LISE++ 18.7.0

Release Documentation

Release date: 23-AUG-2026

Version metadata last revised: 22-AUG-2026

Oleg B. Tarasov
tarasov@frib.msu.edu

Primary release themes: automated charge-state batch workflow, ETACHA4/GLOBAL integration, IsomerAPI beta, and calculation/UI reliability improvements.

Release line	18.7.x
Coverage	Changes accumulated from 18.6.0 through 18.7.0
Bundled codes	ETACHA4 4.9.2; GLOBAL 4.8.1; IsomerAPI beta 1.4.3
Prepared for	LISE++ users, developers, and FRIB/ARIS expert community

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”.

Contents at a glance

1. Executive summary

LISE++ 18.7.0 opens the 18.7.x development line after a concentrated set of changes made in versions 18.6.1-18.6.12. The most important development is a complete LISE-driven workflow for generating charge-state batch input for ETACHA4 and GLOBAL, followed by optional execution of either code. The release also integrates updated ETACHA4 and GLOBAL builds, introduces IsomerAPI as a beta standalone utility inside the LISE package, and includes a series of smaller calculation, plotting, dialog, and source-maintenance improvements.

Key capability: For users, the central change is that one LISE separator file can now be converted into a common .betacha material/energy sequence and immediately analyzed by ETACHA4 and/or GLOBAL without manually rebuilding the charge-state calculation input.

- Generate a .betacha batch file directly from the current LISE configuration for the fragment of interest.
- Determine material composition, thickness, density, and fragment energy block by block, including special treatment of the production target.
- Stop export when the fragment is no longer transported through a later material block.
- Run GLOBAL and/or ETACHA4 from the completion dialog; the selections are remembered between runs.
- Use ETACHA4 and GLOBAL batch CSV summaries for systematic comparison of calculated charge states and Fq0-Fq9 fractions.
- Launch the new IsomerAPI beta utility from LISE to browse an expanded NNDC-derived isomer/gamma data set and draw level schemes.

2. Release scope and version status

LISE++ release	18.7.0
Release date used for this document	23-AUG-2026
Source metadata	Version 18.7.0; last revision 22-AUG-2026
Windows project version	18.7.0.1
Change interval documented here	18.6.0 through 18.7.0
ETACHA4 bundled version	4.9.2 (integration metadata in the 18.7.0 development report)
GLOBAL bundled version	4.8.1 (integration metadata in the 18.7.0 development report)
IsomerAPI snapshot	1.4.3, 23-AUG-2026

The 18.7.0 version-number change itself marks the start of the 18.7.x line. The substantive user-visible changes were accumulated in 18.6.1 through 18.6.12 and are released together in 18.7.0.

Documentation scope note: The specialized ETACHA batch document supplied for this release describes implementation details through ETACHA4 4.9.1, while the LISE development report records 4.9.2 as the bundled version. Likewise, the GLOBAL detail document describes changes through 4.8.0, while the LISE development report records 4.8.1 as bundled. This release document therefore assigns feature-level detail only to the versions documented explicitly and treats 4.9.2/4.8.1 as integration-version metadata.

3. LISE++ batch export for ETACHA4 and GLOBAL

The main new workflow is exposed through the Generate batch file for ETACHA4 and GLOBAL action. LISE builds a .betacha file from the current separator configuration and the fragment of interest, then offers to launch the bundled charge-state codes with that file.

3.1 Batch-file generation sequence

1. The user runs Generate batch file for ETACHA4 and GLOBAL from the LISE main window.
2. LISE creates the .betacha header for the selected fragment of interest.
3. LISE walks through material blocks in separator order and derives the material, density, effective thickness, fragment charge-state context, and energy required by the external-code batch format.
4. The first production target is handled as a reaction-at-mid-target case: the fragment is created at the target midpoint and then traverses the remaining half of the target.
5. For other material blocks, the fragment energy is taken from the LISE transport calculation before that block; stopped/non-transported cases are excluded from subsequent material rows.
6. After the file is written, LISE reports the created path and the number of material blocks and opens a run-selection dialog for GLOBAL and ETACHA4.
7. Selected codes are launched from the LISE package path. The choices are stored with QSettings and restored on the next use.

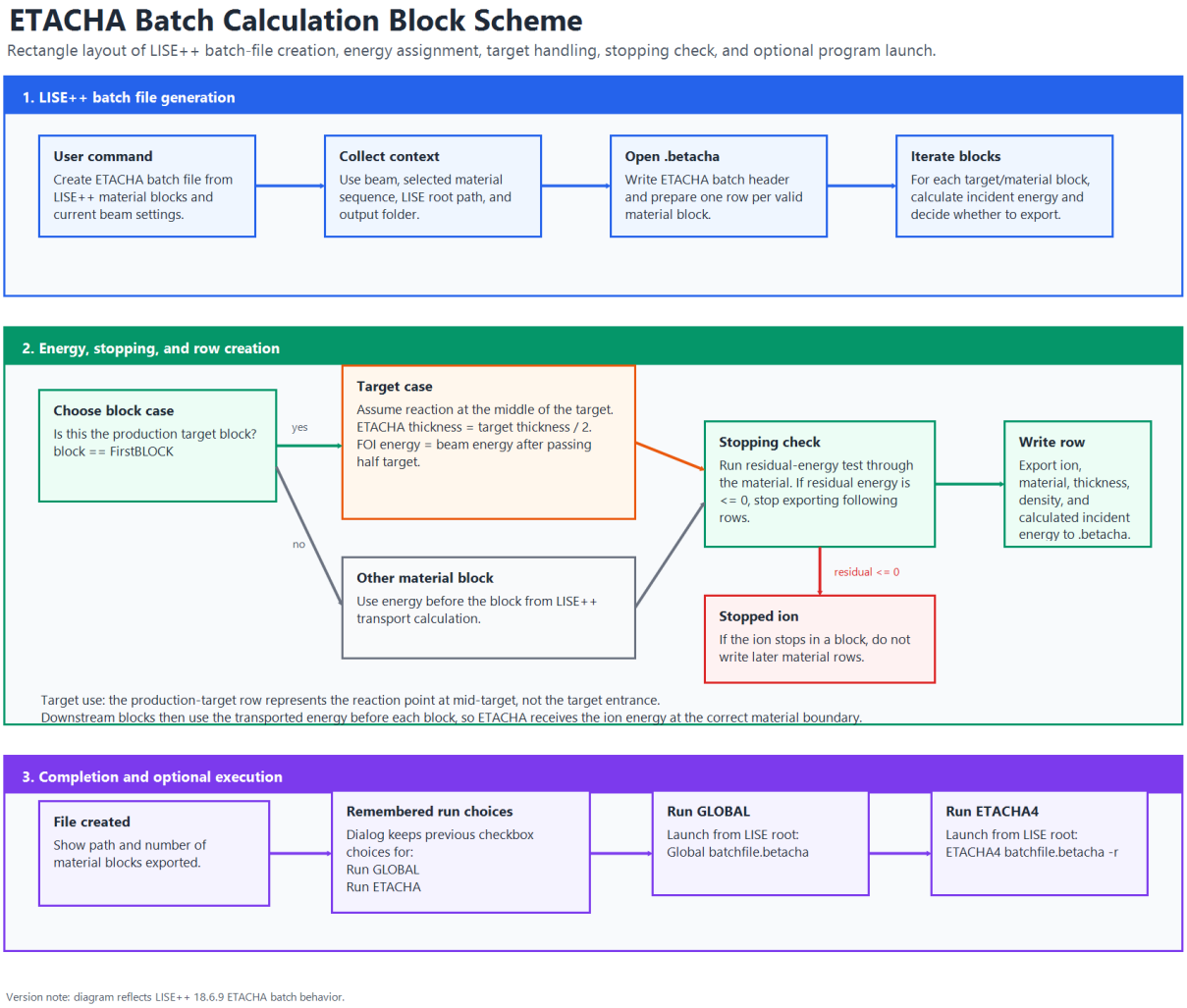

Figure 1. ETACHA/GLOBAL batch calculation scheme from the 18.6.0-18.7.0 development report. The diagram summarizes batch-file generation, target and stopping logic, and optional code execution.

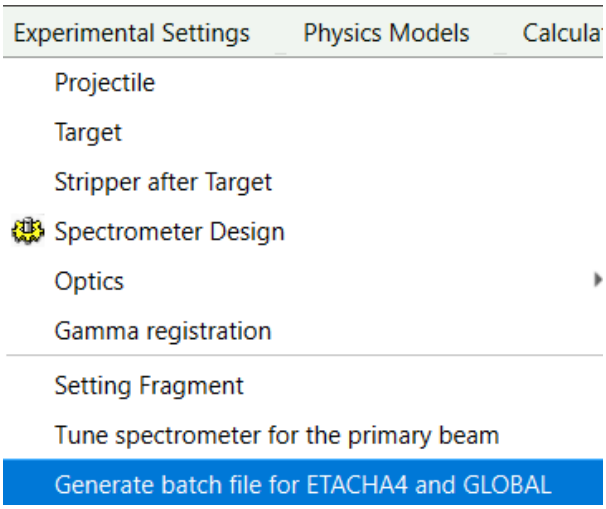

Figure 2a. LISE++ menu action used to generate the common ETACHA4/GLOBAL .betacha batch file.

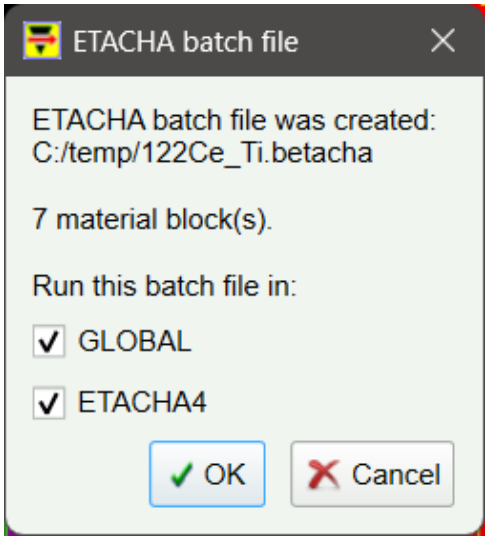

Figure 2b. Batch-file completion dialog. LISE++ reports the output path and material-block count and allows GLOBAL and ETACHA4 to be launched immediately.

The batch-file command is available from the Calculations menu under Spectrometer Design. After generation, LISE++ displays the created file and number of material blocks. The user can run GLOBAL, ETACHA4, or both directly from the completion dialog; the checkbox choices are remembered for the next run.

3.2 Material and energy logic

Case	18.7.0 export behavior
Production target	Reaction is assumed at the target midpoint; the fragment energy corresponds to production at mid-target and the exported traversal represents the remaining target thickness.
Compound material	LISE selects the relevant material component using the electron-weighted abundance rule documented for the export path.
Other material blocks	Energy before the block is obtained using the LISE block-energy helper logic; the row describes the actual material encountered by the transported fragment.
Stopped fragment	If residual energy is nonphysical or transport stops, the export terminates for later material blocks.
Optical blocks / charge state	The fragment Z-Q context is updated after dispersive/optical blocks as required by the LISE transport state.
Excluded material	Materials that are not physically traversed by the fragment are omitted from the batch sequence.

3.3 Run-selection and command-line behavior

The earlier final Yes/No message box was replaced by a custom completion dialog. It keeps the created-file summary visible, provides independent GLOBAL and ETACHA4 checkboxes, uses the standard LISE OK/Cancel resource icons, and remembers the checkbox state.

- GLOBAL is launched from the LISE package root with the generated .betacha filename and -r.

- ETACHA4 is launched from the LISE package root with the generated .betacha filename and -r -p.
- Windows .exe fallbacks follow the established LISE external-code launch convention.
- The design makes the same LISE-generated material sequence available to both codes, which is useful for direct ETACHA4/GLOBAL comparisons and automated studies.

4. ETACHA4 updates

The bundled ETACHA4 line was updated in parallel with LISE batch export. The detailed ETACHA document supplied with this release covers versions 4.8.14-4.9.1; the LISE 18.7.0 development report records ETACHA4 4.9.2 as the integrated package version.

4.1 Batch output and quiet-mode behavior

- The result CSV is saved in the same directory as the selected .betacha file.
- The filename marker is resETACHA, for example 120Ce_011_144Sm_resETACHA_v3i0e0.csv.
- The completion message reports all completed calculation sets and the result CSV path.
- With /q or -q, the completion message closes after 5 seconds and the application closes; without quiet mode, the user closes the message manually.
- The CSV includes Kp(1), dQ(calc-set)=QF-Qb, and charge fractions Fq0-Fq9; the obsolete QM column was removed in the documented 4.8.17-4.9.1 line.

Field / behavior	Meaning
Kp(1)	Projectile perturbation diagnostic written after target density; useful for model-selection checks.
iQmax	Charge state with the largest calculated fraction.
dQ(calc-set)	Difference QF-Qb for the calculation set.
Fq0...Fq9	Fractions for charge Zb, Zb-1, ..., Zb-9.
ibin log	Detailed output records the selected PWBA correction parameter.

4.2 Model-selection correction and guidance

The ETACHA 4.9 model-selection documentation separates the physical model choice from the GUI labels. The important 2026 correction is the explicit mapping of the PWBA correction selector: empirical saturation -> ibin=0; binding correction -> ibin=1; no empirical/no binding correction -> ibin=2. The selected value is also written to the detailed calculation log, removing the earlier ambiguity between visible radio buttons and the internal parameter. Details are available in the ETACHA 4.9 Model Selection Manual.

Use case	Version / model guidance
Robust general production when n=4 may matter	v4 with CDW-EIS ionization and Symmetric-Eikonal excitation is the strongest general starting point supported by the 2015 physics model.
Fast three-shell scan	v3 when n=4 is demonstrably negligible; model choice should still be checked against Kp.
Fast four-shell approximation	v3.4 from the corrected 4.8.10 line; independent n=4 population, useful when full n123-n4 correlation is not expected to control the result.
Upper-shell sensitivity	v4.5 only as an exploratory extension; the explicit coupled population count remains that of v4.

Use case	Version / model guidance
PWBA correction selector	Use ibin=0 for established-code continuity; ibin=2 for an uncorrected-PWBA diagnostic; avoid ibin=1 for routine work unless deliberately studying the historical binding correction.

Physics guidance: There is no single universal projectile-energy boundary for choosing PWBA versus CDW-EIS/SEIK. The supplied manual recommends using the perturbation parameter Kp and the active shell, target Z, and projectile velocity.

5. GLOBAL updates

GLOBAL was extended with an ETACHA-style batch input path and a matching CSV summary workflow. The specialized GLOBAL change document covers the implementation through version 4.8.0; the LISE 18.7.0 development report records GLOBAL 4.8.1 as the bundled package version.

5.1 Batch mode and outputs

- Batch mode accepts rows in the common format: Ab Zb Qb Eb At Zt thickness density.
- Blank lines and lines beginning with ! or ; are comments.
- Batch calculations force GLOBAL option #0: charge state at target exit with initial energy.
- The summary file is written next to the batch file as <batch-name>_resGLOBAL.csv.
- Per-row .global and .gloutput files are written to the LISE document results folder.
- The CSV reports Status, Qcalc, dQ, iQmax, dQ(calc-set), equilibrium thickness, output energy, Fq0-Fq9, and generated file paths.
- GLOBAL recognizes /q and -q; quiet-mode completion auto-closes after 5 seconds while interactive mode remains open for review.

5.2 Numerical-accuracy refinement

GLOBAL 4.8.0 incorporates two numerical refinements proposed by Masahiro Yoshimoto (RIKEN BigRIPS team): the EDIFF divisor was changed from 200 to 2000, and the integration coefficient sequence was changed from {1,10,100,1000,10000,100000} to {1,1,10,100,1000,10000}. These changes address different discretization effects: the first refreshes energy-dependent charge-changing cross sections more frequently, while the second delays integration-step coarsening by one decade.

The supplied benchmark uses 238U86+ at 345 MeV/u on Be and Ta. The modified calculations produce visibly smoother charge-state fraction curves. Timing measurements did not show a large systematic penalty: the combined case was faster for Be and about 10% slower for Ta in the reported 400-run tests.

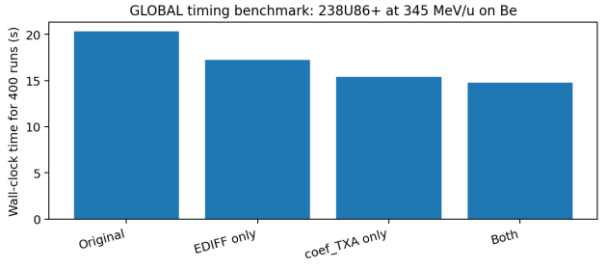

Figure 3a. GLOBAL timing benchmark on Be: the combined numerical refinement was faster than the original case in this test.

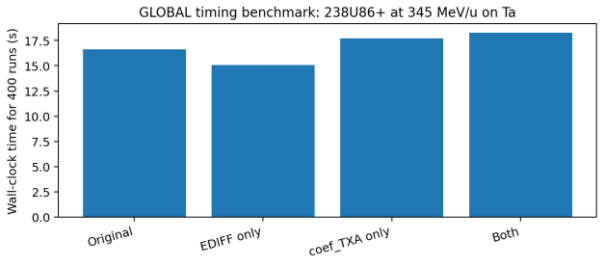

Figure 3b. GLOBAL timing benchmark on Ta: the combined refinement was about 10% slower than the original case in this test.

6. IsomerAPI beta integration

LISE++ 18.7.0 adds an IsomerAPI beta external-code action to the LISE menus. IsomerAPI 1.4.3 is distributed inside the LISE package and can be started directly from LISE in either of two ways: by clicking the IsomerAPI toolbar icon, or by selecting Utilities -> CODES: Charge, Global, PACE4, etc. -> The code "IsomerAPI" (beta).

6.1 Launching IsomerAPI from LISE++

Two equivalent launch paths are available in LISE++ 18.7.0:

1. **Toolbar:** click the IsomerAPI icon (XAPI) on the LISE toolbar.
2. **Menu:** open Utilities -> CODES: Charge, Global, PACE4, etc. -> The code "IsomerAPI" (beta).

Figure 4a. IsomerAPI toolbar action in LISE++.

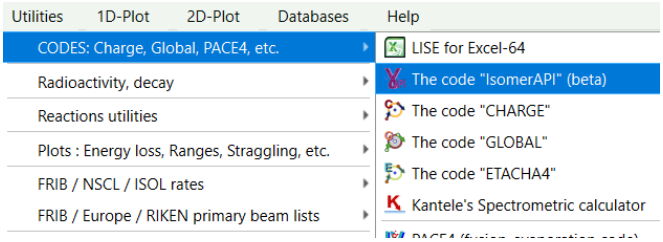

Figure 4b. IsomerAPI beta action in Utilities -> CODES: Charge, Global, PACE4, etc.

IsomerAPI is an undergraduate development project within LISE++. The About dialog highlights Hudson Miltner's contribution to the development of the application and lists the project authors: Hudson Miltner, Oleg B. Tarasov, and Daniel Kaloyanov. Project site: https://lise.frib.msu.edu/isomerapi.html

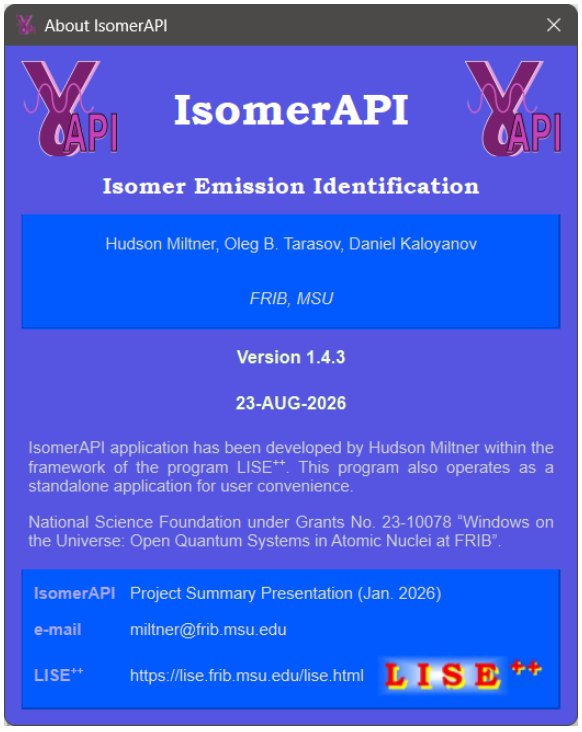

Figure 4c. IsomerAPI About dialog (version 1.4.3), highlighting the undergraduate development contribution and project authorship within LISE++.

In version 18.7.0 this starts IsomerAPI as a standalone utility supplied with the LISE++ package. No fragment, separator, calculated rate, flight-time, or detector-gate data are passed automatically from LISE++ to IsomerAPI in this release.

Current IsomerAPI version	1.4.3, 23-AUG-2026
Database snapshot	79,569 gamma-line records for 923 isotopes
Storage / data layer	SQLite, using nndc_DB_fullScan.sqlite
Primary views	Isomers, Gammas, combined Isomers/Gammas
Filtering	A/Z exact or range, level energy, gamma energy, half-life, source
Visualization	Graphical level-scheme construction with connected transitions
LISE package status	Launchable from LISE; standalone operation
Direct LISE calculation connection	Not yet implemented

6.2 Why IsomerAPI matters for LISE

Historically, LISE used a compact internal isomer database to connect calculated implanted-fragment rates with delayed gamma-ray yields, gamma spectra, and particle-identification plots in coincidence with gamma radiation. A 2006 snapshot contained 1,854 gamma-ray records. The current IsomerAPI snapshot is much larger and uses explicit isotope -> level -> transition relationships, including LEVEL_ID and FINAL_LEVEL_ID, which are better suited to decay-cascade handling and modern NNDC/ENSDF-based workflows.

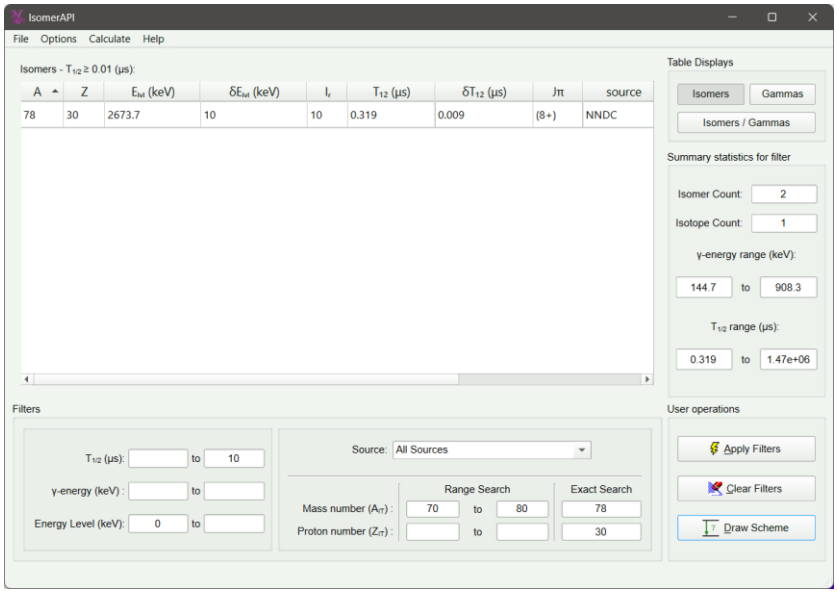

Figure 5a. Current IsomerAPI interface, shown for 78Zn, with isotope, energy, half-life, and source filters.

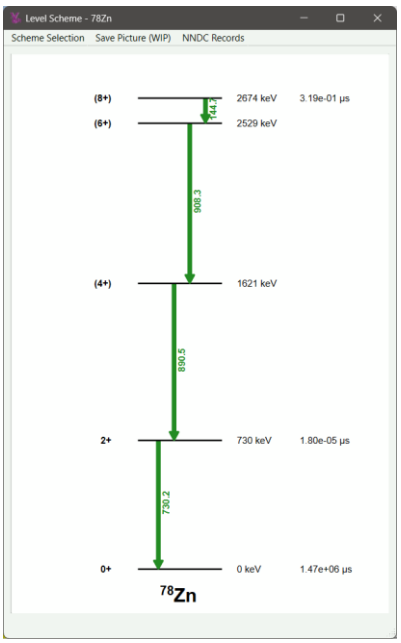

Figure 5b. 78Zn level-scheme view, illustrating connected levels and gamma transitions.

6.3 Current limitation and planned direction

Current limitation: Launching IsomerAPI from LISE does not yet pass the selected fragment, calculated rate, flight information, or detector gate settings. IsomerAPI also does not yet replace the legacy LISE isomer

routines.

The documented integration plan is to reuse IsomerAPI data-access and decay-processing source functions directly inside LISE rather than making LISE invoke the IsomerAPI executable as a calculator. The long-term goal is one maintained nuclear-data layer with two interfaces: the IsomerAPI browser/visualizer and the LISE gamma-yield/coincidence calculation path.

7. Additional LISE++ improvements

Area	Change in 18.6.1-18.6.12
Fragmentation model selector	The previous model combo box plus separate checkbox was replaced by a two-column checkbox table for selecting multiple models in All methods.
AA pickup-aware plot ranges	Shared plot-limit helpers now extend Z, N, and A ranges consistently for one-nucleon pickup in cross-section, prefragment excitation-energy, and evaporation plots.
LSODA MSVC cleanup	Numeric/index type corrections remove MSVC warnings while preserving floating-point pivot magnitudes.
Adjust Slits dialog	Parentage, focus/default-button behavior, temporary calculation-state restoration, SpecialFLagArret restoration, and array deletion were reviewed and corrected.
MainWindow calculation source	Calculation implementation was split/cleaned up; ETACHA energy lookup was aligned with BLOCK energy helpers.
External-code menu integration	The IsomerAPI beta action follows the same runCode pattern as other bundled external applications.

8. Modification log: 18.6.0-18.7.0

Version	Date	Modification
18.6.0	08/15/26	Middle version changed; baseline for this release interval.
18.6.1	08/18/26	Projectile-fragmentation cross-section plot selection changed to a checkbox table for selecting models shown in All methods.
18.6.2	08/18/26	AA pickup-aware ranges added for cross-section, prefragment excitation-energy, and Evaporation Calculator plots.
18.6.3	08/18/26	LSODA MSVC warning cleanup: numeric and index type corrections while preserving floating-point pivot magnitudes.
18.6.4	08/19/26	Adjust Slits dialog focus and temporary calculation-state cleanup.
18.6.5	08/19/26	Generate Batch File for ETACHA4 menu action added, writing .betacha files for the fragment of interest.
18.6.6	08/19/26	MainWindow calculation source split/cleanup; ETACHA energy lookup aligned with BLOCK energy helpers.
18.6.7	08/19/26	Batch-export refinements: dominant electron-weighted material component, FOI Z-Q handling, stopped-particle exclusion, default-name correction, and GetEnergyBeforeBlock helper.

Version	Date	Modification
18.6.8	08/20/26	Production-target export updated: reaction assumed at mid-target and FOI energy taken as beam energy at mid-target.
18.6.9	08/20/26	Final message replaced by remembered GLOBAL/ETACHA4 run-selection dialog; both codes can start from the generated .betacha file.
18.6.10	08/22/26	IsomerAPI beta action added to LISE++ external-code menus.
18.6.11	08/22/26	ETACHA4 version 4.9.2 integrated for LISE++-generated batch files.
18.6.12	08/22/26	GLOBAL version 4.8.1 integrated for LISE++-generated batch files.
18.7.0	08/22/26	Middle version changed to start the 18.7.x development line after ETACHA4, GLOBAL, and IsomerAPI integration updates.

9. Recommended user workflows

9.1 Charge-state calculation from a LISE separator file

1. Open or prepare the LISE file and verify the fragment of interest and separator/material configuration.
2. Run the standard LISE transport/tuning calculation so energies and block states are current.
3. Choose Generate batch file for ETACHA4 and GLOBAL.
4. Review the completion summary, including the generated .betacha path and material-block count.
5. Select ETACHA4, GLOBAL, or both. The selection is remembered for the next run.
6. Use the generated resETACHA and resGLOBAL CSV files to compare Qcalc/iQmax, dQ, charge fractions, and model sensitivities.
7. For automated studies, use the quiet-mode behavior of the external codes so batch completion does not require manual interaction.

9.2 ETACHA model choice for production work

1. Determine the incident bound-electron count and whether n=4 or higher-shell dynamics can matter during the foil traversal.
2. Use Kp for the active shell as the perturbation diagnostic rather than relying on a universal energy cutoff.
3. For final calculations, prefer CDW-EIS ionization and Symmetric-Eikonal excitation unless the weak-perturbation regime is clearly established and PWBA speed is important.
4. Use ibin=0 for continuity with the established ETACHA implementation; use ibin=2 intentionally for an uncorrected-PWBA sensitivity test.
5. For high-stakes predictions, compare neighboring model choices and benchmark against measured charge-state distributions whenever possible.

9.3 IsomerAPI use inside the LISE package

1. Launch IsomerAPI from the toolbar, or use Utilities -> CODES: Charge, Global, PACE4, etc. -> The code "IsomerAPI" (beta).
2. Choose Isomers, Gammas, or Isomers/Gammas display.
3. Apply A/Z, half-life, level-energy, gamma-energy, and source filters for the isotope region of interest.
4. Use summary statistics to confirm the selected data set.
5. Select an isotope/isomer and Draw Scheme to inspect the decay structure and gamma transitions.
6. Treat the utility as a standalone nuclear-data browser in 18.7.0; direct transfer of LISE rates/gates is planned but not yet implemented.

10. Validation status, compatibility, and limitations

Item	Status / limitation
Version and source metadata	Reviewed and consistent for LISE++ 18.7.0 / Windows 18.7.0.1.
Menu/action presence	Generate batch file for ETACHA4 and GLOBAL and IsomerAPI actions reviewed in source.
Launch arguments	GLOBAL .betacha + -r; ETACHA4 .betacha + -r -p reviewed in source.
Full LISE rebuild during documentation pass	Not performed in the supplied 18.7.0 development report.
Runtime ETACHA/GLOBAL batch execution in that pass	Not performed in the supplied report.
Installer validation	Not performed in the supplied report.
GLOBAL convergence	Smoother curves and acceptable timing are documented; an additional finer-step convergence check is recommended.
IsomerAPI-LISE calculation connection	Not implemented in 18.7.0; launch integration only.
Specialized code version detail	ETACHA feature details supplied through 4.9.1 and GLOBAL through 4.8.0; later bundled-version numbers are taken from the LISE 18.7.0 integration report.

11. Affected components and maintenance notes

Category	Representative files / projects
Version/project	LISEcute.pro; L_Init/lise_version.h
ETACHA4/GLOBAL batch export	w_Main/MainWindow.h; MainWindow.ui; MainWindow_actions.cpp; MainWindow_calc.cpp; L_Block/p_Block.cpp/.h
IsomerAPI action	w_Main/MainWindow.*; Icons/Icons.qrc
Bundled external codes	g_Etacha4; g_Global; IsomerAPI project
AA pickup plotting	o_Evap/o_AA.cpp; o_AA_plotLimits.h; prefragment/evaporation/cross-section plot sources
Fragmentation selector	d_Mechanism/d_Mechanism_fragmentation.*
Adjust Slits	d_Setup/d_AdjustSlits.*
LSODA	o_ODE/LSODA.cpp/.h

Documentation wording: Use 'batch file' as the noun phrase and 'batch-file' only as a compound adjective in user-facing documentation. The 18.7.0 source-review report explicitly recommends avoiding terse or inconsistent wording such as 'working with bath-file'.

12. Release quick reference

Question	Answer
What is new first?	LISE can generate a common .betacha sequence and optionally run ETACHA4 and GLOBAL directly.
Where are ETACHA/GLOBAL summaries?	Next to the selected .betacha file, using _resETACHA...csv and _resGLOBAL.csv naming.
Can runs be automated?	Yes. Both external-code workflows include quiet-mode completion behavior; LISE remembers which code(s) to run.
What is the ETACHA general starting model?	For robust production work when n=4 may matter: v4 + CDW-EIS + Symmetric-Eikonal, with Kp/model sensitivity checked as appropriate.
What changed numerically in GLOBAL?	Finer EDIFF refresh and delayed integration-step coarsening; benchmark curves are smoother without a large systematic timing penalty in the supplied tests.
What is IsomerAPI in 18.7.0?	A beta standalone isomer/gamma database and level-scheme utility bundled with and launchable from LISE.
Is IsomerAPI already connected to LISE rates/gates?	No. Direct in-process data integration is planned for a later development stage.

Appendix A. Source basis and documentation references

Reference	Document
[1]	LISE++ 18.6.0-18.7.0 Development Report, prepared 22-AUG-2026. Primary source for LISE version history, batch export, menu integration, and verification scope.
[2]	ETACHA Batch Mode Update Details, versions 4.8.14-4.9.1, 21-AUG-2026. Primary source for resETACHA CSV behavior, Kp(1), Fq0-Fq9, ibin mapping, and quiet mode.
[3]	GLOBAL 2026 Modification Details, through version 4.8.0, 21-AUG-2026. Primary source for GLOBAL batch mode, resGLOBAL CSV, /q behavior, and 4.8.0 numerical changes.
[4]	GLOBAL Numerical-Accuracy Benchmark: Summary and Recommended Follow-up Checks, August 2026. Source for timing results, smoothness interpretation, and convergence recommendation.
[5]	ETACHA 4.9 Model and Version Selection Guide. Source for Kp-driven model-selection guidance, v3/v3.4/v4/v4.5 scope, and the ibin interpretation.
[6]	IsomerAPI - LISE++ Technical Description, current snapshot 1.4.3, 23-AUG-2026. Source for IsomerAPI database statistics, current package integration, limitations, and migration plan.

This document is a synthesis of the supplied release materials. It intentionally distinguishes verified source behavior from proposed future integration and from recommended follow-up validation.