPTED LEVELS
LEVEL/D:E,T,COMM/W:14.8/M:
PAGE
REORDER
XREF 0
 40SI     ADOPTED LEVELS, GAMMAS
LEVEL/D:E,J,T,XREF,COMM/W:11.5/M:
GAMMA/D:LEV,JI,LEVF,JF,E,COMM/W:10.7/E:/M:
DRAW/N:1
PAGE
REORDER
XREF 2
 40SI     C(44S,40SIAG)                2012TA20
LEVEL/D:E,J,COMM/W:14.2/M:
GAMMA/D:LEV,JI,LEVF,JF,E/E:/M:
DRAW/N:1
REORDER
XREF 0
```

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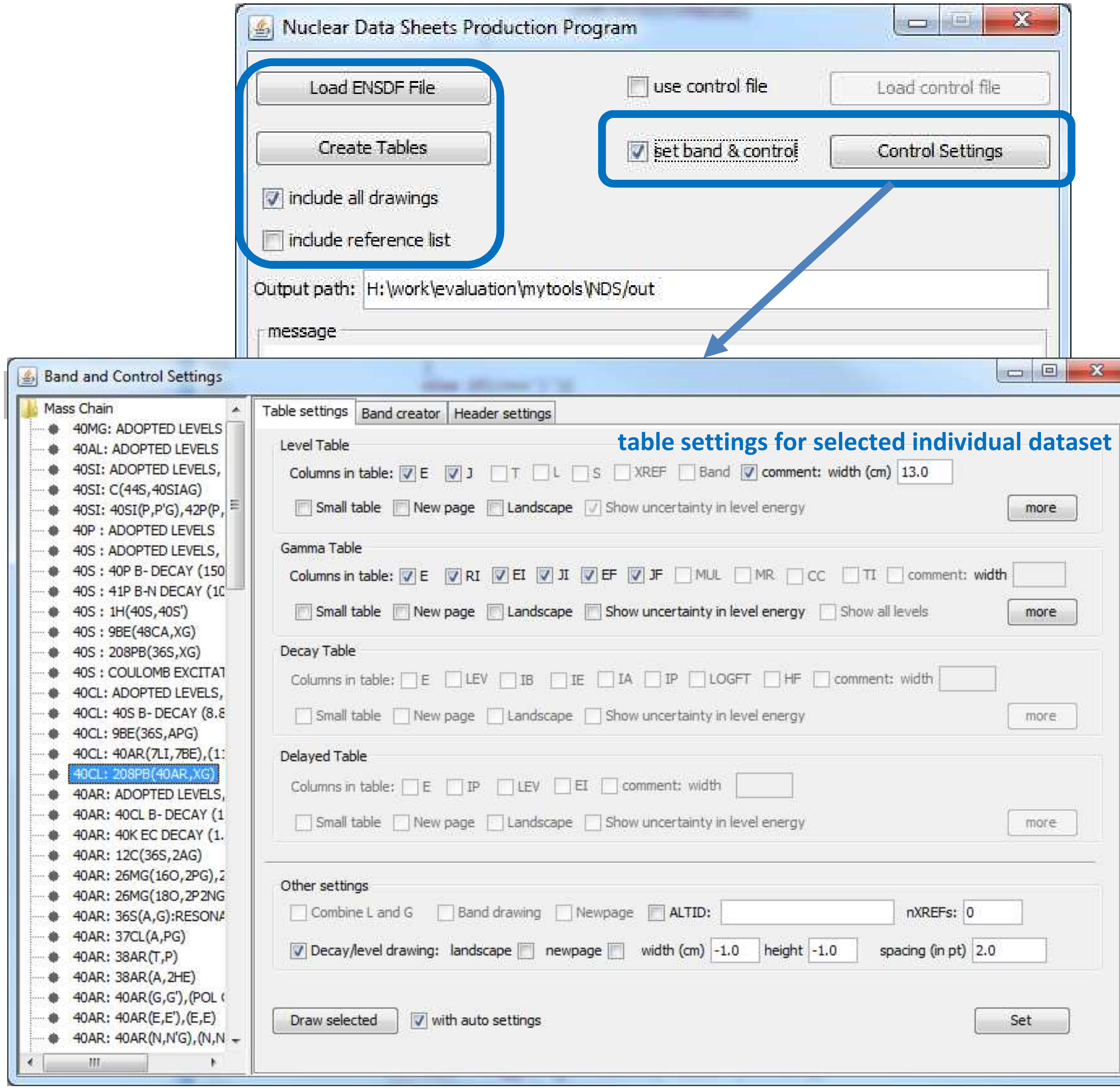

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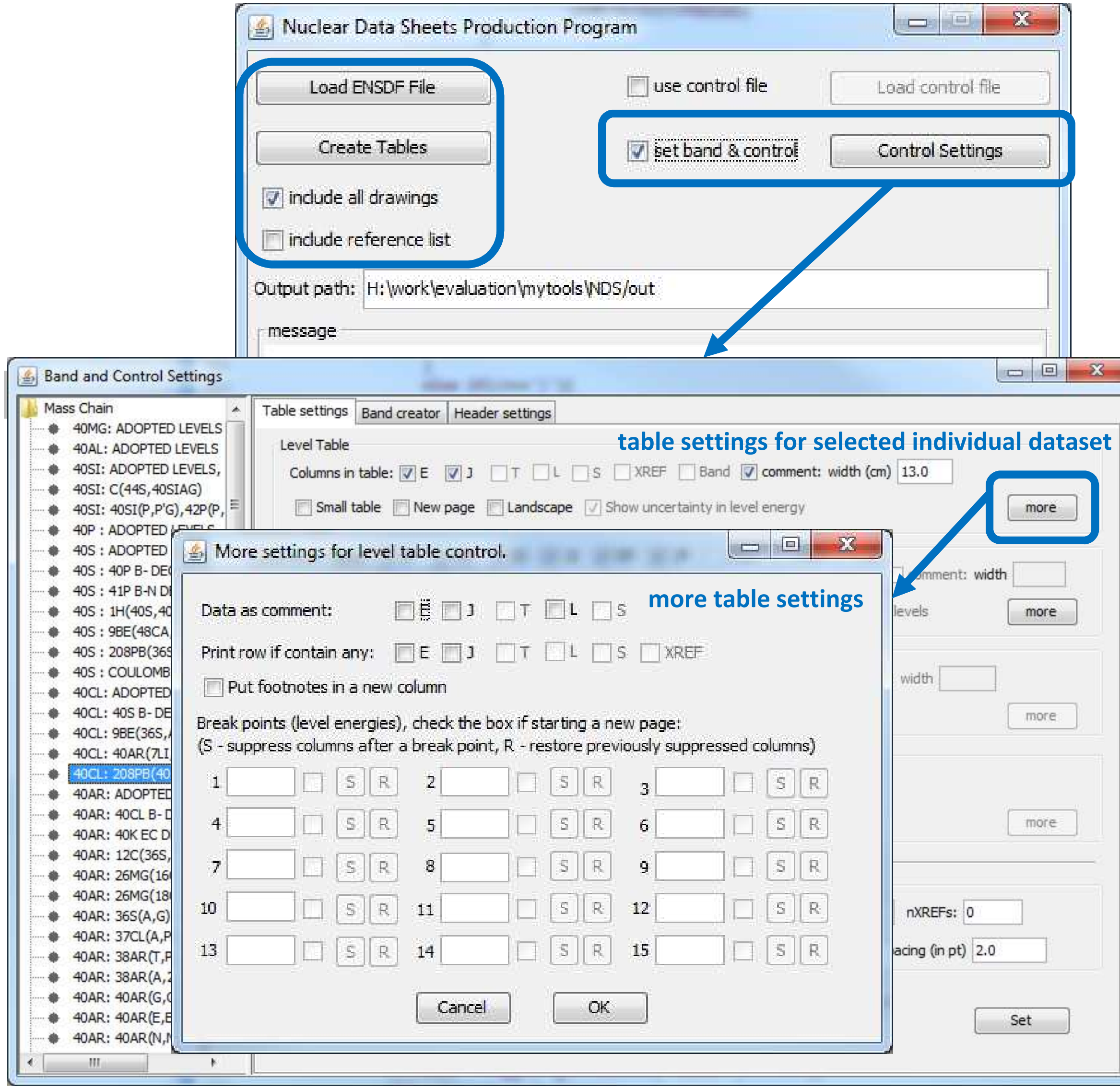

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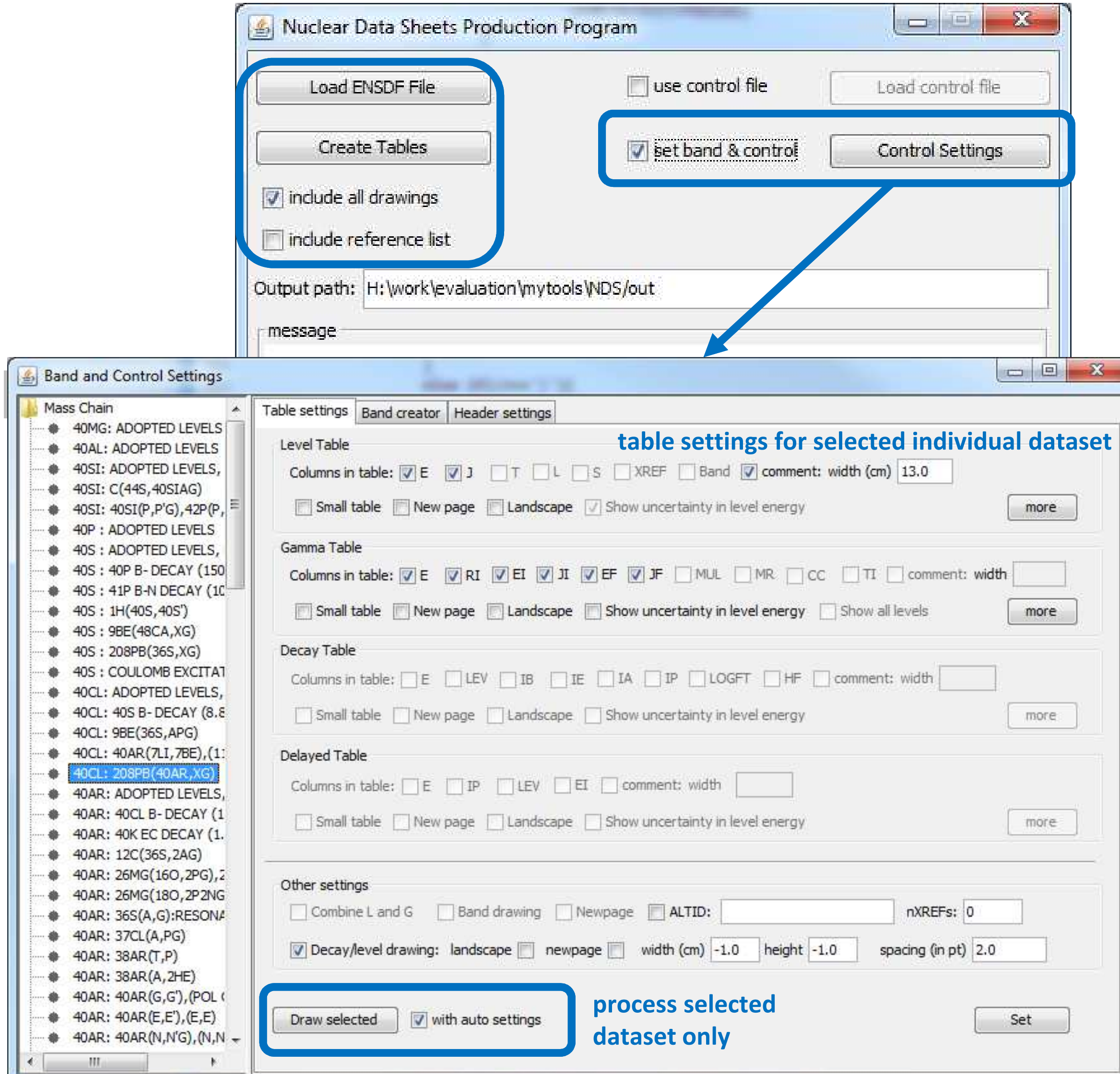

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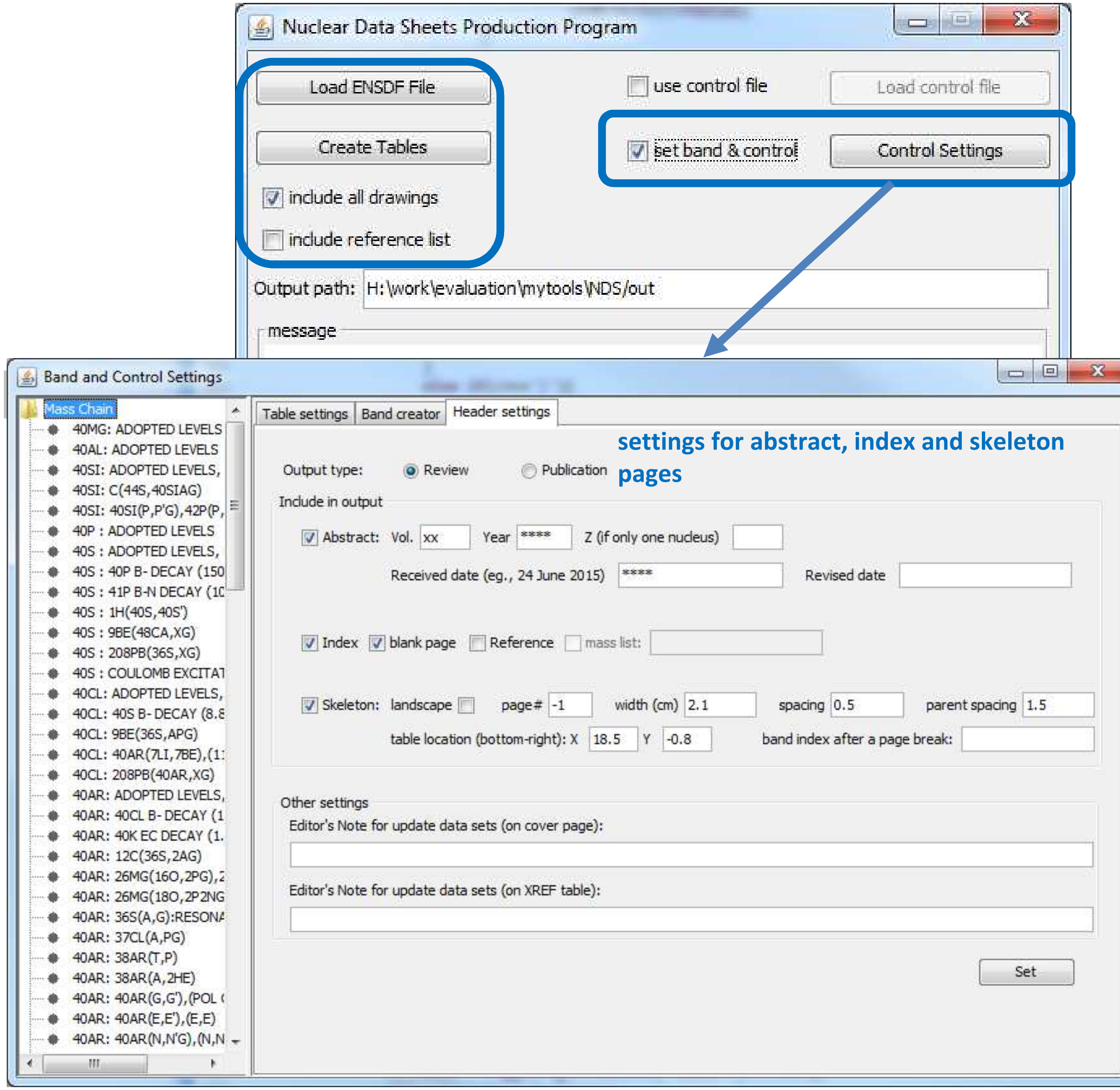

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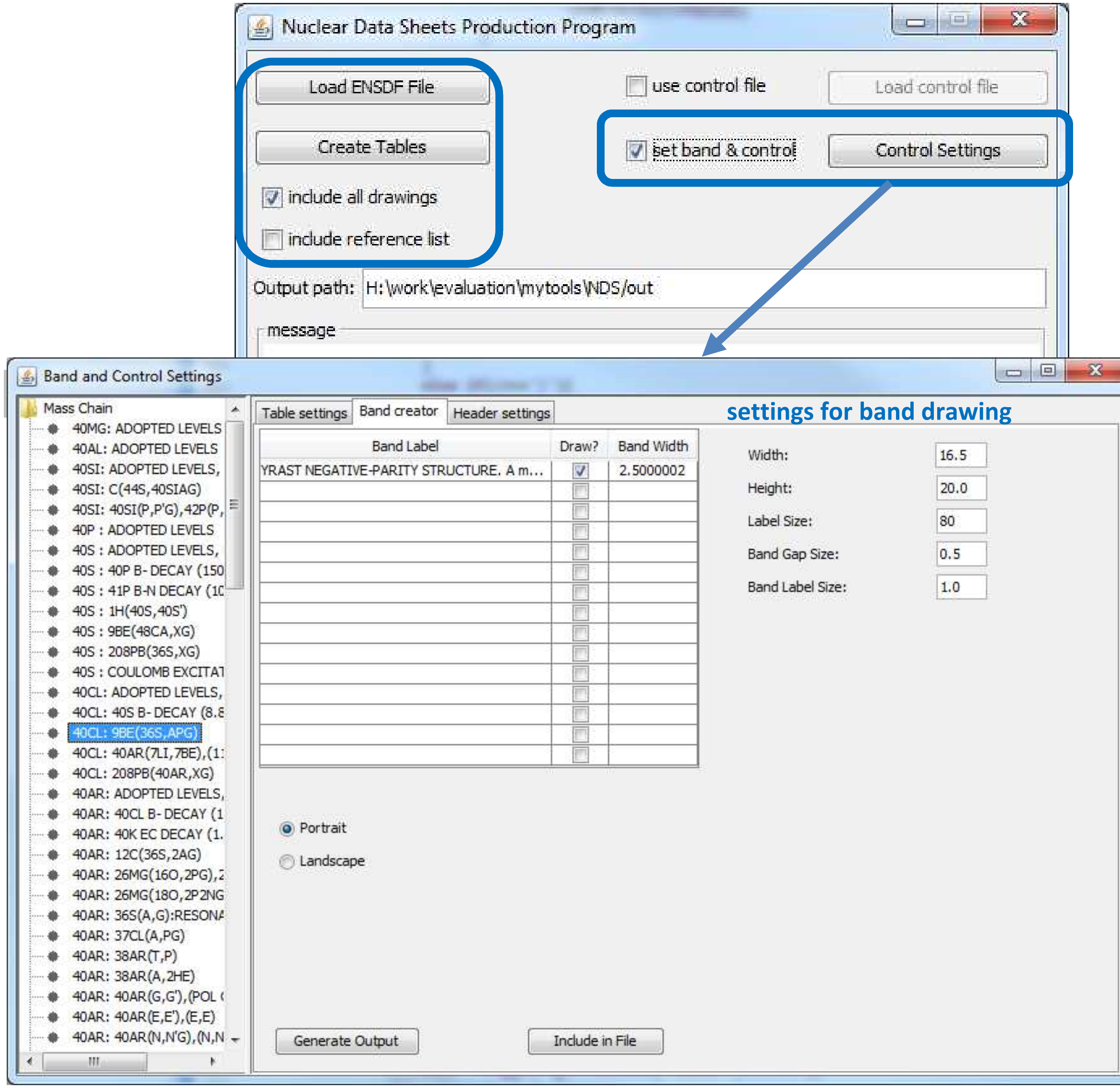

Sample output: A=40 cover page

Nuclear Data Sheets xx, 1 (****)

Nuclear Data Sheets for A=40*

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*(Received ****)*

Abstract: The experimental nuclear structure data and decay data are evaluated for the known nuclides of mass 40 (Mg, Al, Si, P, S, Cl, Ar, K, Ca, Sc, Ti). Detailed evaluated nuclear structure information are presented with the best values recommended for level energies, half-lives, γ-ray energies and intensities, decay properties (energies, intensities and placement of radiations), and other spectroscopic data. The ^{40}Ca and ^{40}K nuclides remain as the most extensively studied from many different reactions and decays; there are available for the excited states in ^{40}Mg, ^{40}Al, ^{40}P and ^{40}Ti. This work supersedes the earlier full evaluation of A=40 by J. Cameron and B. Singh (2004Ca38).

Cutoff Date: Literature available up to September 30, 2015 has been included. Main bibliographic source was the NSR database (2011Pr03) at Brookhaven laboratory webpage: www.nndc.bnl.gov/nsr/

General Policies and Organization of Material: See the January issue of the *Nuclear Data Sheets* or http:// www.nndc.bnl.gov /nds/NDSPolicies.pdf.

General Comments: The statistical analysis of γ-ray data and deduced level schemes is carried out through computer codes available at NNDC, BNL website: www.nndc.bnl.gov. The direct feedings to excited states in β^- and ε decays have generally been computed from I(γ+ce) intensity balances at each level; the associated log *ft* values are calculated using the log *ft* code. The Q values and particle-separation energies have been adopted from 2012Wa38 (AME-12). In cases where weighted averaging procedures have been used, the assigned uncertainty is generally not lower than the lowest uncertainty given in a measurement. Nuclear charge radii have been adopted from 2013An02 evaluation. Moments are from 2014StZZ and 2013StZZ whenever possible. Theoretical total conversion coefficients are from BrIcc code (2008Ki07) for frozen-orbit option with an implicit uncertainty of 1.4% when not stated

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Citations: ENSDF

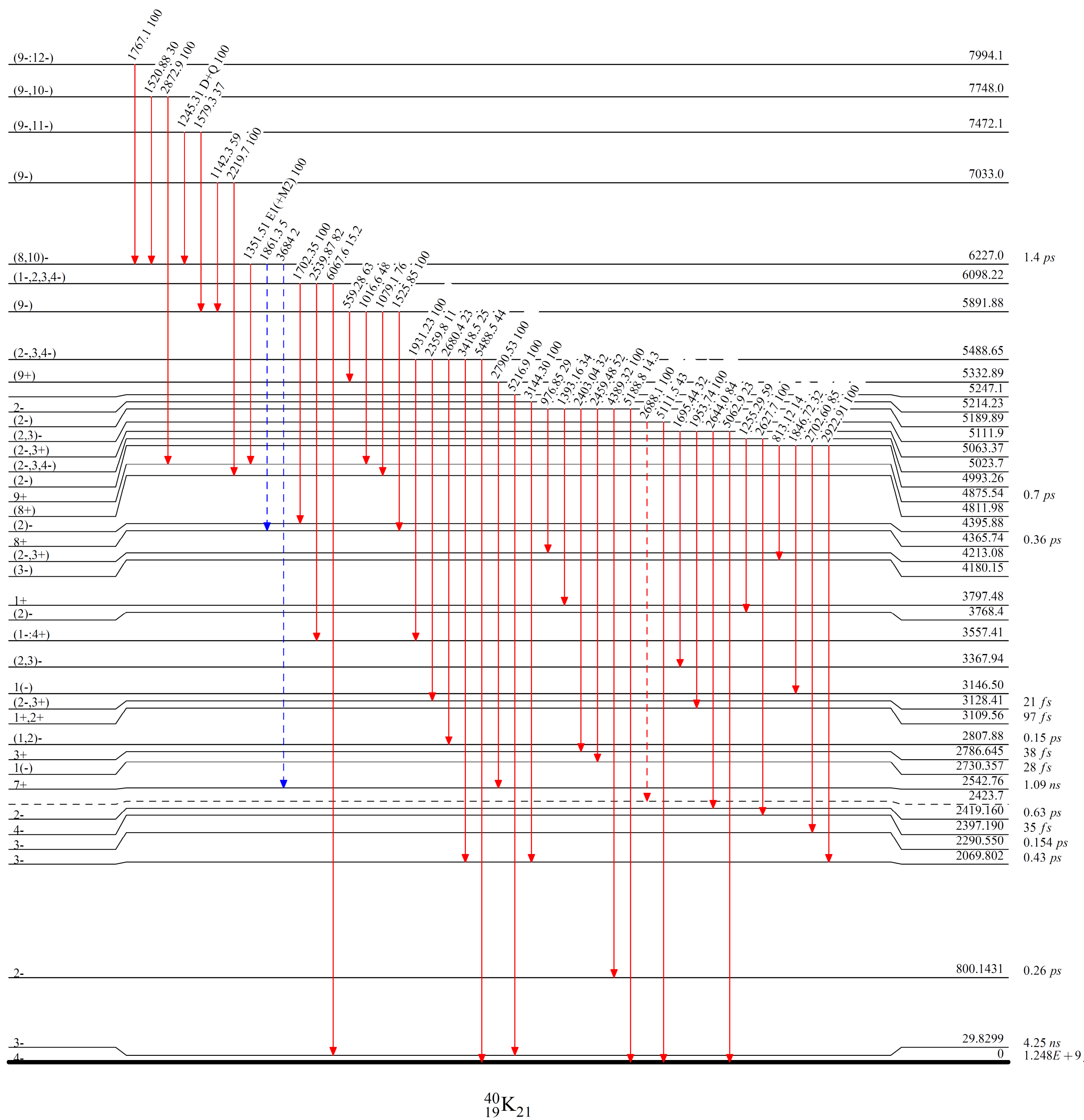
Sample output: γ table in ^{40}K Adopted dataset

$\gamma(^{40}K)$

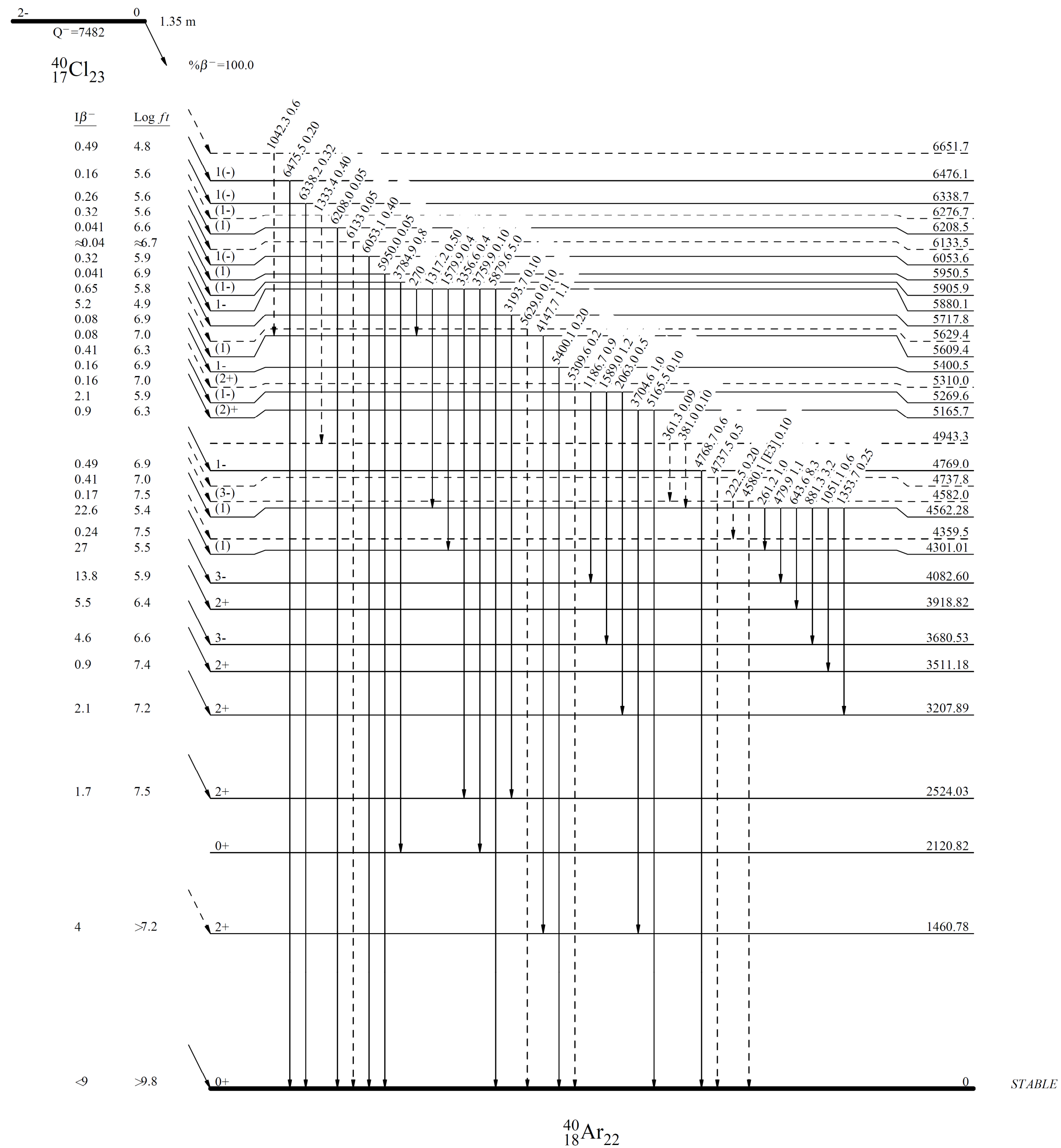
E_i(level)	J_i^π	E_f(level)	J_f^π	E_γ[†]	I_γ[†]	Mult.[‡]	δ[‡]	α	Comments
29.8299	3-	0	4-	29.8299 *5*	100	M1		0.298	B(M1)(W.u.)=0.150 *3*. Mult.: δ(E2/M1)≤0.07 from $\gamma\gamma(\theta)$ in (n,γ) E=thermal, but RUL favors pure M1
800.1431	2-	29.8299	3-	770.3053 *18*	100 *9*	M1(+E2)	+0.04 *+3-6*		B(E2)(W.u.)=(1.6 *+44−16*). B(M1)(W.u.)=(0.18 *+5−3*). Mult.: from $\gamma\gamma(\theta)$ in (n,γ) E=thermal. Other: δ(Q/D)=0.00 *1* in (p,nγ)
		0	4-	800.3 *3*	0.15 *2*	[E2]			B(E2)(W.u.)=1.22 .
891.394	5-	29.8299	3-	862.2 *3*[b]	<1.3[b]	[E2]			B(E2)(W.u.)=1.14 .
		0	4-	891.372 *21*	100 *10*	M1+E2	+0.085 *15*		B(E2)(W.u.)=1.1 *+9−5*. B(M1)(W.u.)=0.037 *+11−7*. Mult.: from $\gamma(\theta$,pol) in ^{26}Mg^{16}O,npγ)
1643.638	0+	800.1431	2-	843.478 *16*	24.4 *24*	[M2]			B(M2)(W.u.)=0.00363 . I_γ: weighted average of 25 *6* from (α,nγ), 27.5 *28* from (n,γ) E=thermal, 22.0 *24* from (p,nγ)
		29.8299	3-	1613.84 *4*	100 *3*	[E3]			B(E3)(W.u.)=1.07 *+8−7*. I_γ: from (p,nγ)
1959.071	2+	800.1431	2-	1158.901 *20*	100 *3*	E1(+M2)	0.00 *5*		B(E1)(W.u.)=(0.00058 *+13−9*). I_γ: from (p,nγ) Mult.: from $\gamma(\theta)$ in (p,nγ)
		29.8299	3-	1929.34 *10*	21.5 *24*	E1+M2	+0.11 *3*		B(E1)(W.u.)=2.657×10^{-5} *+16−20*. B(M2)(W.u.)=0.40 *+24−19*. I_γ: weighted average of 22.0 *24* from (α,nγ), 23 *4* from (n,γ) E=thermal, 20.5 *24* from (p,nγ). other: 36 *18* from ^{40} (mu-,nuγ) and 14.3 *15* from (n,pγ) Mult.: from $\gamma(\theta)$ in (p,nγ)
2047.338	2-	800.1431	2-	1247.173 *24*	100 *3*	M1+E2	+0.09 *4*		B(E2)(W.u.)=0.23 *+37−18*. B(M1)(W.u.)=0.0142 *+36−25*. I_γ: from (p,nγ) δ: weighted average of +0.10 *4* from (n,γ) E=thermal and +0.05 *8* fom (p,nγ).
		29.8299	3-	2017.53 *4*	74.5 *25*	M1+E2	+0.07 *4*		B(E2)(W.u.)=0.010 *+20−8*. B(M1)(W.u.)=0.0025 *+7−5*. I_γ: weighted average of 88 *13* from (α,nγ), 67 *7* from (d,pγ), 75.0 *25* from (p,nγ), 83 *40* from

Continued on next page (footnotes at end of table)

Sample output: partial level scheme in ^{40}K Adopted dataset

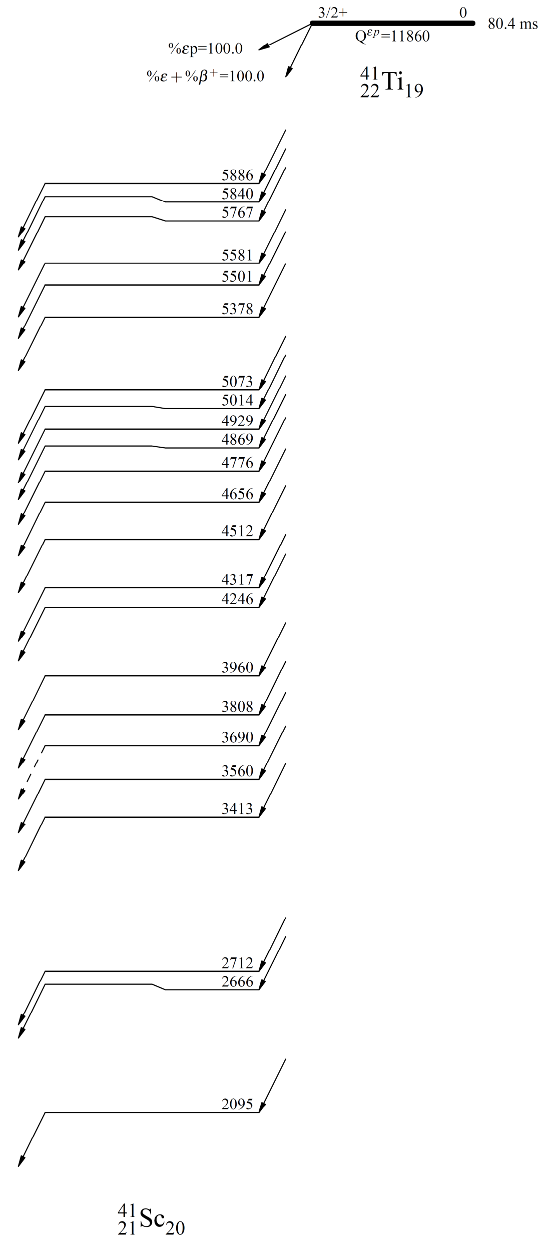


Sample output:
^{40}Cl β⁻ decay scheme



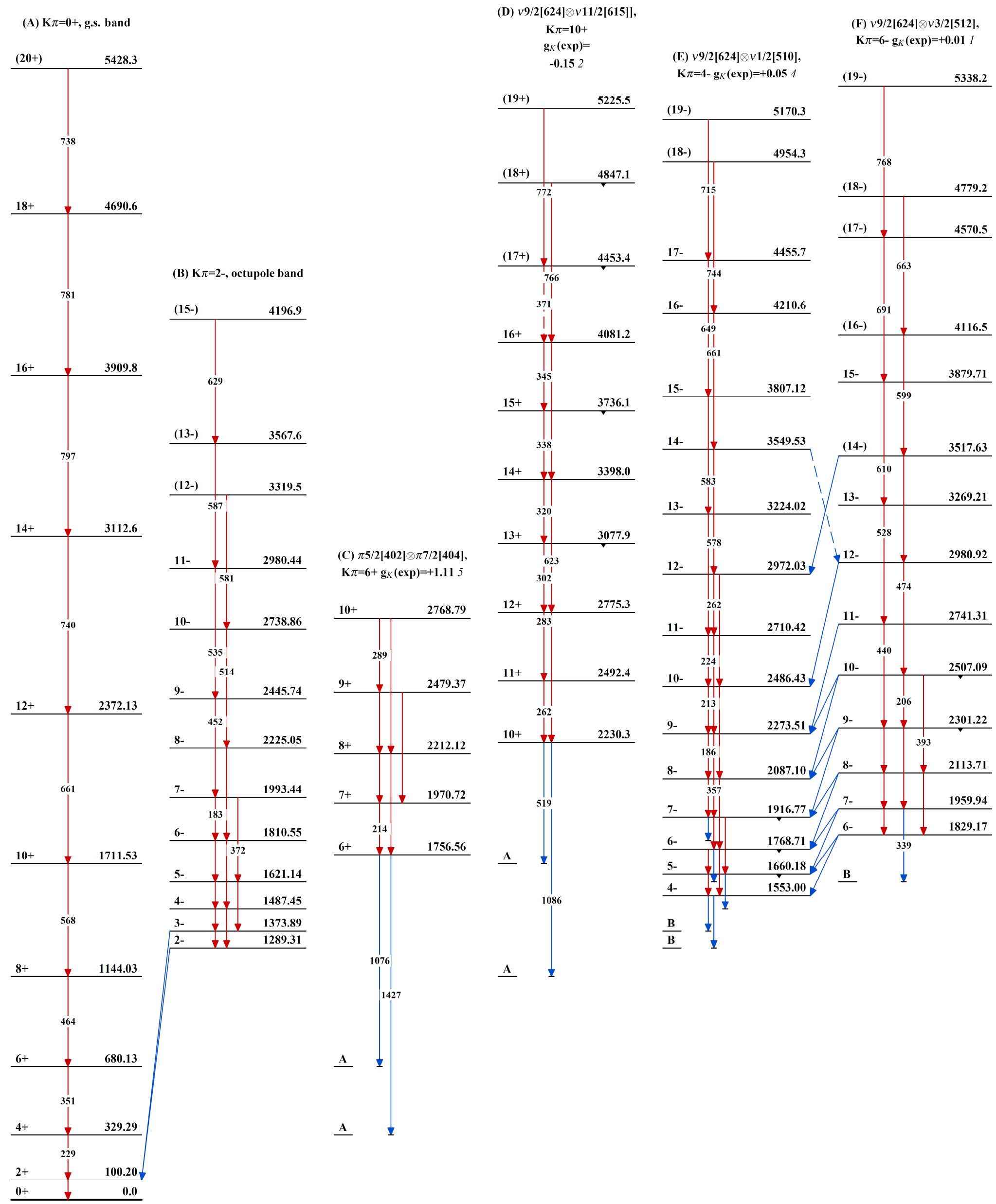
Sample output: decay scheme in ^{41}Ti εp decay

NDS-PUB does not generate particle-delayed decay schemes



	E(p)	I(p)	E($^{41}_{21}$Sc$_{20}$)	E($^{40}_{20}$Ca$_{20}$)
p_1	986.0	5.6	2095	0
p_2	1542.0	4.2	2666	0
p_3	1587.0	0.48	2712	0
p_4	2271.0	5.0	3413	0
p_5	2414.0	3.4	3560	0
p_6	2540.0	0.62	3690	0
p_7	2656.0	1.5	3808	0
p_8	2804.0	0.89	3960	0
p_9	3083.0	15.8	4246	0
p_{10}	3152.0	0.80	4317	0
p_{11}	3343.0	0.60	4512	0
p_{12}	3483.0	0.65	4656	0
p_{13}	3600.0	2.15	4776	0
p_{14}	3691.0	3.7	4869	0
p_{15}	3749.0	7.4	4929	0
p_{16}	3832.0	0.62	5014	0
p_{17}	3890.0	0.43	5073	0
p_{18}	4187.0	3.72	5378	0
p_{19}	4307.0	0.34	5501	0
p_{20}	4385.0	1.69	5581	0
p_{21}	4570.0	0.88	5767	0
p_{22}	4638.0	5.3	5840	0
p_{23}	4683.0	1.06	5886	0

Sample output:
^{182}W bands



Sample output: A=40 reference list

REFERENCES FOR A=40

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