



IsomerAPI Project Progress Update

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Date 01/04/2026



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This material is based upon work supported by the U.S. Department of Energy, Office of Science, Office of Nuclear Physics and used resources of the Facility for Rare Isotope Beams (FRIB) Operations, which is a DOE Office of Science User Facility under Award Number DE-SC0023633, and by the US National Science Foundation under Grants No. PHY-20-12040 and 23-10078 “Windows on the Universe: Open Quantum Systems in Atomic Nuclei at FRIB”.

Background

- The Isomer database within LISE⁺⁺ contains large amounts of data for gamma emissions from isomer-state products yielded in experiment.
- Currently, the database is only interfaced in LISE⁺⁺ per emission (Fig. 1) and characterizing decay schemes is difficult.
- The goal has been to develop a restful API for users to easily access the LISE⁺⁺ Isomer database and search for desired isomer information.
 - This is useful for identifying gamma emission sources for PID, visualizing decay schemes and granting user access to Isomer data for research questions
- Initially this application was developed in Python for ease of interfacing the database with packages such as *Pandas* and *sqlite3*.

The screenshot shows the 'Isomer Database' window in LISE⁺⁺. At the top, there are input fields for 'A' (12), 'Element' (Be), and 'Z' (4). Below these are buttons for 'β⁻ & β⁻n decay' and a 'Table of Nuclides' button. To the right is a 'Database Index' section with a search bar containing '12042251'. The main section is titled 'for this isotope' and contains a table with columns 'Value' and 'Error'. The table lists various nuclear properties: γ-energy (2251 keV), Isomeric ratio (10%), T_{1/2} (2.33e-01 μs), Level energy (2251 keV), J^π (0+), I_γ, M_γ (E0), M ratio, Conversion Coef., Data source (Atlas2), and User Name (DK). On the right side of the window are buttons for 'Save', 'Quit', 'Help', 'NNDC', 'Add Record', 'Delete Record', 'Check fields', and 'Show Structure'.

	Value	Error
γ-energy	2251	1.00 keV
Isomeric ratio (level population)	10	%
T _{1/2}	2.33e-01	8.00E-03 μs
Level energy	2251	1.00 keV
J ^π	0+	
I _γ		%
M _γ	E0	
M ratio		
Conversion Coef.		
Data source	Atlas2	
User Name	DK	

Figure 1: Existing Isomer database interface in LISE⁺⁺

IsomerAPI Updates

- Since early drafts of the IsomerAPI in Qt for Python (Fig. 2), the application has been manually ported to Qt for C++, the common language of LISE++.
 - Previous limitations included:
 - » Level schemes for only single isotopes, lack of integration with LISE++ components, slower data processing
- The new general methodology remains similar:
 - IsomerAPI provides an interface for the SQL database
 - Users may filter data based on Isotope selection, energy ranges, half-lives, etc.
 - » Uses controlled read-only queries internal to the program
 - Level schemes may be drawn with the custom decay scheme program

	INDEX_IT	A_IT	Z_IT	E_GAMMA	D_EG	IT_RATIO	D_IT_RA
1	1.20401E+07	12	4	142	2.00	10	0
2	1.20423E+07	12	4	2251	1.00	10	
3	1.60701E+07	16	7	120.42	0.12	10	
4	1.80902E+07	18	9	184		10	
5	1.90901E+07	19	9	87.3		10	
6	1.90902E+07	19	9	197.1		10	
7	2.60906E+07	26	9	643.4	0.01	10	
8	1.91002E+07	19	10	238.3		10	
9	2.4102E+07	24	10	1980		10	
10	2.4104E+07	24	10	3962		10	
11	2.21106E+07	22	11	583.02	0.09	10	
12	2.41105E+07	24	11	472.202	0.0008	10	

Figure 2: Old Python version of IsomerAPI

IsomerAPI Updates

- The IsomerAPI has gone through major UI updates in the C++ version.
 - Formatting of table view
 - Palette and style consistent with LISE⁺⁺
 - Improved layout for filtering options
- Internally, the structure of data containers in the application has been completely revamped for later improvements of the application.
 - Moved from vector storage to hash maps for isotope-specific data selection
 - Later allows specific level and transition editing
- Externally, the isomer database is being reorganized into two SQL tables containing levels and transitions separately for better readability and applicability.

The screenshot displays the IsomerAPI application window. At the top, there's a title bar 'IsomerAPI' and a menu bar 'my menu'. Below the menu bar is a table with 11 columns: INDEX_IT, A_IT, Z_IT, E_GAMMA, D_EG, IT_RATIO, D_IT_RATIO, T12, D_T12, and LEVEL. The table contains 11 rows of data. To the right of the table is a 'Summary statistics for filter' panel with input fields for 'Isomer Count' and 'max γ-Energy:'. Below the table is a 'User operations' panel with buttons for 'Apply Filters', 'Clear Filters', 'Draw Level Scheme', and 'Download CSV'. At the bottom, there are several input fields for filtering: 'T12', 'γ-energy (KeV)', 'Final Levels', 'I_γ transmission', 'Source' (a dropdown menu), 'Mass number (A_{IT})', and 'Proton number (Z_{IT})'. There are also 'Range Search' and 'Exact Search' options for the mass and proton numbers.

	INDEX_IT	A_IT	Z_IT	E_GAMMA	D_EG	IT_RATIO	D_IT_RATIO	T12	D_T12	LEVEL
1	12040142	12	4	142	2.00	10	0	0.233	8.00E-03	2251
2	12042251	12	4	2251	1.00	10		0.233	8.00E-03	2251
3	16070120	16	7	120.42	0.12	10		5.306	2.80E-02	120.42
4	18090184	18	9	184		10		0.16	4.00E-03	1121.3
5	19090087	19	9	87.3		10		0.0893	1.00E-02	197.14
6	19090197	19	9	197.1		10		0.0893	1.00E-02	197.14
7	26090643	26	9	643.4	0.01	10		2200	1.00E+03	643.4
8	19100238	19	10	238.3		10		0.018	5.00E-03	238.27
9	24101980	24	10	1980		10		0.02	LT	3962
10	24103962	24	10	3962		10		0.02	LT	3962
11	22110583	22	11	583.02	0.09	10		0.244	6.00E-03	583.03

Figure 3: Current C++ version of IsomerAPI

IsomerAPI Updates

- Level scheme creation for multiple isotope searches are now possible (Fig. 5).
- Unique schemes are created and selectable for each isotope in user's search (Fig. 4)

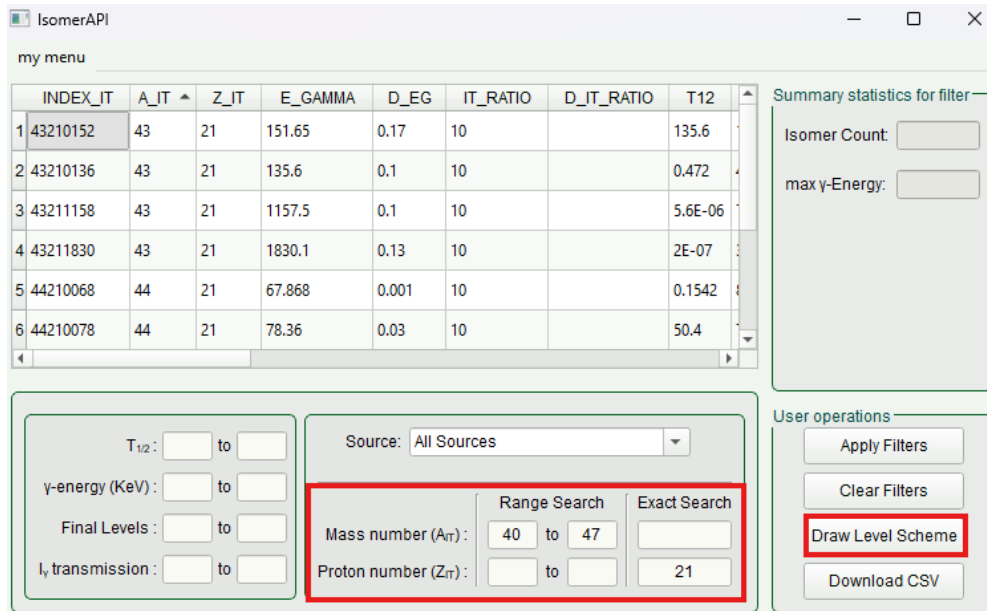


Figure 4: Search for Scandium isotopes with mass between 40 and 47

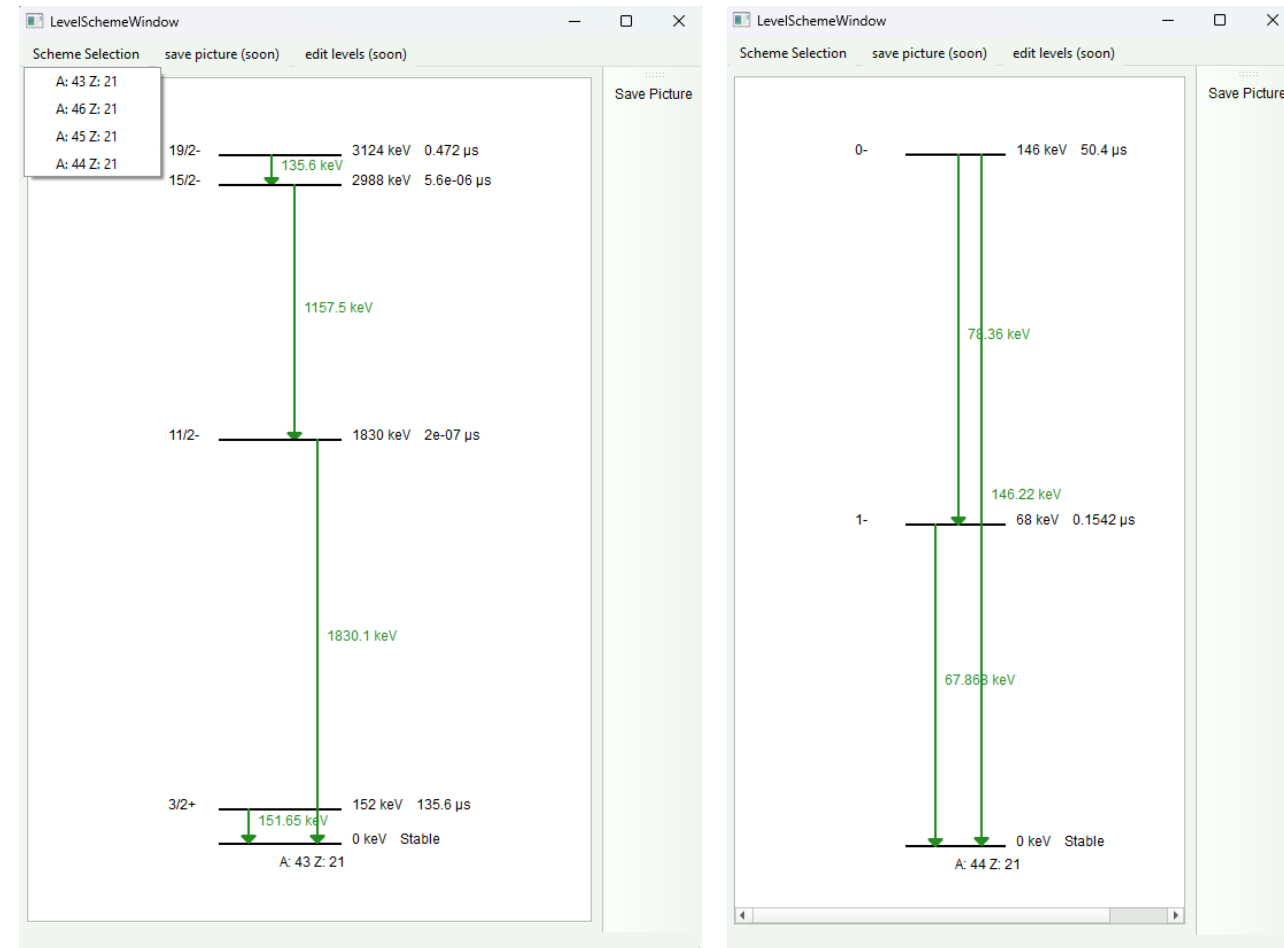


Figure 5: Level schemes for ^{43}Sc (left) and ^{44}Sc (right) with selection dropdown