



Version 8.0

Fragment production in Material (FPiM)
Monte Carlo transmission of fragment
New utilities and Modifications

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1. Fragment production in Material (FPiM)

Use the following link: http://groups.nsl.msu.edu/lise/8_0/secondary_targets.pdf

2. Monte Carlo transmission of fragment

Use the following link: http://groups.nsl.msu.edu/lise/8_0/monte_carlo.pdf

3. LISE++ possibilities to estimate energy losses in materials

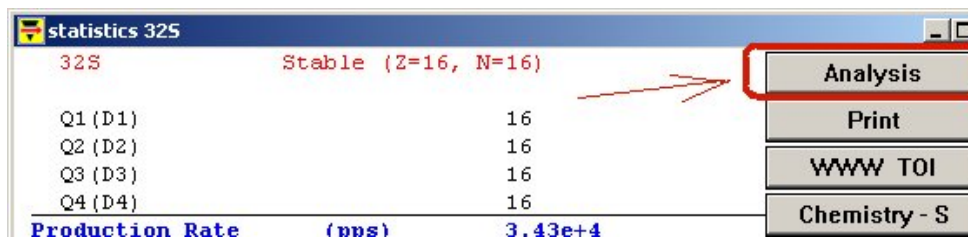
Use the following link: http://groups.nsl.msu.edu/lise/8_0/methods.pdf

4. New features

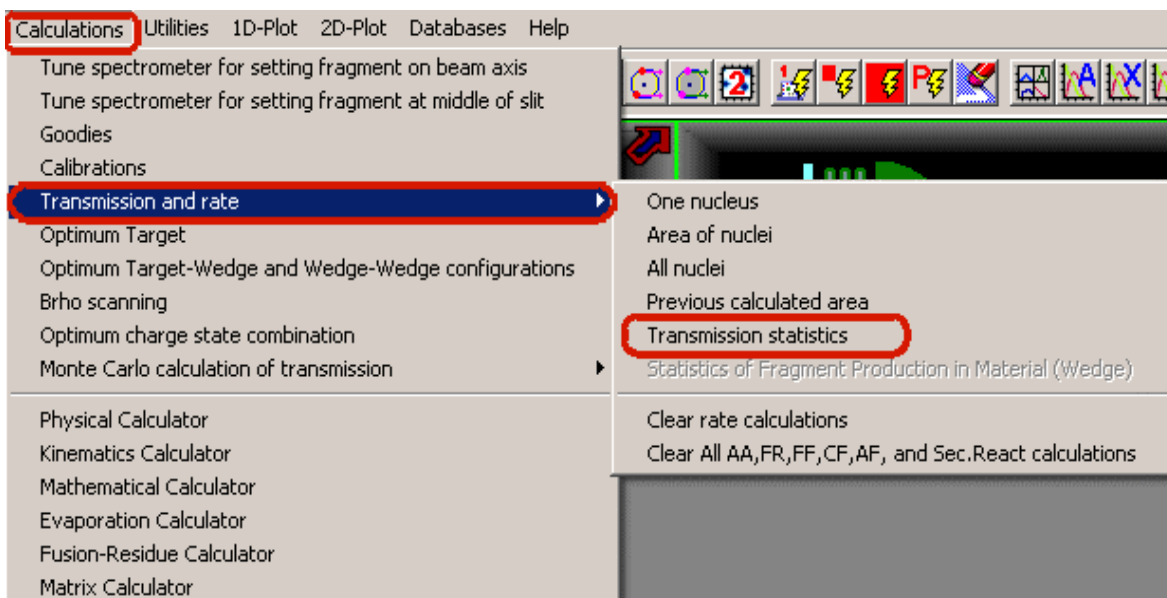
4.1. Transmission Statistics Dialog

There are two ways to reach this dialog

- through the “Calculations” menu
- using the “Analysis” button in the “Statistics” window (after clicking by right button of mouse on an isotope of interest in the table of nuclides)



statistics 32S		
32S	Stable (Z=16, N=16)	
Q1 (D1)		16
Q2 (D2)		16
Q3 (D3)		16
Q4 (D4)		16
Production Rate	(nps)	3.43e+4



1. Possibility to choose determinate reaction in which the fragment of interest was produced
2. Statistical characteristics of distributions after the selected block

[mm]
 X'(Theta) [mrad]
 Y [mm]
 Y'(Phi) [mrad]
 dP/P [%]
 Energy [MeV/u]
 TKE [MeV]
 Momentum [GeV/c]
 Brho [T*m]
 Velocity [cm/ns]

3. Statistical characteristics of distribution of energy loss in materials as well as possibility to plot this distribution. This is unique place in the code where it is possible to plot an energy loss obtained by the "Distribution" method
4. "Previous" and "Next" navigation buttons between blocks

Transmission statistics dialog

Choose a BLOCK

A: 32, Element: S, Z: 16
 Stable
 Table of Nuclides
 Charge states: 16+ D1
 Reaction: Projectile Fragmentation
 Quit

4 Choose a BLOCK: FP_PPACO

1 AFTER this BLOCK:

Production rate	3.433e+4	pps
Sum of all "reactions"	3.433e+4	pps
Total transmission	21.38	%
Spatial transmission	24.9	%
Angular transmission	86.64	%
Unreacted in mater.	99.13	%
Unstopped in mater.	100	%
Q (charge) ratio	100	%
Secondary Reactions	100	%

2

X [mm]: mean* = 1.717e-4, FWHM = 3.904e+0, max = 1.717e-4, St.Dev. = 1.639e+0

3 INTO this BLOCK:

Lost events	0e+0	pps
Lost all "reaction" events	0e+0	pps
Total transmission	100	%
X space transmission	100	%
Y space transmission	100	%
X angular transmission	100	%
Y angular transmission	100	%
Unreacted in mater.	100	%
Unstopped in mater.	100	%
Q (charge) ratio	100	%

Energy Loss [MeV]: mean* = 2.359e+0, FWHM = 5.166e-1, max = 2.359e+0, St.Dev. = 2.191e-1

Plot

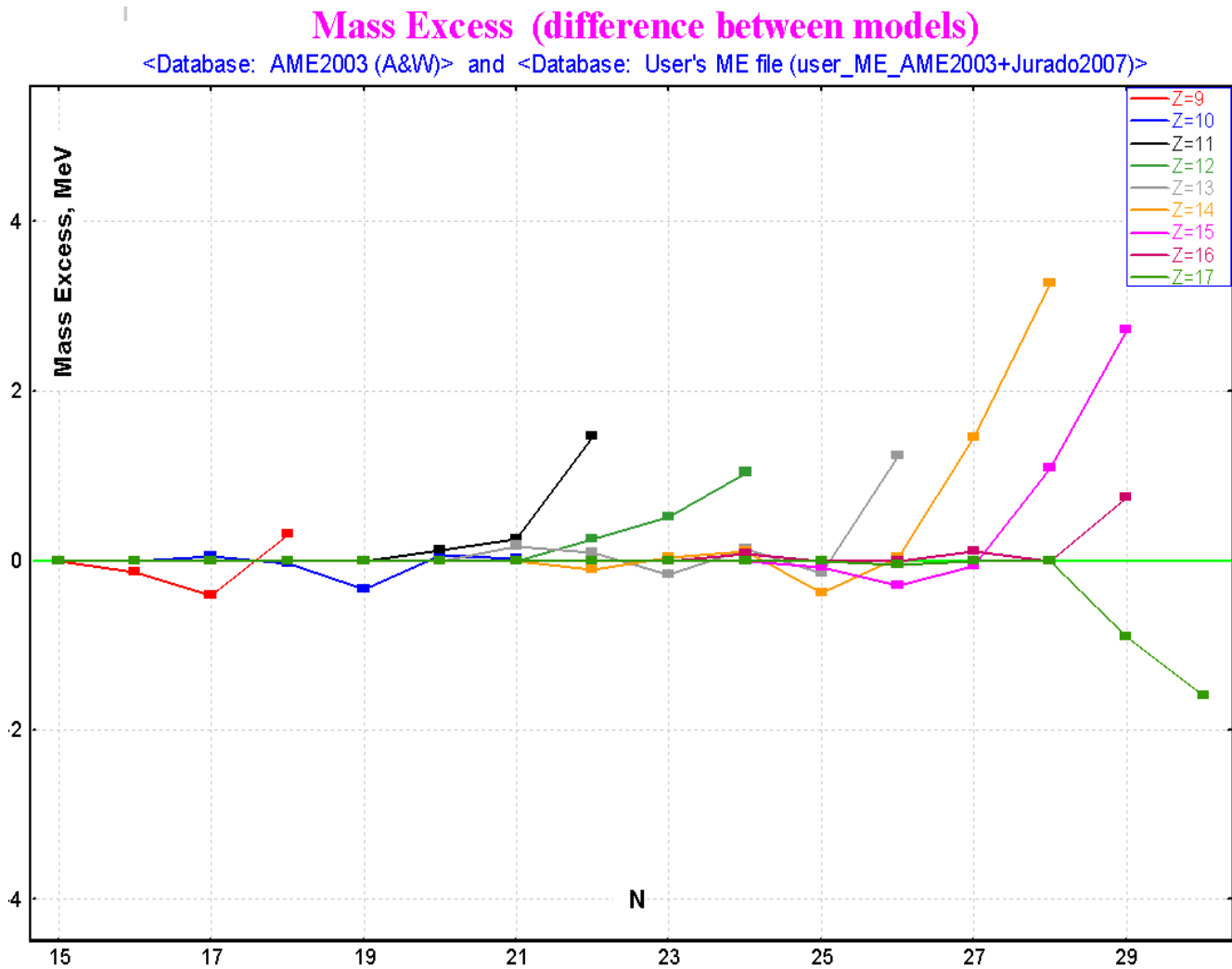
* - calculated by "Distribution" method

4.2. Mass databases

4.2.1. New user mass excess files

New user mass excess file "user_ME_AME2003+Jurado2007.lme" is based on AME2003 and recent experimental data from recent work of B.Jurado et al., PLB(2007)

<http://dx.doi.org/10.1016/j.physletb.2007.04.006>



New user mass excess file "user_ME_AME2003+Jurado2007+O.lme" is based on the "user_ME_AME2003+Jurado2007.lme" file with mass excess values for ^{28}F , ^{37}Mg , $^{40-43}\text{Al}$, ^{43}Si , $^{45,46}\text{P}$ manually set in order to correspond to the particle-bound & unbound experimental picture.

4.2.2. Mass Errors

- Mass excess errors can be edited in the Database dialog and being plotted.
- Mass excess errors can be kept in User Mass Excess file
- Calculation of error for mass excess extrapolation
- Calculation of error for Q-value of reaction

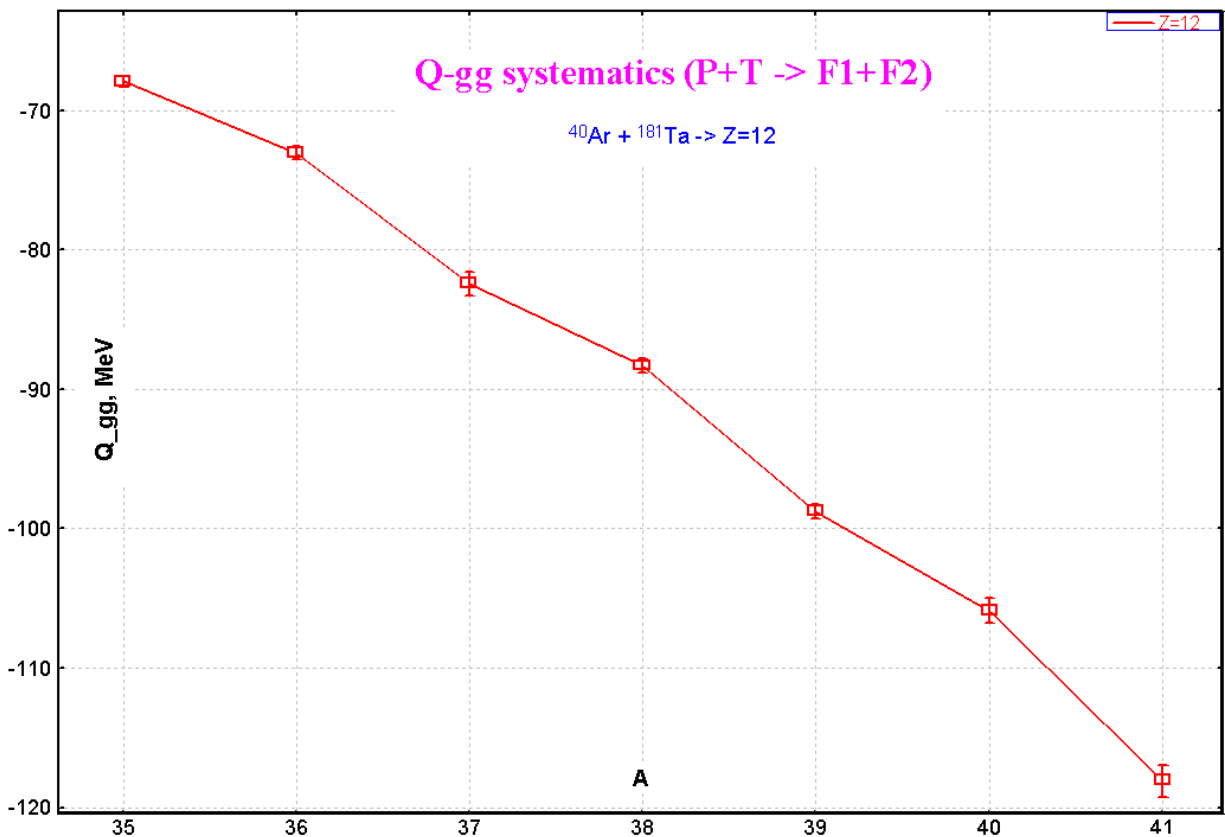
```

statistics 46Si
Information for this isotope is absent in the AME2003 database!
Database(D - AME2003 (A&W) + LDM #2 is used to get masses

ME      48.403  1.561
BE      311.925 1.561
BE/A    6.781   0.034
S1n    1.558   1.789
S2n    0.580   1.754
S1p    26.795  2.859
S2p    52.291  3.084
Qa     -21.602  1.942
BetaM   22.903  1.802
BetaP  -30.044  3.100

Q-reaction (b+t -> f1+f2)  -98.46 MeV  (error=1.5615 MeV)
  
```

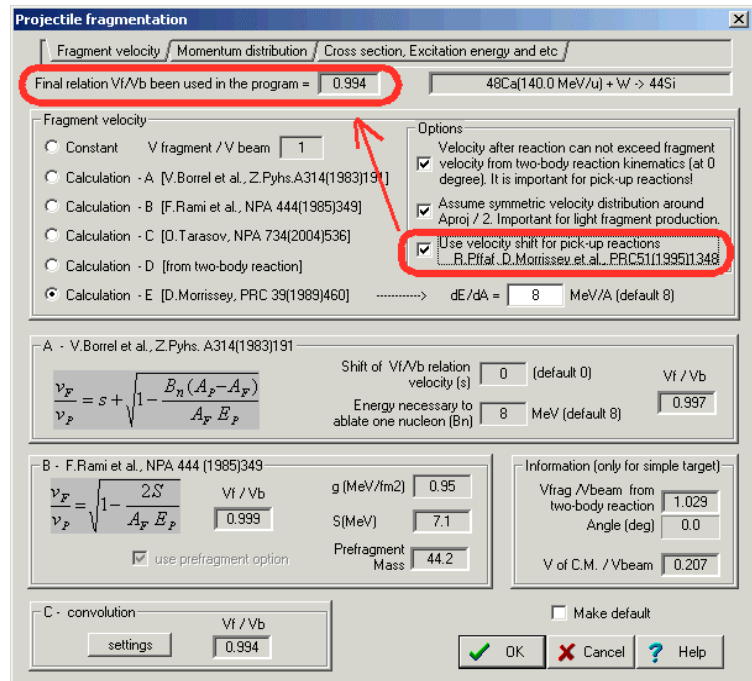
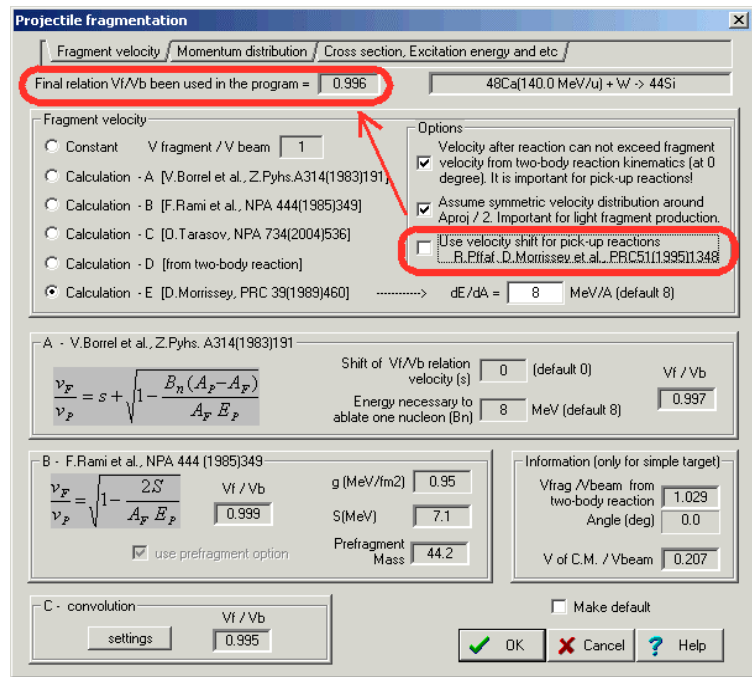
	Value	Error	MeV
Mass Excess	-22.9400	0.1200	MeV
Binding Energy	333.2752	0.1200	MeV
Beta-decay energy	4.6200	0.1237	MeV
S 2n	12.2216	0.1202	MeV
S 2p	33.3479	0.1389	MeV
Q alpha	-12.9949	0.1628	MeV
S 1n	7.8513	0.1300	MeV
S 1p	17.3590	0.1562	MeV



4.3. Pick-up

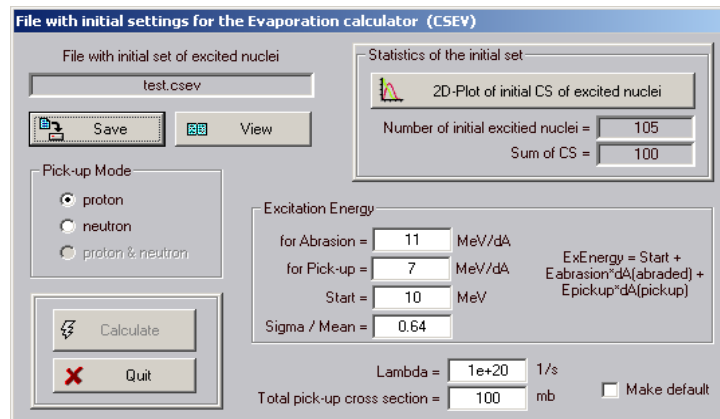
4.3.1. Momentum distribution

Pickup corrections for momentum distributions in the "Fragmentation" dialog based on the R.Pffaf, D.Morrissey et al., PRC51 (995) 1348) paper.



4.3.2. File with initial cross sections for pick-up case (under construction)

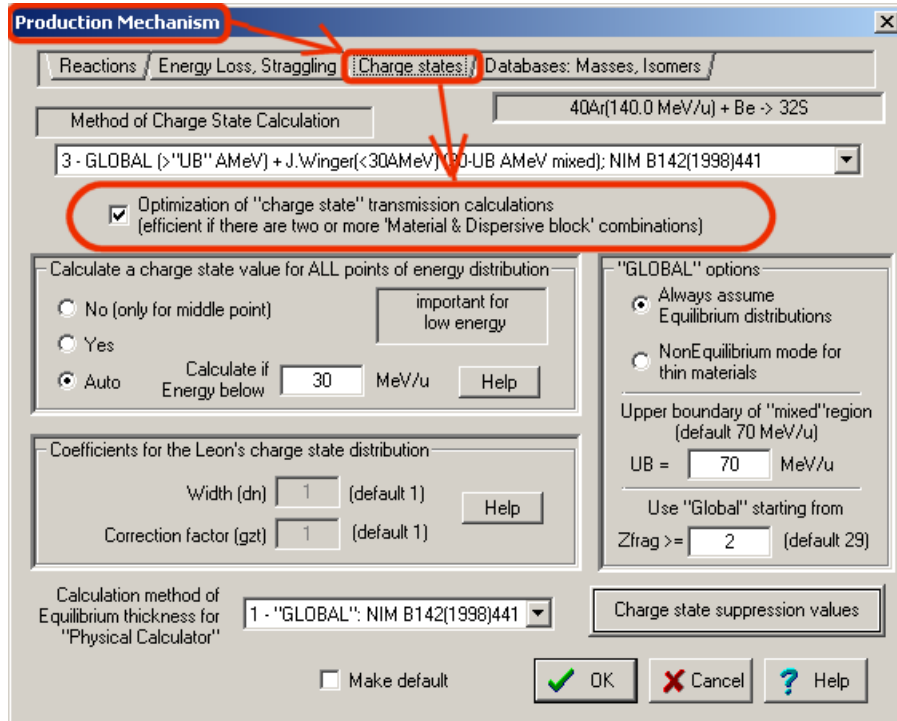
Through the "Utilities" menu. Under constructions.



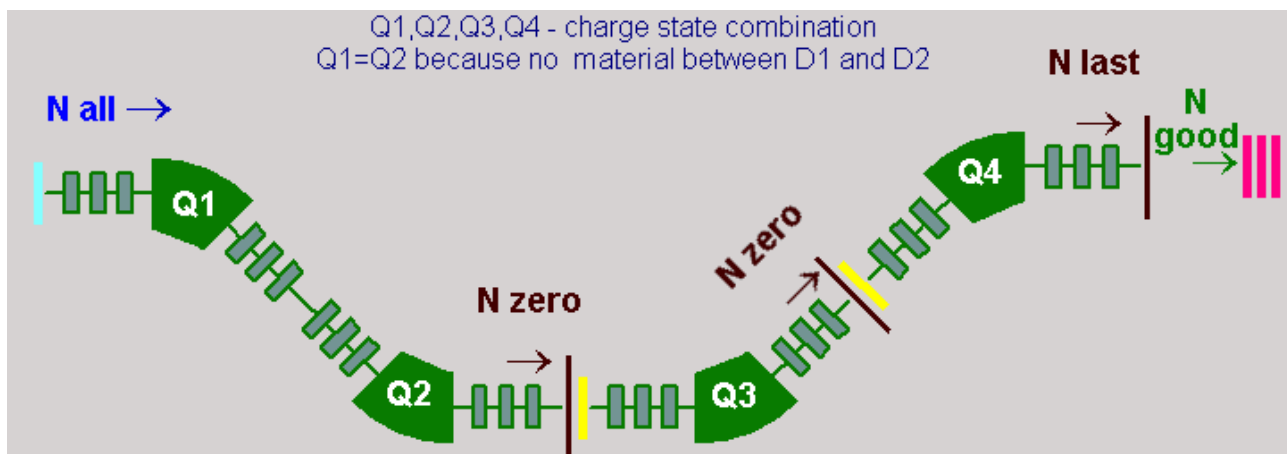
4.4. Optimizations

4.4.1. Optimization of "charge state" transmission calculations

Transmission calculation optimization for the case of charge states through the "Production mechanism" dialog.

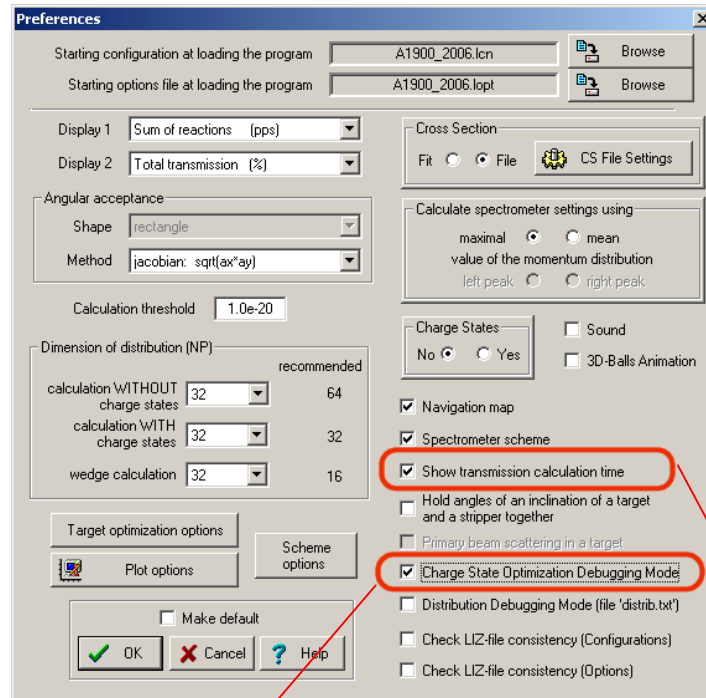


Efficient if there two or more "Material & Dispersive block" combinations

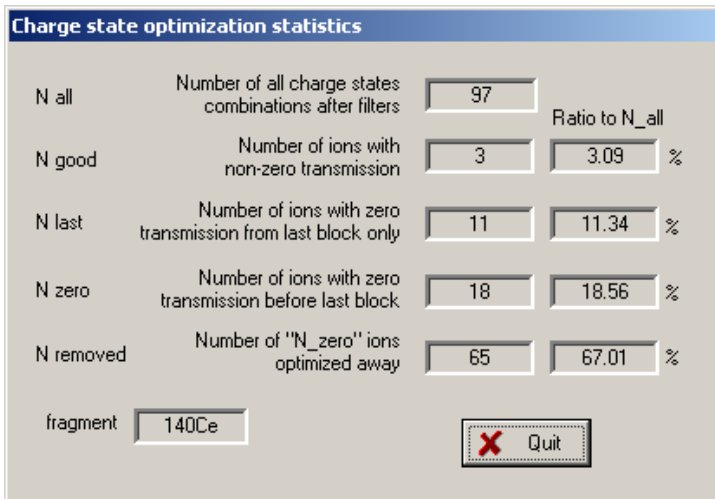


see next page for explanation of Nall, Nzero, Nlast values.

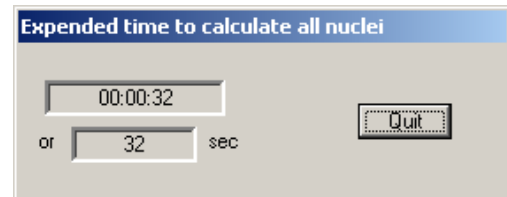
The “Preferences” dialog:



Charge state Optimization Debugging mode



"Show transmission calculation time" option



4.4.2. Optimization of transmission calculations for low-rate case

Before calculate fragment transmission the LISE++ code checks fragment rate suggesting 100% transmission. If this value is larger than the threshold (set in the “Preferences” dialog) then the code calculates transmission. If lower, than this fragment will be missed in calculations.

4.5. Other

4.5.1. The Evaporation Calculator: Loading initial settings from file

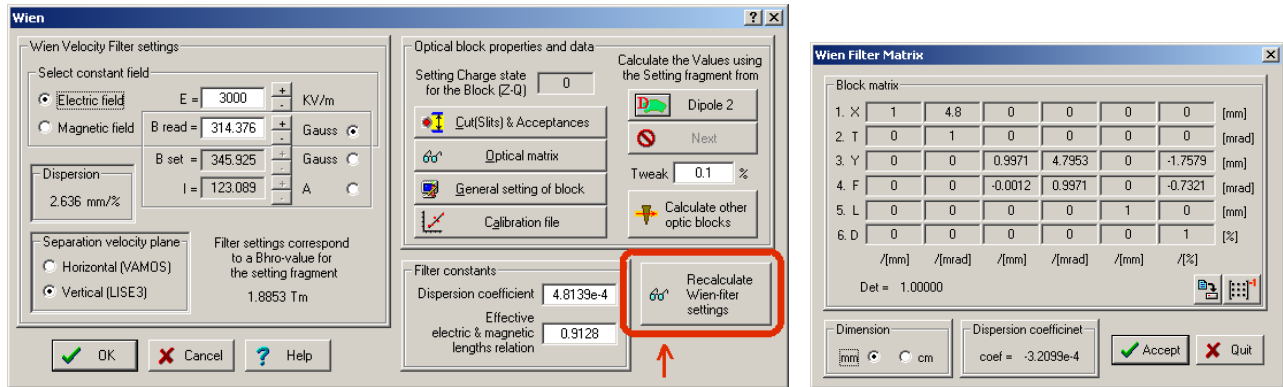
The screenshot shows the 'Evaporation calculator' window. In the 'Initial nucleus' section, the radio button for 'Load initial conditions from file' is selected and circled in red. A red arrow points from this option to the 'File with initial settings for the Evaporation calculator (CSEV)' dialog box below. The main interface includes fields for 'Excitation energy window' (Lower and Upper in MeV), 'Initial nucleus production cross-section', and 'make calculations down to Z = 16'. The 'Final nucleus' section shows 'A 32', 'Element S', and 'Z 16'. A table of decay modes is visible, and a summary of calculated nuclei is shown at the bottom.

The 'File with initial settings for the Evaporation calculator (CSEV)' dialog box shows a file named 'test.csev' selected. A red arrow points from the 'View' button to the 'CSEV file format' text area below. The text area explains the CSEV file format and provides a detailed description of the columns and excitation energy shapes.

```

c:\program files\lise\CrossSections\test.csev
! 40Ar(140.0 MeV/u) + Ta -> proton pickup
19 12 0.0246 0 0 90.249 143.751
19 13 0.0586 0 0 80.567 131.433
19 14 0.134 0 0 70.957 119.043
19 15 0.295 0 0 61.433 106.567
19 16 0.626 0 0 52.012 93.988
19 17 1.29 0 0 42.720 81.280
19 18 2.58 0 0 33.594 68.406
19 19 5.02 0 0 24.697 55.303
19 20 9.54 0 0 16.139 41.861
19 21 17.7 0 0 8.170 27.830
19 22 32.2 0 0 1.723 12.277
19 23 13.7 0 0 6.537 21.463
19 24 2.89 0 0 11.859 30.141
19 25 0.405 0 0 17.445 38.555
19 26 0.0425 0 0 23.199 46.801
  
```

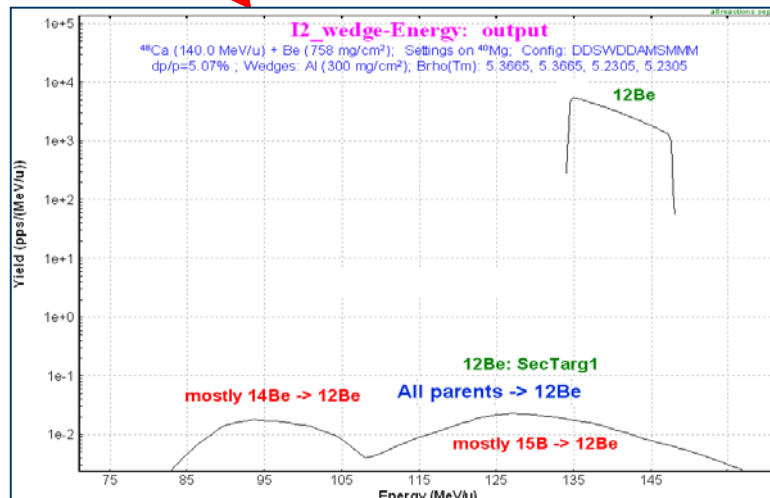
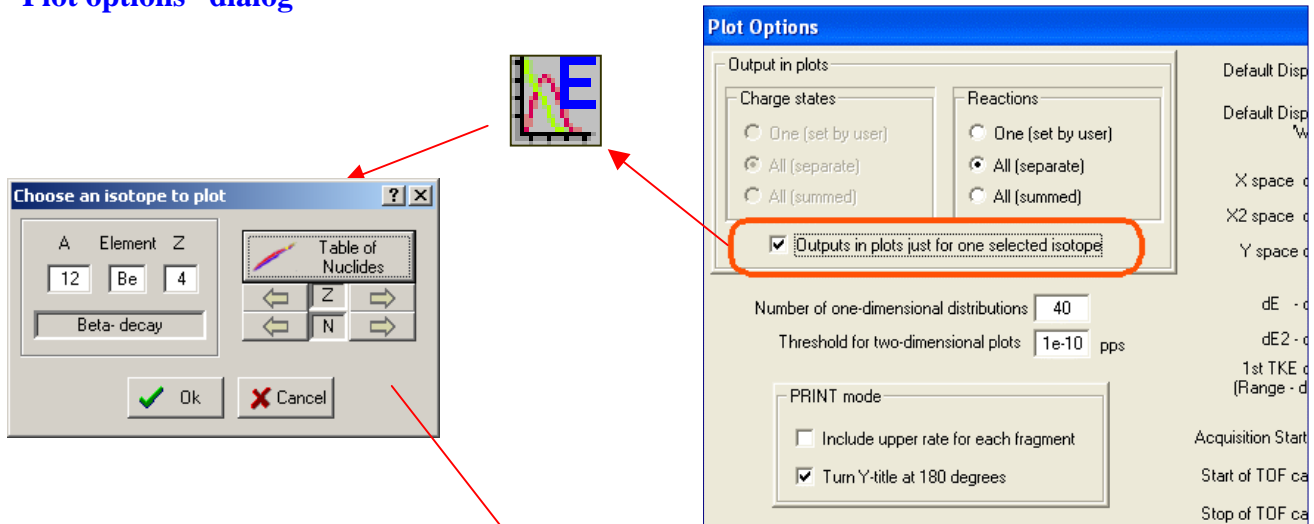
4.5.2. The "Wien filter" block: calculation of dispersion coefficient and optic matrix



4.5.3. Outputs in plots just for one selected isotope

It is very useful for the "Fragment production in Material" case

"Plot options" dialog



4.5.4. Configuration files renewal

<i>Set-up</i>	<i>Laboratory</i>
BigRIPS	RIKEN
FRS	GSI
LISE3	GANIL

5. Corrections

- Modification of Gamma registration results output
- Correction in the subroutine of value entry in the Kinematics dialog
- Correction of the "Gas-filled separator" block
- Correction in the "Gas pressure optimization" utility
- Correction in the distribution convolution subroutines
- Some corrections were done for the case of large momentum acceptance and thick wedge
- Width of Momentum distribution for isobars of the projectile