From 12/28/25

Summary

This series of updates delivers a fully modernized dBE minimization framework, introduces new excitation-energy and mass definitions, and strengthens numerical stability and diagnostics, while laying the groundwork for unified USER cross-section tables and the LISE v18 transition.

1. dBE Cross-Section Systematics and Minimization
2. Excitation Energy and Mass Models
3. Normalization and Scaling
4. Plotting, GUI, and Diagnostics
5. Bug Fixes and Stability

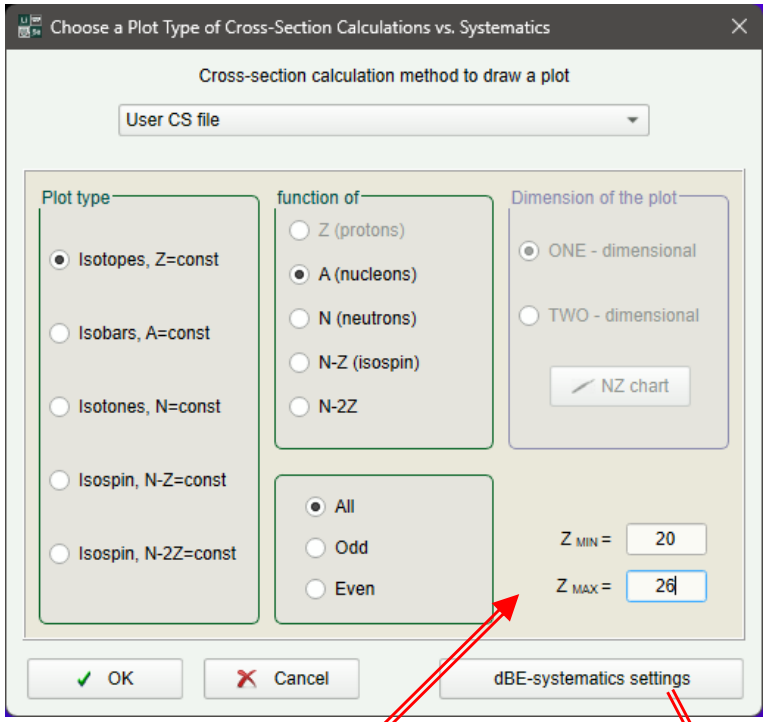
1. dBE Cross-Section Systematics and Minimization

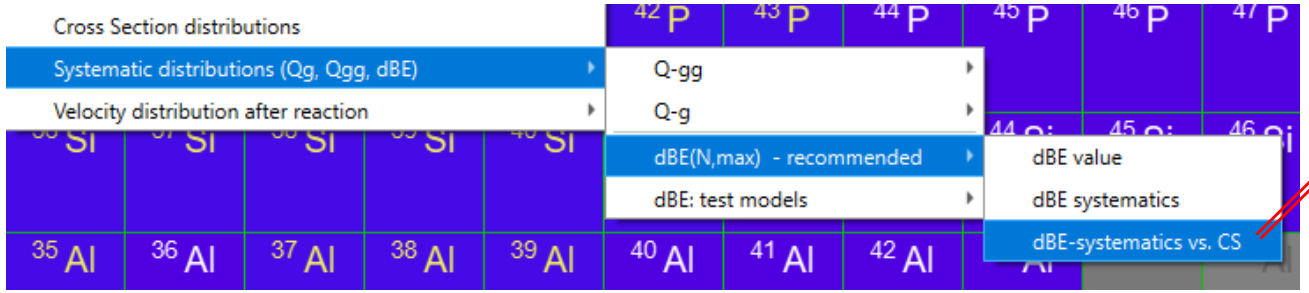
1.1 User-visible functionality

- Completed new dBE minimization workflow
- Added upper cross-section limit control for fits
- Extended minimization to additional operational modes (1–3)
- Introduced persistent output file for dBE minimization results
- Display of minimization results and diagnostics in the Log window
- Optional log-scale display enabled after minimization
- Improved dBE settings dialog with a dedicated minimization group box
- Real-time plotting of fit diagnostics (N, χ^2)

1.2 Internal implementation

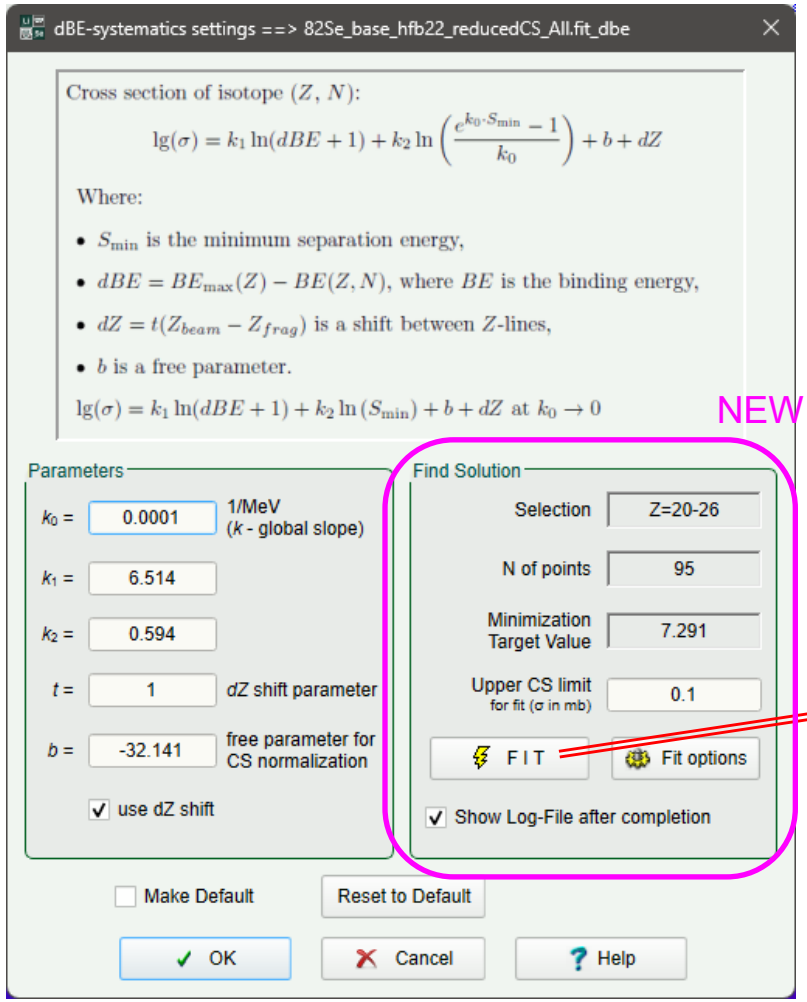
- Major redesign of dBE minimization architecture
- Transition from fixed χ^2 vectors to dynamic per-point handling
- Centralized target-value calculation
- Unified scaling using lm_dscl
- Revised minimization bounds and parameter handling





Next slide

dBE Cross-Section Systematics and Minimization

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28-12-2025 17:48:24   Version 17.17.53

82Se (140.0 MeV/u) + C  -->  Z=20-26
Database:  User's ME file 'hfb22' + LDM3; dBE method = 0;  N_points = 95

TARGET VALUEs: Initial    7.29114  and Final  0.153968  LISE++ reduced values

Parameters :      LeftBound   <   Initial     <  RightBound |  Final
1. k0               +1.0e-05  <  +1.0000e-04  <  +1.0e+01   | +1.0000e-04
2. k1               +1.0e-01  <  +6.5140e+00  <  +1.0e+02   | +6.5130e+00
3. k2               +1.0e-02  <  +5.9400e-01  <  +1.0e+01   | +5.9300e-01
4. b0               -1.0e+02  <  -3.2141e+01  <  +2.0e+01   | -3.2141e+01
5. temperature      +1.0e-06  <  +1.0000e+00  <  +5.0e+00   | +1.8300e-01

Results:    0.1611      0.0001      6.5130      0.5930      -32.1410    0.1830


Levenberg-Marquardt returned 100.0 in 100 iter, reason 3
Termination reason: 3 - stopped by itmax


Minimization info:
0: 7.766e+05            ||e||_2 at initial p
1: 3.918e+02            ||e||_2
2: 2.823e+00            ||J^T e||_inf
3: 6.357e-08            ||Dp||_2
4: 9.912e-04            mu/max[J^T J]_ii
5: 100                  # iterations
6: 3                    reason for terminating
7: 5460                 # function evaluations
8: 100                  # Jacobian evaluations
9: 100                  # linear systems solved, i.e. # attempts for reducing error

--------------------------------------------------------------------------------

Covariance of the fit :
+2.722960e-02 -2.544894e-03 -2.728646e-02 +1.387639e-02 -3.212551e-04
-2.544894e-03 +5.466165e-03 +4.247143e-04 -1.896004e-02 +2.590170e-04
-2.728646e-02 +4.247143e-04 +3.070004e-02 -1.128210e-02 +3.483836e-04
+1.387639e-02 -1.896004e-02 -1.128210e-02 +1.034084e-01 -3.642046e-03
-3.212551e-04 +2.590170e-04 +3.483836e-04 -3.642046e-03 +2.430098e-04
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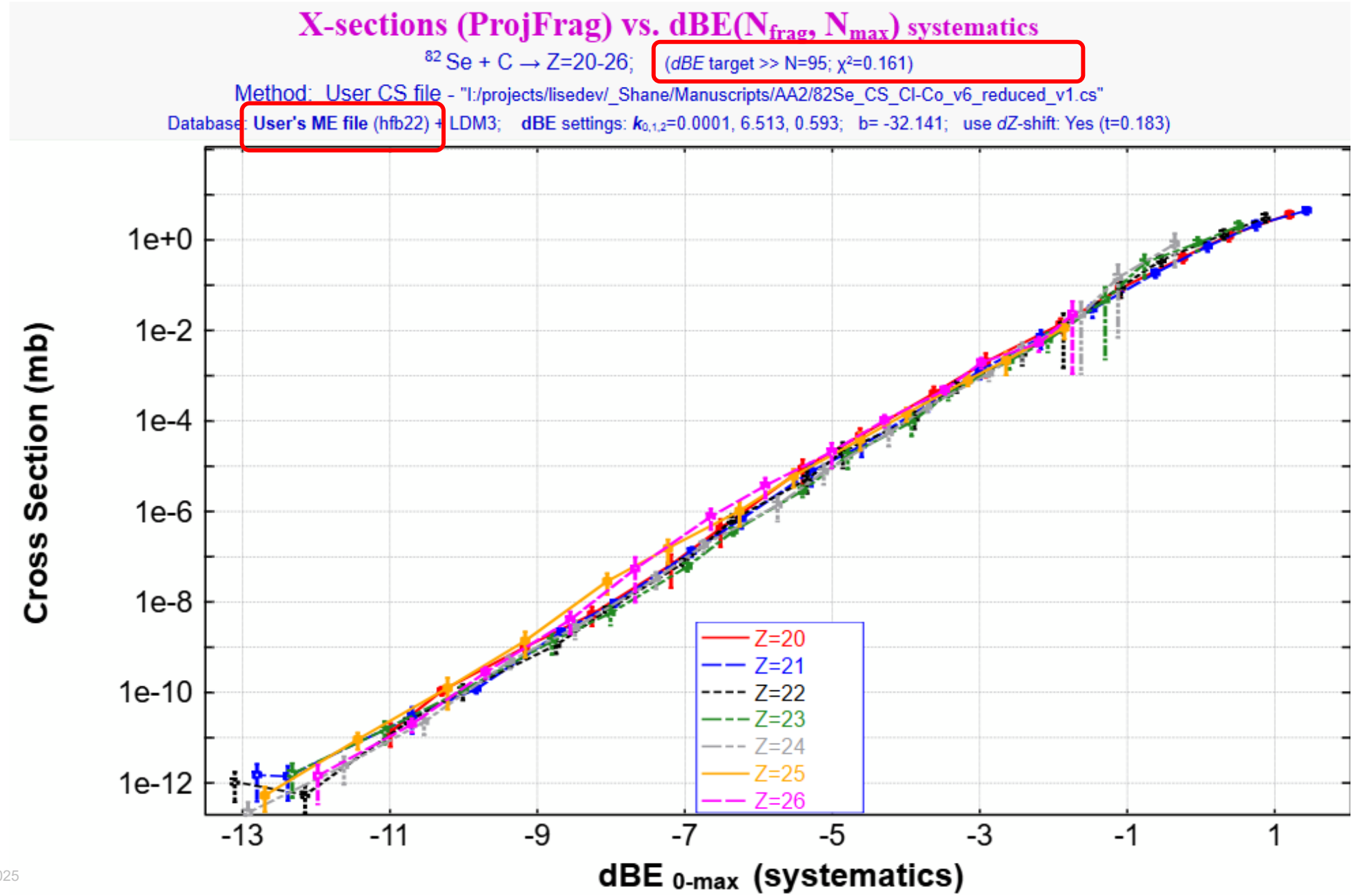
dBE Cross-Section Systematics plot : hfb22

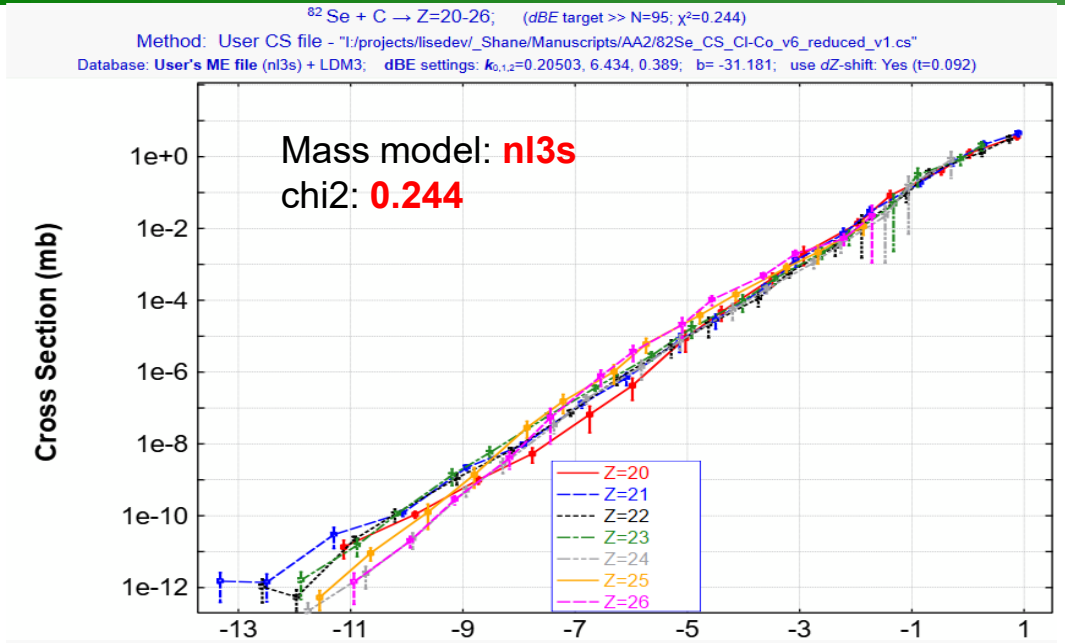


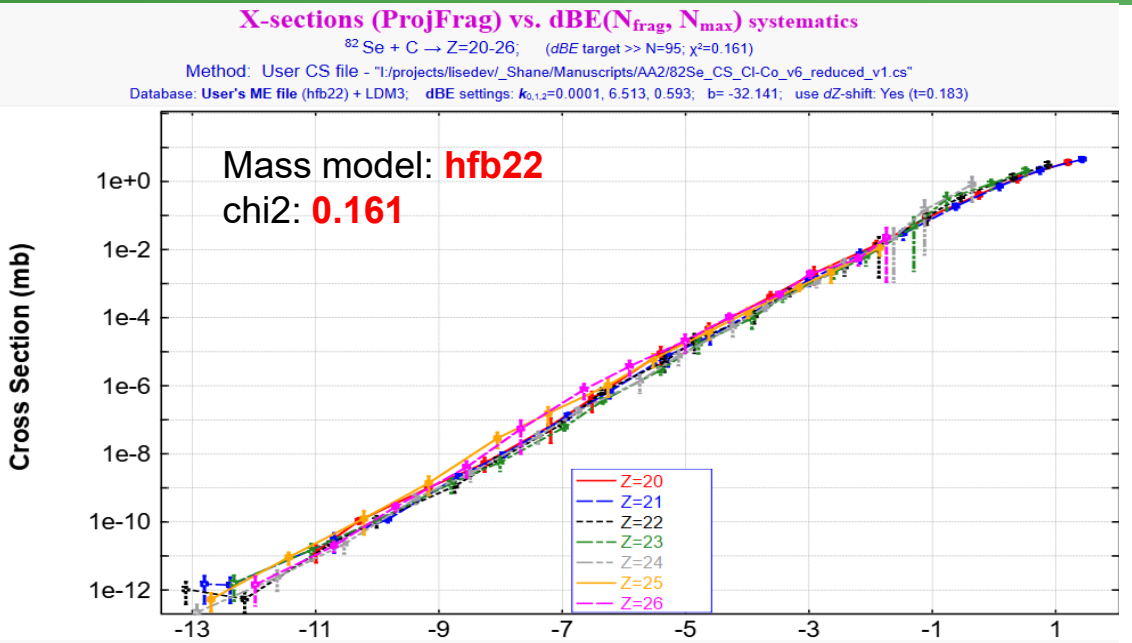
Minimization results with different mass models

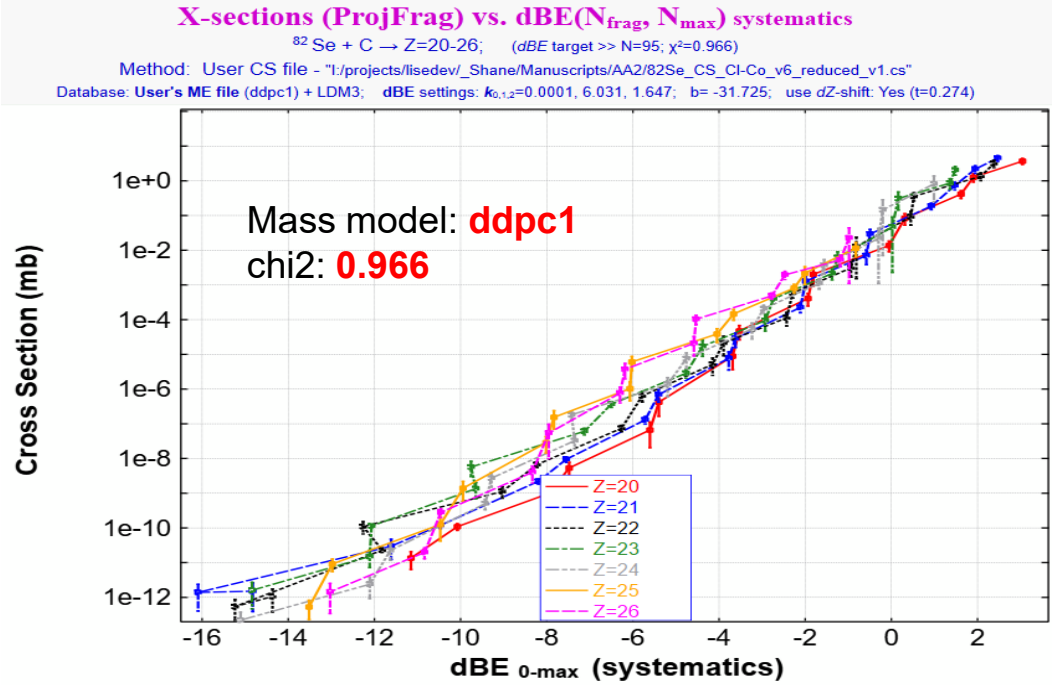
selection Z=20-26							
	chi2 result	k0	k1	k2	b	t	
AME2003	0.67	0.00	6.42	0.58	-32.11	0.36	Iterations=50
AME2011	0.44	4.77	5.13	0.06	-25.91	0.16	82Se_base_hfb22_reducedCS_All
AME2016	0.38	0.61	5.14	0.35	-25.83	0.16	Upper CS limit = 0.1
AME2020	0.69	0.00	6.46	0.45	-32.12	0.36	
FRDM2012	0.50	0.00	6.47	0.78	-32.11	0.26	
hfb17	0.20	0.50	6.02	0.28	-29.56	0.17	
hfb22	0.16	0.00	6.51	0.59	-32.14	0.18	
hfb27	0.21	0.30	5.43	0.40	-27.56	0.21	
hfb8	0.27	0.68	5.53	0.24	-28.55	0.29	
hfb9	0.25	0.00	6.34	0.68	-32.06	0.28	
ktuy	0.31	0.00	5.70	1.34	-30.97	0.32	
Moller95	0.51	0.00	6.43	0.72	-32.00	0.27	
tuyy	0.27	0.13	6.15	0.57	-28.53	0.00	
WS4	0.65	0.00	6.04	0.01	-28.54	0.30	
WS4_RBF	0.77	0.00	6.36	0.01	-31.99	0.53	
FRIB_mass\SKMS	0.83	0.20	5.79	0.15	-28.60	0.00	
FRIB_mass\SKP	0.32	0.00	6.04	0.60	-32.02	0.39	
FRIB_mass\SLY4	0.21	0.31	5.15	0.37	-25.91	0.19	
FRIB_mass\SV-MIN	0.31	0.02	5.92	0.64	-31.76	0.38	
FRIB_mass\UNEDF0	0.37	0.09	5.81	0.79	-32.11	0.40	
FRIB_mass\UNEDF1	0.44	0.14	5.76	0.63	-32.09	0.49	
RMF_mass\ddme2	not fitted						
RMF_mass\ddmed	1.29	0.35	5.85	0.15	-32.09	0.55	
RMF_mass\ddpc1	0.97	0.00	6.03	1.65	-31.73	0.27	
RMF_mass\nl3s	0.24	0.21	6.43	0.39	-31.18	0.09	

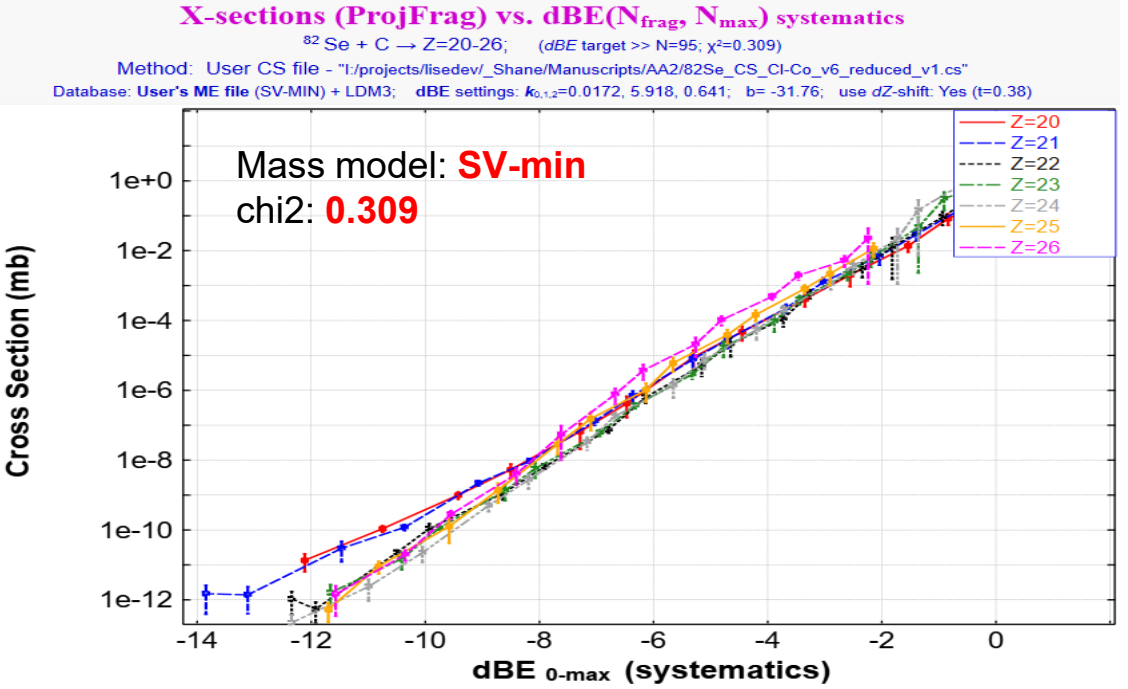
$$\chi^2_{\mathrm{red}} = \frac{1}{N-P}\sum_{i=1}^{N}\left(\frac{\log_{10}(\sigma_i^{\mathrm{exp}}) - dBE_i}{\log_{10}(\sigma_i^{\mathrm{exp}} + \delta\sigma_i^{\mathrm{exp}}) - \log_{10}(\sigma_i^{\mathrm{exp}})}\right)^2$$

Minimization results examples









2. Excitation Energy and Mass Models

2.1 User-visible additions

- New mass-based ground-state energy definition (db_GroundState)
- Introduction of invariant-mass excitation-energy model (o_EE_invariantMass)

2.2 Internal development

- Continued development and stabilization of the invariant-mass excitation-energy model
- Updates to core physics class definitions

The new excitation model based on Invariant Mass (O.Ferrari et al.) will be available soon for LISE Abrasion-Ablation

THE PRODUCTION OF RESIDUAL NUCLEI IN PERIPHERAL HIGH ENERGY NUCLEUS-NUCLEUS INTERACTIONS

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Abstract

A formation zone intranuclear cascade model is applied to peripheral nucleus-nucleus collisions. We calculate the excitation energies of prefragments, treat their further nuclear disintegration and introduce a model for nuclear deexcitation by photon emission. Results are compared to data on target associated particle production in nucleus-nucleus collisions. We discuss implications of these models to the description of particle production in the fragmentation regions. Special emphasis is put on applications for air showers induced by cosmic ray nuclei and for residual nucleus production at heavy ion colliders.

$$(E_{\rm res}, \vec{p}_{\rm res}) = (M_{\rm A}, \vec{0}) - \sum_{i=1}^{N_w} (E_i^{\rm F}, \vec{p}_i^{\rm F}) + (E_{\rm rcl}, \vec{p}_{\rm rcl}).$$

Summary of other updates

3.1 Numerical behavior

- Corrected normalization of intermediate dscl results
- Proper handling of lm_dscl[n] and lm_covar[n] scaling factors

3.2 Infrastructure

- Consistent propagation of scaling factors across minimization routines

4. Plotting, GUI, and Diagnostics

4.1 User-visible fixes

- Improved isotope linking in calculation windows
- Corrected Power Deposition window caption
- More stable plotting behavior during dBE operations

4.2 Internal changes

- Plotting infrastructure updated to pass state and N pointers consistently

5. Bug Fixes and Stability

5.1 Physics-related fixes

- Fixed missing error distributions in Qg(dBE) systematics for non-positive scaling factors
- Corrected behavior of the dBE-method selection menu

5.2 Code maintenance

- Constants file revision
- General internal consistency and cleanup