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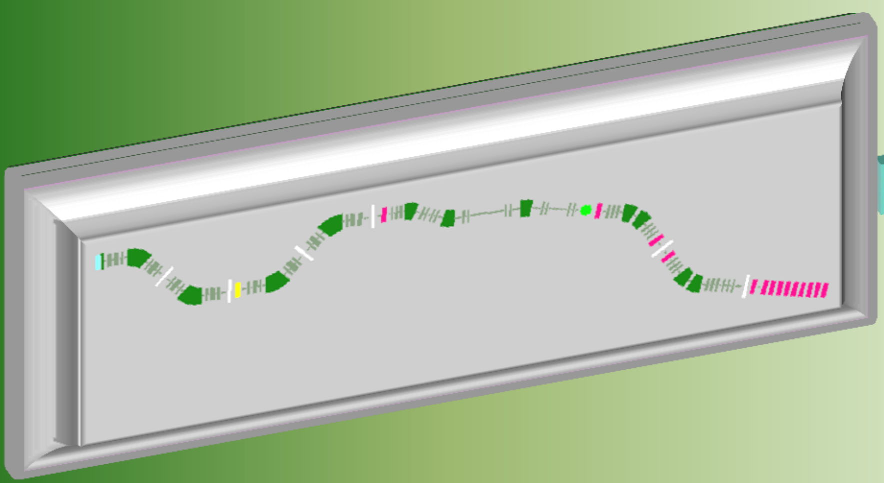
NCSL / MSU, USA

LISE++
Modeling Exotic Beam Production with Fragment Separators

5th Fragment-Separator Experts Meeting
5th Fragment-Separator Experts Meeting

10-12 / 12 / 2013

LISE++



LISE++

1. Introduction
2. Types of transmission calculations in LISE++
3. 2011-2013 principal modifications
4. Some complications
5. Perspectives, next tasks
6. Statistics
7. Conclusion

NSCL

1. Introduction

4th Fragment-Separator experts meeting : v. 9.2.33 (10-DEC-2010)

5th Fragment-Separator experts meeting : v. 9.7.01 (01-NOV-2013)

v.9.3 01/06/2012
v.9.5 03/06/2013
v.9.7 11/01/2013

Lectures at the Euroschool on Exotic Beams 2013

August 26-31, 2013
Dubna, Russia

"Production of Fast Rare Ion Beams"
with the use of examples prepared with the LISE++ code

(available on-line through LISE++ and Euroschool sites)

4th Fragment-Separator experts meeting

LISE++ : high order optic calculations

MOCADI : make user-friendly, interface

COSY : use of materials

→ Introduction to transmission calculations in LISE++

LISE++ site address and download link

New address:

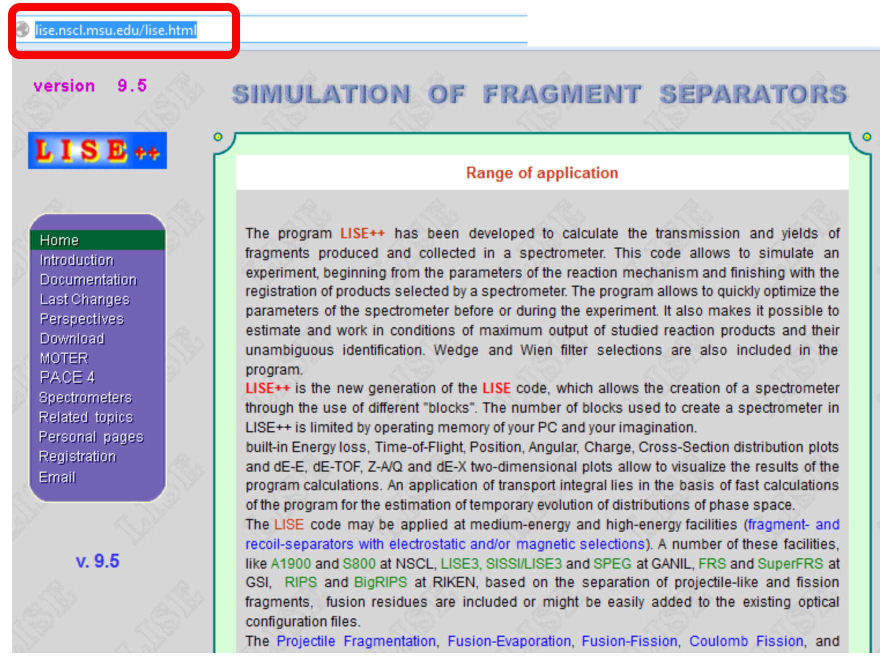
http://lise.nscl.msu.edu

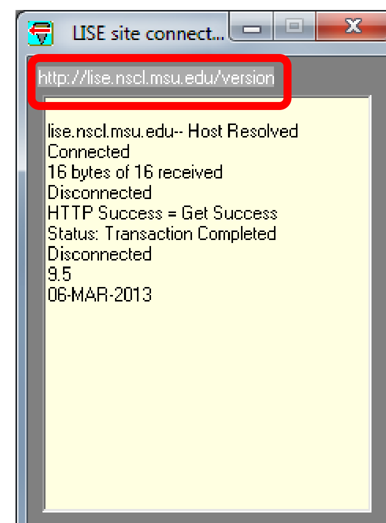
Redirection from previous addresses

http://www.nscl.msu.edu/lise
http://groups.nscl.msu.edu/lise

New download link is
http://lise.nscl.msu.edu/download

No more FTP-server to download the LISE++ package





LISE^{++} : NRV `s partner site

MICHIGAN STATE UNIVERSITY

lise.nscl.msu.edu/lise.html

it's diffused freely

SIMULATION OF FRAGMENT SEPARATORS

Home
Introduction
Documentation
Last Changes
Perspectives
Download
MOTER
PACE 4
Spectrometers
Related topics
Personal pages
Registration
Email

v. 9.4.52

Range of application

The program LISE++ has been developed to calculate the transmission and yields of fragments produced and collected in a spectrometer. This code allows to simulate an experiment, beginning from the parameters of the reaction mechanism and finishing with the registration of products selected by a spectrometer. The program allows to quickly optimize the parameters of the spectrometer before or during the experiment. It also makes it possible to estimate and work in conditions of maximum output of studied reaction products and their unambiguous identification. Wedge and Wien filter selections are also included in the program.
LISE++ is the new generation of the LISE code, which allows the creation of a spectrometer through the use of different "blocks". The number of blocks used to create a spectrometer in LISE++ is limited by operating memory of your PC and your imagination.
built-in Energy loss, Time-of-Flight, Position, Angular, Charge, Cross-Section distribution plots and dE-E, dE-TOF, Z-A/Q and dE-X two-dimensional plots allow to visualize the results of the program calculations. An application of transport integral lies in the basis of fast calculations of the program for the estimation of temporary evolution of distributions of phase space.
The LISE code may be applied at medium-energy and high-energy facilities (fragment- and recoil-separators with electrostatic and/or magnetic selections). A number of these facilities, like A1900 and S800 at NSCL, LISE3, SISSI/LISE3 and SPEG at GANIL, FRS and SuperFRS at GSI, RIPS and BigRIPS at RIKEN, based on the separation of projectile-like and fission fragments, fusion residues are included or might be easily added to the existing optical configuration files.
The Projectile Fragmentation, Fusion-Evaporation, Fusion-Fission, Coulomb Fission, and Abrasion-Fission assumed in this program as the production reaction mechanism allows to simulate experiments at beam energies above the Coulomb barrier.

Built-in powerful tools:

- «Physical Calculator»,
- «Relativistic Kinematics Calculator»,
- «Evaporation Calculator»,
- «Spectroscopic calculator" (of J.Kantele»),
- «Matrix calculator",
- «PACE4» (fusion-evaporation code),
- «Global» (charge-state distribution code),
- «Charge» (charge-state distribution code),
- Nuclide and Isomeric state Databases utilities,
- Units converter,
- ISOL catcher,
- Twinsol (solenoid) utility,
- Transport calculations,
- Brho analyzer,
- Stripper foil lifetime utility (new),
- Monte Carlo simulation of fragment transmission (new),
- Monte Carlo simulation of fission fragment kinematics,
- «BI» - the automatized search of two-dimensional peaks in spectra and definition of their characteristics

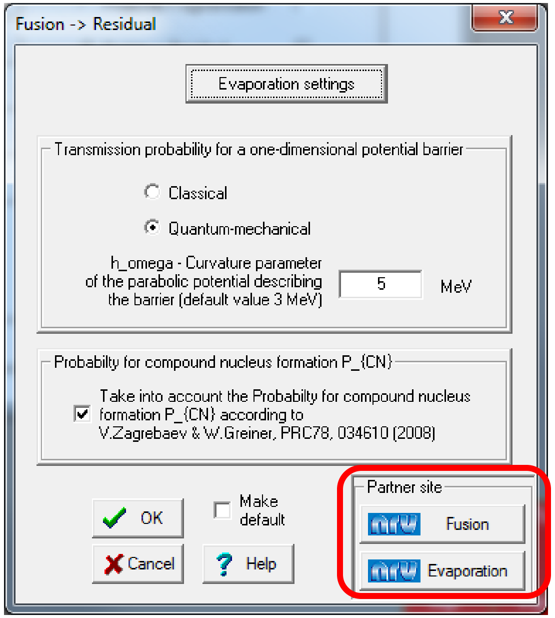
permit to work well below this energy limit, and this makes the program very attractive for all users dealing with physics of heavy ions from 10 keV up to some GeV per nucleon.

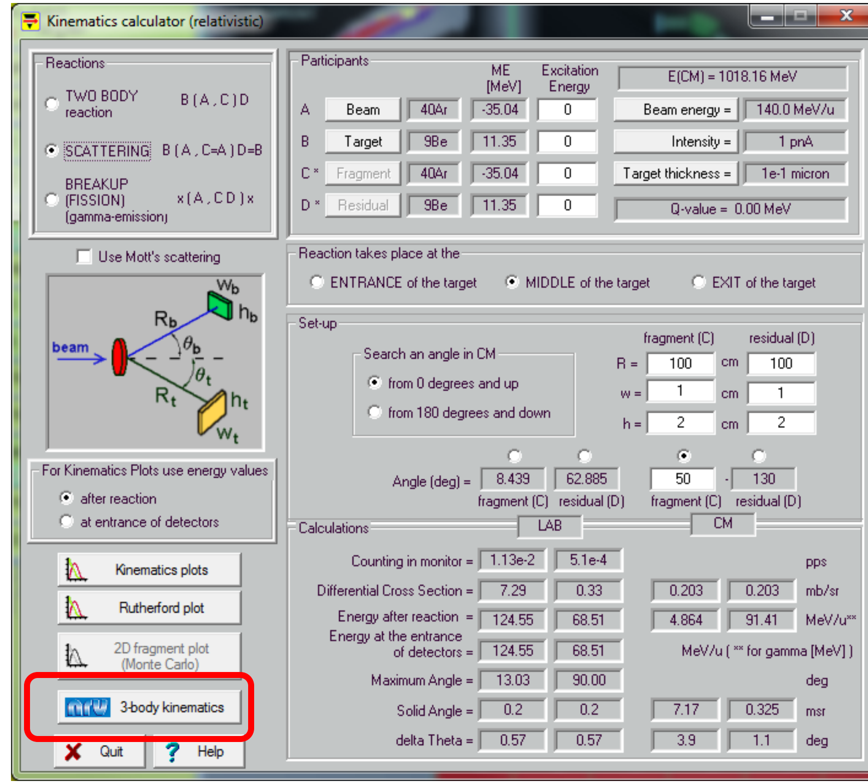
LISE++ presentation on EBSS2011 - PDF (1.6 MB)
LISE++ first steps - PDF (EBSS2011-tutorial)
LISE++ status (2008) - PDF (1,8 MB)
LISE++ presentation (2007) - PowerPoint (4,3 MB)
LISE++ presentation (2004) - PowerPoint (4 MB)
LISE++ Coulomb fission - PowerPoint (3 MB)
LISE++ Abrasion-Fission - PowerPoint (3 MB)

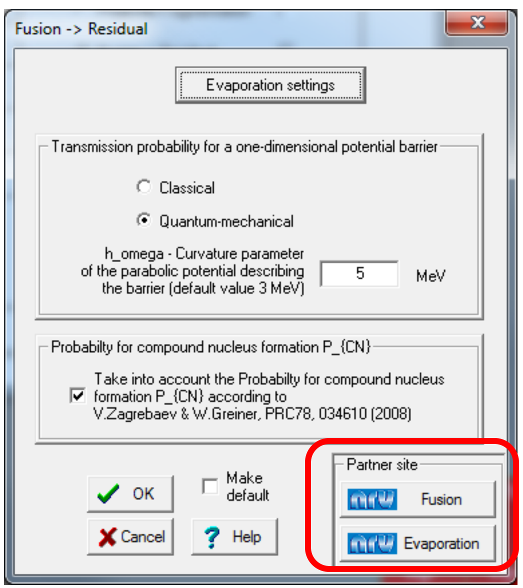
partner site

nrv

Low Energy Nuclear Knowledge Base


Fusion -> Residual
Evaporation settings
Transmission probability for a one-dimensional potential barrier
Classical
Quantum-mechanical
h_omega - Curvature parameter of the parabolic potential describing the barrier (default value 3 MeV)
5
MeV
Probabilty for compound nucleus formation P_{CN}
Take into account the Probabilty for compound nucleus formation P_{CN} according to V.Zagrebaev & W.Greiner, PRC78, 034610 (2008)
OK
Make default
Cancel
Help
Partner site
Fusion
Evaporation


Kinematics calculator (relativistic)
Reactions
TWO BODY reaction
B (A , C) D
SCATTERING
B (A , C=A) D=B
BREAKUP (FISSION) (gamma-emission)
x (A , C D) x
Use Mott's scattering
beam
For Kinematics Plots use energy values
after reaction
at entrance of detectors
Kinematics plots
Rutherford plot
2D fragment plot (Monte Carlo)
3-body kinematics
Quit
Help
Participants
ME [MeV]
Excitation Energy
E(CM) = 1018.16 MeV
A Beam 40Ar -35.04 0
Beam energy = 140.0 MeV/u
B Target 9Be 11.35 0
Intensity = 1 pnA
C* Fragment 40Ar -35.04 0
Target thickness = 1e-1 micron
D* Residual 9Be 11.35 0
Q-value = 0.00 MeV
Reaction takes place at the
ENTRANCE of the target
MIDDLE of the target
EXIT of the target
Set-up
Search an angle in CM
from 0 degrees and up
from 180 degrees and down
fragment (C) residual (D)
R = 100 cm 100
w = 1 cm 1
h = 2 cm 2
Angle (deg) = 8.439 62.885 50 130
fragment (C) residual (D) fragment (C) residual (D)
Calculations
LAB
CM
Counting in monitor = 1.13e-2 5.1e-4 pps
Differential Cross Section = 7.29 0.33 0.203 0.203 mb/sr
Energy after reaction = 124.55 68.51 4.864 91.41 MeV/u**
Energy at the entrance of detectors = 124.55 68.51 MeV/u (** for gamma [MeV])
Maximum Angle = 13.03 90.00 deg
Solid Angle = 0.2 0.2 7.17 0.325 msr
delta Theta = 0.57 0.57 3.9 1.1 deg


Fusion -> Residual
Evaporation settings
Transmission probability for a one-dimensional potential barrier
Classical
Quantum-mechanical
h_omega - Curvature parameter of the parabolic potential describing the barrier (default value 3 MeV)
5
MeV
Probabilty for compound nucleus formation P_{CN}
Take into account the Probabilty for compound nucleus formation P_{CN} according to V.Zagrebaev & W.Greiner, PRC78, 034610 (2008)
OK
Make default
Cancel
Help
Partner site
Fusion
Evaporation

Types of transmission calculations in LISE^{++}

Types of transmission calculations in LISE++

➢ "Distribution" (analytical) method

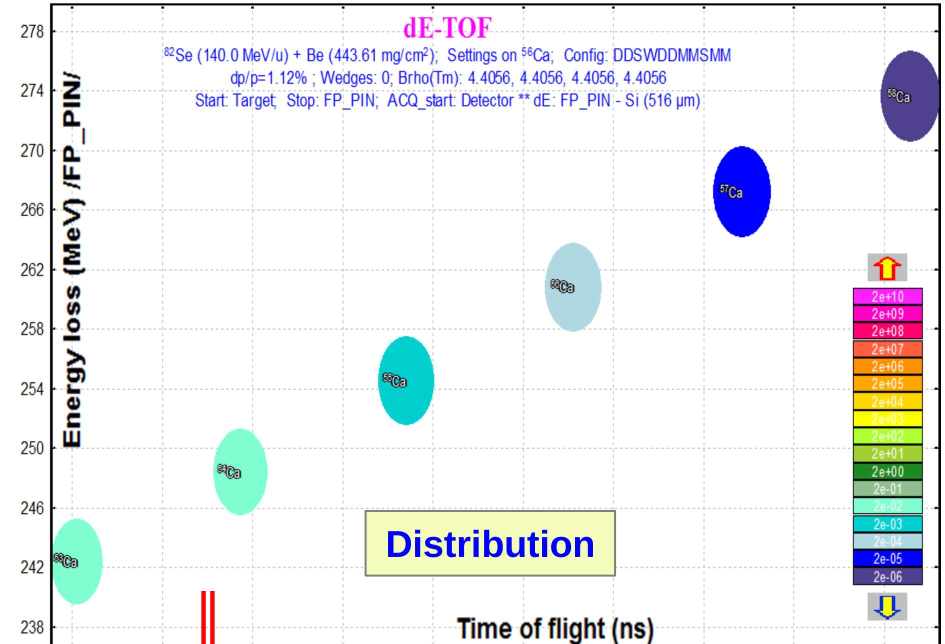
- Fast calculations
- All Optimization procedures in the code based on this method
- Effective with segmented configurations for experiment planning
- Calculation of low transmission (important for primary beams)

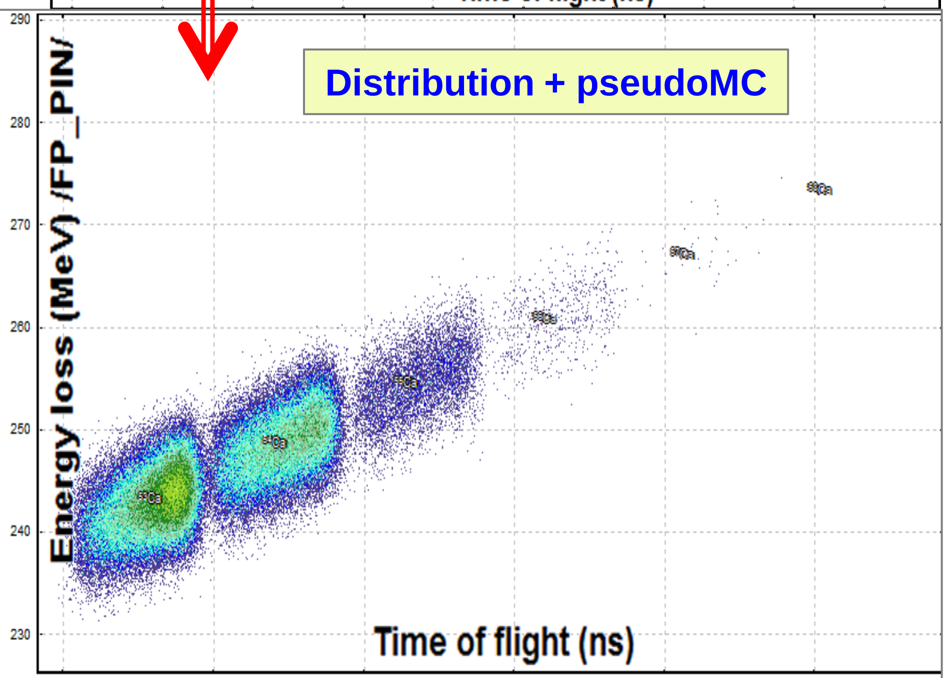
LISE class	"Distribution"	: D. Bazin, B. Sherrill, Phys. Rev. E 50 (1994) 4017
LISE class	"Distribution2"	: 2000
LISE++ class	"Distribution4"	: 2003

➢ Monte Carlo method: (from 2007)

- Benchmark for the "Distribution" method
- Detailed analysis of transmission with extended configurations
- Possibility to use High Order Optics
- Observation of correlations between different parameters of different blocks
- Possible gates on different parameters
- Good tools for understanding (learning) ion-beam optics issues
- Effective for fragment separator design
- Some optical blocks (Solenoid, RF buncher) are effective only in MC mode

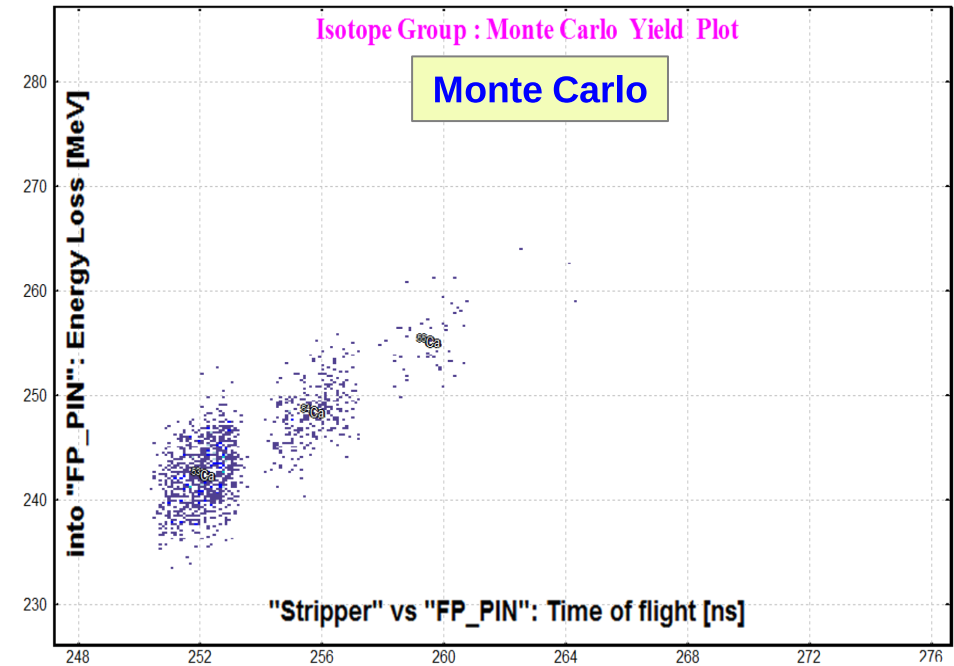
Distribution & Monte Carlo methods





pseudoMC method for plots :

Monte Carlo method is applied to analytically calculated Final Distributions



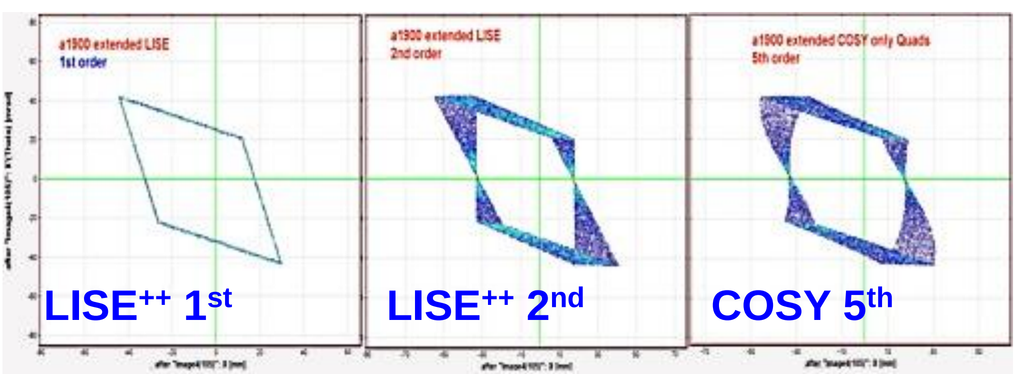
High Order Optics in LISE^{++}

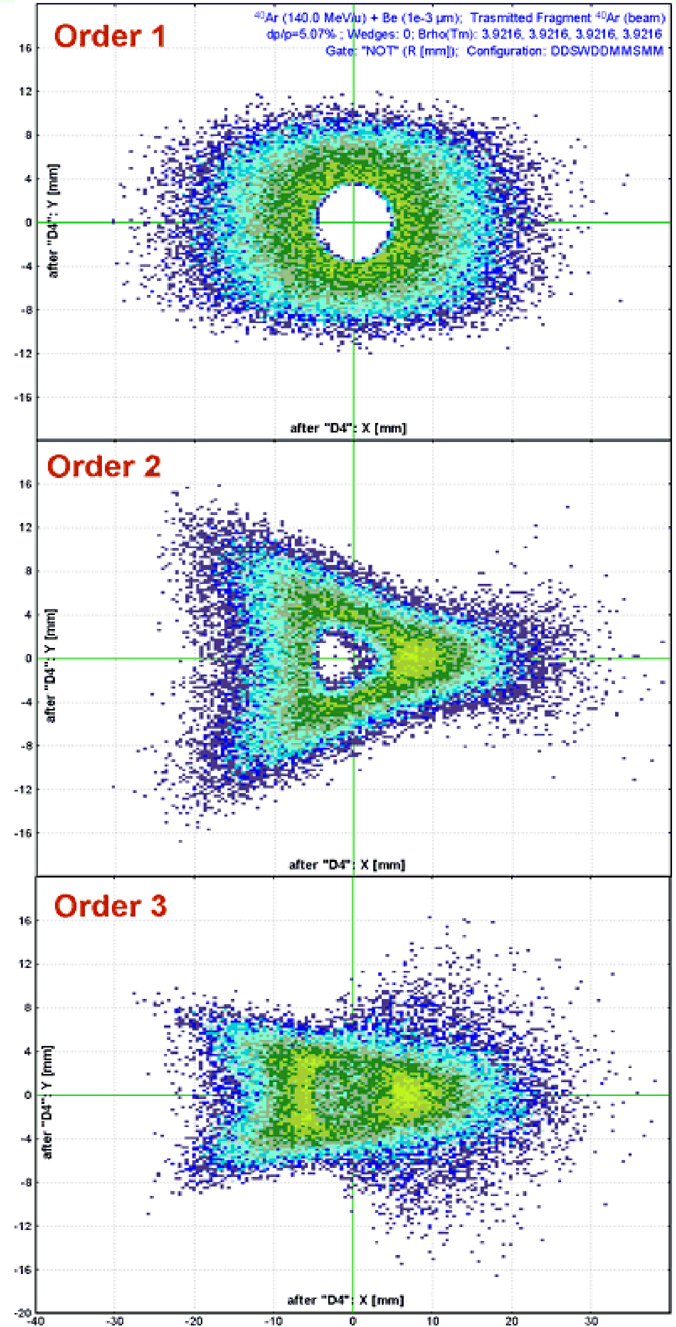
- LISE^{++} is able to operate with 5th order matrices
- High order optics can be used only in Monte Carlo mode

  http://lise.nscl.msu.edu/8_3/HighOrder_v8_3_158.pdf

- LISE^{++} can calculate 1st and 2nd order matrices based on the Transport formalism
- Higher matrices can be loaded (or linked) from files prepared by the COSY code

  http://lise.nscl.msu.edu/9_2/9_2_33/9_2_33.pdf





Classical Segmented & Extended configurations : Pros & Cons

➢ Classical (segmented) configuration:

- Fast transmission calculations
- Simple structure
- Effective with analytical calculations for experiment planning

➢ Extended (elemental) configuration:

- Detailed analysis of transmission
- Optical matrices can be calculated in the code, and used in segmented configurations
- Tools to obtain angular acceptances, which can be used in segmented configurations
- Good tools for understanding (learning) ion-beam optics issues
- Effective with Monte Carlo calculations for fragment separator design

Tuning of Optical Blocks

Calculations

- **Optics** ▸
  - Tune spectrometer for setting fragment on beam axis
  - Tune spectrometer for setting fragment at middle of slit
  - Update matrices linked with COSY files
  - Envelope plot
  - First order matrix elements : PLOT
  - First order matrix elements : View & Print
  - **Quad & Dipole settings : EDIT**
  - Quad & Dipole settings : View & Print
  - Brho(Erho) Analyzer
  - The First- and Second-Order Matrix Elements for an Ideal Magnet
- Goodies
- Calibrations
- Transmission and rate ▸
- Optimum Target
- Optimum Target-Wedge and Wedge-Wedge configurations
- Brho scanning
- Optimum charge state combination
- Monte Carlo calculation of transmission ▸
- Calculators ▸

segmented

Block	Given Name	Start(m)	Length(m)	B0(kG)	Br(Tm)corr/*real	DriftM/*Angle	Rapp(cm)/*R(m)	L_eff(m)/*L_dip(m)	2 nd order	CalcMatr/*Z-Q	AngAcc,Apps,Slits
Dipole	D1	0.000	8.7190	+14.2116	* 4.4056	* 45.0	* 3.1000	* 2.4347	no	* 0	HV -- HV

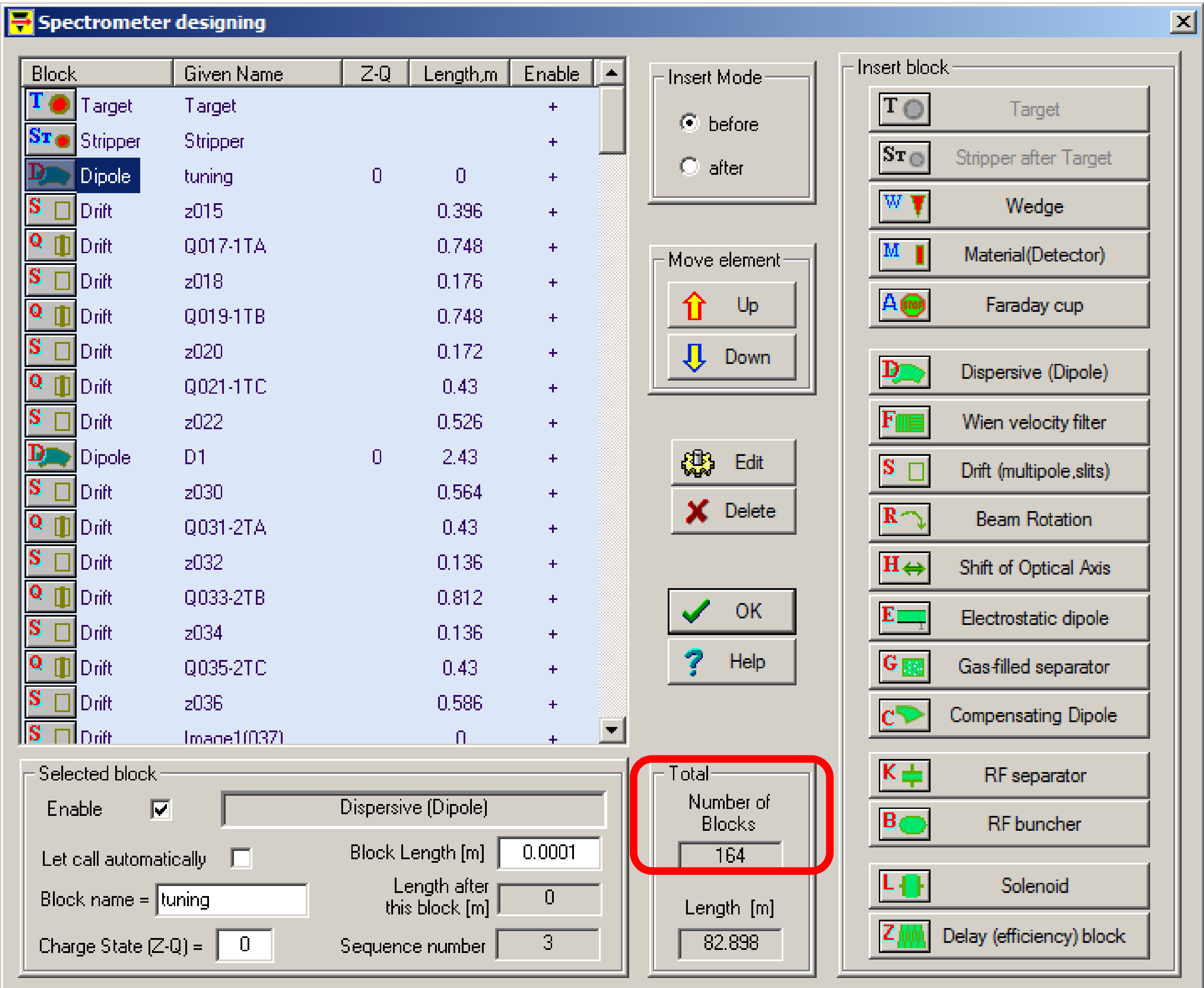
Brho

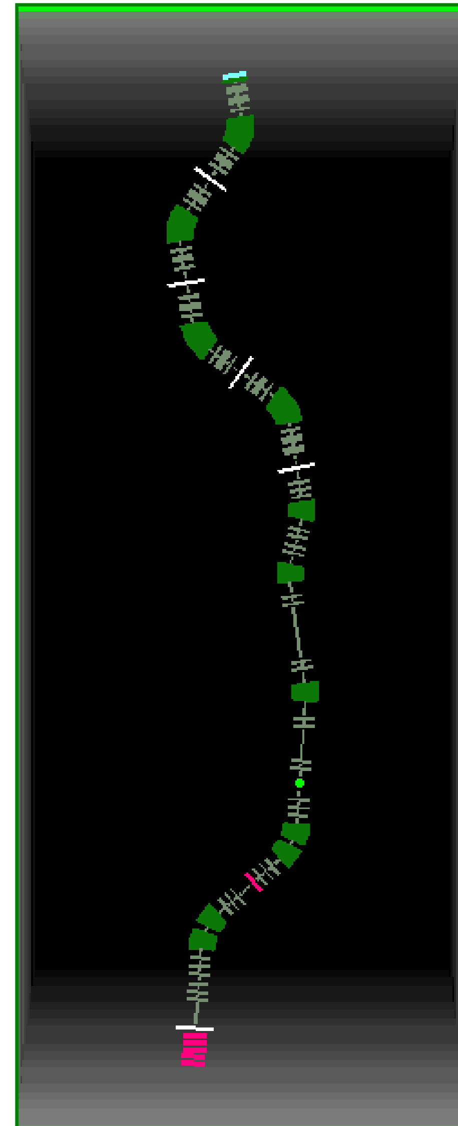
Slits, acceptance

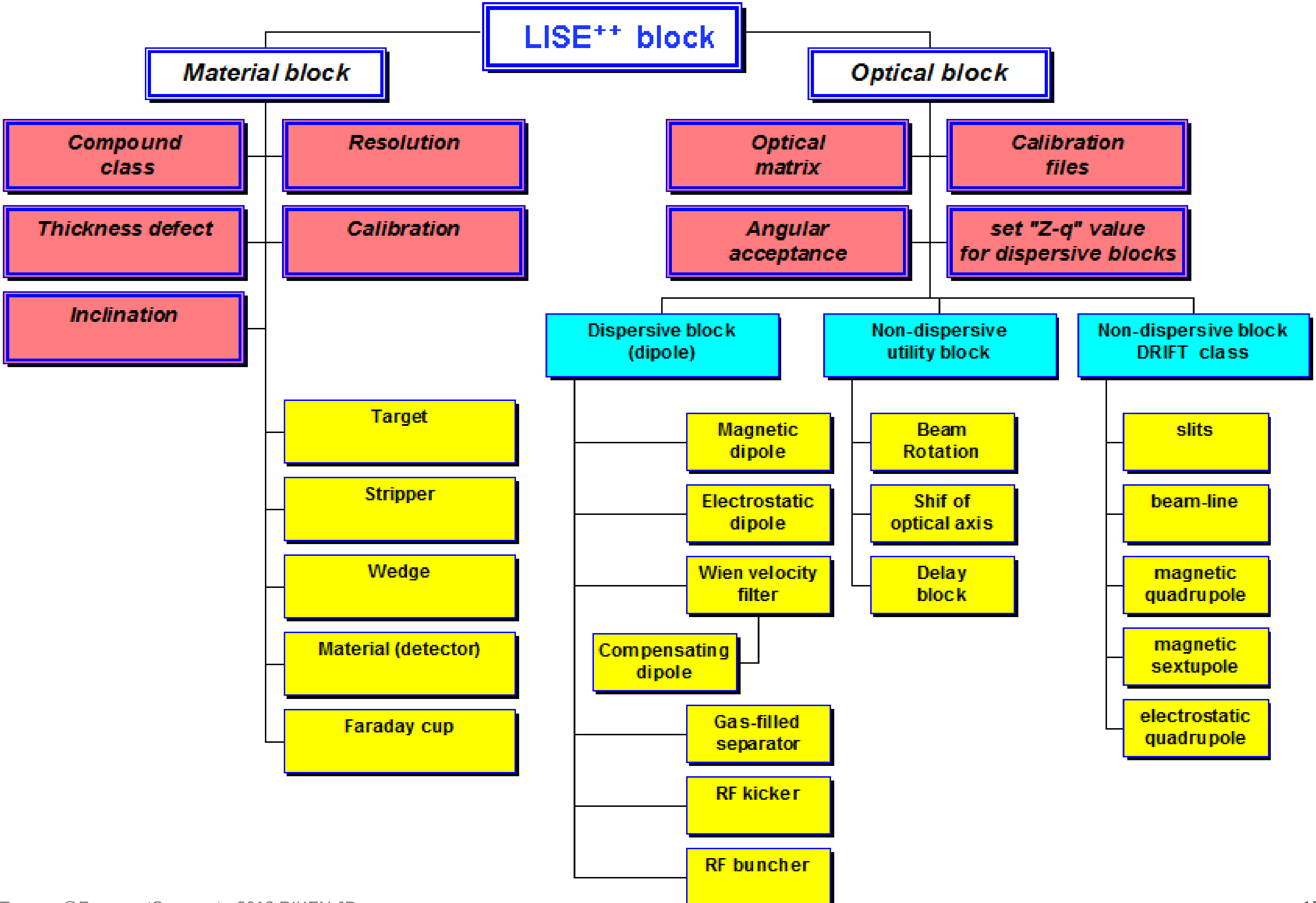
extended

Block	Given Name	Start(m)	Length(m)	B0(kG)	Br(Tm)corr/*real	DriftM/*Angle	Rapp(cm)/*R(m)	L_eff(m)/*L_dip(m)	2 nd order	CalcMatr/*Z-Q	AngAcc,Apps,Slits
Dipole	tuning	0.000	0.0001	+14.6853	* 4.4056	* 0.0	* 3.0000	* 0.0000	no	* 0	-- -- --
Drift	z015	0.000	0.3960			standard					-- HV --
Drift	Q017-1TA	0.396	0.7480	+15.4196	4.4056	quadrupole	13.3000	0.7480	yes	1	-- HV --
Drift	z018	1.144	0.1756			standard					-- HV --
Drift	Q019-1TB	1.320	0.7480	-14.3295	4.4056	quadrupole	13.3000	0.7480	yes	1	-- HV --
Drift	z020	2.068	0.1720			standard					-- HV --
Drift	Q021-1TC	2.240	0.4300	+10.3091	4.4056	quadrupole	15.0000	0.4300	yes	1	-- HV --
Drift	z022	2.670	0.5260			standard					-- HV --
Dipole	D1	3.196	2.4300	+14.2396	* 4.4056	* 45.0	* 3.0939	2.4299	yes	* 0	-- HV --
Drift	z030	5.626	0.5640			standard					-- HV --
Drift	Q031-2TA	6.190	0.4300	+12.6140	4.4056	quadrupole	15.0000	0.4300	yes	1	-- HV --
Drift	z032	6.620	0.1358			standard					-- HV --
Drift	Q033-2TB	6.755	0.8120	-15.5591	4.4056	quadrupole	15.0000	0.8120	yes	1	-- HV --
Drift	z034	7.567	0.1358			standard					-- HV --
Drift	Q035-2TC	7.703	0.4300	+13.6724	4.4056	quadrupole	15.0000	0.4300	yes	1	-- HV --
Drift	z036	8.133	0.5860			standard					-- HV --
Drift	Image1(037)	8.719	0.0000			SLITS					-- -- HV

Configuration: A1900_S800BL_extended_LISE 2012   2nd order



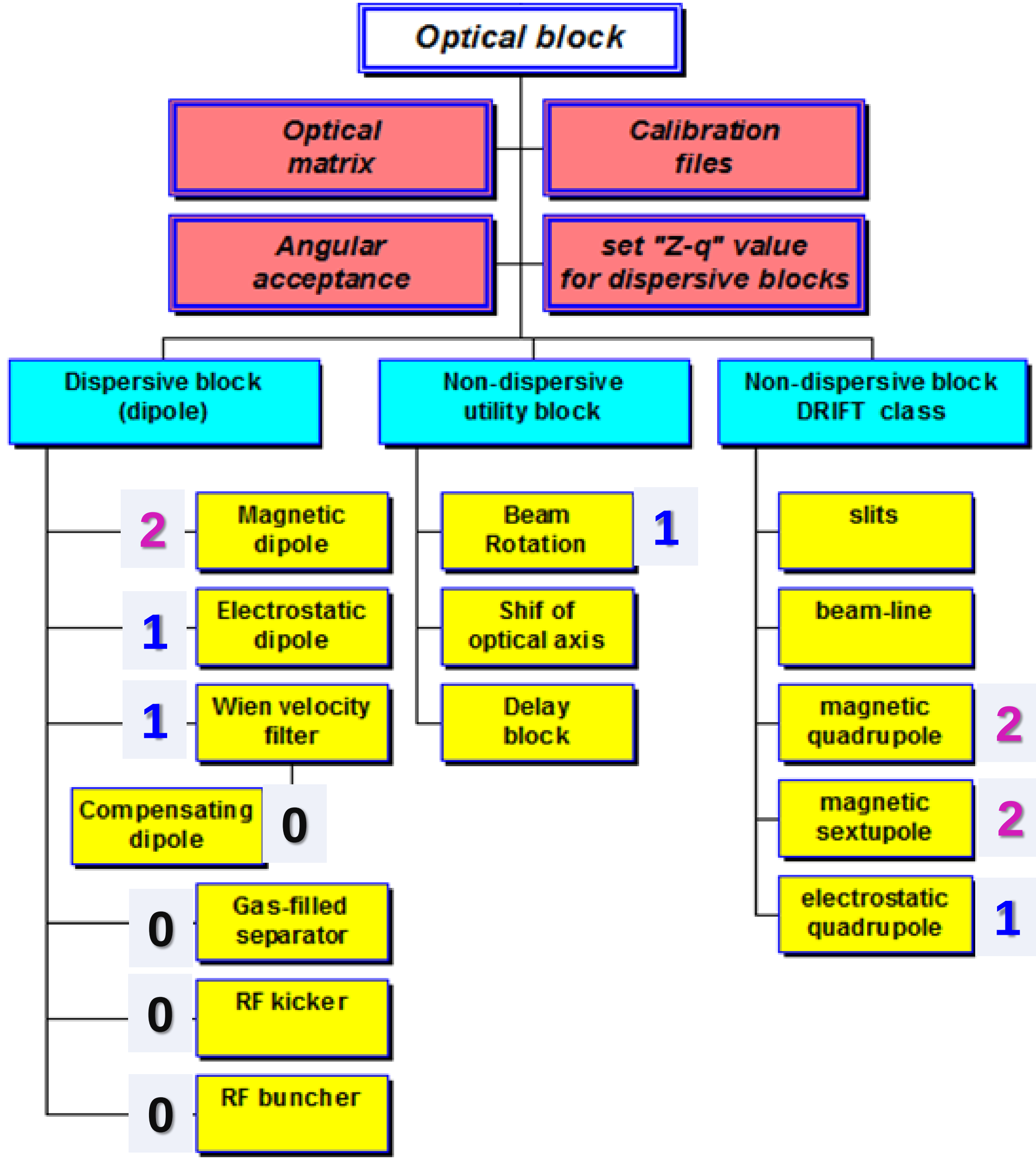



LISE++ block
Material block
Optical block
Compound class
Resolution
Thickness defect
Calibration
Inclination
Optical matrix
Calibration files
Angular acceptance
set "Z-q" value for dispersive blocks
Dispersive block (dipole)
Non-dispersive utility block
Non-dispersive block DRIFT class
Target
Stripper
Wedge
Material (detector)
Faraday cup
Magnetic dipole
Electrostatic dipole
Wien velocity filter
Compensating dipole
Gas-filled separator
RF kicker
RF buncher
Beam Rotation
Shif of optical axis
Delay block
slits
beam-line
magnetic quadrupole
magnetic sextupole
electrostatic quadrupole

LISE^{++} optical blocks (2013)

High order optics calculated by LISE^{++}

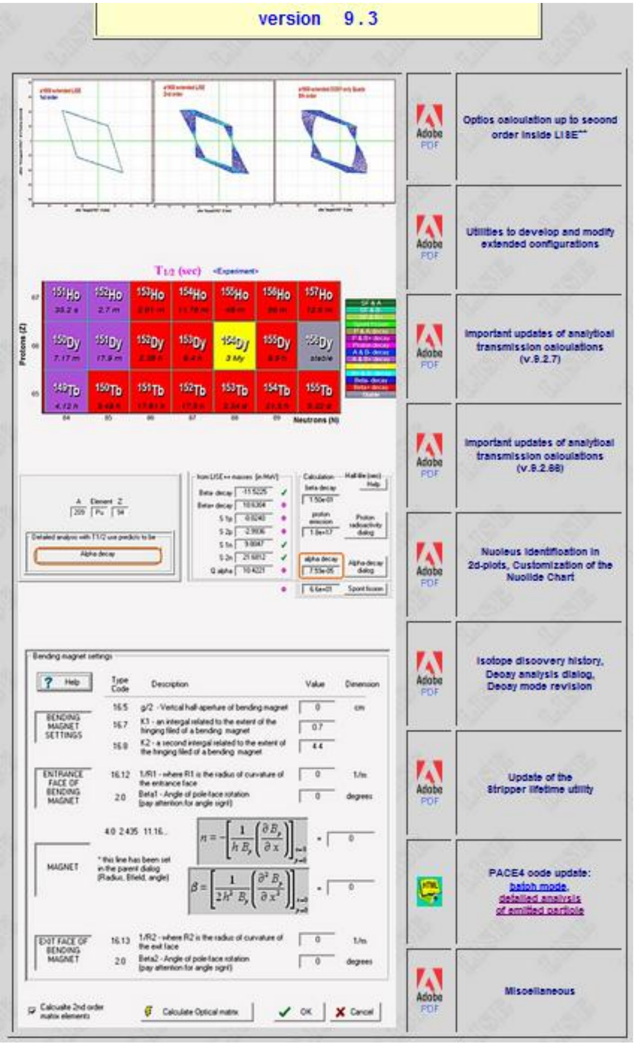
0 1 2

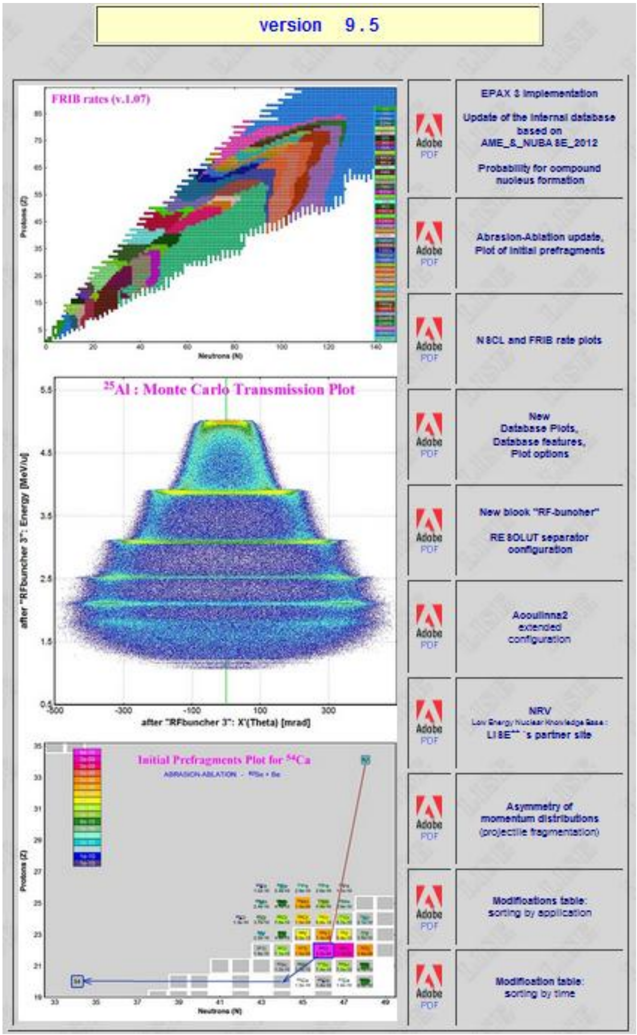


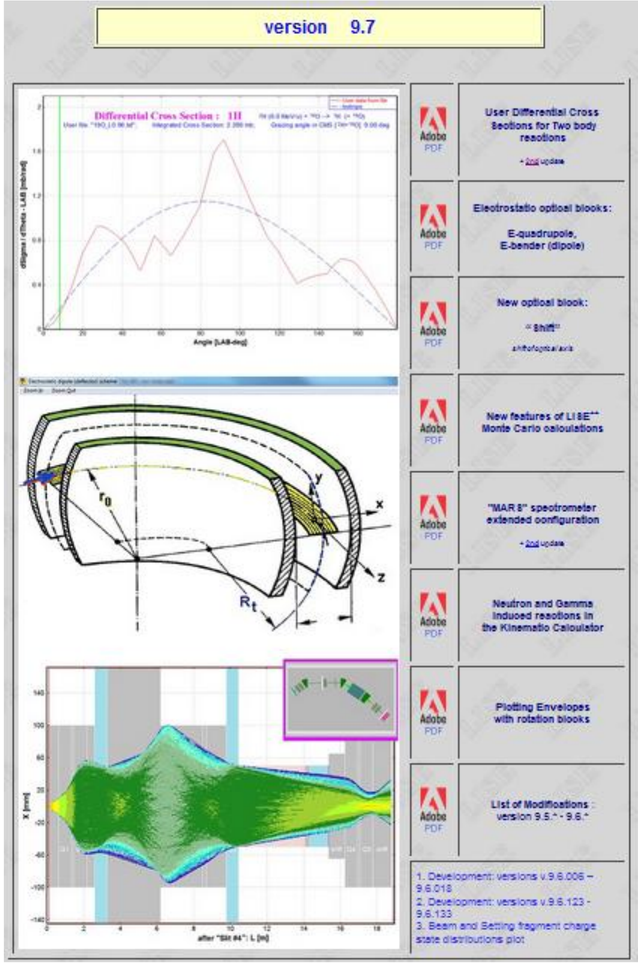
LISE^{++}
Development
2011-2013

Official versions

v.9.3 01/06/2012 **v.9.5 03/06/2013** **v.9.7 11/01/2013**







New blocks

- **RF-buncher**
- **Shift of optical axis**
- **Electrostatic dipole (revision, matrix calculation)**
- **Electrostatic quadrupole**

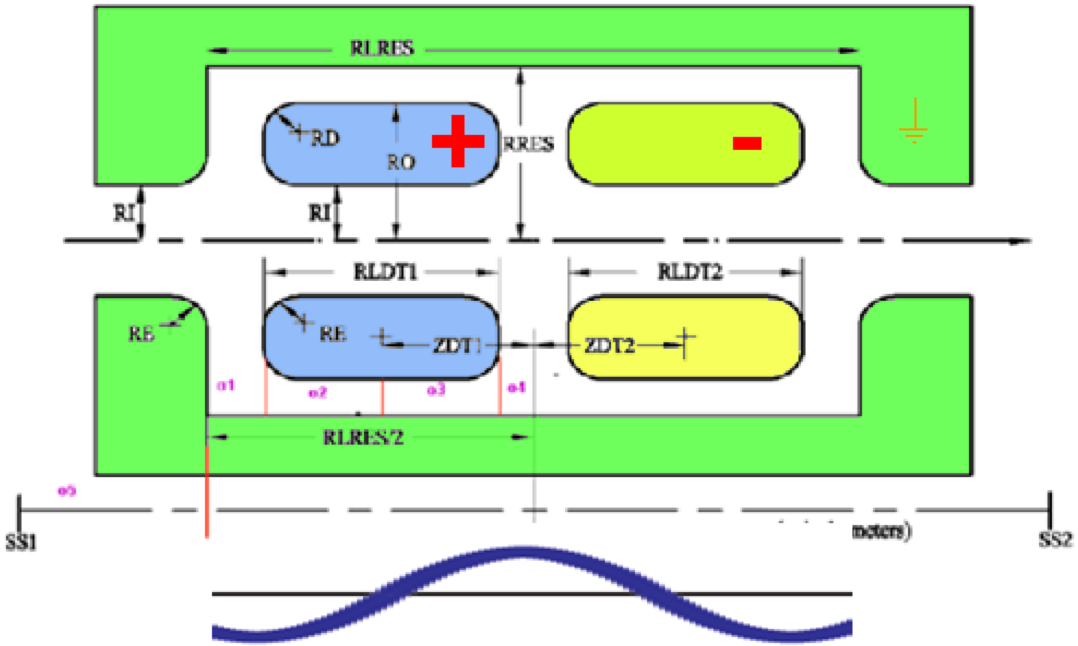
RF-buncher

3-gaps buncher

Note: RF-buncher block is more effective in MC mode

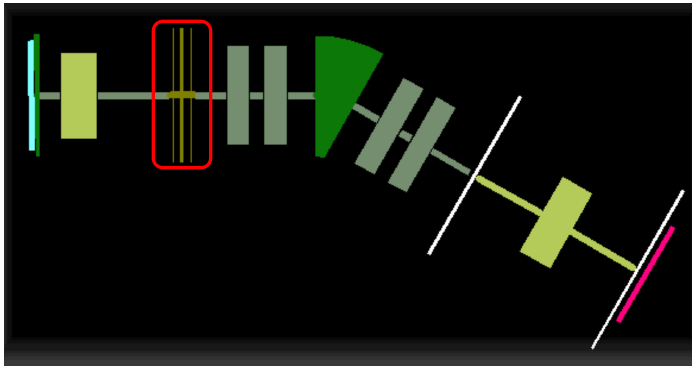
RESOLUT (FSU) configuration

http://lise.nscl.msu.edu/9_4/buncher/9_4_87_buncher.pdf



Gap	Gap Size	Bias
1	D	+V
2	2D	-2V
3	D	+V

Multi-gaps bunchers are constructed for specified speed



RESOLUT_3gap.lpp

COSY 3 gaps :

Gap	Gap Size	Bias
1	D	+V
2	2D	-2V
3	D	+V

LISE++ 3 bunchers:

Buncher	Gap Size	Bias	Phase
1	D	V	a
2	2D	2V	a+180
3	D	V	a

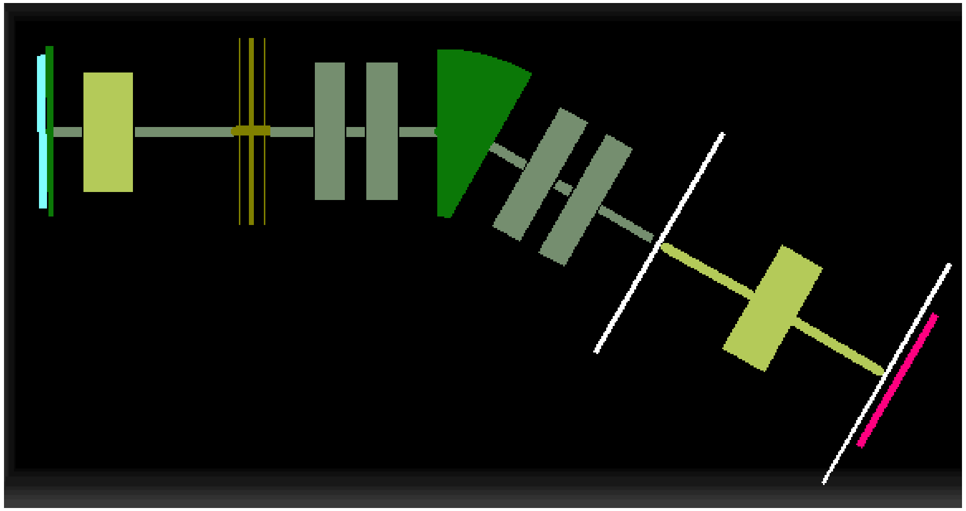
Initial RESOLUT scheme

Tuning dipole to define magnetic rigidity of the separator, Unitary matrix, no slits, zero length

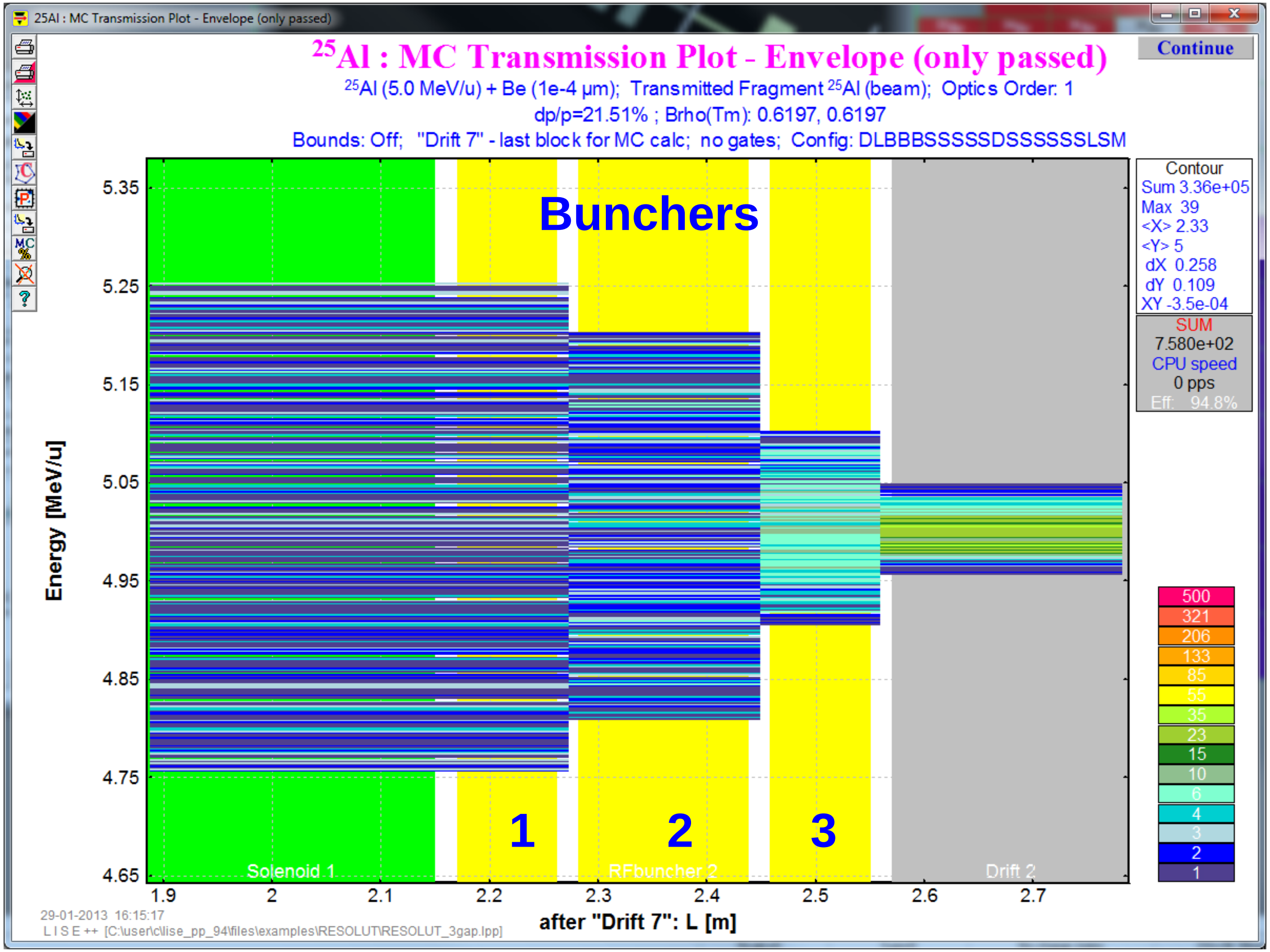
Initial drift+solenoid+drift configuration to define angular acceptance

3 gap Rf-buncher was realized as 3 RF bunchers

QQDQQ spectrometer



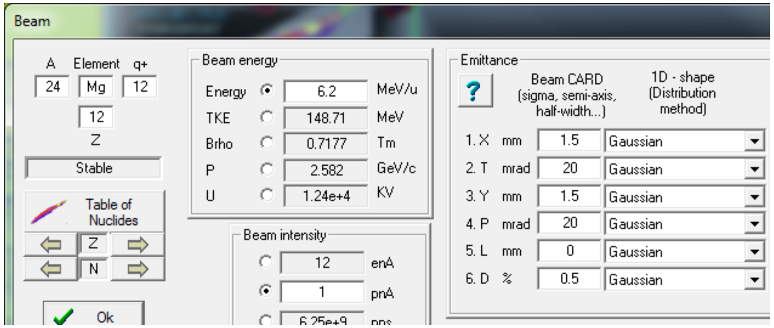
Three RF-bunchers in LISE++

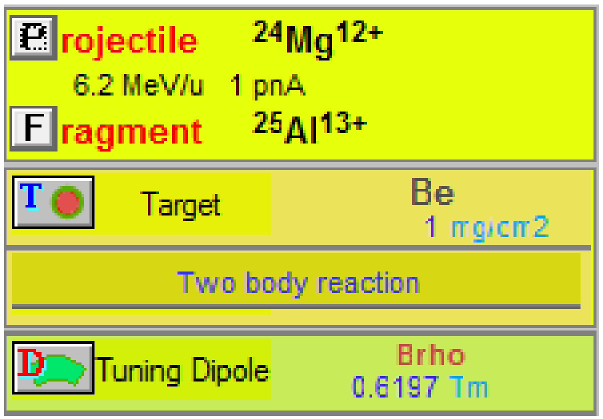


File: RESOLUT_3gap.lpp

Three RF-bunchers in LISE++ vs. Reaction (separation, transmission)

File: **RESOLUT_3gap_reaction.lpp**

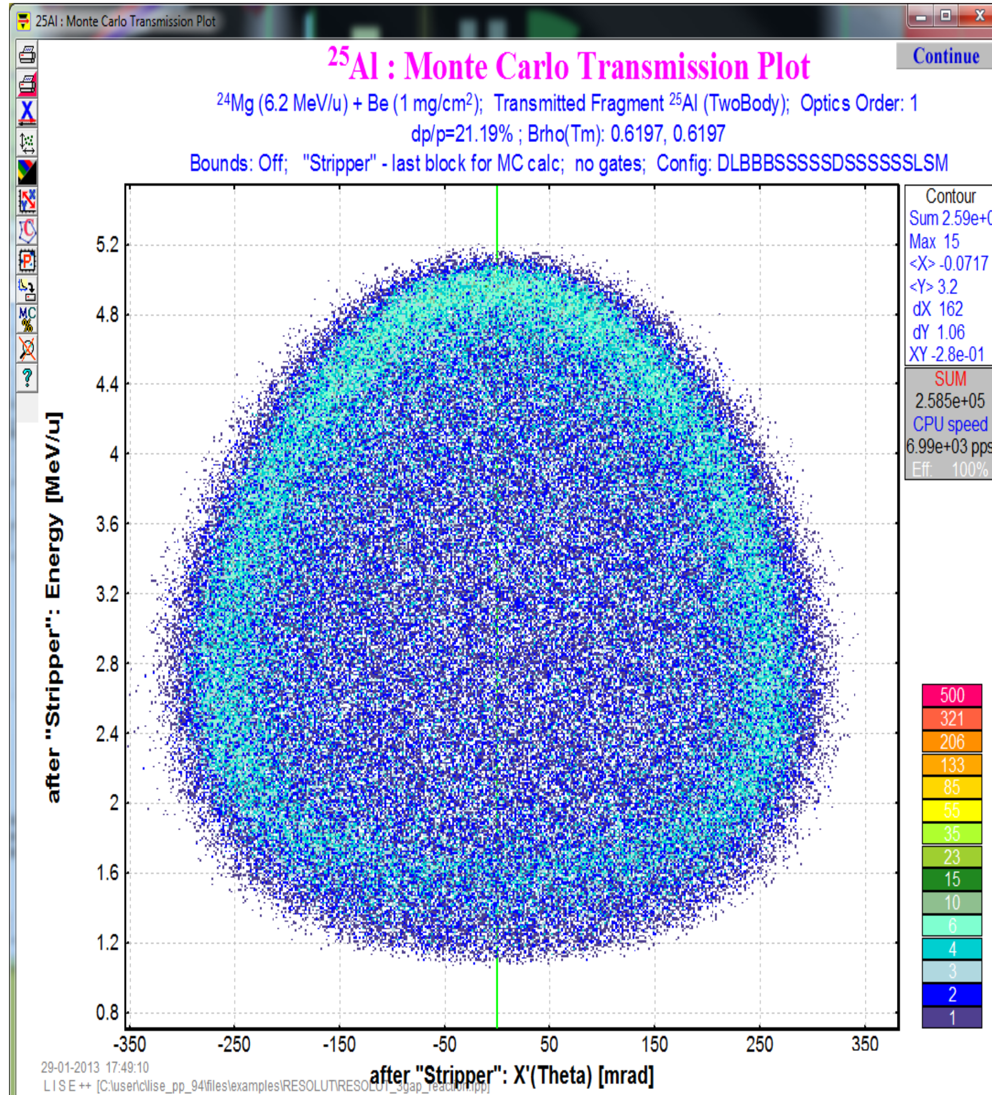




Primary beam is taken into account, but Think about other reactions.

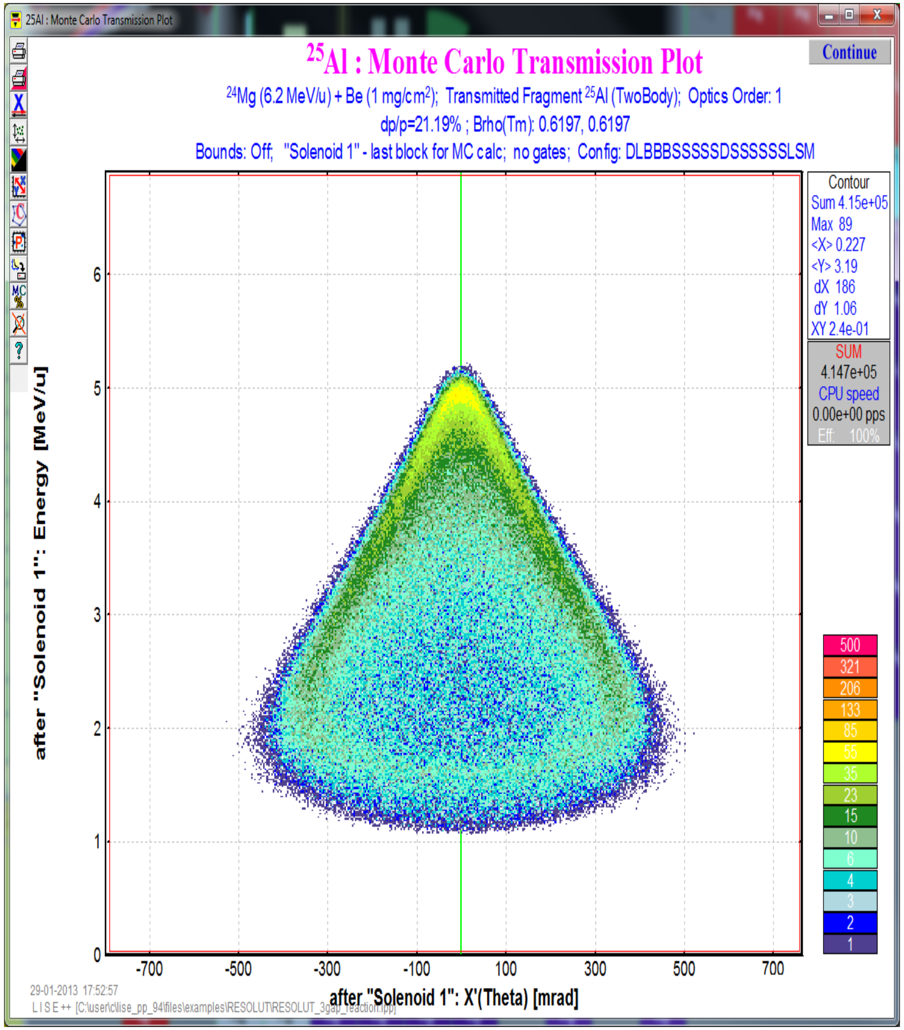
EPAX cross section have been used for Two-body reactions

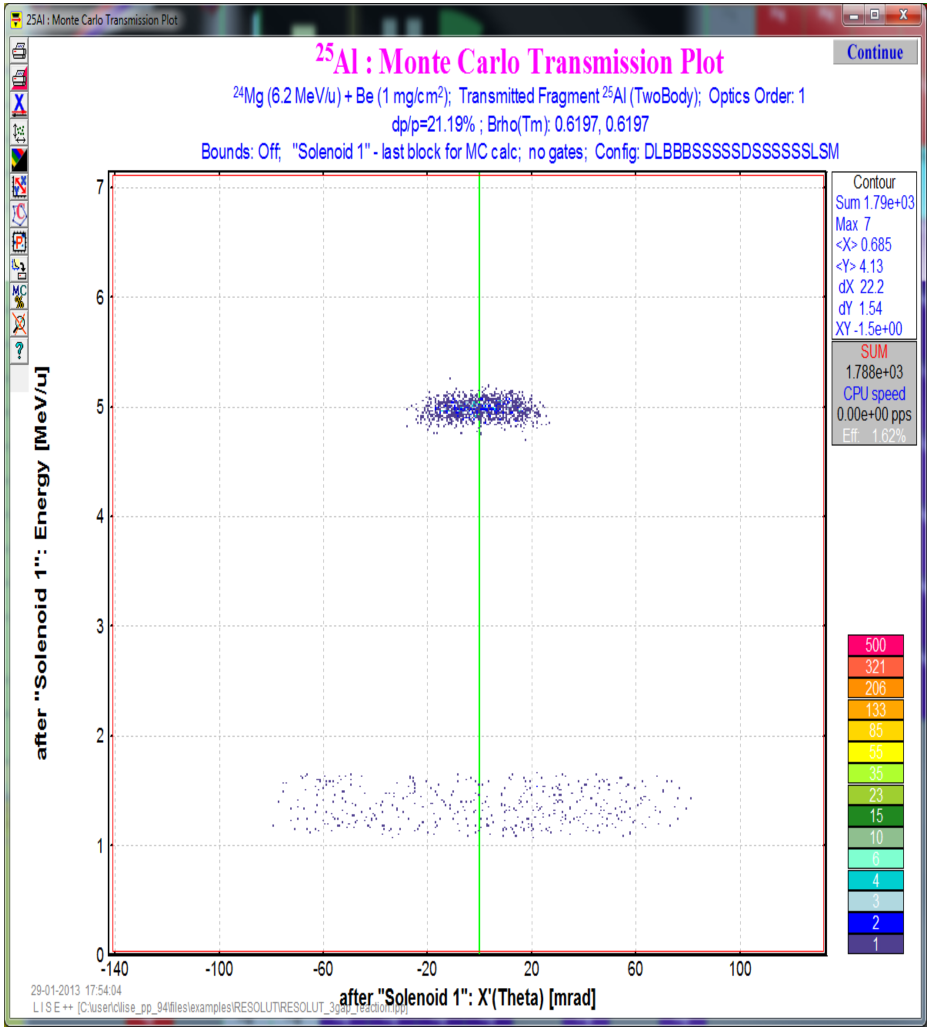
After target



After the 1st solenoid **without** angular acceptance

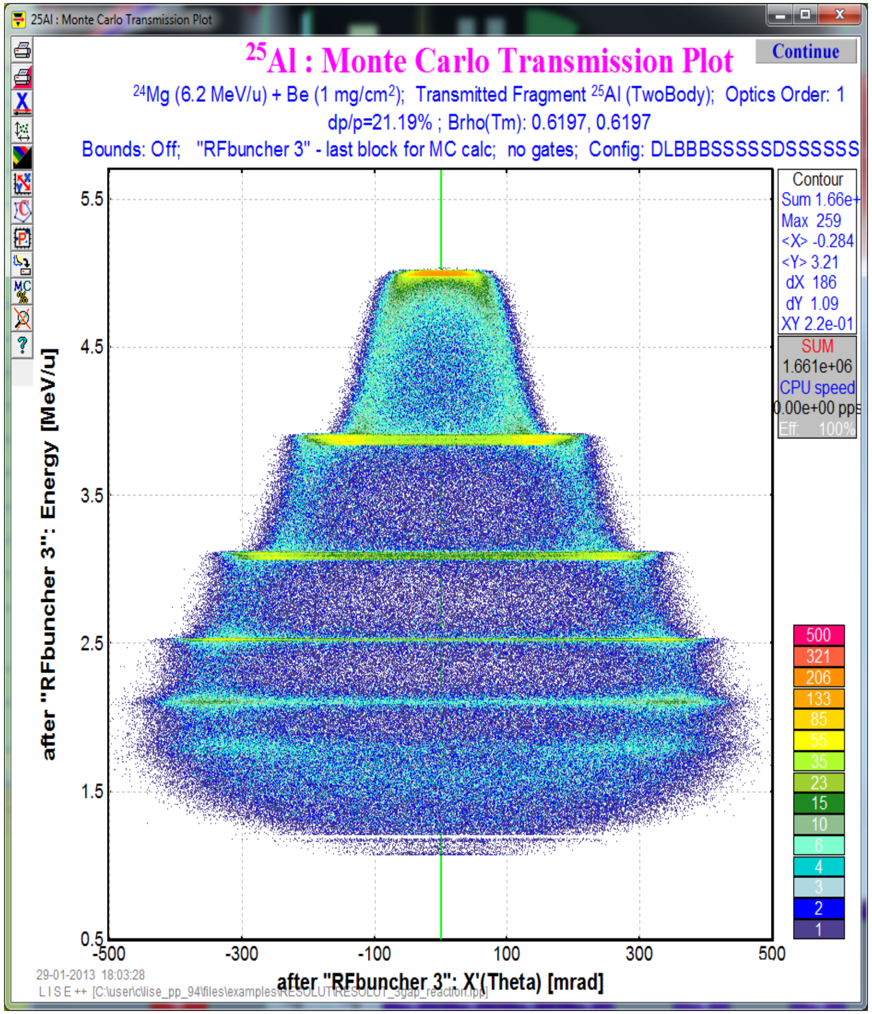
After the 1st solenoid **with** angular acceptance

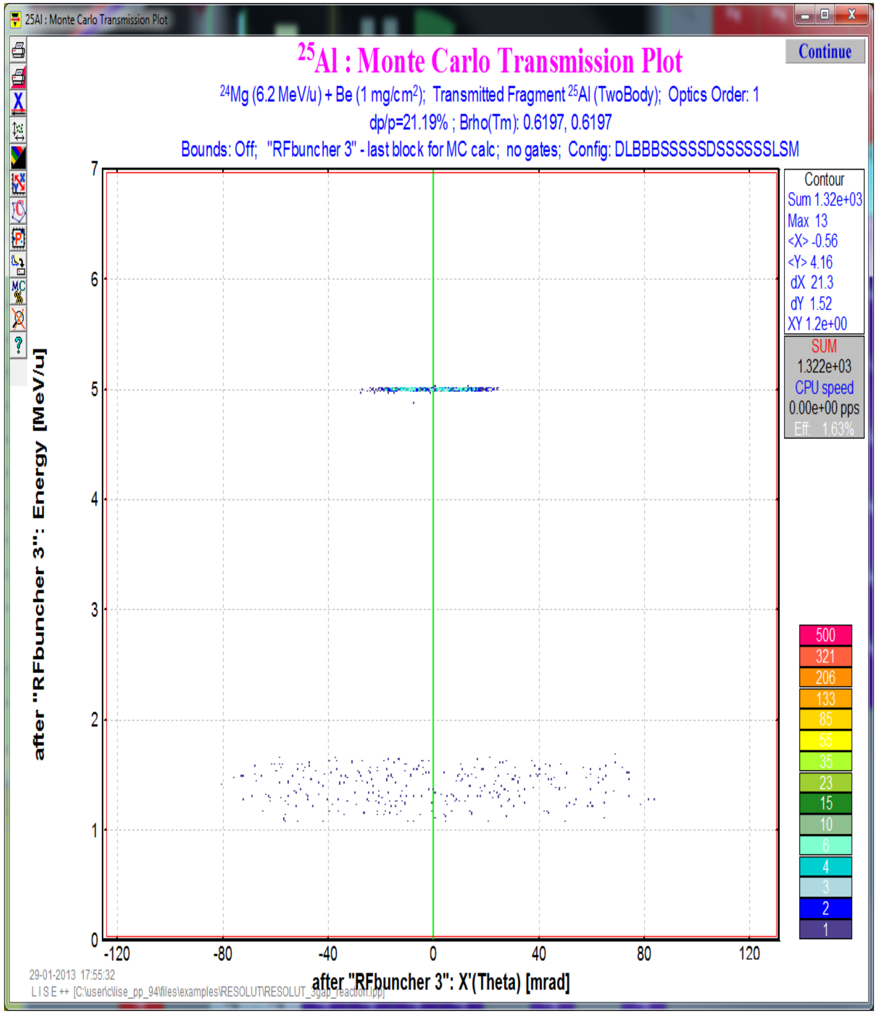




After the 3 gap buncher without angular acceptance

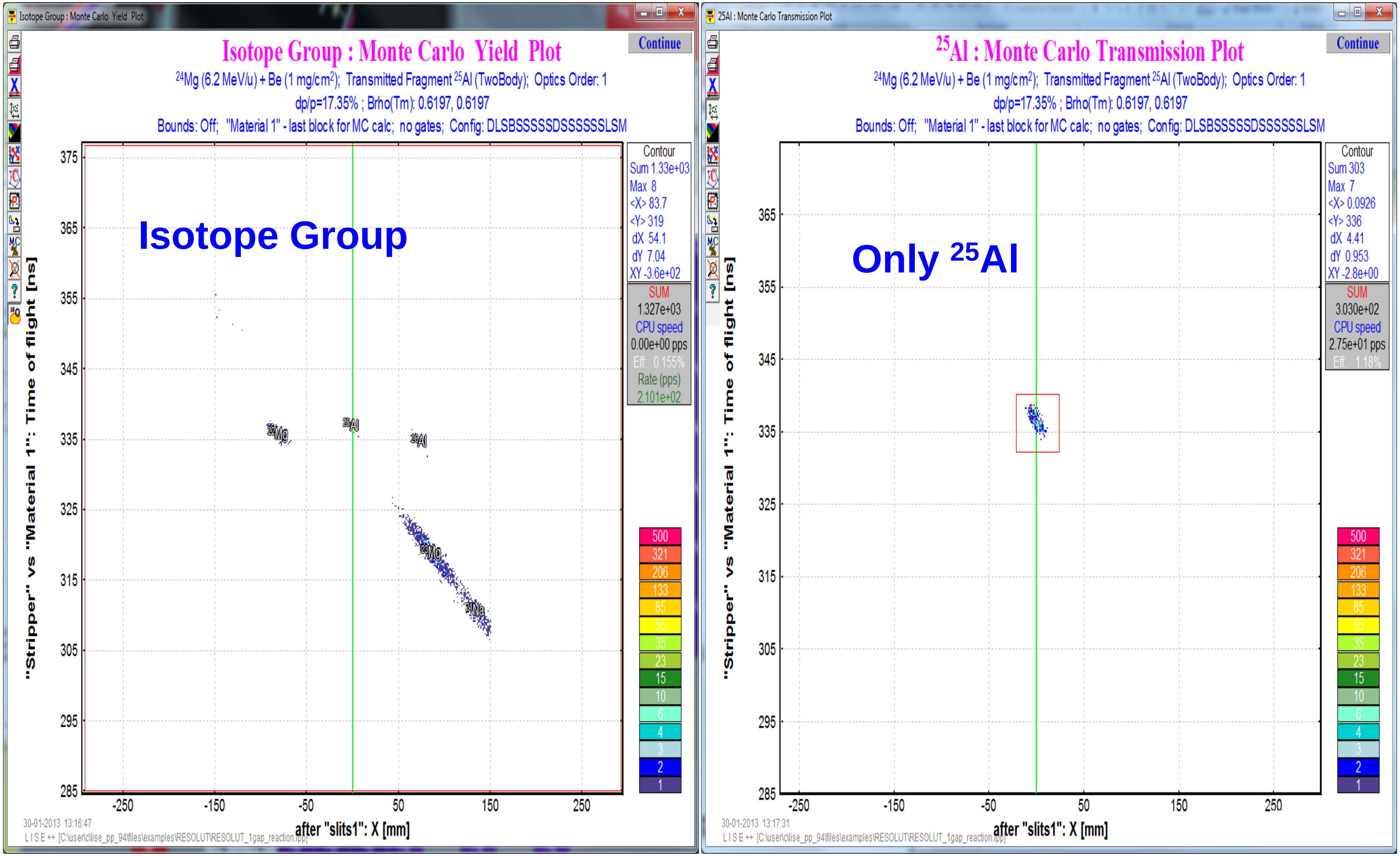
After the 3 gap buncher with angular acceptance





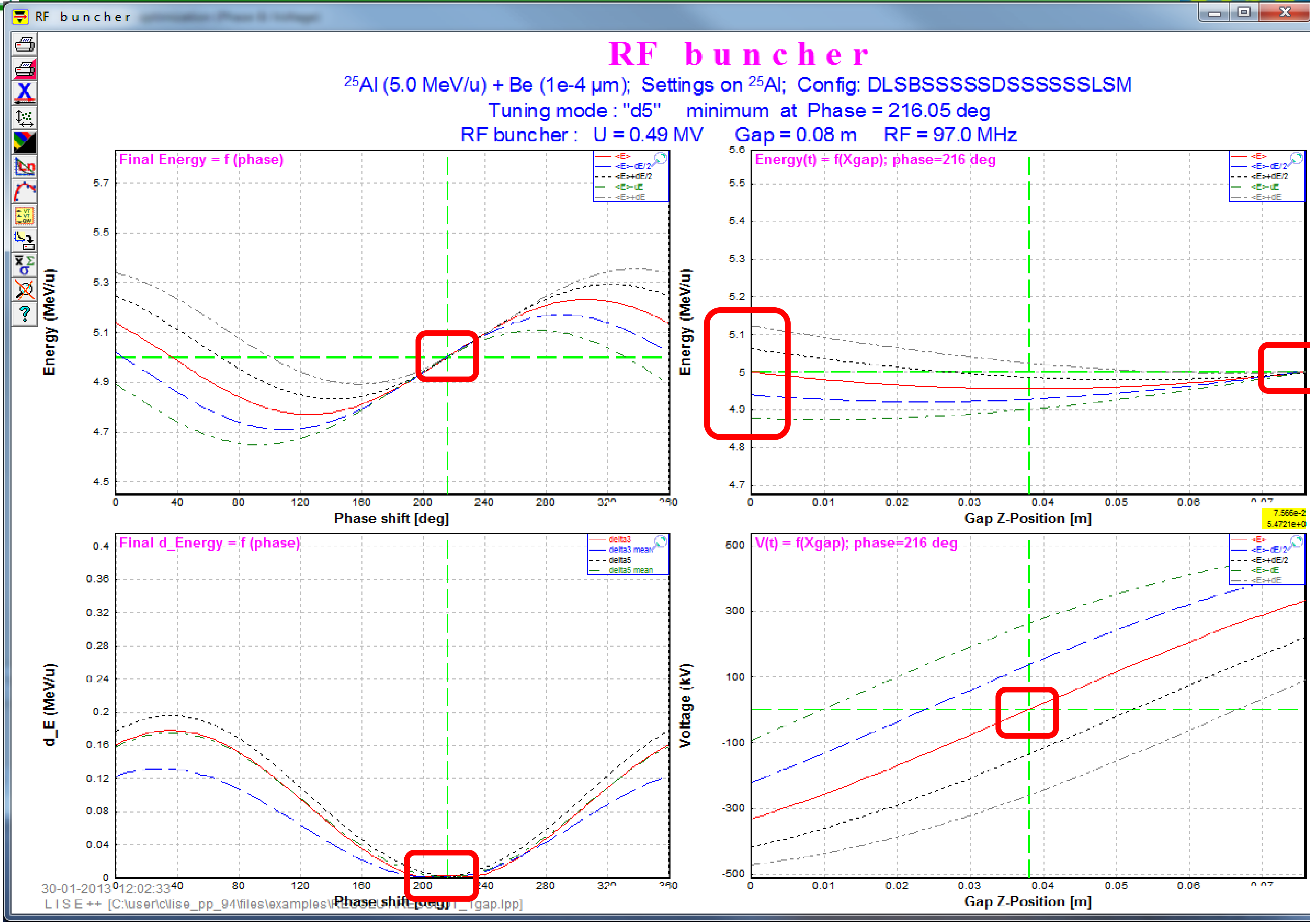
+/- 47 mrad acceptance, Transmission 1.6%

After the Slits1 with angular acceptance, Bounds OFF

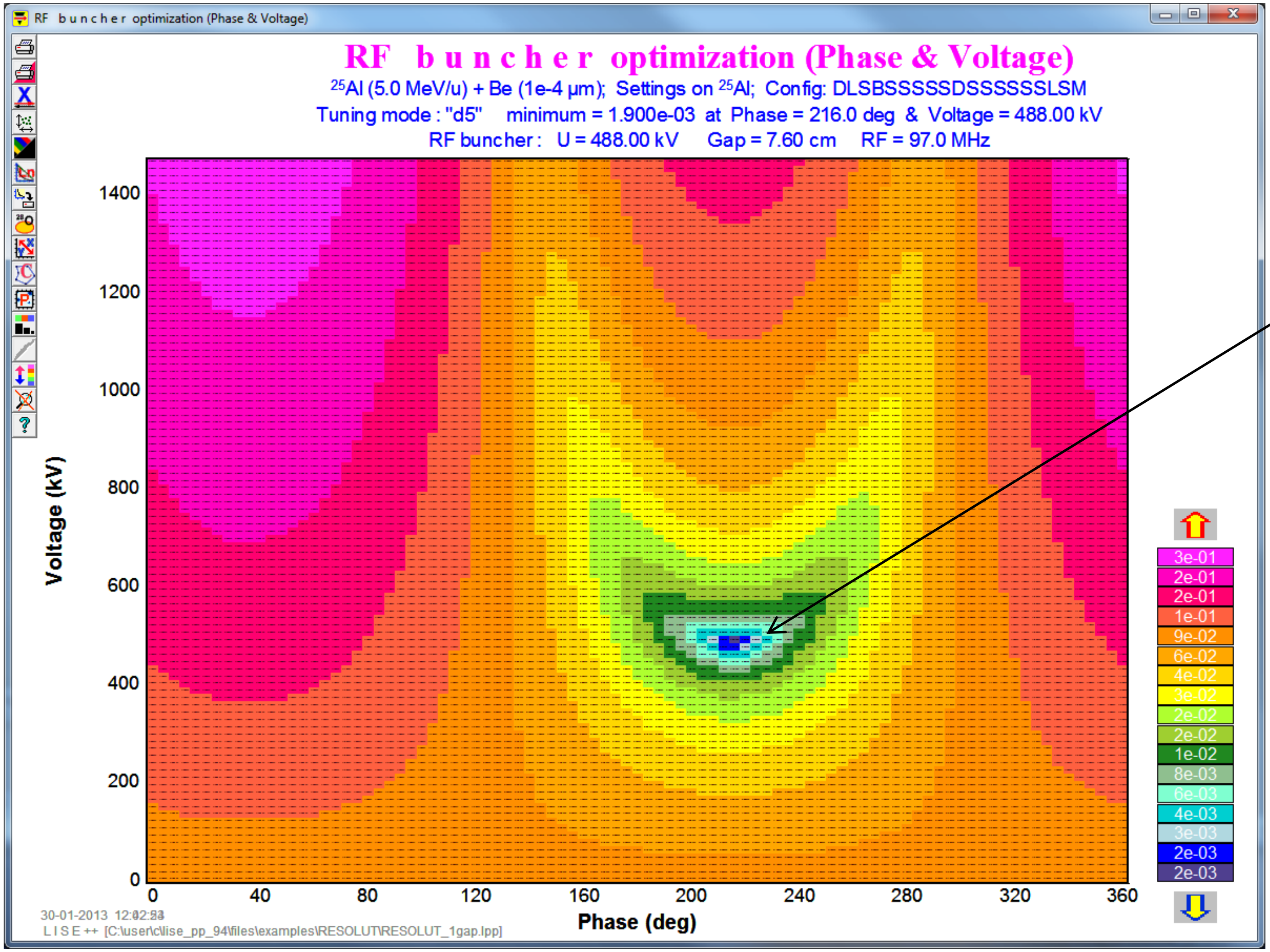


Transmission values are identical in RESOLUT_1gap & RESOLUT 3_gap

RESOLUT : RF buncher plots



RESOLUT : optimization



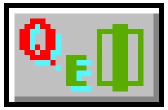
488 kV
216 degrees

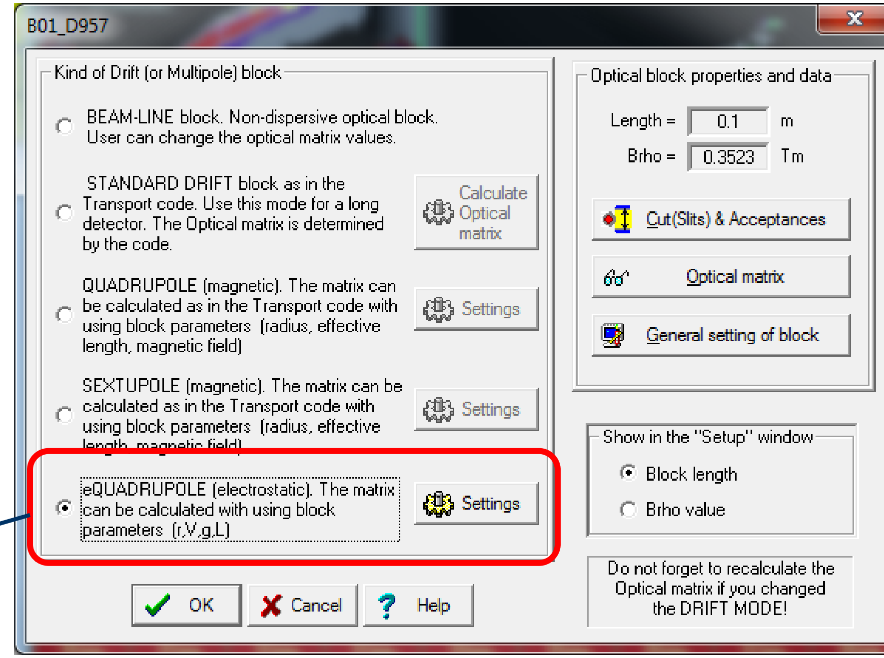
488 kV in this mode corresponds to 122 kV nominal value.

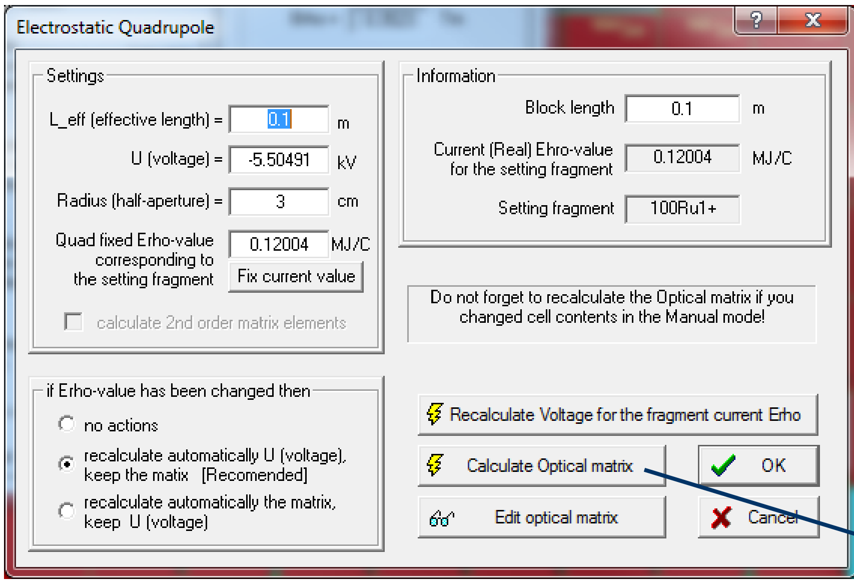
From FSU COSY file
V= 119.6 kV
(see page 7)

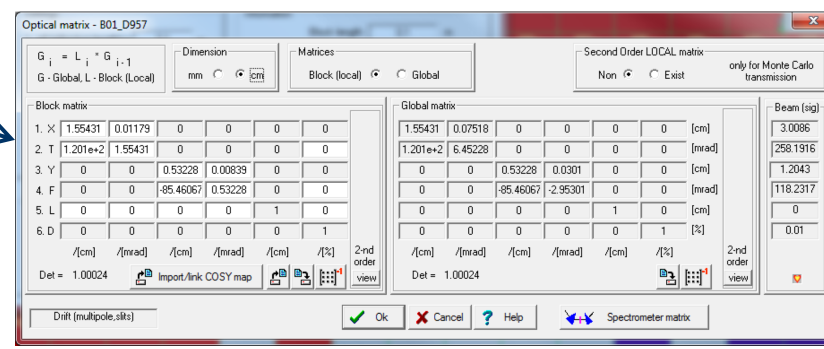
Optical blocks : E-quad, E-bender

Electrostatic quadrupole





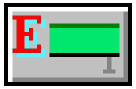


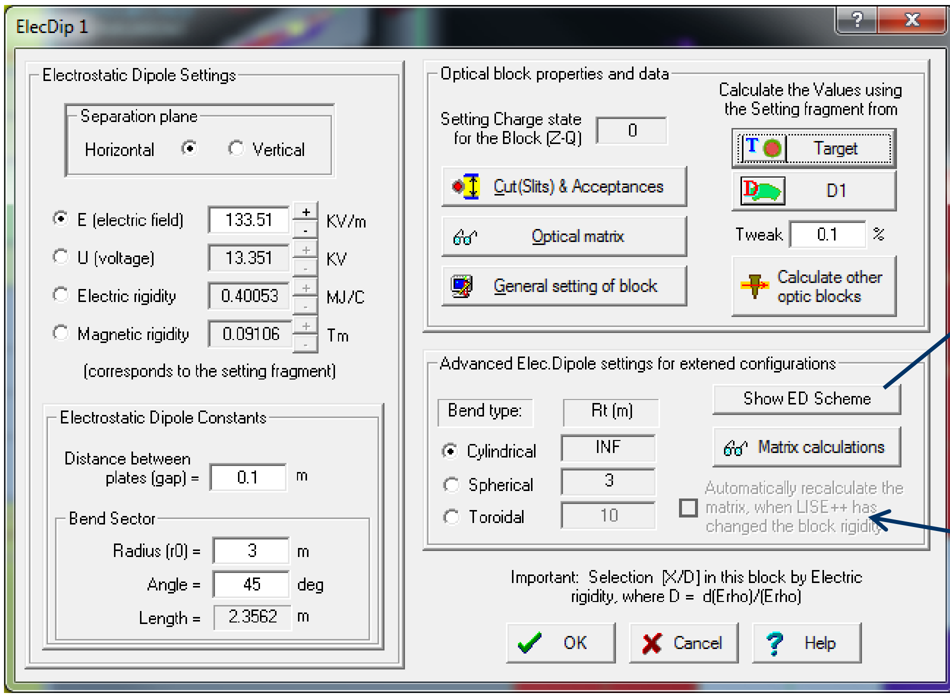


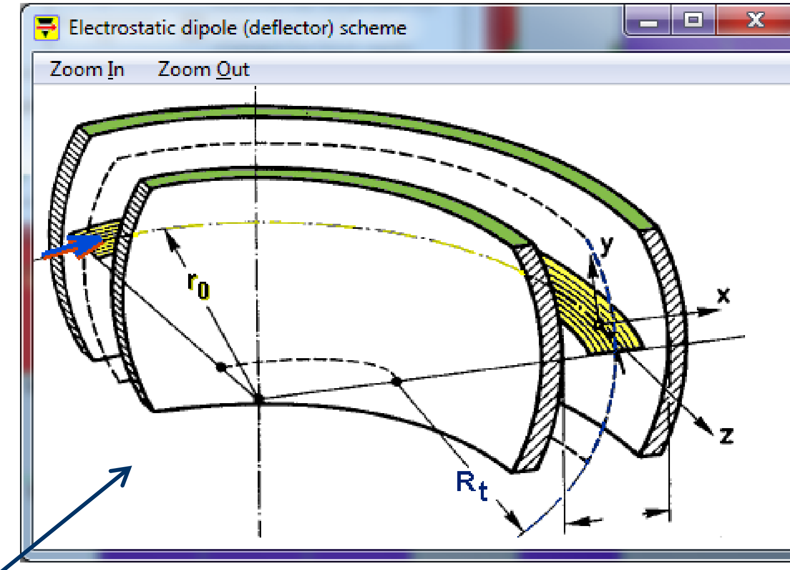
Right now it is only 1-st order calculations

E-quad -- options : matrix keeping & automatic U recalculation, and U-keeping & automatic matrix recalculation

Electrostatic bender (dipole)







This checkbox is available after matrix calculations done

E & B bends example

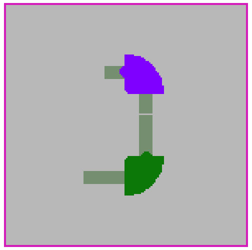
http://lise.nscl.msu.edu/9_6/Edipole/EB_case.lpp

M.Portillo's example, and COSY calculations

Purpose

- Create an energy achromat system
  - Using double focusing
  - E-dipole
    - » Bend of 90deg at R=0.2 m spherical electrodes for equal x- and y-focus strength
    - » Drift before and after bend = R
  - B-dipole
    - » Bend of 90deg at R=0.2 m
    - » 26.56deg entranc & exit edge angles for equal x- and y-focus strength
    - » Drift before and after bend = 2R

LISE++



COSY

Global | Dimension: mm / cm (selected)

Global matrix

-1	0	0	0	0	0.8	[cm]
-50	-1	0	0	0	20	[mrad]
0	0	-1	0	0	0	[cm]
0	0	-50	-1	0	0	[mrad]
-2	-0.08	0	0	1	-0.45664	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

Det = 1.00000

E bend focus

Lister - [c:\user\cosy\LISE_COSY_App\EB_focus1.TXT]

File Edit Options Help

```
 -.10000E+01   .55116E-07   .00000E+00   .00000E+00   .00000E+00   .80000E+00
 -.50000E+02  -.10000E+01   .00000E+00   .00000E+00   .00000E+00   .20000E+02
  .00000E+00   .00000E+00  -.10000E+01   .00000E+00   .00000E+00   .00000E+00
  .00000E+00   .00000E+00  -.50000E+02  -.10000E+01   .00000E+00   .00000E+00
 -.20000E+01  -.80000E-01   .00000E+00   .00000E+00   .10000E+01  -.45664E+00
  .00000E+00   .00000E+00   .00000E+00   .00000E+00   .00000E+00   .10000E+01
------------------- MAP IN TRANSPORT UNITS, COSY FORMAT, PM
 -.2945573E-08 -.7363969E-07  .0000000      .0000000      .1681321E-08 00000000
 -.9999986     -49.99997      .0000000      .0000000     -2.000000     10000000
  .5511577E-07 -.9999986      .0000000      .0000000     -.7999999E-01 01000000
  .0000000      .0000000     -1.000000     -50.00000      .0000000     00100000
  .0000000      .0000000      .0000000     -1.000000      .0000000     00010000
  .0000000      .0000000      .0000000      .0000000     1.000000      00001000
  .7999999      20.00000      .0000000      .0000000     -.4566366     00000100
 -39.99997     -999.9994      .0000000      .0000000     22.83182      00000010
 -40.00002     -1000.001      .0000000      .0000000     22.83184      00000001
```

Dimension: mm / cm (selected) | Matrices: Block (local) / Global (selected)

Global matrix

1.00121	0.00002	0	0	0	-0.00066	[cm]
87.52197	1.00033	0	0	0	-35.0121	[mrad]
0	0	0.99885	-0.00002	0	0	[cm]
0	0	80.34935	0.99973	0	0	[mrad]
3.49967	0	0	0	1	-3.37062	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

Det = 0.99998

E + B bend focus

Lister - [c:\user\cosy\LISE_COSY_App\EB_focus2.TXT]

File Edit Options Help

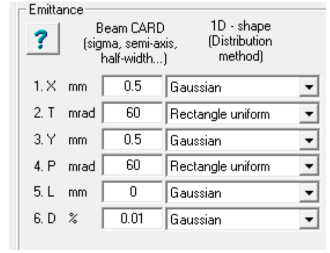
```
  .10000E+01   .61419E-06   .00000E+00   .00000E+00   .00000E+00  -.24965E-04
  .87501E+02   .10000E+01   .00000E+00   .00000E+00   .00000E+00  -.35000E+02
  .00000E+00   .00000E+00   .99996E+00  -.66931E-06   .00000E+00   .00000E+00
  .00000E+00   .00000E+00   .80364E+02   .99999E+00   .00000E+00   .00000E+00
  .35000E+01  -.34741E-06   .00000E+00   .00000E+00   .10000E+01  -.33708E+01
  .00000E+00   .00000E+00   .00000E+00   .00000E+00   .00000E+00   .10000E+01
------------------- MAP IN TRANSPORT UNITS, COSY FORMAT, PM
  .1061954E-12  .1288709E-06  .0000000      .0000000      .1241115E-07 00000000
  1.000045      87.50076      .0000000      .0000000     3.499983      10000000
  .6141881E-06  1.000009      .0000000      .0000000     -.3474118E-06 01000000
  .0000000      .0000000      .9999564     80.36445       .0000000     00100000
  .0000000      .0000000     -.6693090E-06  .9999898      .0000000     00010000
  .0000000      .0000000      .0000000      .0000000     1.000000      00001000
 -.2496493E-04 -35.00045      .0000000      .0000000     -3.370789     00000100
  40.00114      2500.019      .0000000      .0000000     162.8314      00000010
 -39.99865      1000.026      .0000000      .0000000     174.2475      00000001
```

E & B bends example

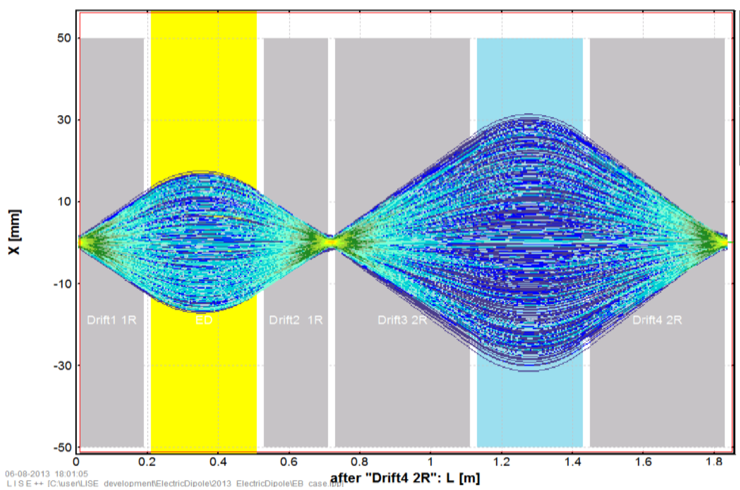
http://lise.nscl.msu.edu/9_6/Edipole/EB_case.lpp

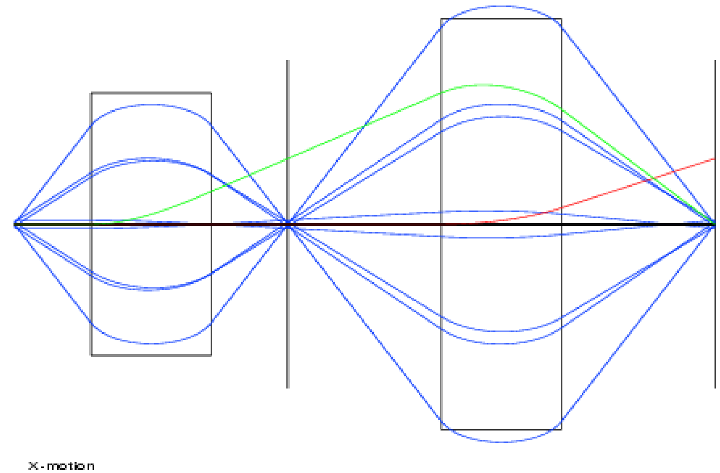
M.Portillo's example, and COSY calculations

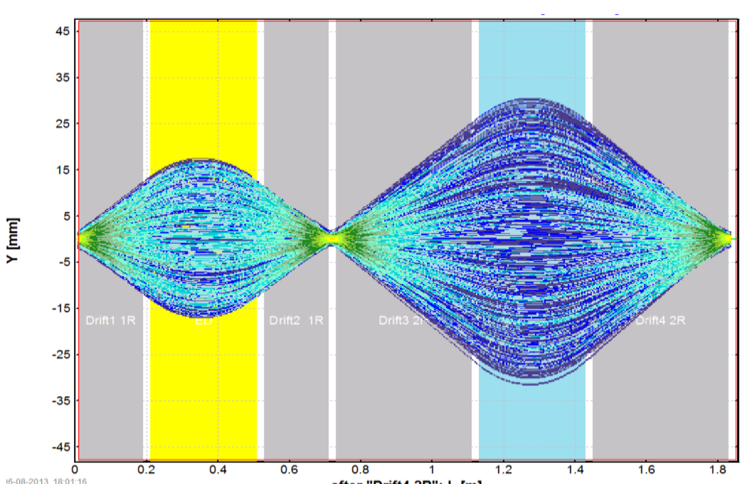
LISE++

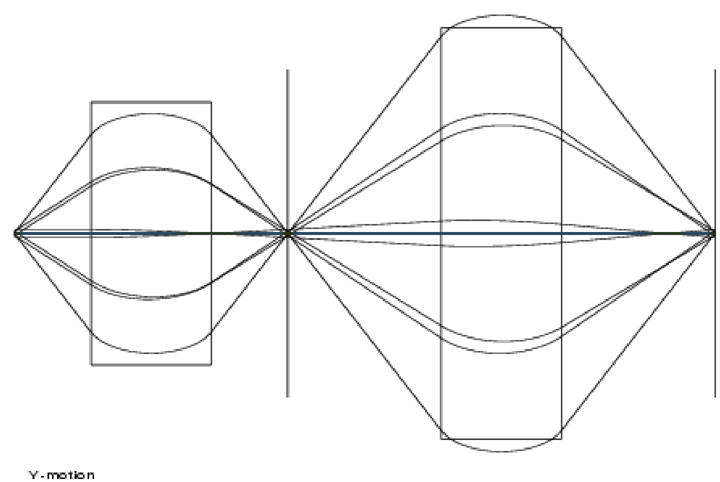


COSY



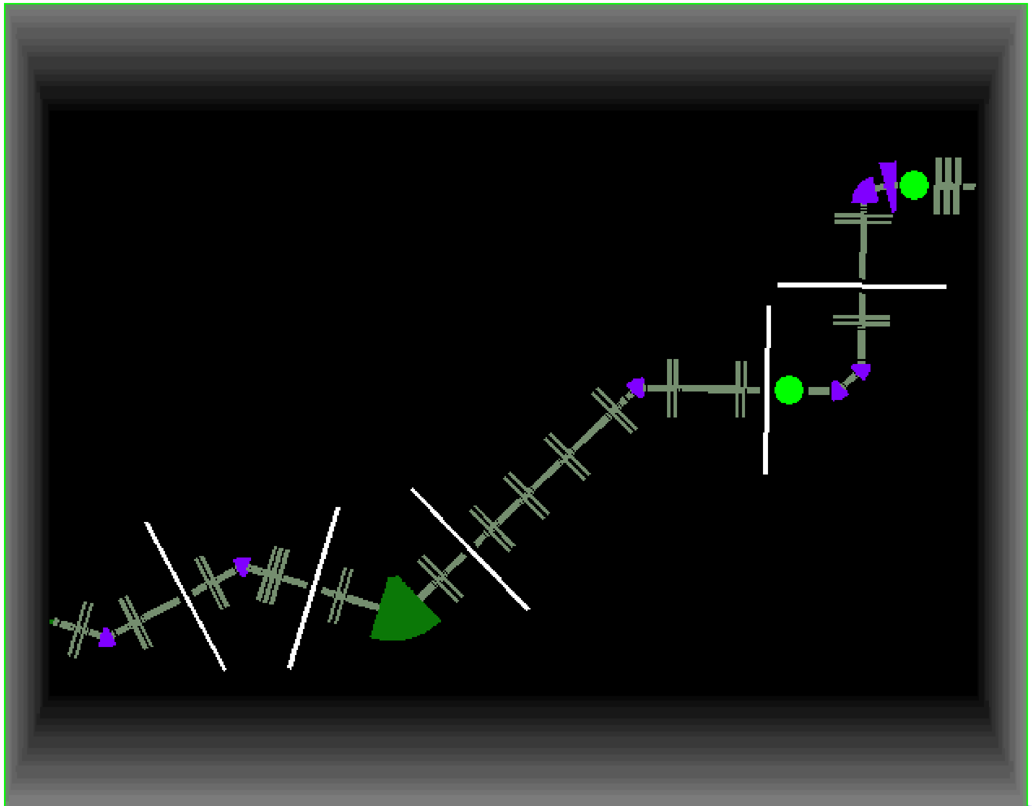






D-line : extended configuration

LISE^{++} file: http://lise.nscl.msu.edu/9_6/Edipole/D-line_BTS01-12%20with%20rotation.lpp

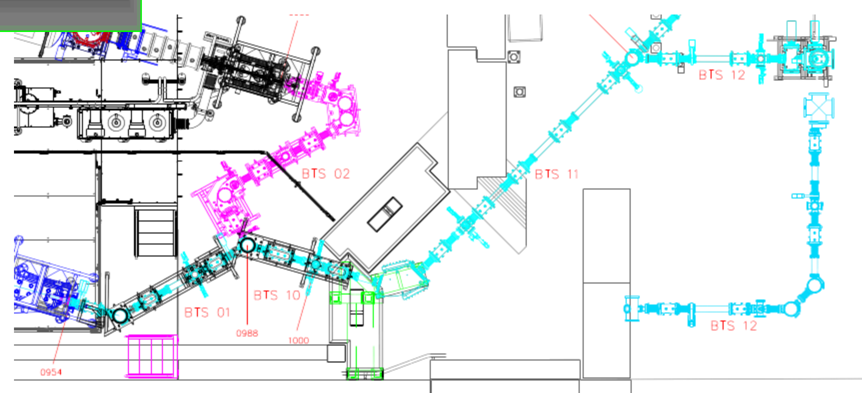


Almost 137 blocks, where

M-dipole : 1

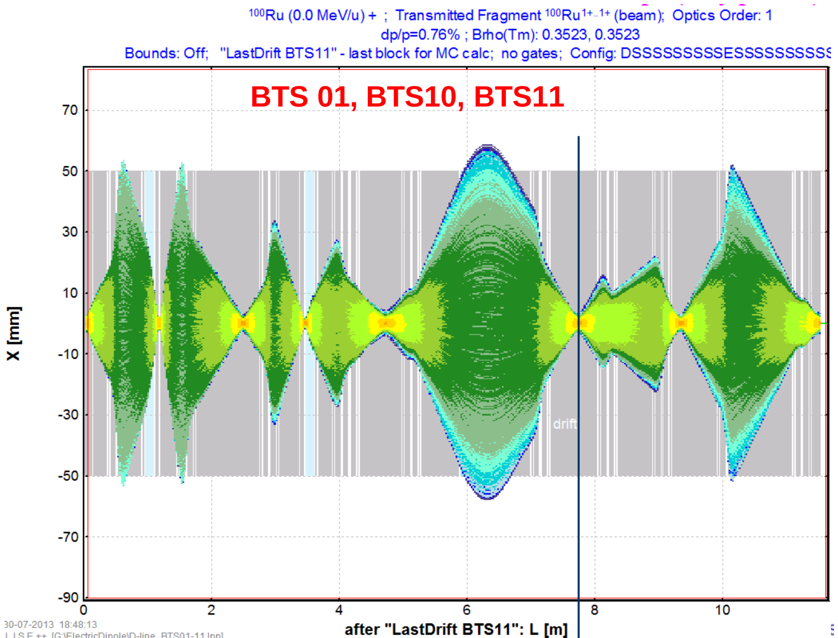
E-dipole : 7

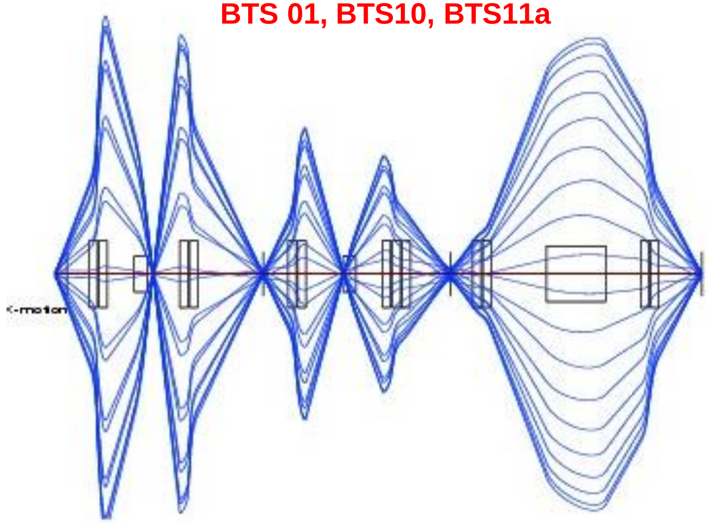
E-quad : 32



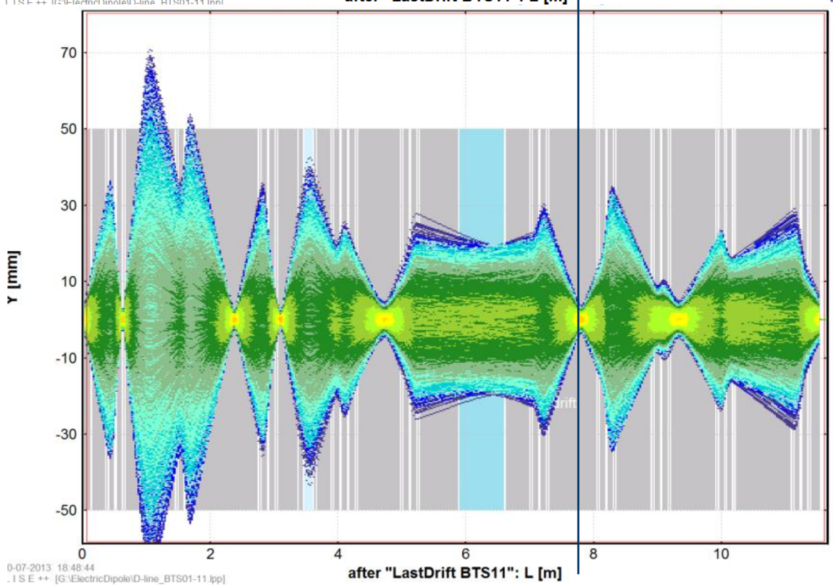
LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/D-line_BTS01-12%20with%20rotation.lpp

From "Report on recalculation of Low-E beam lines" by M.Portillo

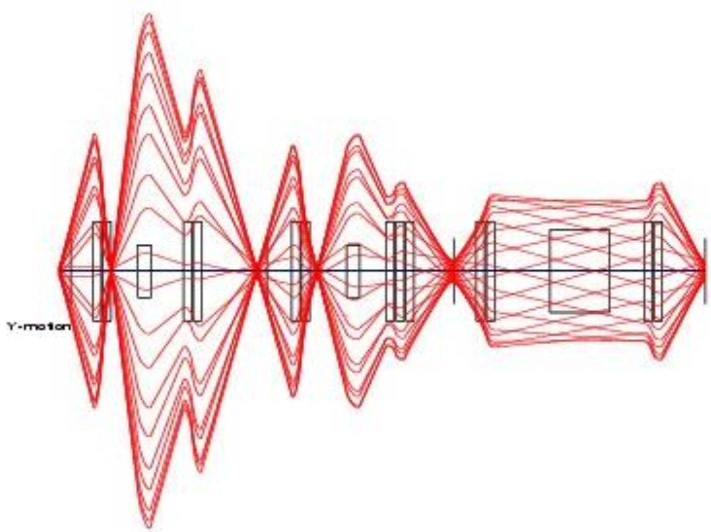




X

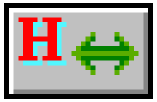


Y

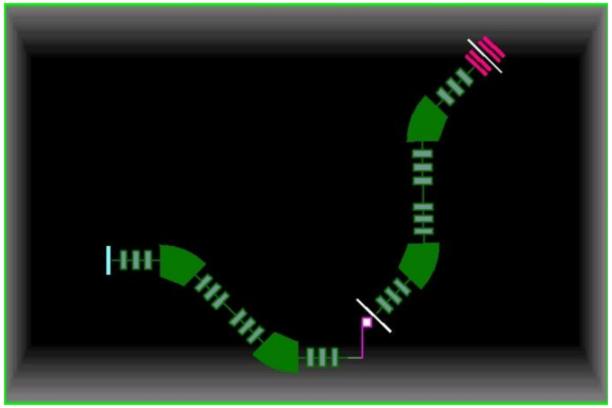


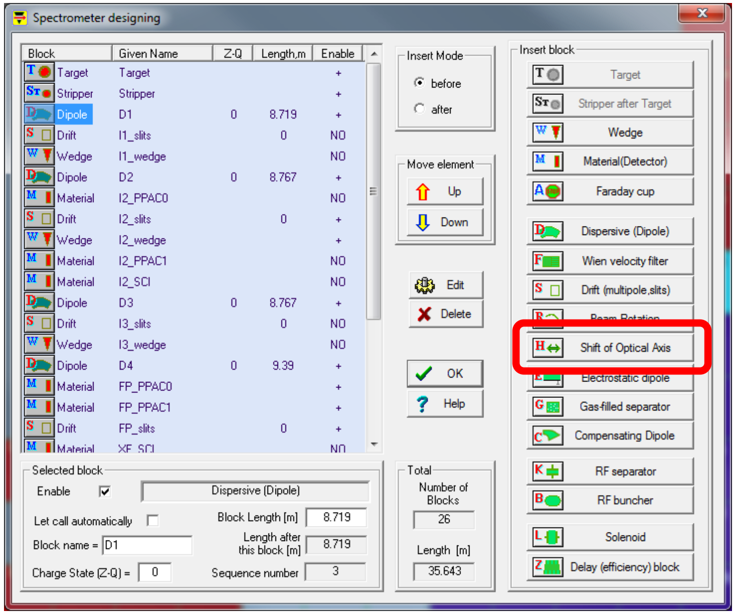
Optical blocks :
Shift of optical axis

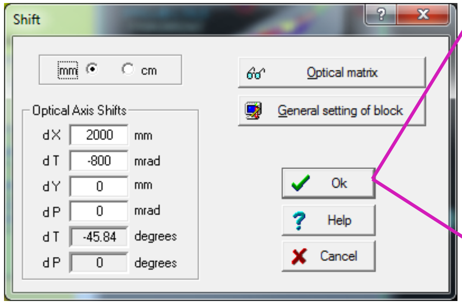
New optical block : "Shift of optical axis"

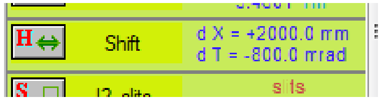


Allows to simulate misalignment, projectile scattering and so on.







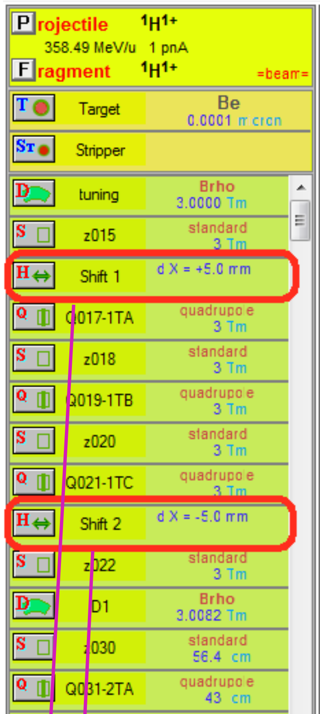


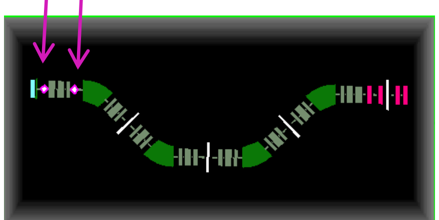
- **Property : optical block**
- **Always Identity matrix**
- **Length block = 0**

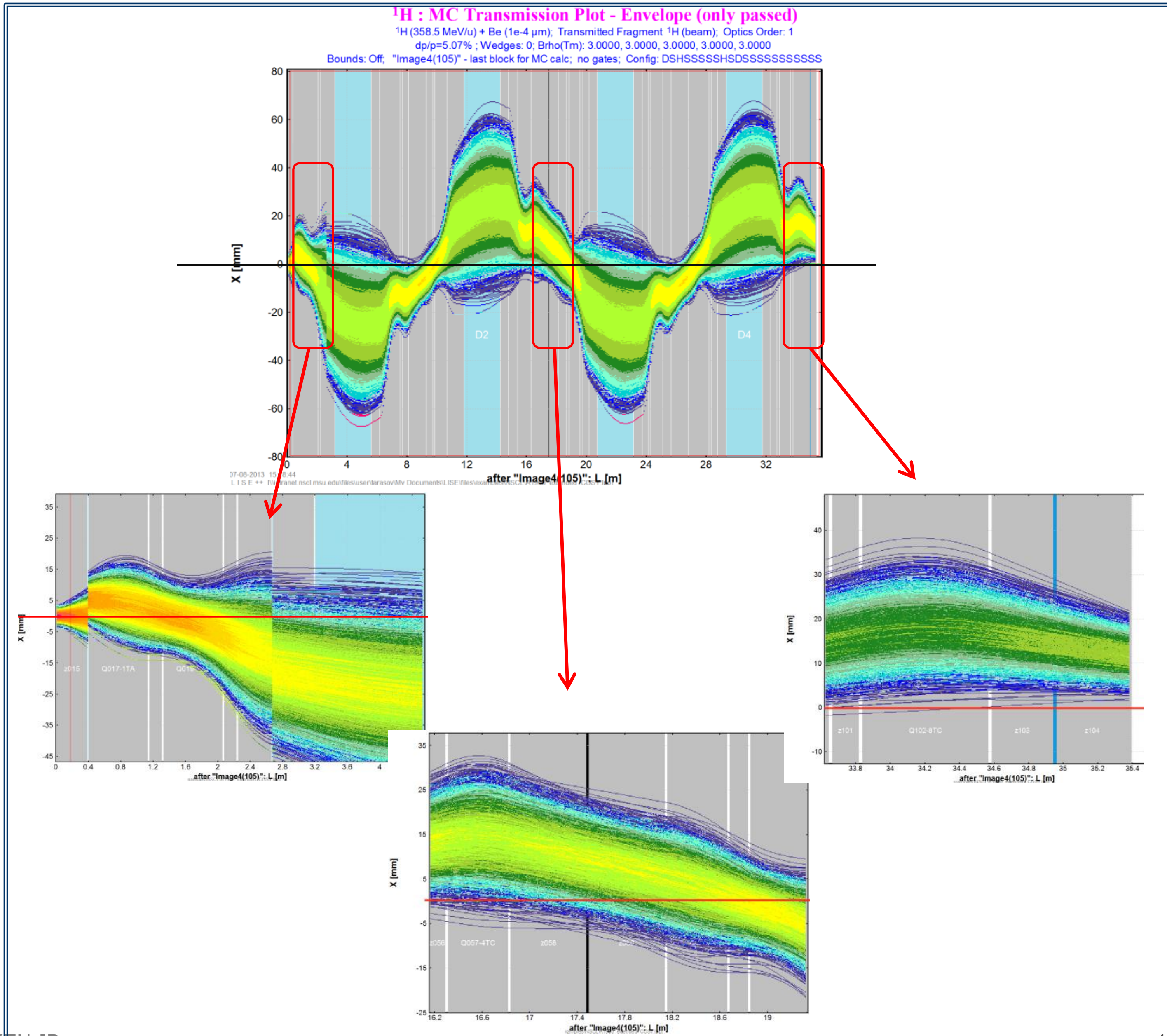
Optical block "Shift" : triplet misalignment

Example:
1st triplet 5 mm
All dipoles set to 3.0 Tm

LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/misalignemnt_A1900_extended_COSY.lpp







Optical block "Shift" : triplet misalignment

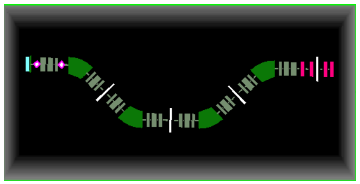
MICHIGAN STATE UNIVERSITY

LISE++

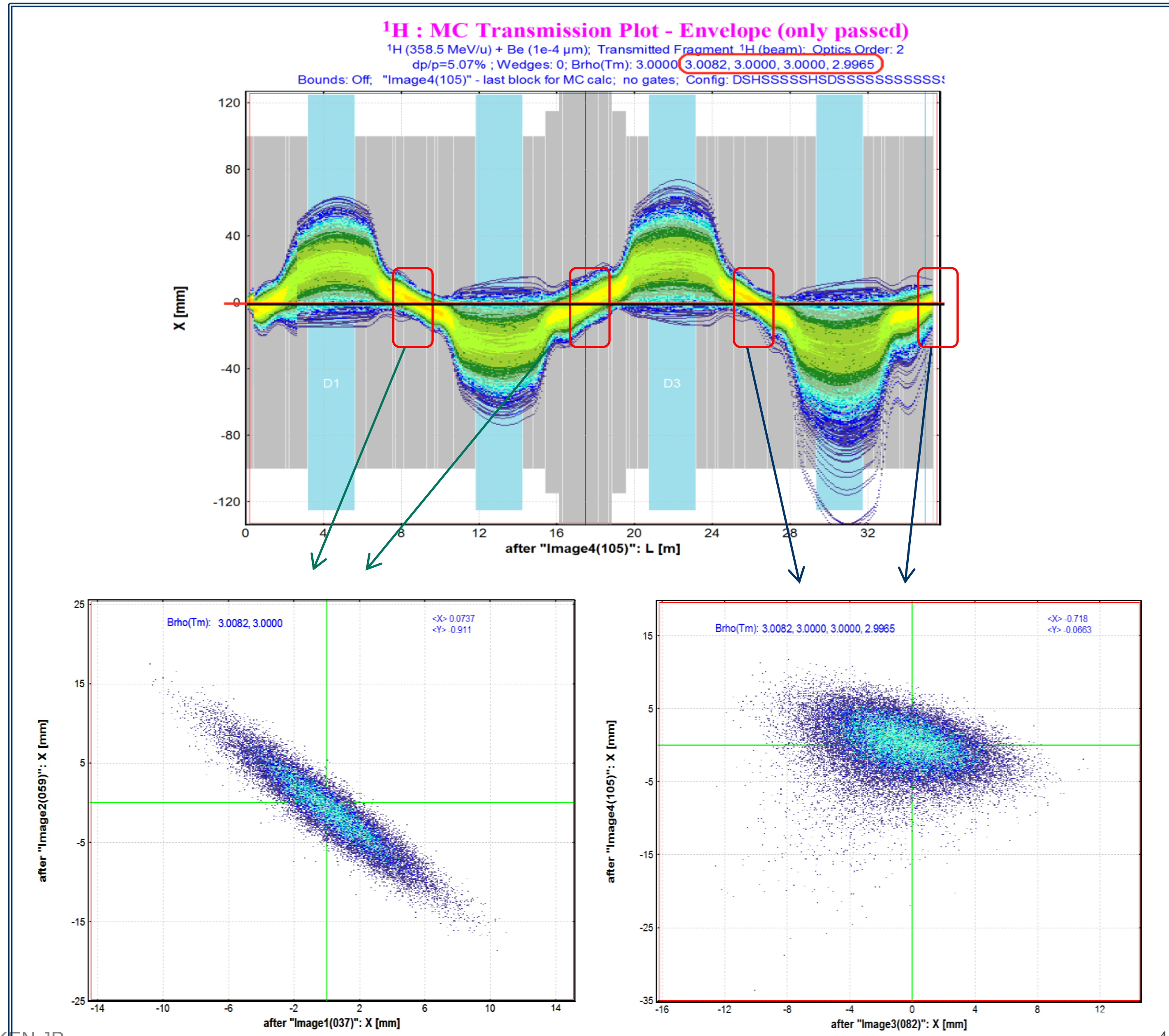
LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/misalignemnt_A1900_extended_COSY.lpp

Example:
1st triplet 5 mm

Playing with Dipoles to be for Images at the central axis



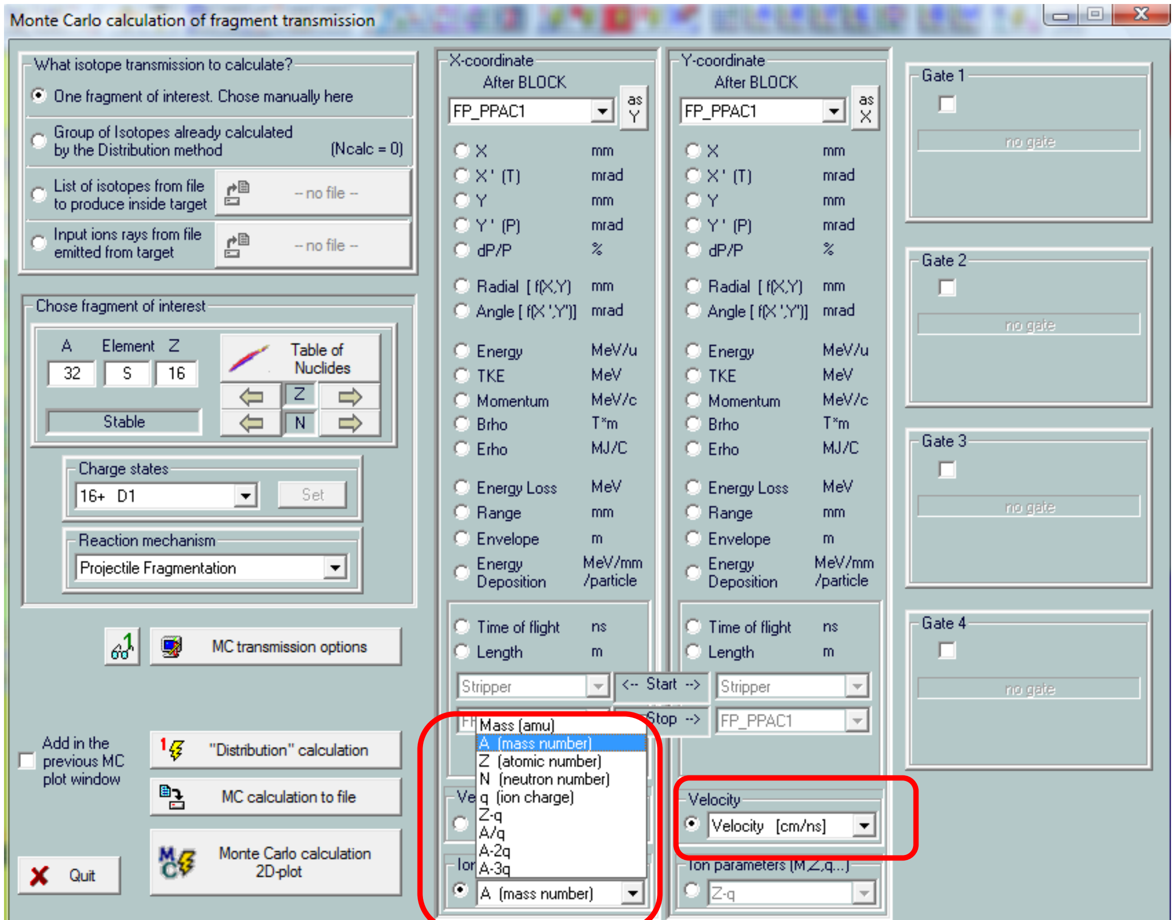
	Brho, Tm		
	Initial	Set	Set/Init
Beam	3	3	-
Dipole 1	3	3.0082	0.27%
Dipole 2	3	3	-
Dipole 3	3	3	-
Dipole 4	3	2.9965	-0.12%



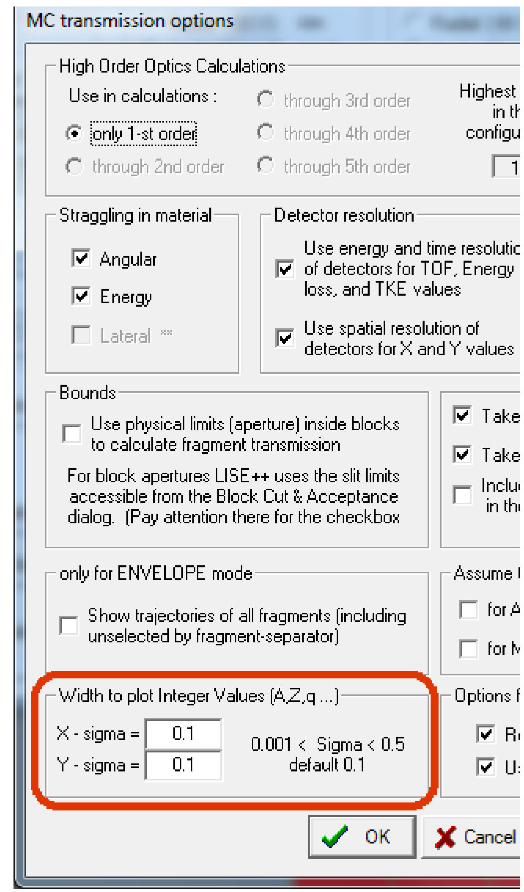
Monte Carlo calculation of Transmission

New A, Z, q, A/q, v** , … fields and filters in MC (1)

MC dialog

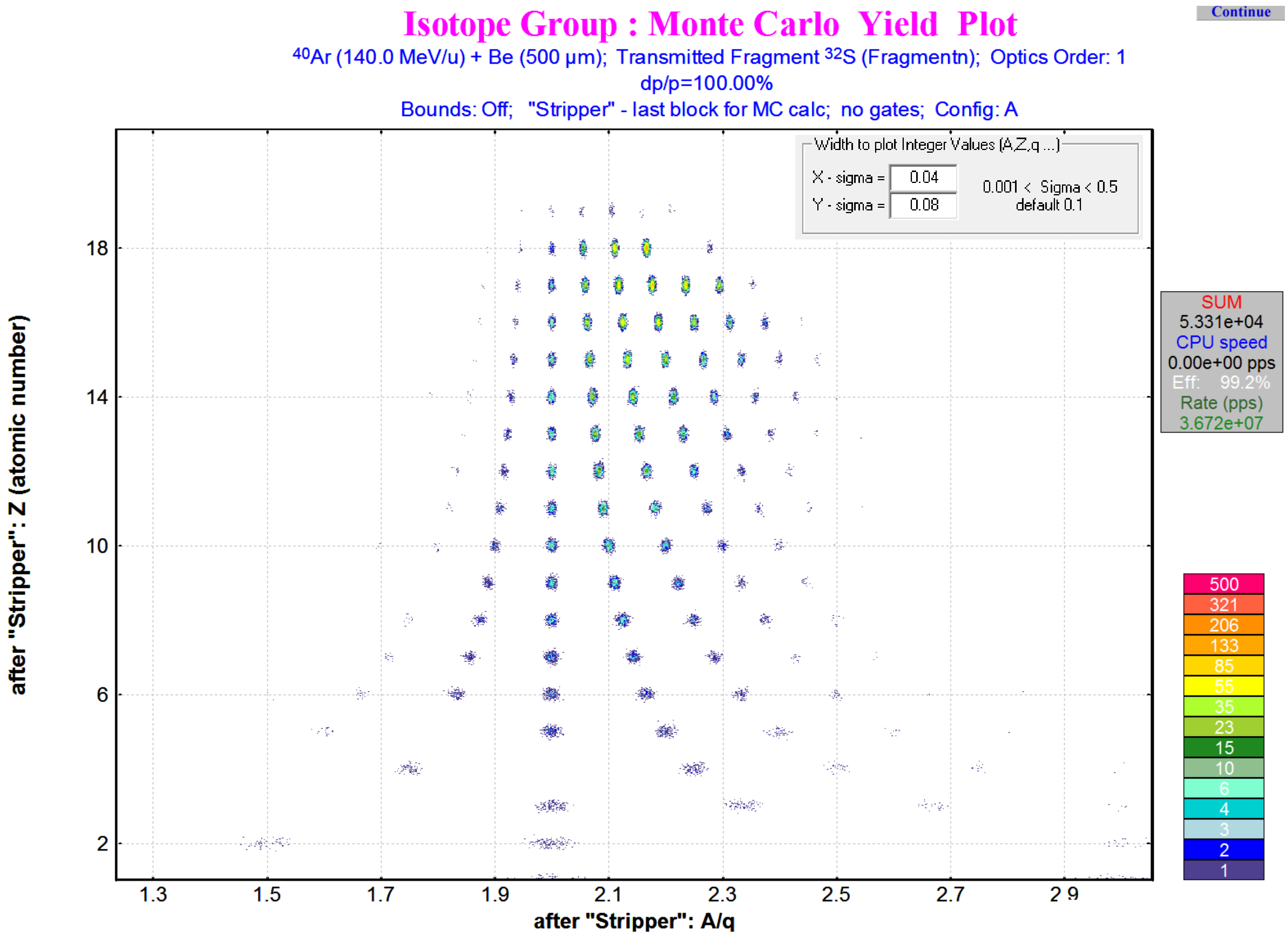


MC option dialog



New A, Z, q, A/q, … fields and filters in MC (2)

Example: After target without beam



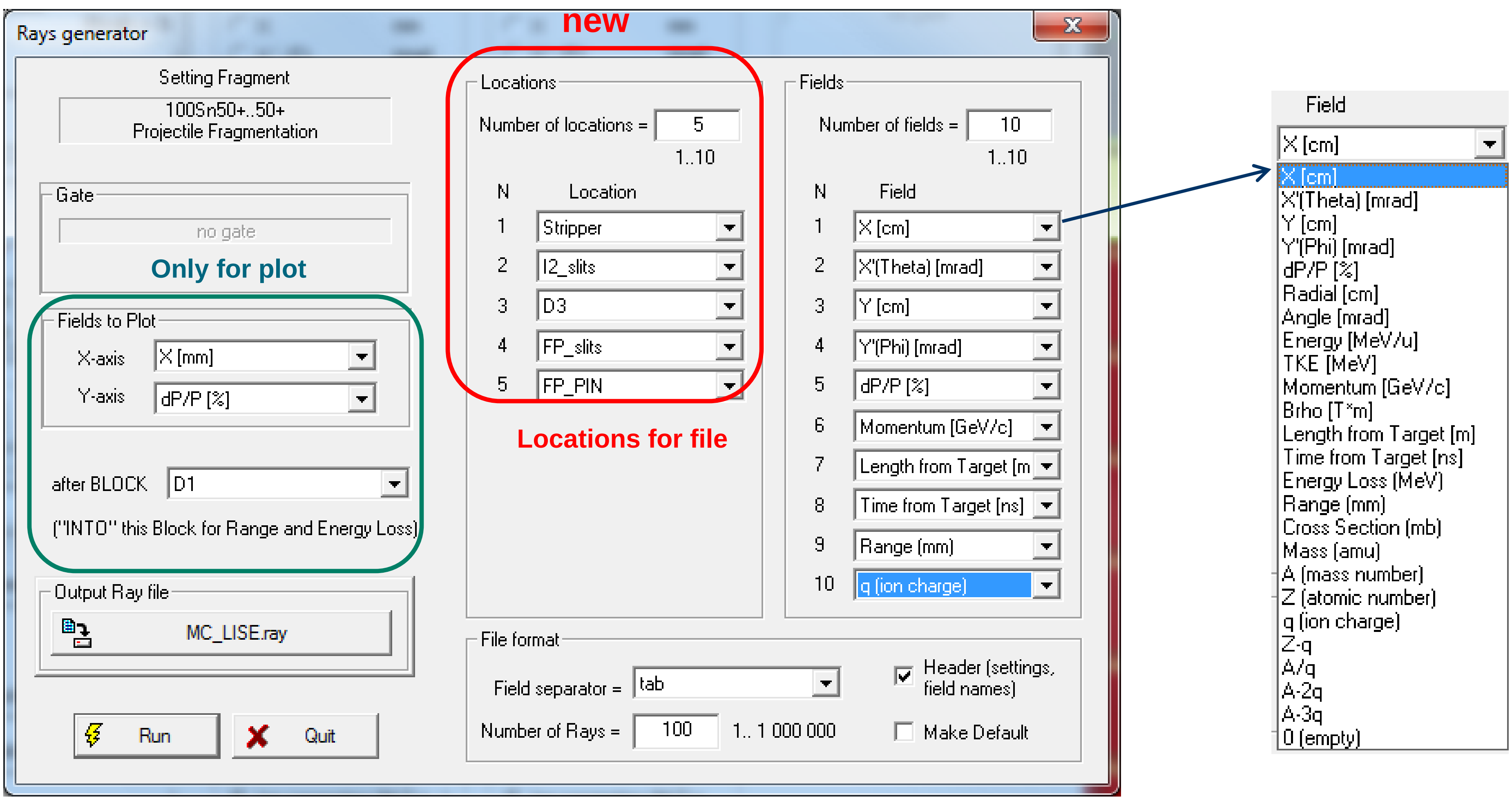
Several locations for output MC file (1)

MH's request

1 ≤ Number of locations ≤ 10
1 ≤ Number of fields ≤ 10

In previous version:
Number of locations =1

"last" block" (most downstream) is defined from gate locations, location for file, location for plot



Several locations for output MC file (2)

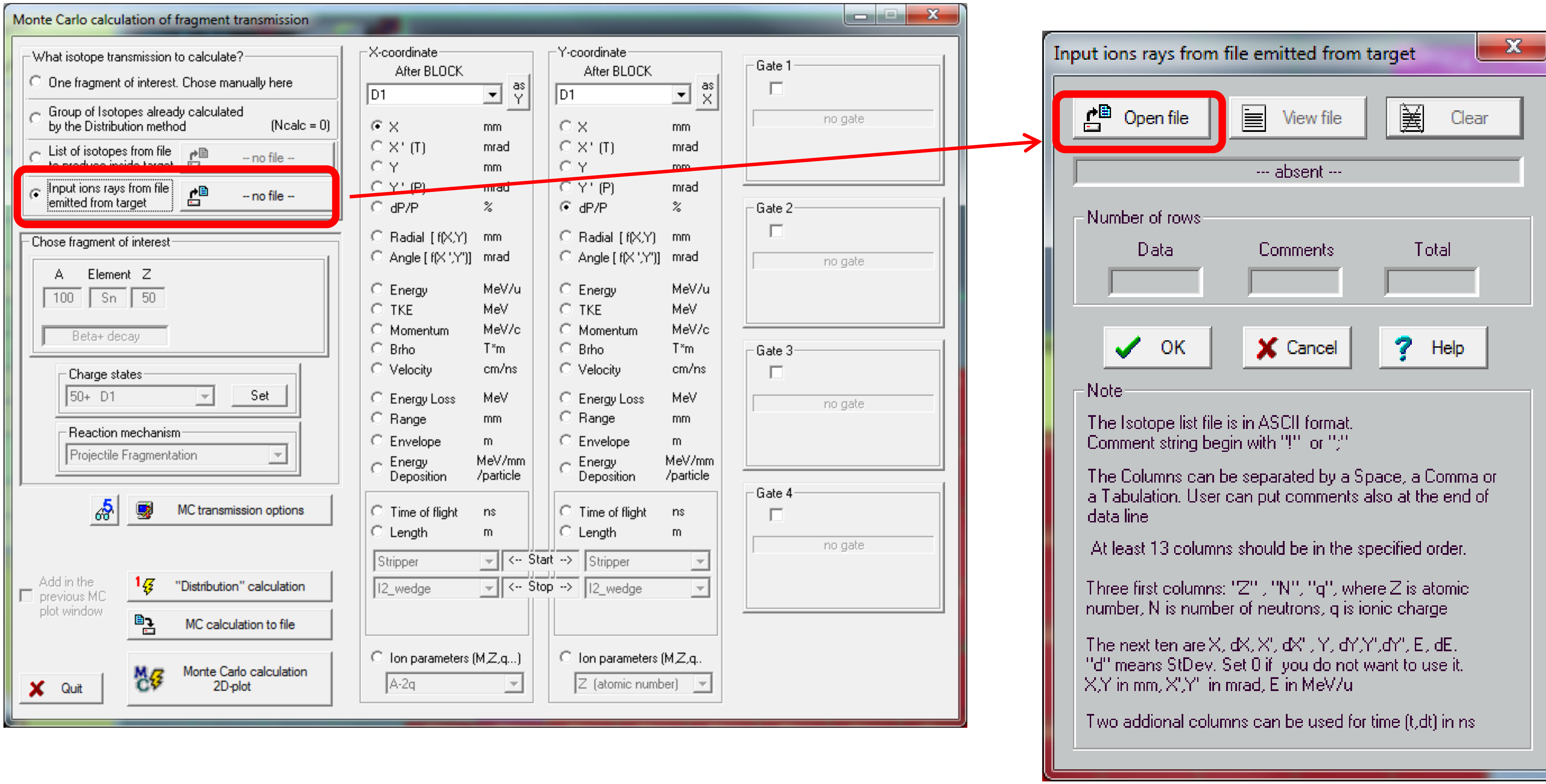
Column name: "Location position (0,1,2..) – Field Name"

! Last block "FP_PIN", setting fragment: 100Sn50+..50+ (Projectile Fragmentation); N_Locations=5; N_fields=10; N_Rays=100
! location #01 : Stripper
! location #02 : I2_slits
! location #03 : D3
! location #04 : FP_slits
! location #05 : FP_PIN

! N	01-X [cm]	01-X'(Theta) [mrad]	01-Y [cm]	01-Y'(Phi) [mrad]	01-dP/P [%]	01-Momentum [GeV/c]	01-q (ion charge)	02-X [cm]	02-X'(Theta) [mrad]	02-Y [cm]	02-Y'(Phi) [mrad]	02-dP/P [%]	02-Momentum [GeV/c]	02-Length from Target [m]	02-Time from Target [ns]	02-Range (mm)	02-q (ion charge)	03-X [cm]	03-X'(Theta) [mrad]
1	-0.1129	7.1959	-0.08535	15.994	0.55118	60.997	50	-3.4593	4.9788	-0.0412	15.21	0.55118	60.997	17.521	106.64	0	50	1.7004	-5.371
2	-0.1034	-11.708	-0.18591	-13.868	-0.4247	60.404	50	2.3029	-2.3776	-0.1548	-27.278	-0.4247	60.404	17.472	107.07	0	50	-1.1027	1.071
3	-0.0763	10.787	1.58E-05	2.1415	0.14412	60.75	50	-1.0236	5.5121	0.01037	3.0404	0.14412	60.75	17.521	106.94	0	50	0.51187	-5.770
4	-0.2455	16.445	-0.07911	16.538	0.01029	60.668	50	-0.5326	11.026	0.04611	20.454	0.01029	60.668	17.553	107.24	0	50	0.12823	-12.49
5	0.03839	-8.1885	0.11778	6.0167	0.36481	60.883	50	-2.0458	-3.5871	0.08634	13.784	0.36481	60.883	17.468	106.46	0	50	0.90589	3.372
6	-0.1524	4.346	-0.13551	0.96609	-0.6603	60.262	50	3.5747	3.2643	-0.1306	-7.3991	-0.6603	60.262	17.504	107.45	0	50	-1.6265	-3.407
7	-0.0803	16.51	-0.21527	5.5061	0.67223	61.07	50	-4.1487	7.9158	-0.1736	-7.1395	0.67223	61.07	17.539	106.66	0	50	1.9576	-8.359
8	0.10658	30.736	0.024456	-4.2877	-0.0938	60.605	50	0.79488	12.473	-0.0018	-4.8769	-0.0938	60.605	17.561	107.36	0	50	-0.8	-13.22
9	-0.0447	-16.965	0.08971	-4.7103	-0.3342	60.459	50	1.8671	-6.5517	0.07398	-0.1478	-0.3342	60.459	17.447	106.85	0	50	-0.9158	6.707
10	0.03292	-2.2843	0.19896	-20.981	-0.5731	60.314	50	3.557	-0.4255	0.16668	-13.721	-0.5731	60.314	17.484	107.25	0	50	-1.8213	0.4869
11	-0.0066	1.9967	-0.1925	6.2534	0.49975	60.965	50	-2.9596	0.78228	-0.1613	-4.9283	0.49975	60.965	17.495	106.52	0	50	1.4361	-0.8354
12	-0.0745	16.087	0.010426	2.5637	-0.8187	60.165	50	4.7286	7.3007	0.03743	4.8563	-0.8187	60.165	17.528	107.72	0	50	-2.3646	-7.379
13	0.01758	11.048	0.11291	2.412	-0.5771	60.312	50	3.4812	4.4142	0.1192	10.614	-0.5771	60.312	17.511	107.43	0	50	-1.7954	-4.7
14	-0.0596	-2.5842	-0.01268	-9.1291	-0.092	60.606	50	0.4208	-0.0777	-0.0308	-12.41	-0.092	60.606	17.486	106.91	0	50	-0.1648	-0.1801
15	-0.0878	-3.9601	-0.00054	-10.435	-0.1519	60.57	50	0.71231	-0.2775	-0.0265	-13.431	-0.1519	60.57	17.485	106.94	0	50	-0.2788	-0.0082
16	0.03588	-7.0353	-0.13446	-4.0601	-0.1641	60.563	50	1.0604	-3.0864	-0.1162	-12.988	-0.1641	60.563	17.468	106.85	0	50	-0.5912	2.820
17	0.07869	8.0604	-0.10436	3.5092	-0.0457	60.634	50	0.45453	2.6144	-0.0839	-2.0557	-0.0457	60.634	17.502	106.97	0	50	-0.3286	-2.732

Input ions rays from file emitted from target in MC mode (1)

DJM's request



Input ions rays from file emitted from target in MC mode (3)

Data line structure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	! 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	! Z	N	q	X	d(X)	X'	d(X')	Y	d(Y)	Y'	d(Y')	E	d(E)	t	d(t)
3	!			mm	mm	mrad	mrad	mm	mm	mrad	mrad	MeV/u	MeV/u	ns	ns
4	18	20	18	-0.549	1	-0.409	4	-1.521	0.8	-4.046	5	95.20	1	-0.891	2
5	18	23	18	-0.509	1	6.557	4	0.120	0.8	7.029	5	102.66	1	-0.463	2
6	16	19	16	-1.603	1	-1.041	4	-1.435	0.8	8.051	5	97.17	1	0.869	2
7	15	19	15	-2.177	1	4.244	4	1.317	0.8	-0.575	5	104.09	1	0.683	2
8	15	19	15	0.209	1	-2.225	4	1.561	0.8	1.710	5	98.53	1	0.004	2
9	14	15	14	2.412	1	-4.756	4	-1.051	0.8	0.530	5	102.42	1	-0.095	2
10	14	17	14	2.288	1	0.295	4	0.992	0.8	4.415	5	95.77	1	-0.173	2
11	14	15	14	1.495	1	1.112	4	0.580	0.8	-0.943	5	102.13	1	0.455	2
12	17	20	17	1.533	1	4.954	4	0.863	0.8	6.794	5	98.28	1	-0.404	2
13	16	17	16	2.462	1	-5.620	4	1.109	0.8	-1.494	5	104.95	1	0.424	2
14	13	15	13	1.185	1	-4.911	4	1.873	0.8	-1.027	5	99.03	1	-0.504	2
15	18	22	18	1.373	1	7.311	4	0.105	0.8	-9.834	5	98.95	1	0.191	2
16	16	19	16	0.710	1	5.501	4	-0.534	0.8	-6.920	5	98.37	1	-0.057	2
17	15	19	15	1.785	1	5.563	4	1.699	0.8	8.535	5	104.78	1	-0.263	2
18	18	20	18	0.117	1	-2.653	4	0.445	0.8	9.797	5	98.79	1	0.593	2
19	17	19	17	0.203	1	1.481	4	0.955	0.8	-9.887	5	95.41	1	-0.557	2
20	17	18	17	-1.885	1	-7.375	4	-0.024	0.8	-7.897	5	99.34	1	0.995	2
21	15	16	15	-0.357	1	-0.539	4	0.392	0.8	-6.350	5	98.54	1	0.800	2
22	18	22	18	-1.197	1	7.231	4	-1.778	0.8	-2.706	5	99.27	1	-0.911	2
23	16	20	16	-2.477	1	1.283	4	-0.446	0.8	-5.652	5	96.69	1	-0.120	2
24	16	19	16	0.857	1	5.091	4	0.604	0.8	5.536	5	104.44	1	-0.002	2
25	15	17	15	0.849	1	2.037	4	-1.268	0.8	-8.649	5	98.56	1	0.614	2
26	17	22	17	2.320	1	2.574	4	1.015	0.8	-2.753	5	95.23	1	0.680	2
27	14	15	14	0.974	1	-6.327	4	-1.404	0.8	9.402	5	99.26	1	-0.119	2
28	18	20	18	-0.816	1	4.964	4	-0.116	0.8	5.200	5	97.26	1	0.200	2
29	16	17	16	-0.543	1	-6.363	4	1.384	0.8	-0.102	5	101.26	1	0.429	2
30	14	15	14	-1.535	1	-1.722	4	0.291	0.8	-0.900	5	97.06	1	0.120	2
31	15	19	15	-2.164	1	4.317	4	1.030	0.8	5.206	5	102.23	1	-0.493	2
32	16	19	16	0.135	1	5.462	4	1.926	0.8	9.343	5	100.70	1	-0.119	2
33	18	22	18	-1.250	1	6.402	4	1.069	0.8	-3.461	5	98.95	1	0.736	2
34	14	18	14	-1.402	1	2.364	4	1.405	0.8	-7.775	5	97.24	1	0.716	2
35	16	17	16	-0.948	1	-7.159	4	0.966	0.8	1.677	5	97.07	1	-0.595	2
36	15	17	15	-1.916	1	-1.048	4	-1.879	0.8	1.071	5	103.65	1	-0.446	2

The Isotope list file is in ASCII format.
Comment string begin with "!" or ";"

The Columns can be separated by a Space, a Comma or a Tabulation. User can put comments also at the end of data line

At least 13 columns should be in the specified order.

Three first columns: "Z", "N", "q", where Z is atomic number, N is number of neutrons, q is ionic charge

The next ten are X, dX, X', dX', Y, dY,Y',dY', E, dE.
"d" means StDev. Set 0 if you do not want to use it.
X,Y in mm, X',Y' in mrad, E in MeV/u

Two addional columns can be used for time (t,dt) in ns

Example of Input ion rays file is located in LISE++ package:

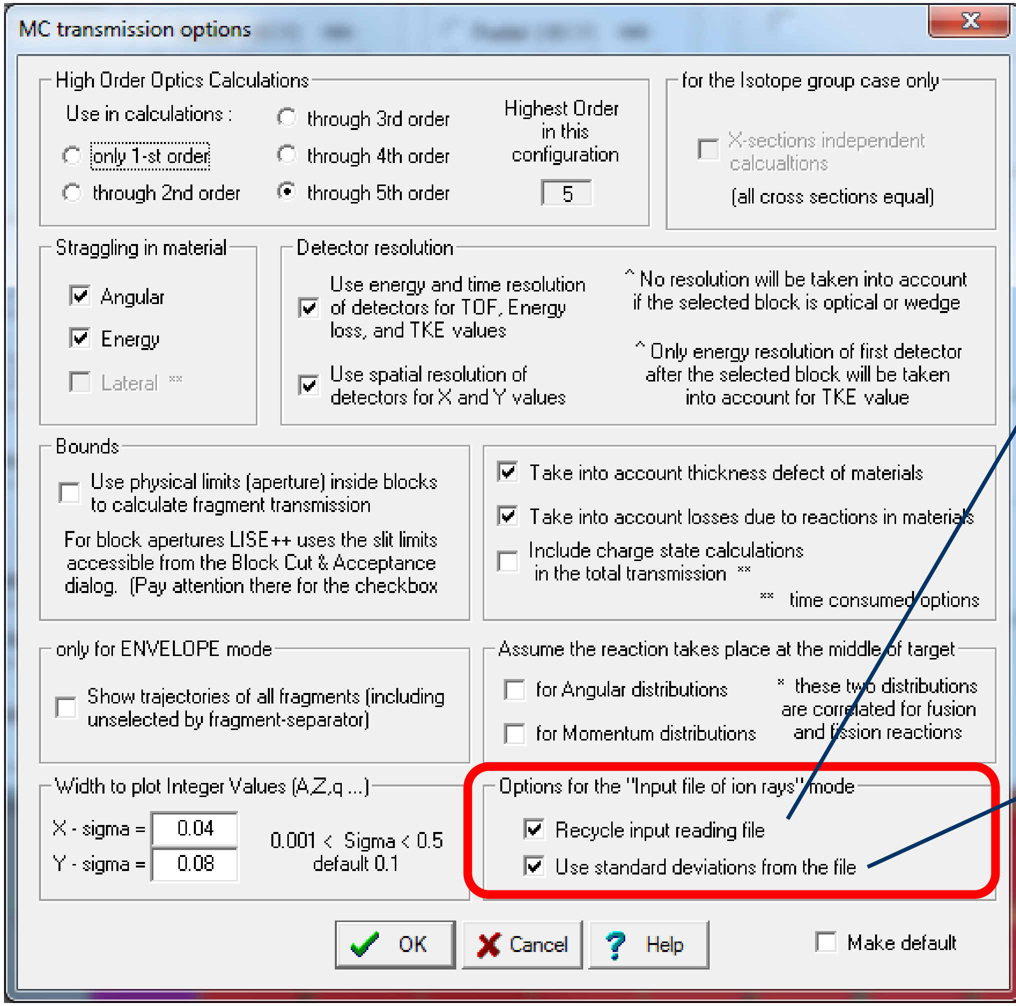
\Files\examples\ Input MC rays.inrays

This Excel example with random generator values is located at

http://lise.nscl.msu.edu/9_6/Input MC rays.xlsx

Input ions rays from file emitted from target in MC mode (4)

Options:

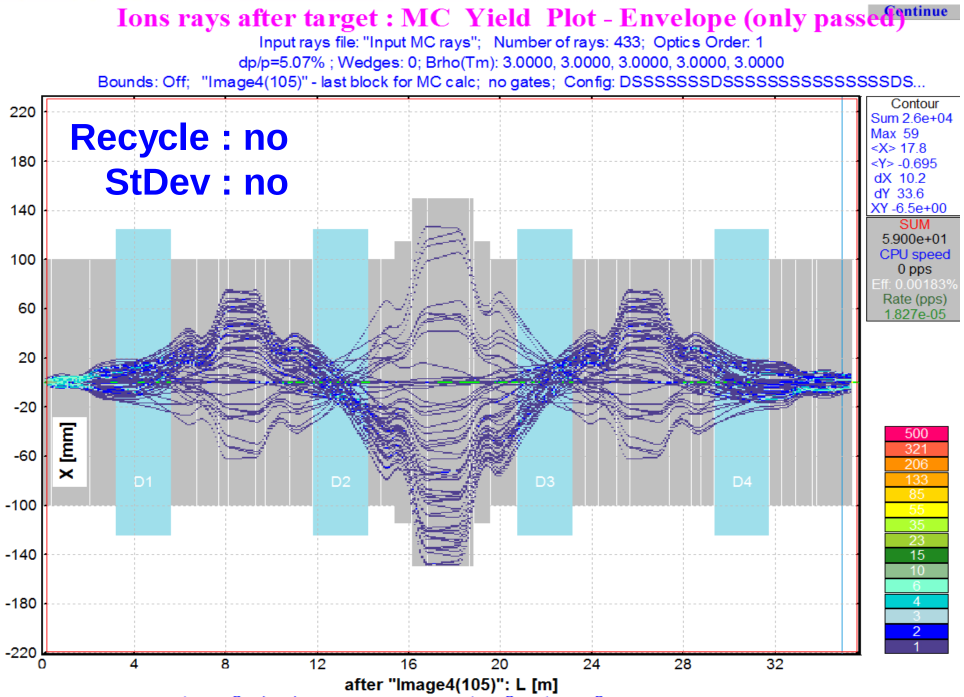


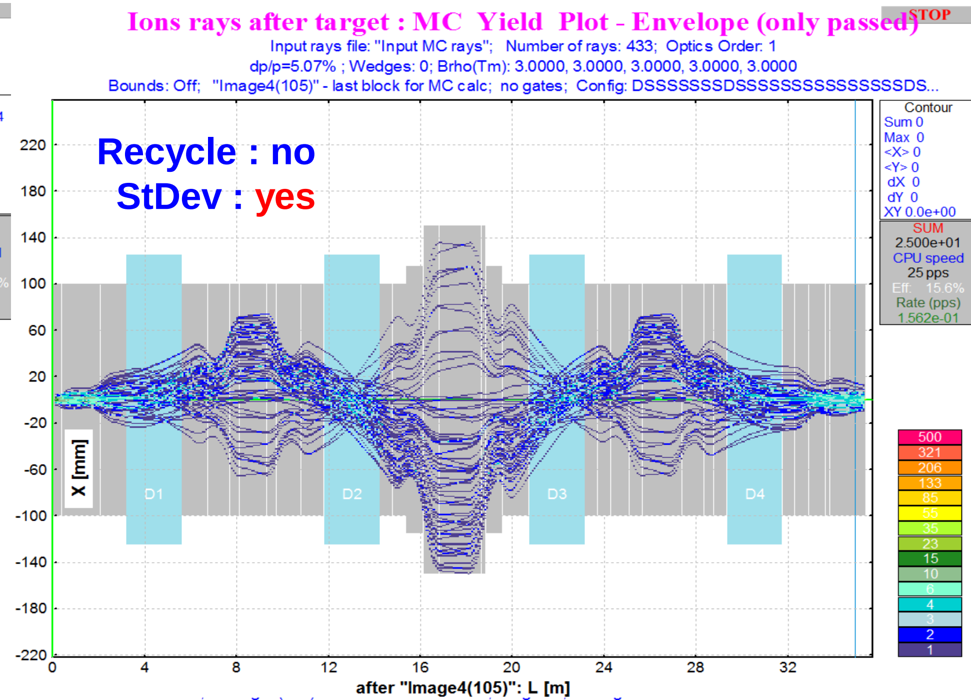
If this option is set, then after MC reaches the end of file, MC starts to read file from beginning

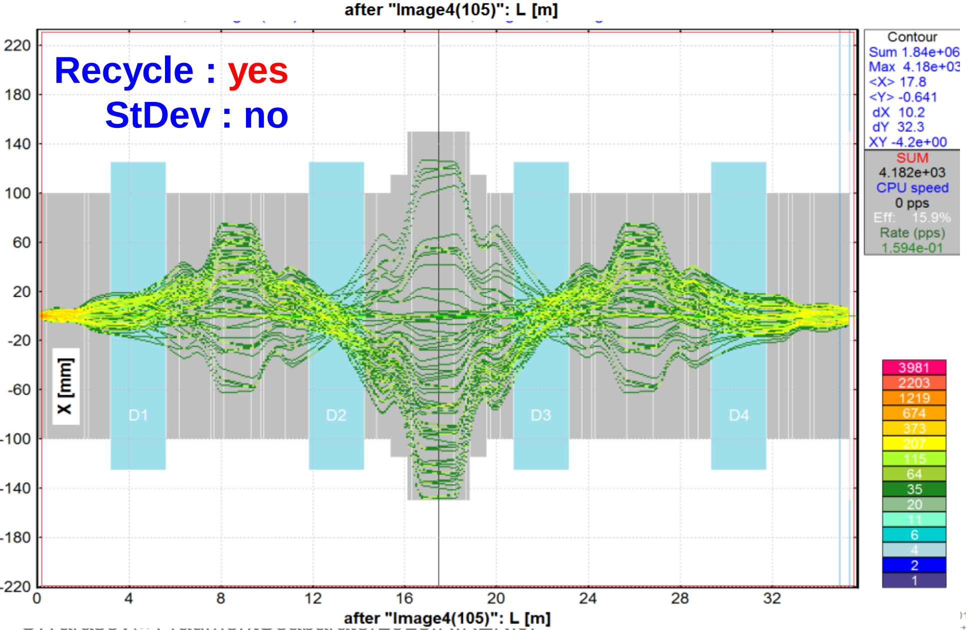
If this option is set, MC uses St.Dev. values from file to randomize output values.

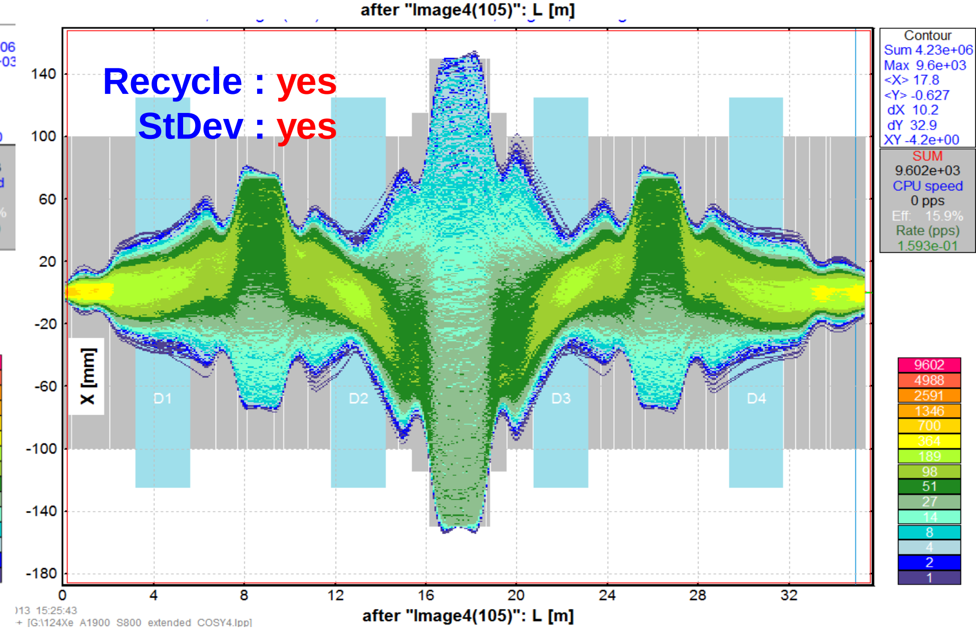
If this option is not set, then it is equivalent to all of St.Dev values are zero

Input ions rays from file emitted from target in MC mode (5)

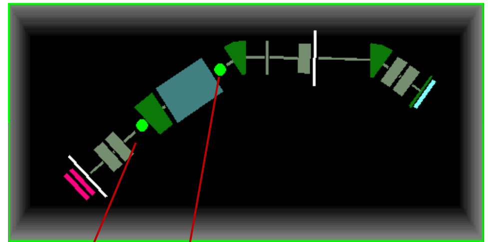




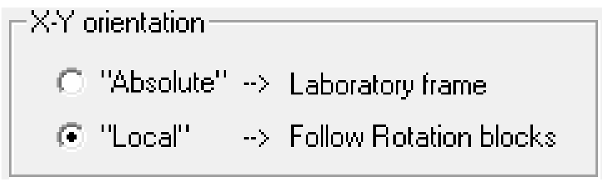


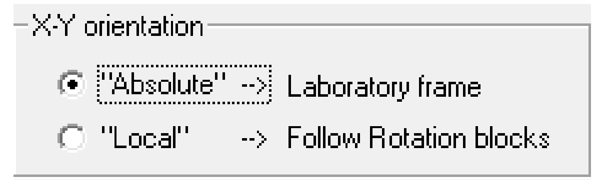


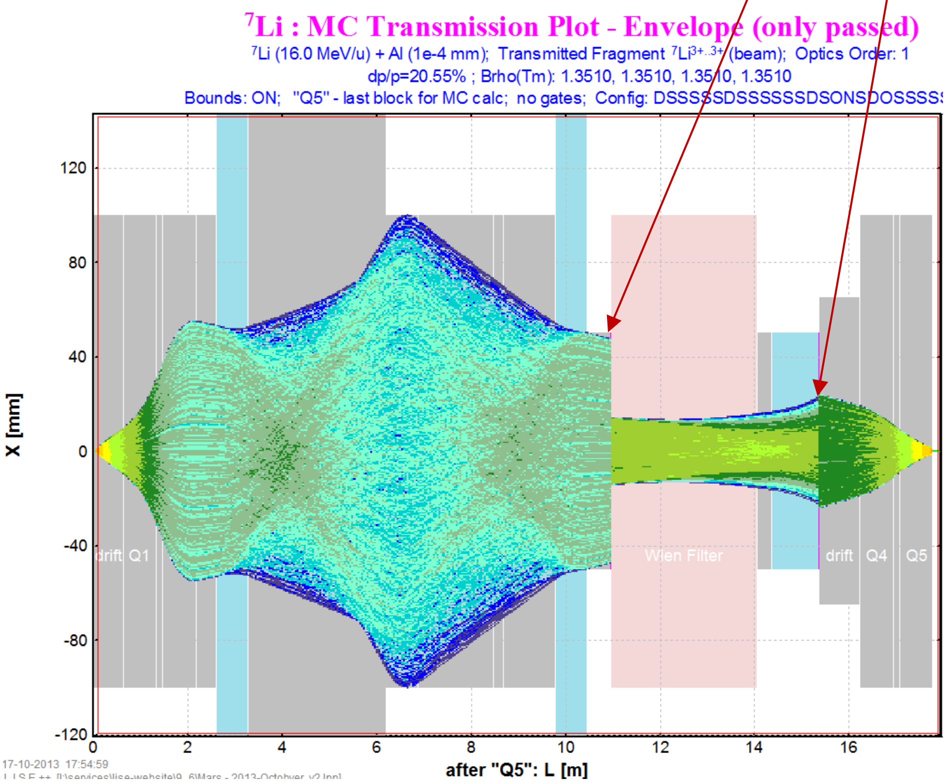
Plotting configurations with Rotation blocks

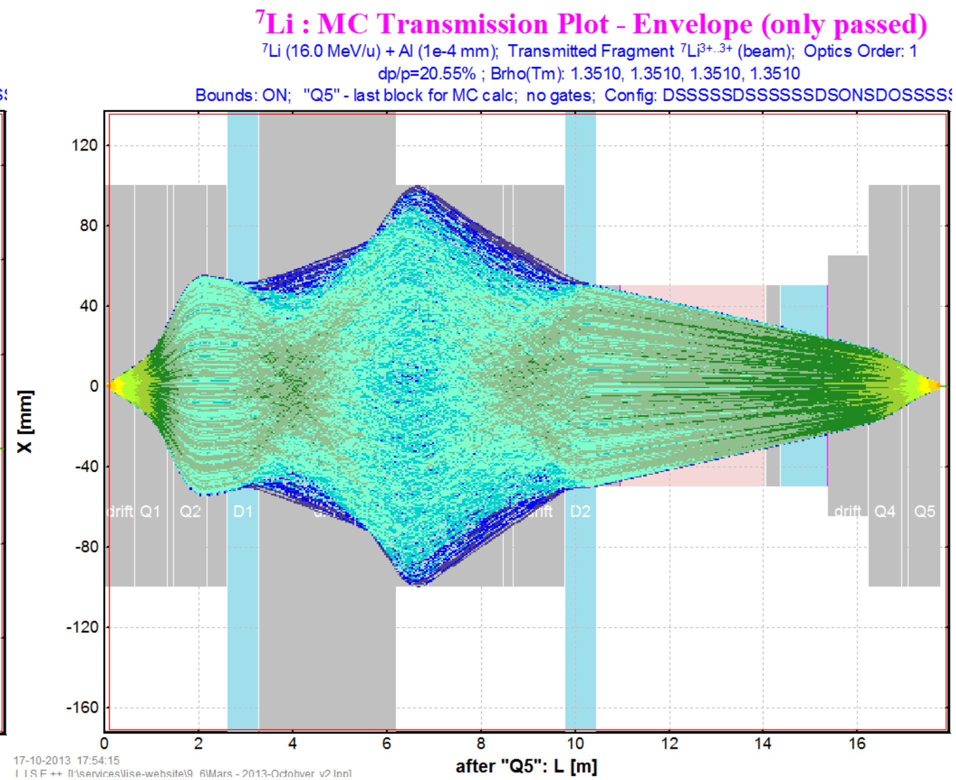


Previous versions and

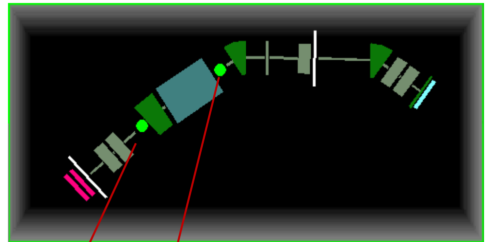




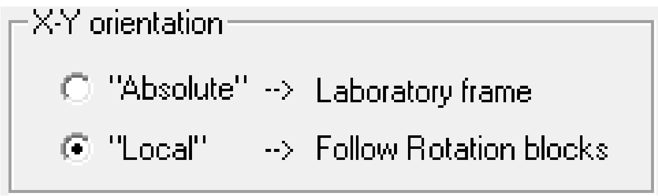


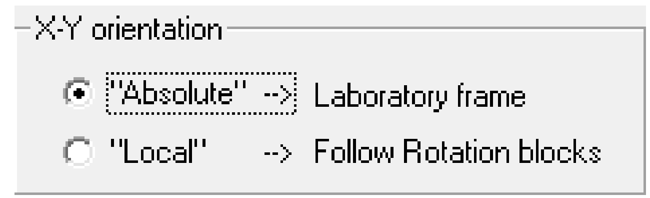


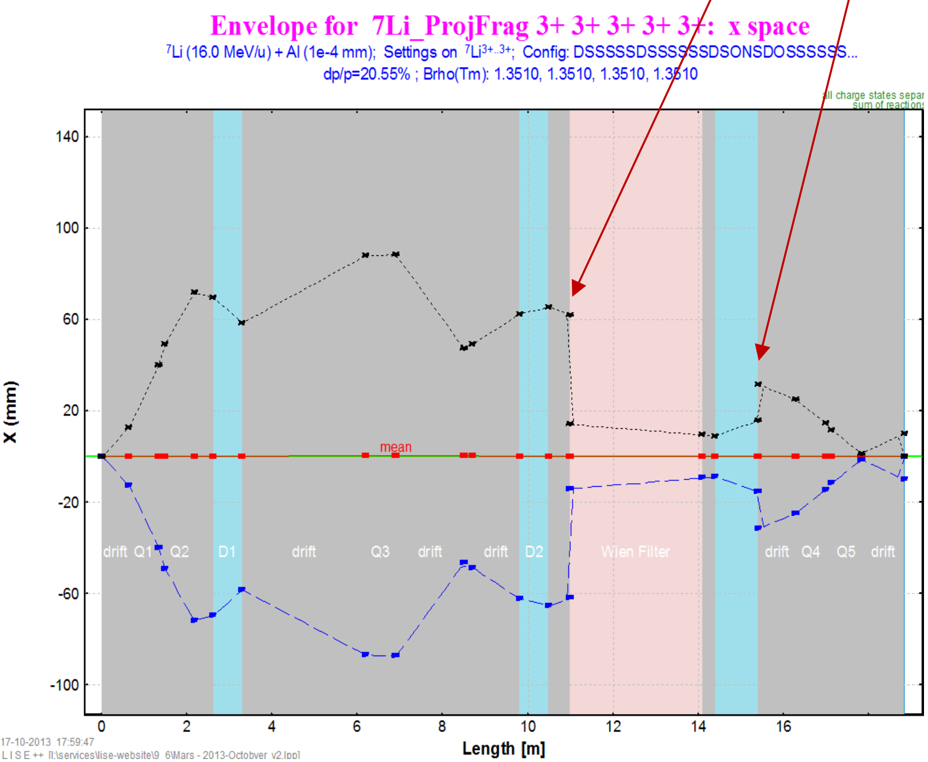
Plotting Envelopes with rotation blocks : Distribution method

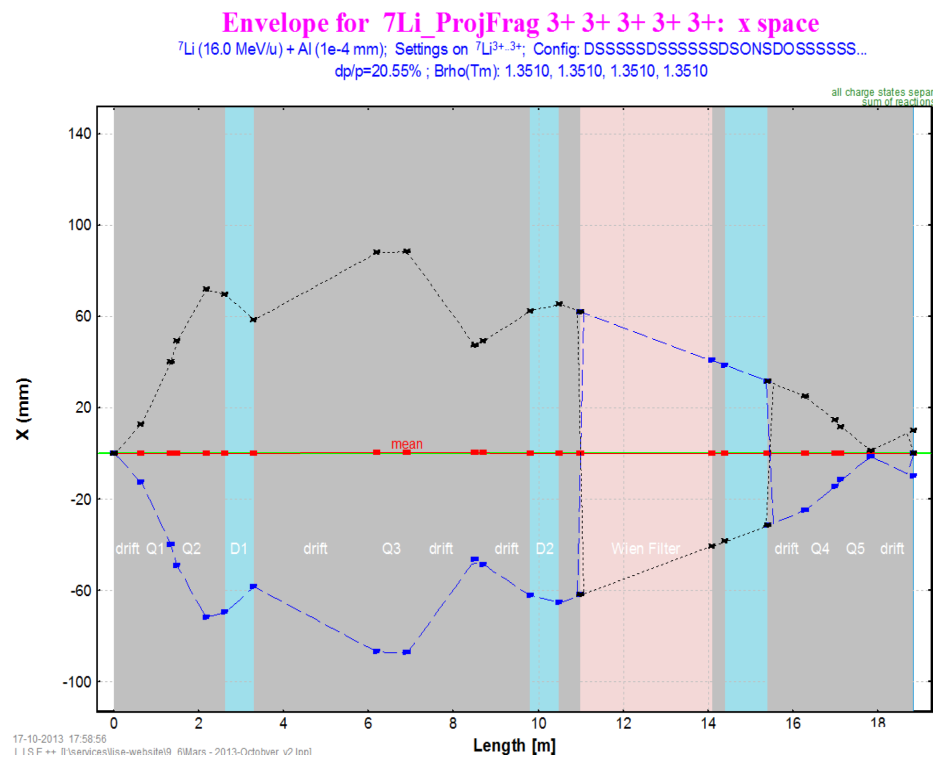


Previous versions and





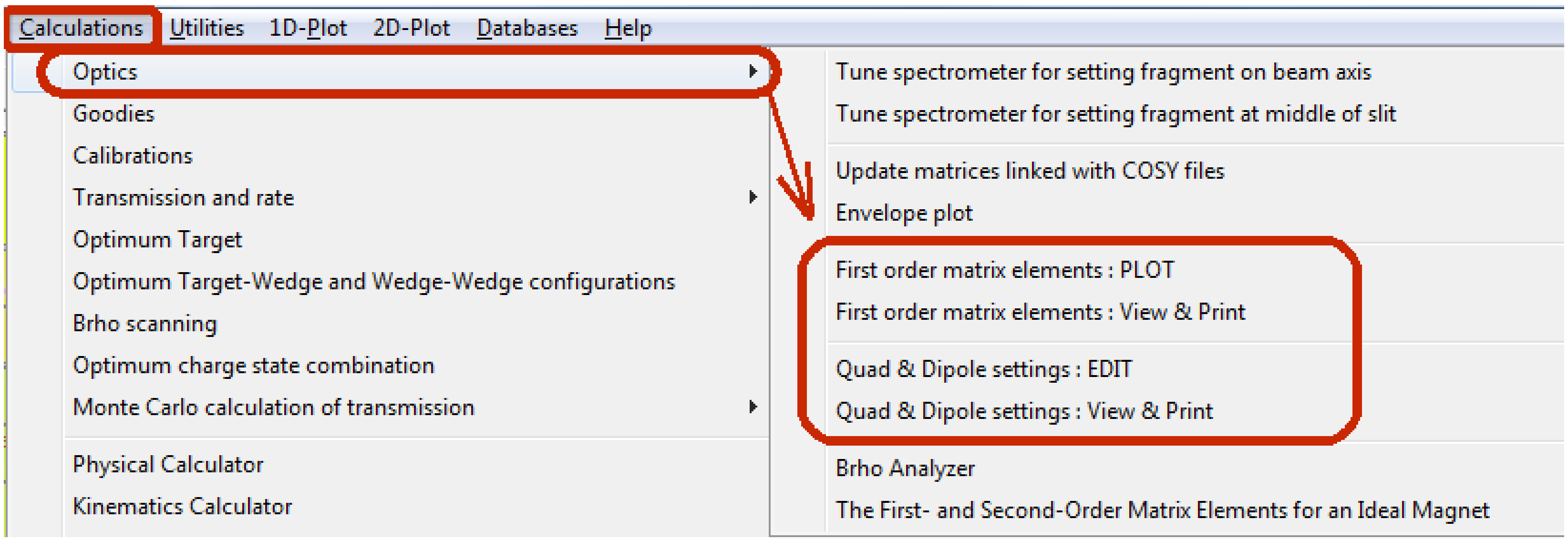




Optics: utilities

Utilities to develop and modify extended configurations

version 9.2.95

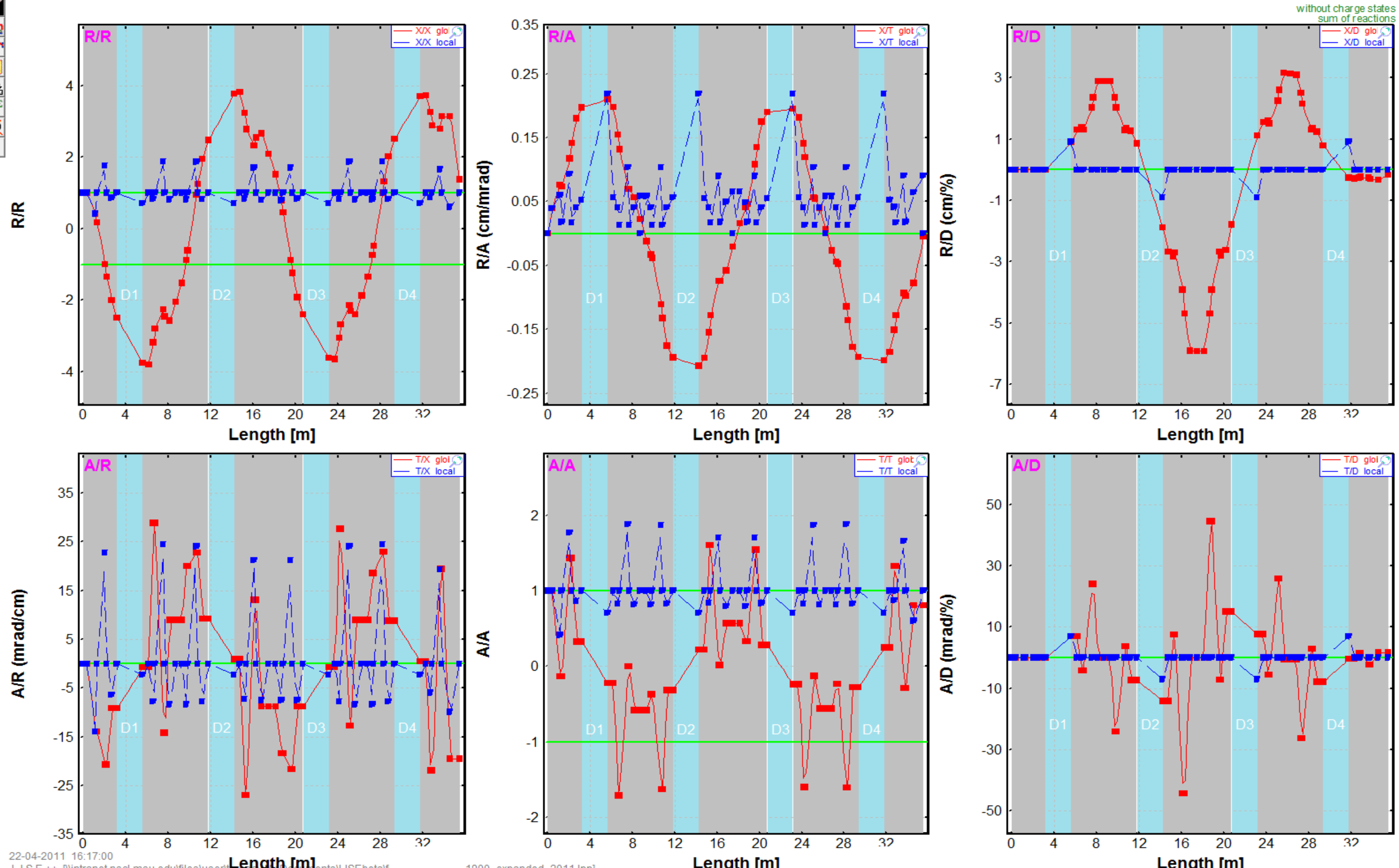


Envelope of First order matrix elements

First order matrix elements

First order matrix elements

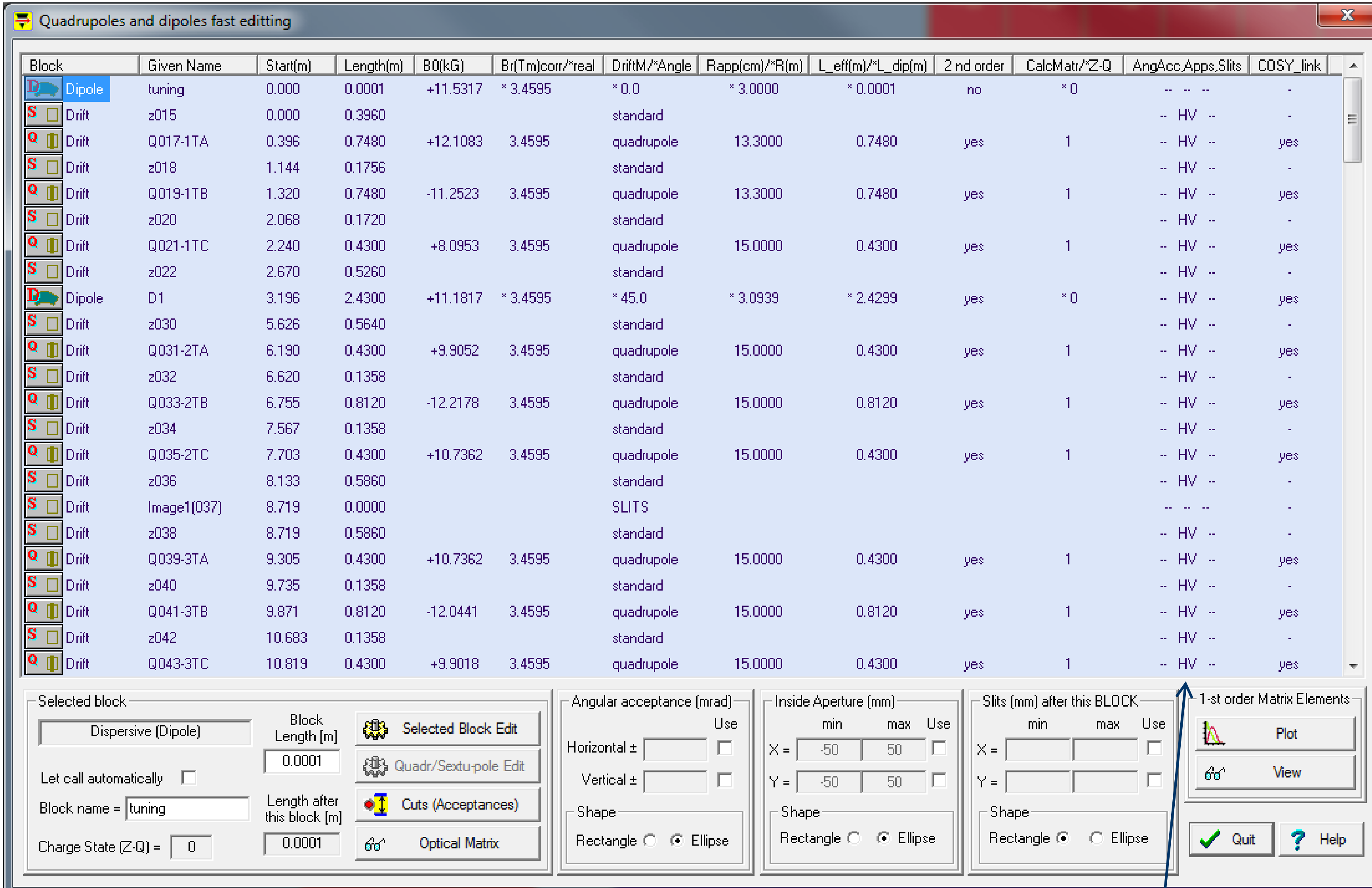
^{40}Ar (84.3 MeV/u) + Be (1e-4 μm); Settings on ^{40}Ar; Config: SSSSSSSDSSSSSSSSSSSSSSSSDSS...
dp/p=5.07% ; Brho(Tm): 3.0000, 3.0000, 3.0000, 3.0000



Quads & Dipoles settings : EDIT

It's easy access to edit all kind of slits

Example of extended configuration



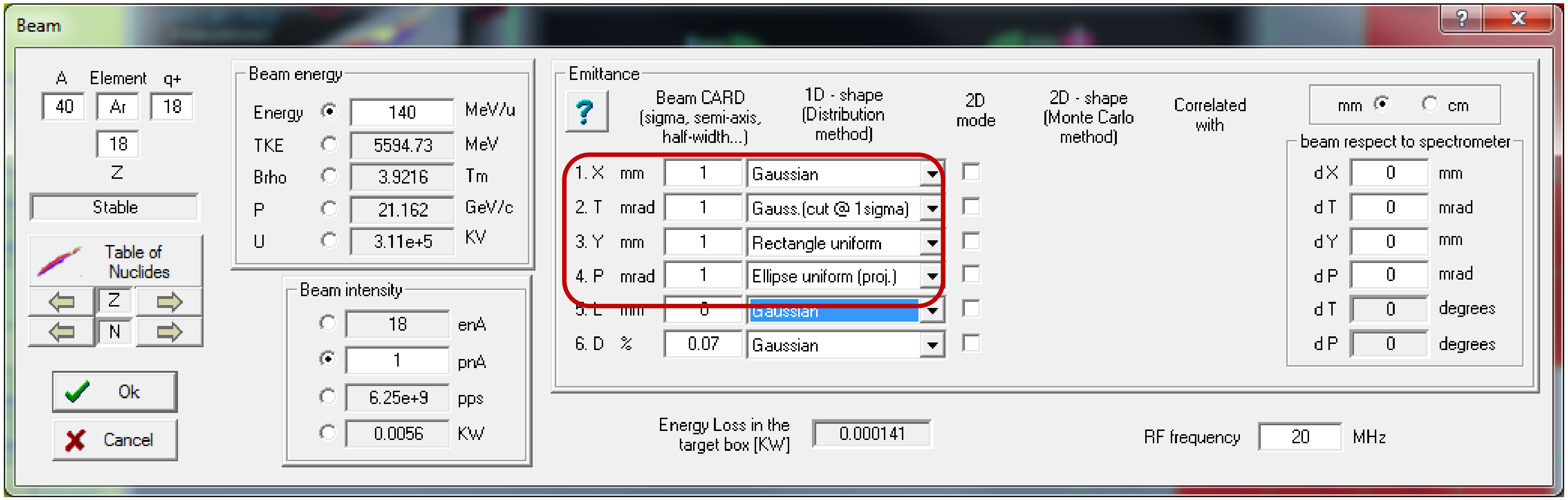
Block	Given Name	Start(m)	Length(m)	B0(kG)	Br(Tm)corr/*real	DriftM/*Angle	Rapp(cm)/*R(m)	L_eff(m)/*L_dip(m)	2 nd order	CalcMatr/*Z-Q	AngAcc,Apps,Slits	COSY_link
Dipole	tuning	0.000	0.0001	+11.5317	* 3.4595	* 0.0	* 3.0000	* 0.0001	no	* 0	-- -- --	-
Drift	z015	0.000	0.3960			standard					-- HV --	-
Drift	Q017-1TA	0.396	0.7480	+12.1083	3.4595	quadrupole	13.3000	0.7480	yes	1	-- HV --	yes
Drift	z018	1.144	0.1756			standard					-- HV --	-
Drift	Q019-1TB	1.320	0.7480	-11.2523	3.4595	quadrupole	13.3000	0.7480	yes	1	-- HV --	yes
Drift	z020	2.068	0.1720			standard					-- HV --	-
Drift	Q021-1TC	2.240	0.4300	+8.0953	3.4595	quadrupole	15.0000	0.4300	yes	1	-- HV --	yes
Drift	z022	2.670	0.5260			standard					-- HV --	-
Dipole	D1	3.196	2.4300	+11.1817	* 3.4595	* 45.0	* 3.0939	* 2.4299	yes	* 0	-- HV --	yes
Drift	z030	5.626	0.5640			standard					-- HV --	-
Drift	Q031-2TA	6.190	0.4300	+9.9052	3.4595	quadrupole	15.0000	0.4300	yes	1	-- HV --	yes
Drift	z032	6.620	0.1358			standard					-- HV --	-
Drift	Q033-2TB	6.755	0.8120	-12.2178	3.4595	quadrupole	15.0000	0.8120	yes	1	-- HV --	yes
Drift	z034	7.567	0.1358			standard					-- HV --	-
Drift	Q035-2TC	7.703	0.4300	+10.7362	3.4595	quadrupole	15.0000	0.4300	yes	1	-- HV --	yes
Drift	z036	8.133	0.5860			standard					-- HV --	-
Drift	Image1(037)	8.719	0.0000			SLITS					-- -- --	-
Drift	z038	8.719	0.5860			standard					-- HV --	-
Drift	Q039-3TA	9.305	0.4300	+10.7362	3.4595	quadrupole	15.0000	0.4300	yes	1	-- HV --	yes
Drift	z040	9.735	0.1358			standard					-- HV --	-
Drift	Q041-3TB	9.871	0.8120	-12.0441	3.4595	quadrupole	15.0000	0.8120	yes	1	-- HV --	yes
Drift	z042	10.683	0.1358			standard					-- HV --	-
Drift	Q043-3TC	10.819	0.4300	+9.9018	3.4595	quadrupole	15.0000	0.4300	yes	1	-- HV --	yes

H – horizontal
V – vertical

Optics:
Beam shapes

Beam Shapes

version 9.2.88

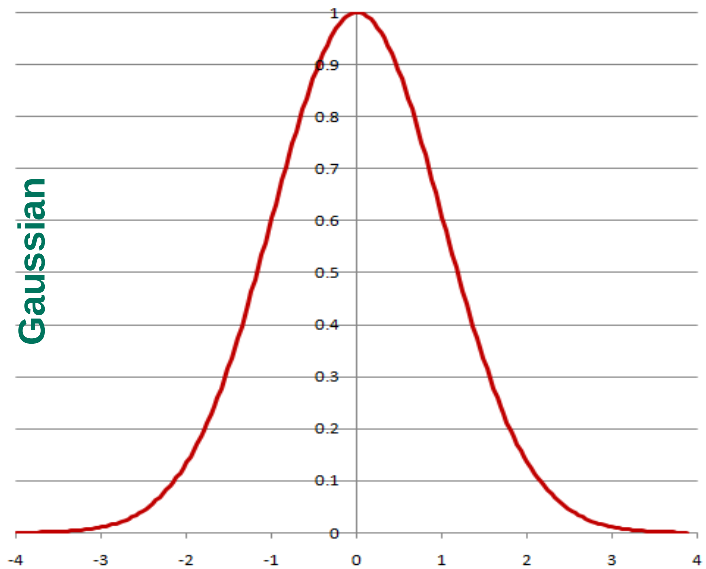


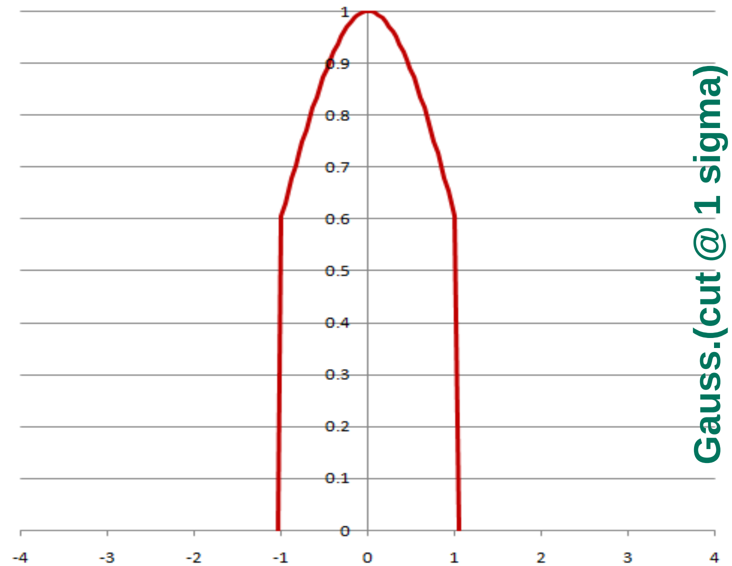
1D-shape

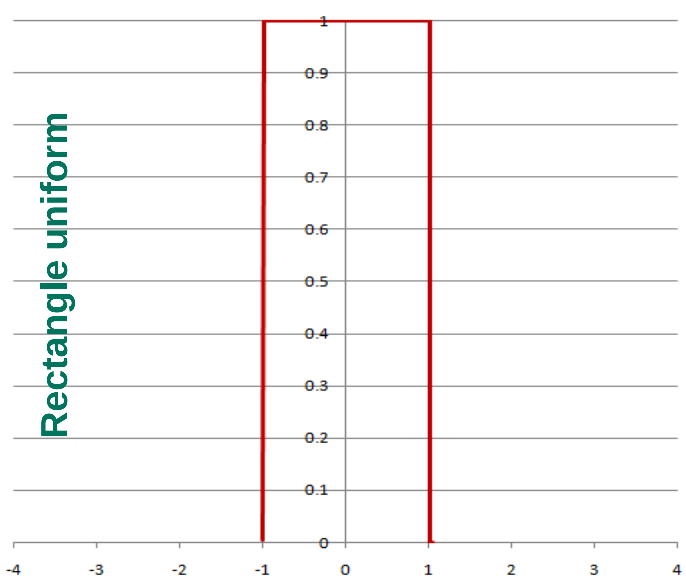
1.	Gaussian	Sigma=1	=>	Area = 2.51	St.Dev = 1
2.	Gauss.(cut @ 1 sigma)	Sigma=1	=>	Area = 1.74	St.Dev = 0.55
3.	Rectangle uniform	Half-width=1	=>	Area = 2.00	St.Dev = 0.58
4.	Ellipse uniform(proj.)	Semi-axis=1	=>	Area = 1.56	St.Dev = 0.51

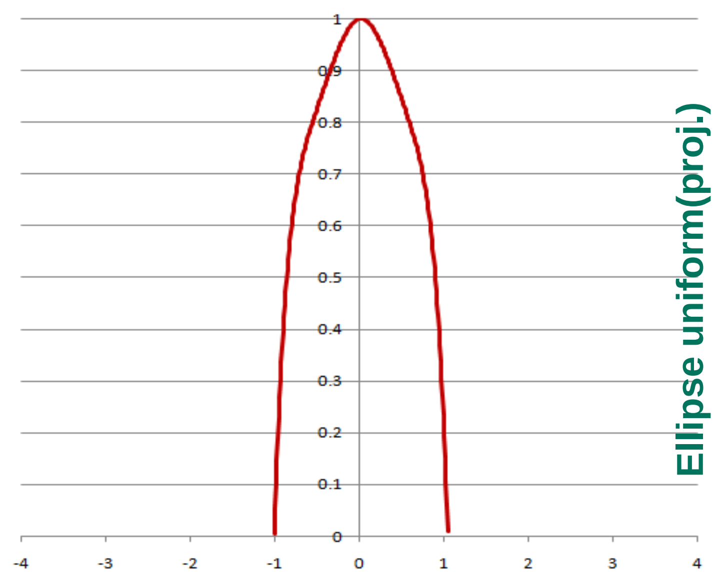
See the next slide

1D - shapes

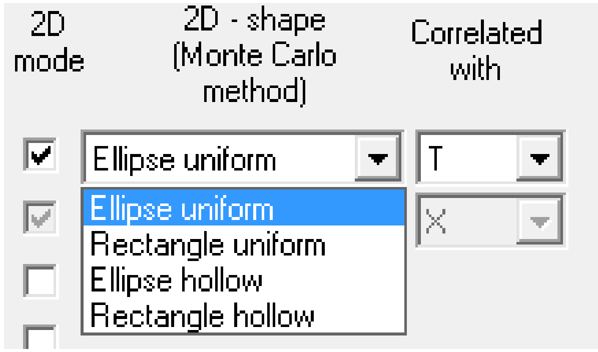

Gaussian


Gauss.(cut @ 1 sigma)


Rectangle uniform

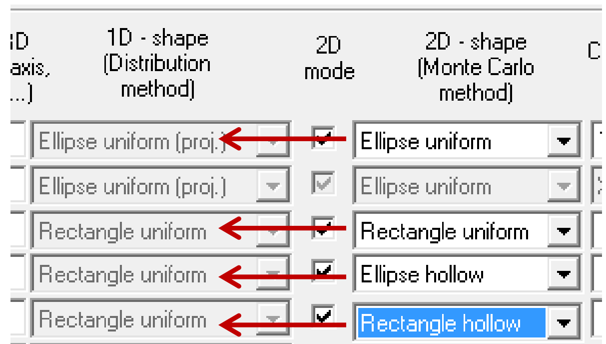

Ellipse uniform(proj.)

2D - shapes (for Monte Carlo mode)

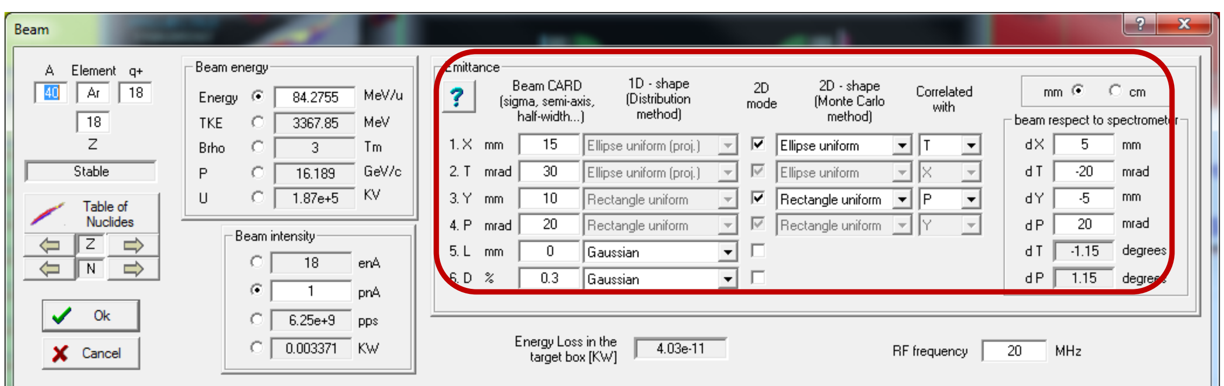


Four 2D-shapes.
Hollow configurations (which are not physical) are designed for debug purposes

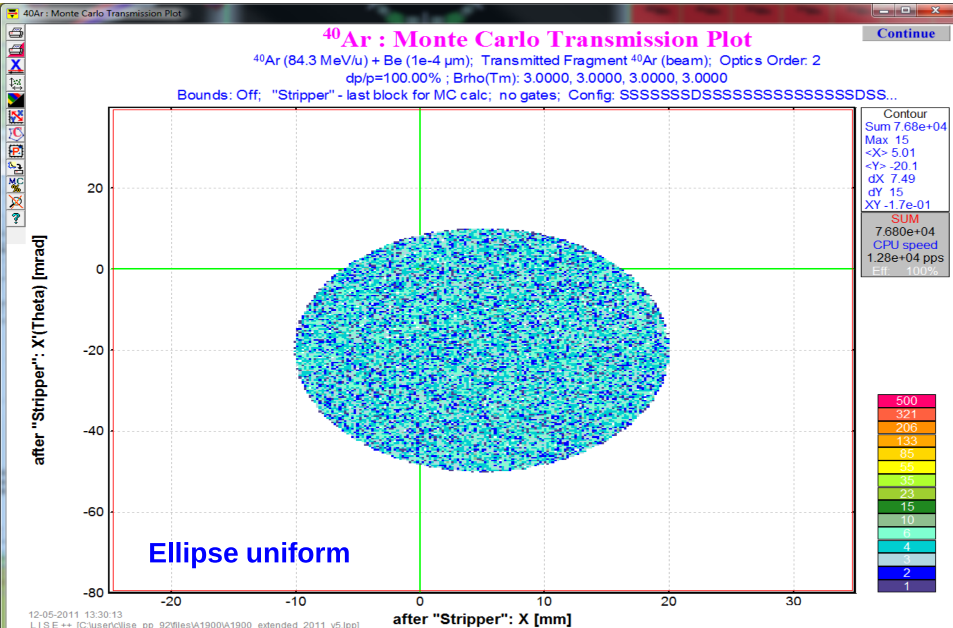
Assignment for 1D-shapes, which are used for the Distribution method

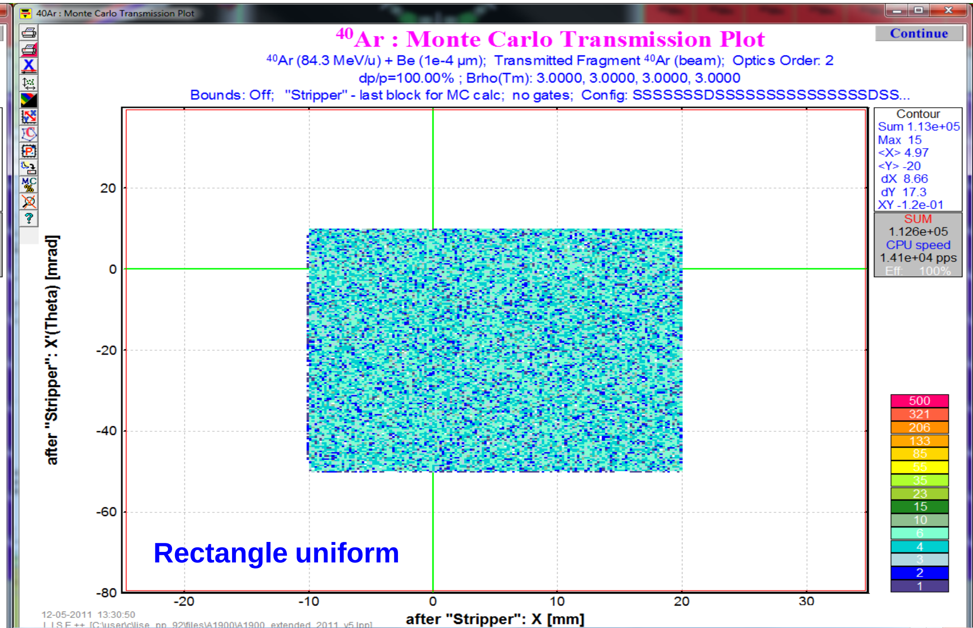


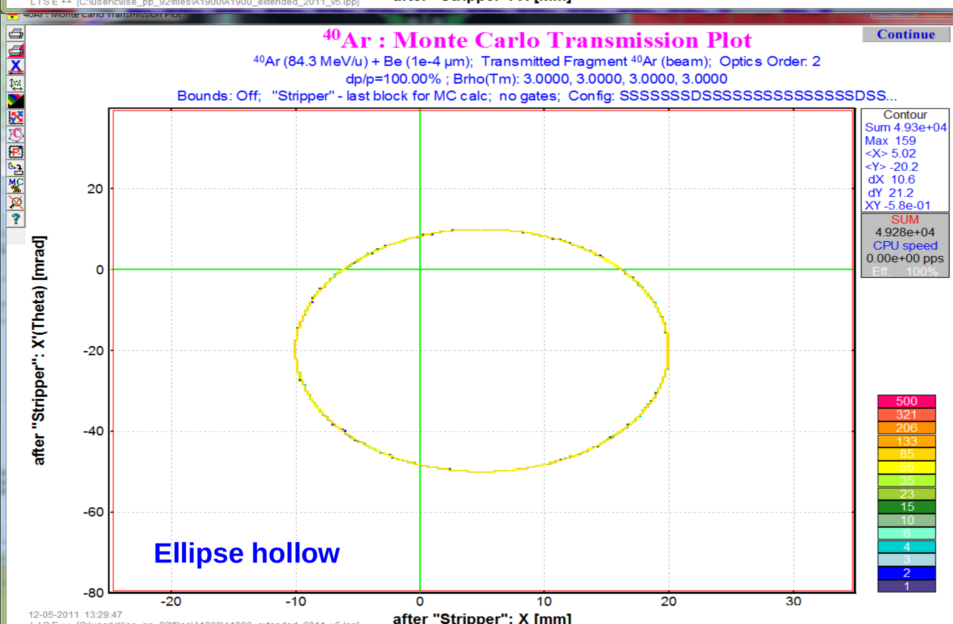
File used for the next slides: http://groups.nscl.msu.edu/lise//9_2/9_2_85/A1900_extended_2011_v5.lpp

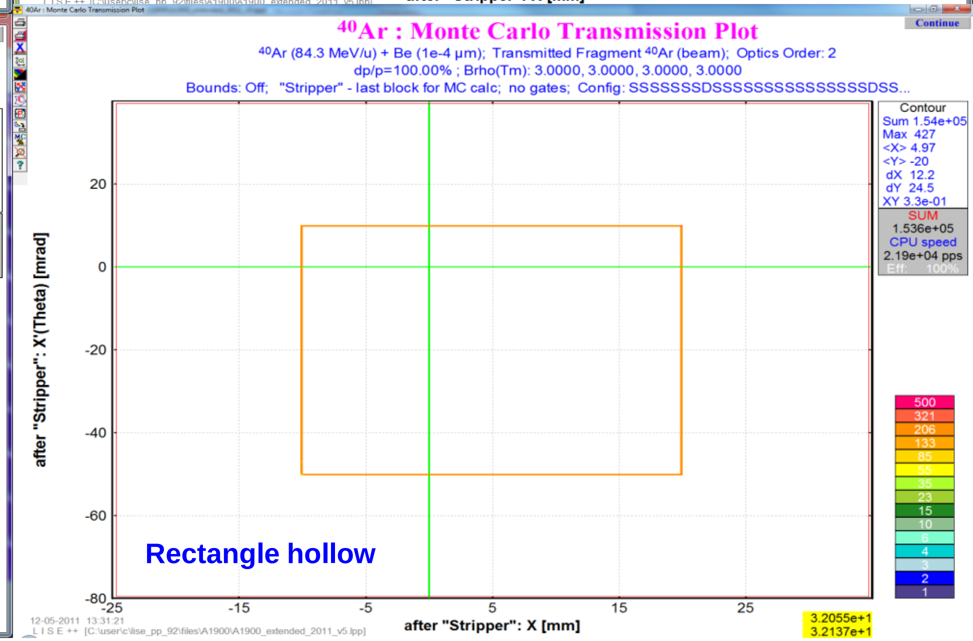


2D - shapes : after target









Physics

Probability for compound nucleus formation

PHYSICAL REVIEW C **78**, 034610 (2008)

Synthesis of superheavy nuclei: A search for new production reactions

Valery Zagrebaev[1] and Walter Greiner[2]
[1] *Flerov Laboratory of Nuclear Reactions, JINR, Dubna, Moscow Region, Russia*
[2] *Frankfurt Institute for Advanced Studies, J. W. Goethe-Universität, Frankfurt, Germany*
(Received 23 May 2008; published 24 September 2008)

Nuclear reactions leading to the formation of new superheavy (SH) elements and isotopes are discussed in the paper. "Cold" and "hot" synthesis, fusion of fission fragments, transfer reactions, and reactions with radioactive ion beams are analyzed along with their abilities and limitations. If the possibility of increasing the beam intensity and the detection efficiency (by a total of one order of magnitude) is found, then several isotopes of new elements with Z = 120–124 could be synthesized in fusion reactions of titanium, chromium, and iron beams with actinide targets. The use of light- and medium-mass neutron-rich radioactive beams may help us fill the gap between the SH nuclei produced in the hot fusion reactions and the mainland. In these reactions, we may really approach the "island of stability." Such a possibility is also provided by the multinucleon transfer processes in low-energy damped collisions of heavy actinide nuclei. The production of SH elements in fusion reactions with accelerated fission fragments looks less encouraging.

$$P_{\rm CN}(E^*, l) = \frac{P^0_{\rm CN}}{1 + \exp\left[\dfrac{E^*_B - E^*_{\rm int}(l)}{\Delta}\right]},$$

where

$$P^0_{\rm CN} = \frac{1}{1 + \exp\left[\dfrac{Z_1 Z_2 - \zeta}{\tau}\right]},$$

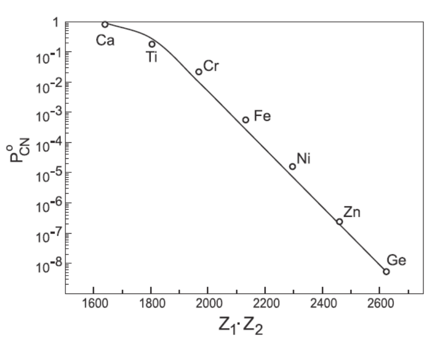
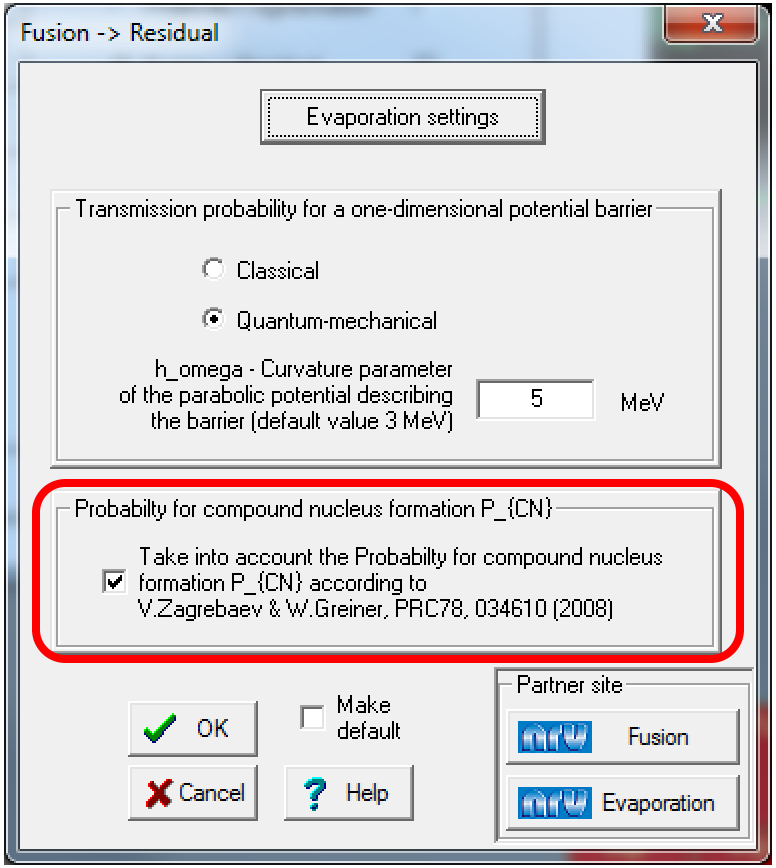


FIG. 5. Above-barrier CN formation probability in the ^{208}Pb induced fusion reactions. Results of calculation are shown by the circles, whereas the fitted curve corresponds to expression (3).



Probability for compound nucleus formation

PHYSICAL REVIEW C **78**, 034610 (2008)

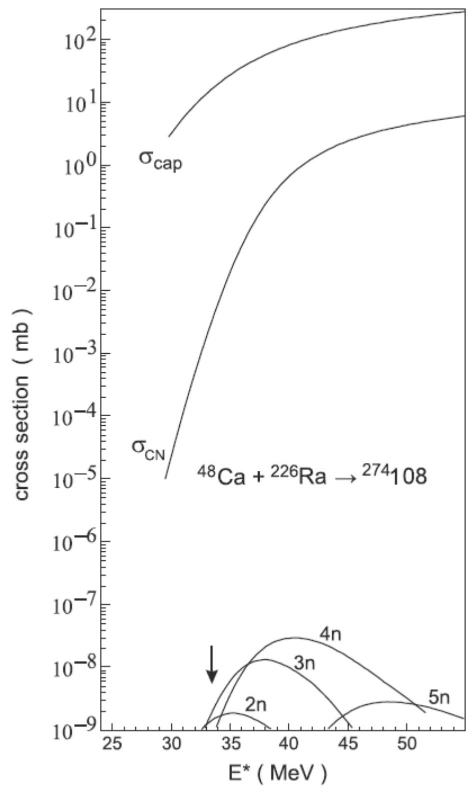
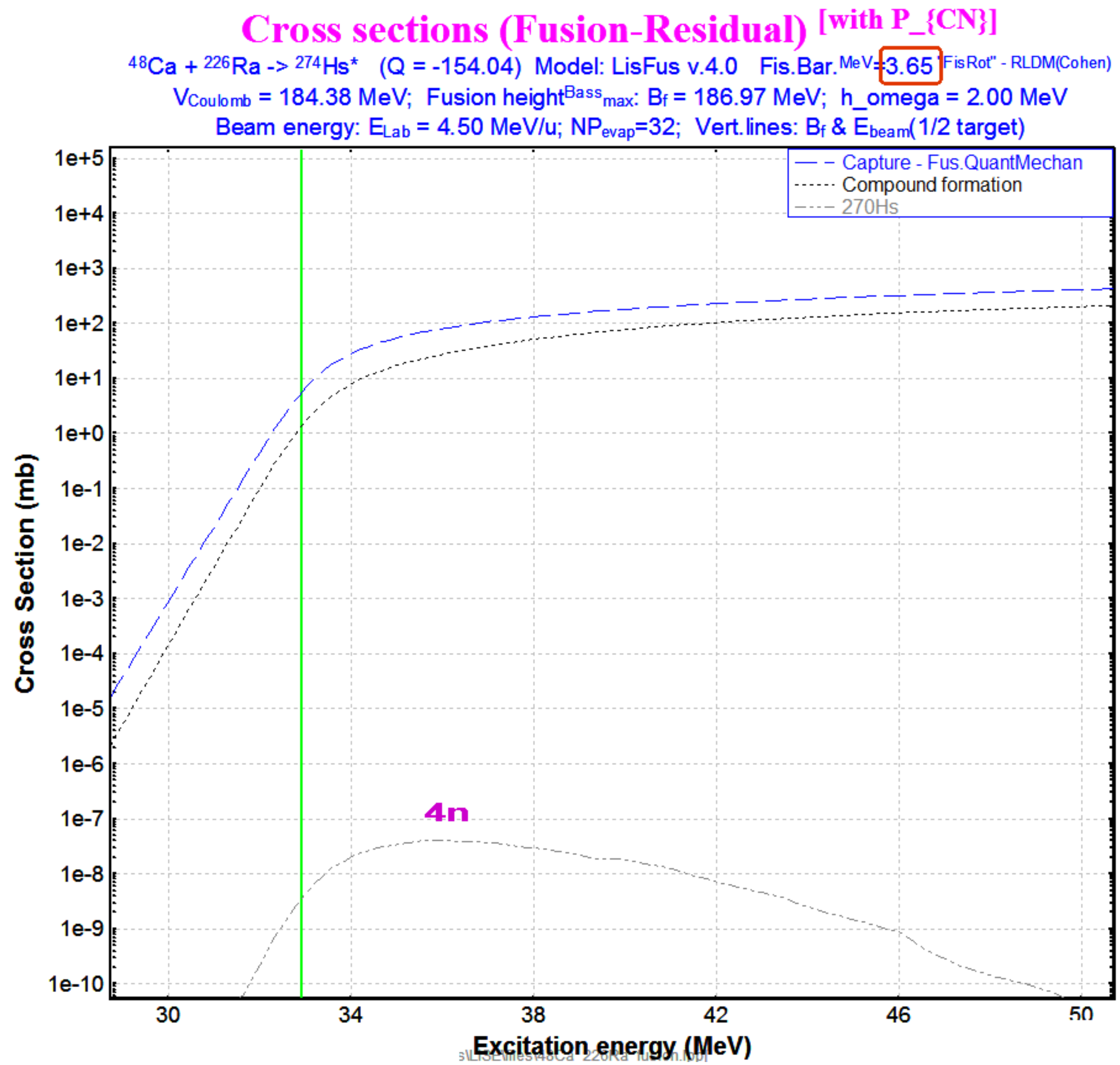


FIG. 7. Calculated capture, fusion, and evaporation residue ($2n, 3n, 4n$, and $5n$ channels) cross sections in the ^{48}Ca + ^{226}Ra fusion reaction. The arrow indicates the Bass barrier.

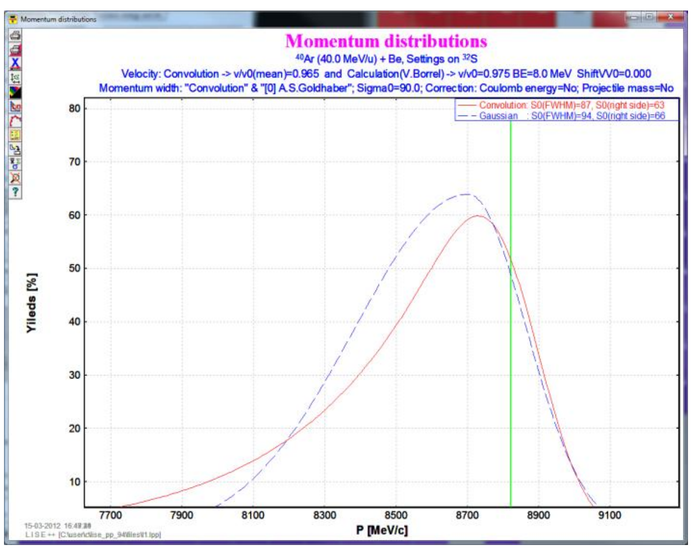


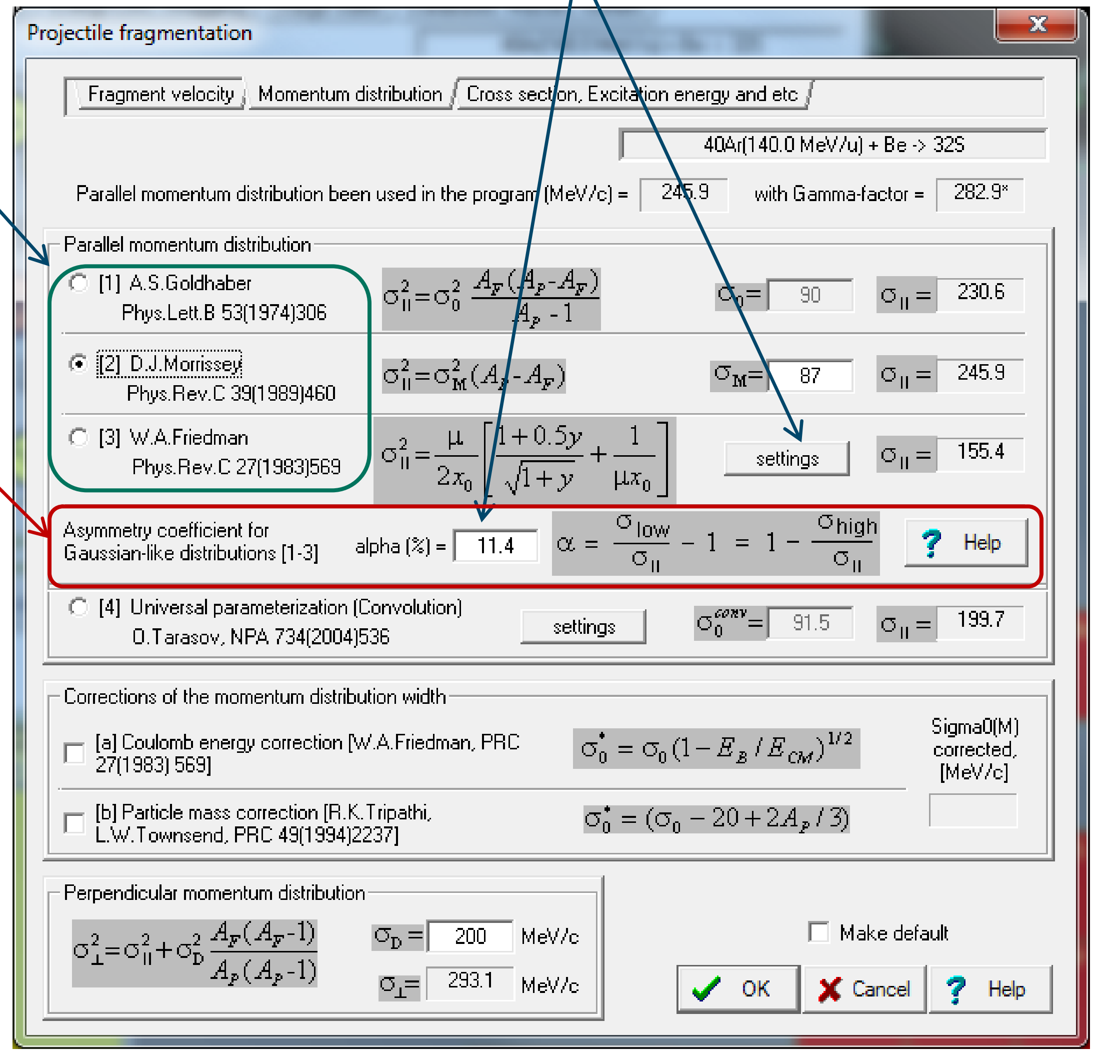
Asymmetry in momentum distributions

The asymmetry coefficient “alpha” is applied for models [1-3]

asymmetry coefficient “α” (in %) and reduced width “σ” are used to describe an asymmetrical Gaussian momentum distribution

asymmetry





EPAX 3 set by default in the version 9.5

PHYSICAL REVIEW C **86**, 014601 (2012)

Improved empirical parametrization of fragmentation cross sections

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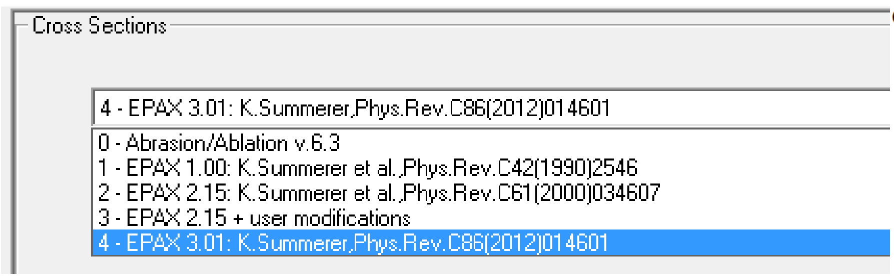
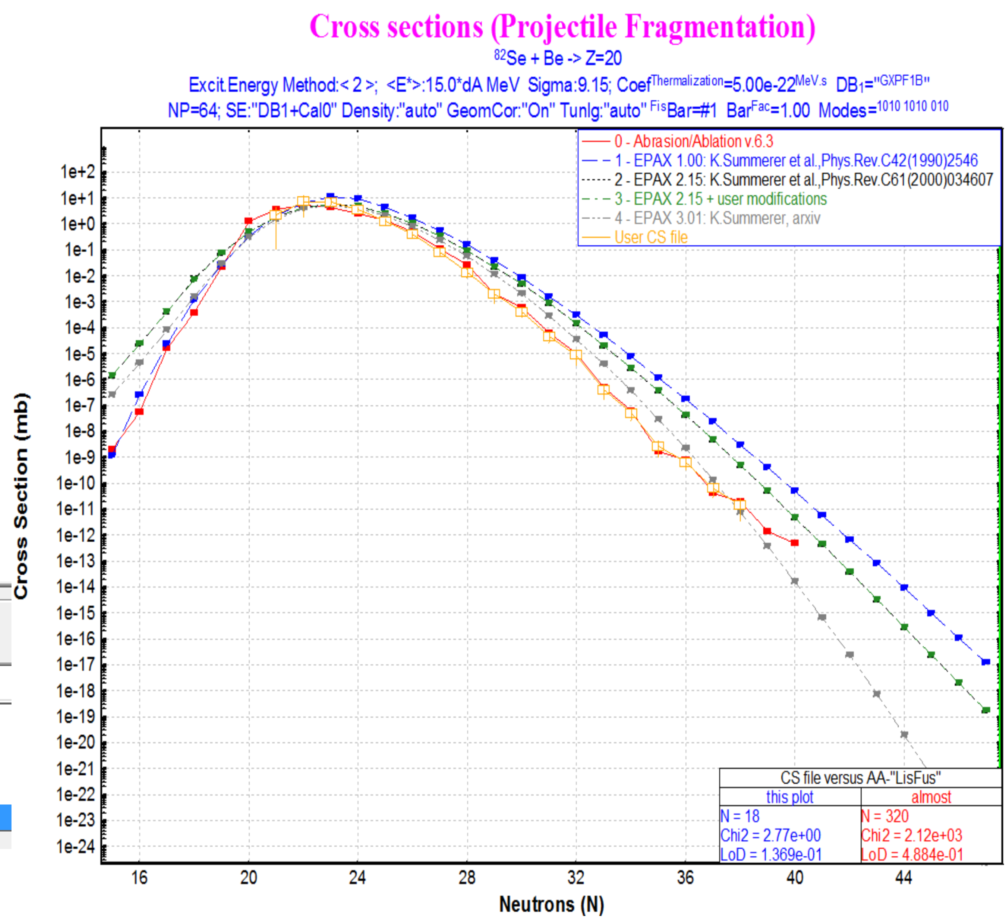
GSI Helmholtzzentrum für Schwerionenforschung, Planckstr.1, D-64291 Darmstadt, Germany
(Received 25 May 2012; published 2 July 2012)

A new version is proposed for the universal empirical formula, EPAX, which describes fragmentation cross sections in high-energy heavy-ion reactions. The new version, EPAX 3, is shown to yield cross sections that are in better agreement with experimental data for the most neutron-rich fragments than the previous version. At the same time, the very good agreement of EPAX 2 with data on the neutron-deficient side has been largely maintained. Comparison with measured cross sections shows that the bulk of the data is reproduced within a factor of about 2, for cross sections down to the picobarn range.





Selected for a Viewpoint in *Physics*

PHYSICAL REVIEW C **87**, 054612 (2013)

Production cross sections from ^{82}Se fragmentation as indications of shell effects in neutron-rich isotopes close to the drip-line

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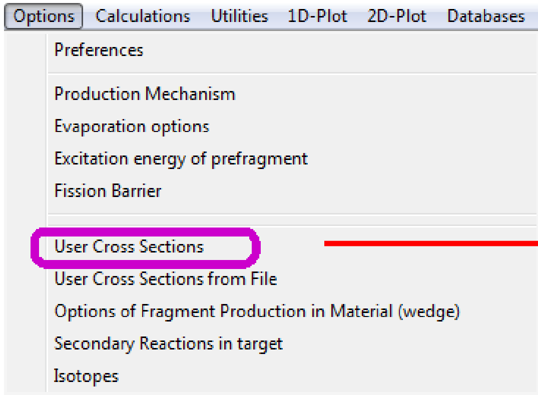
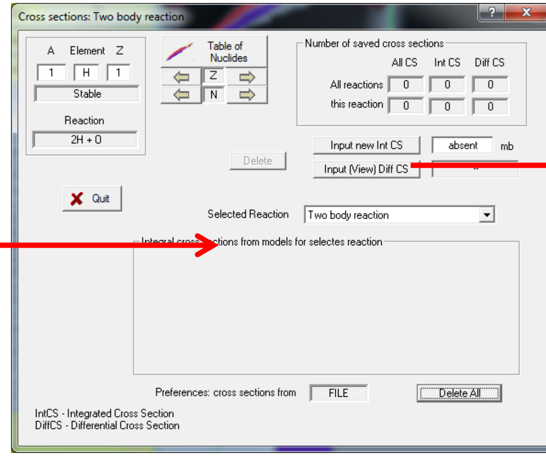
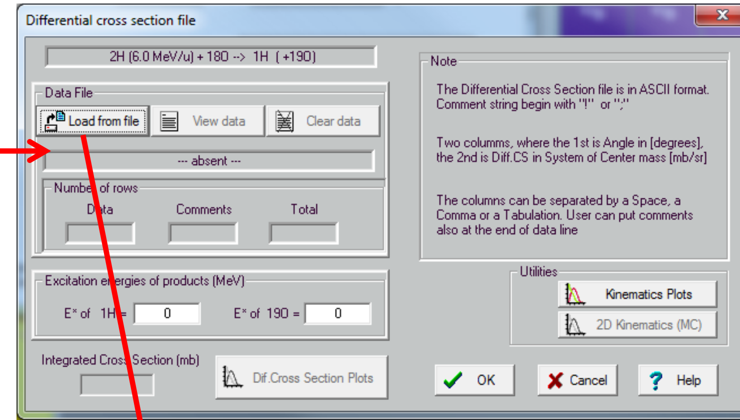
Physics :

User differential cross sections

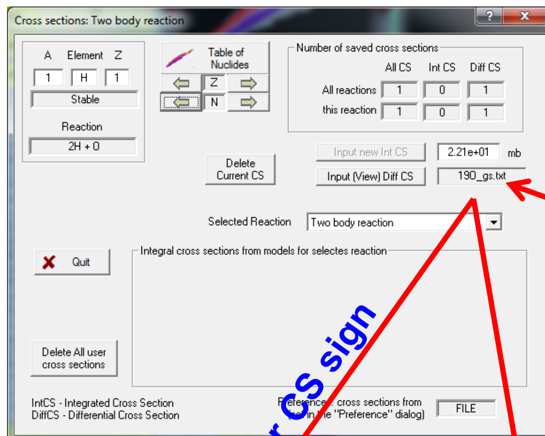
Loading User Differential Cross Sections in LISE^{++}

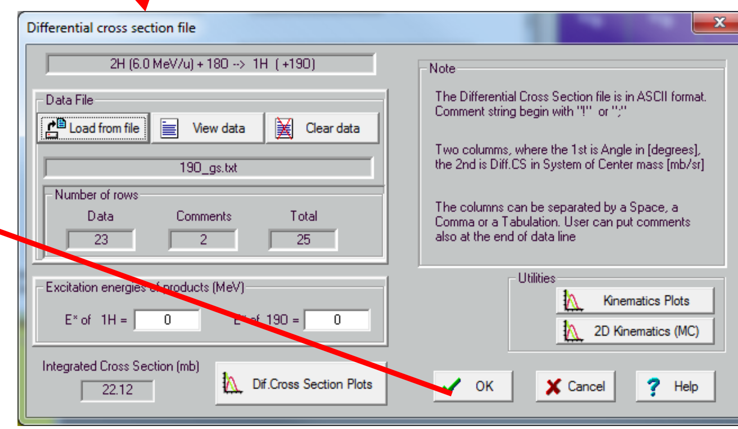






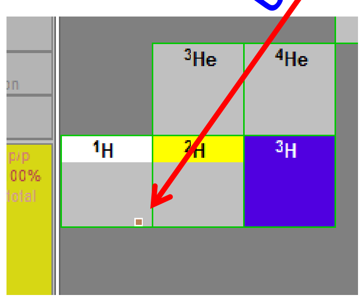
Two body reactions

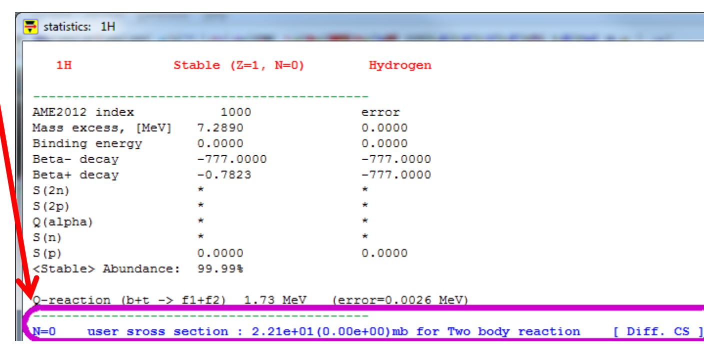




User CSs are saved to LISE^{++} files and retrieved at reading of LISE^{++} files

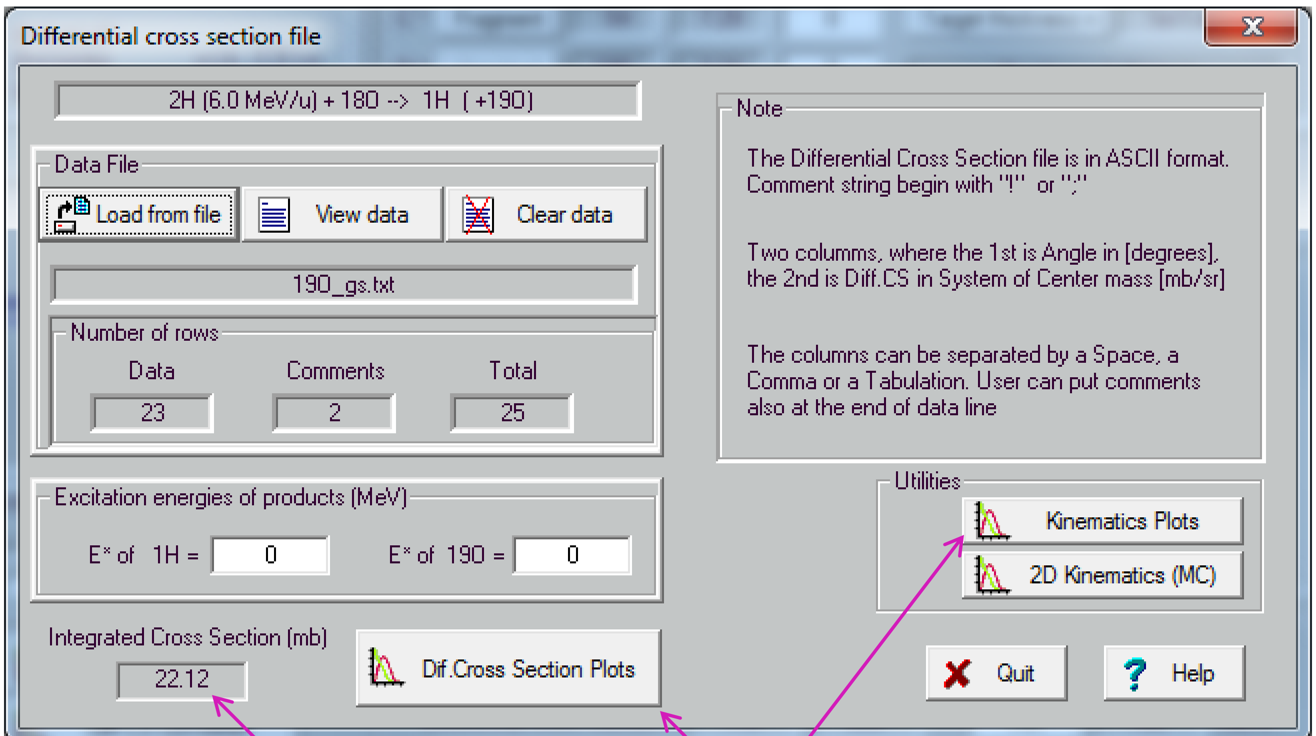
User CS sign





The User Differential Cross Sections dialog

User Diff Cs file is $d\sigma / d\Omega$ (mb/sr) in CMS



LISE++ automatically integrates the UserDiffCS (dSigma/ dTheta)

These buttons become enable after the UserDiffCS file loaded

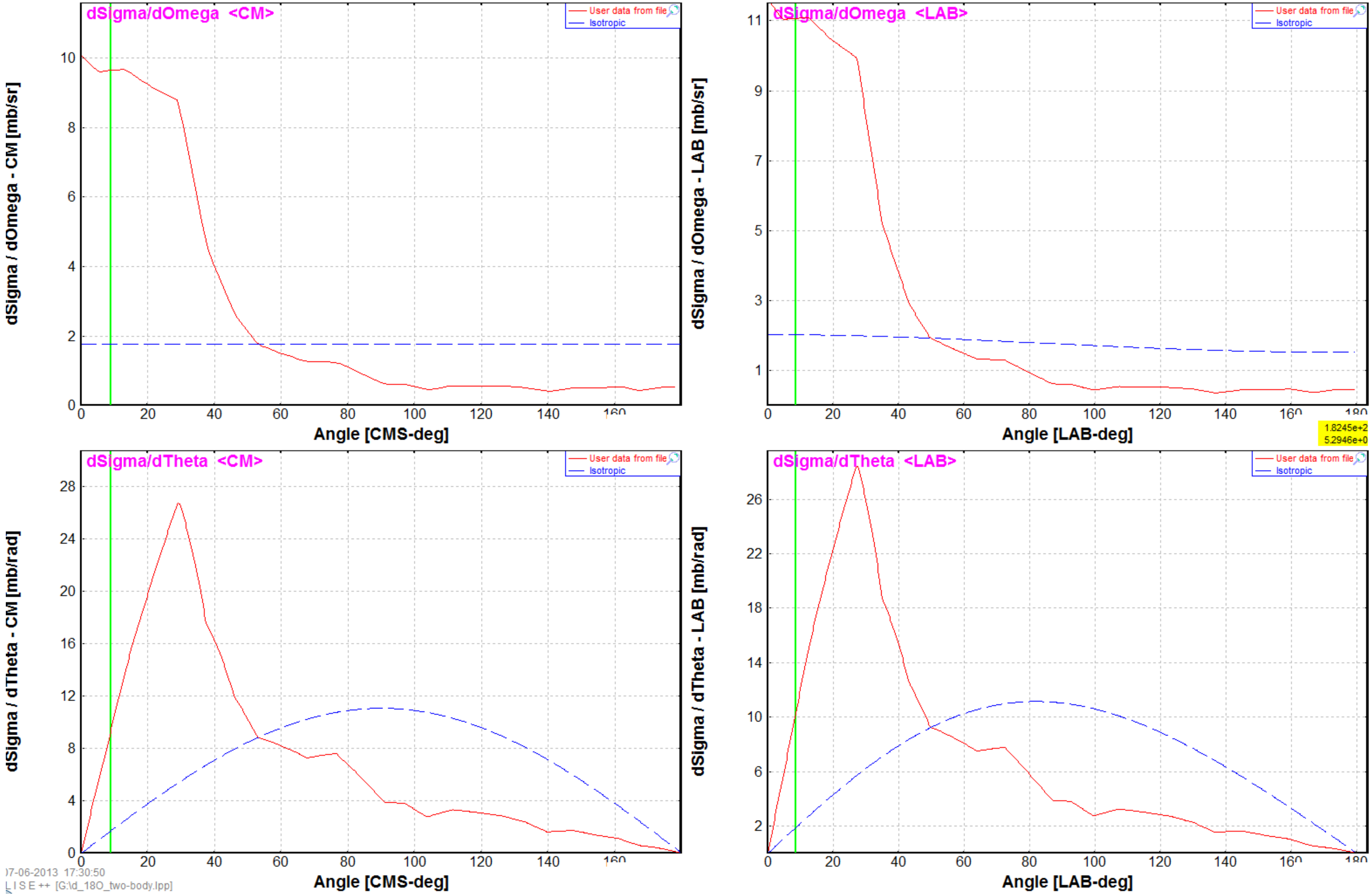
The UserDiffCS dialog plots : cross sections (file “19O_gs.txt”, E*=0)

Differential Cross Section

^{2}H (6.0 MeV/u) + ^{18}O --> ^{1}H (+ ^{19}O)

User file: "19O_gs.txt"; Integrated Cross Section: 22.12 mb; Grazing angle in CMS [^{2}H+^{18}O]: 9.00 deg

Max.Angle in Lab: 180.00 deg corresponds to CM Angle 180.0 deg; Q reaction : 1.73 MeV (Excitations 0.0+0.0=>0.0+0.0)



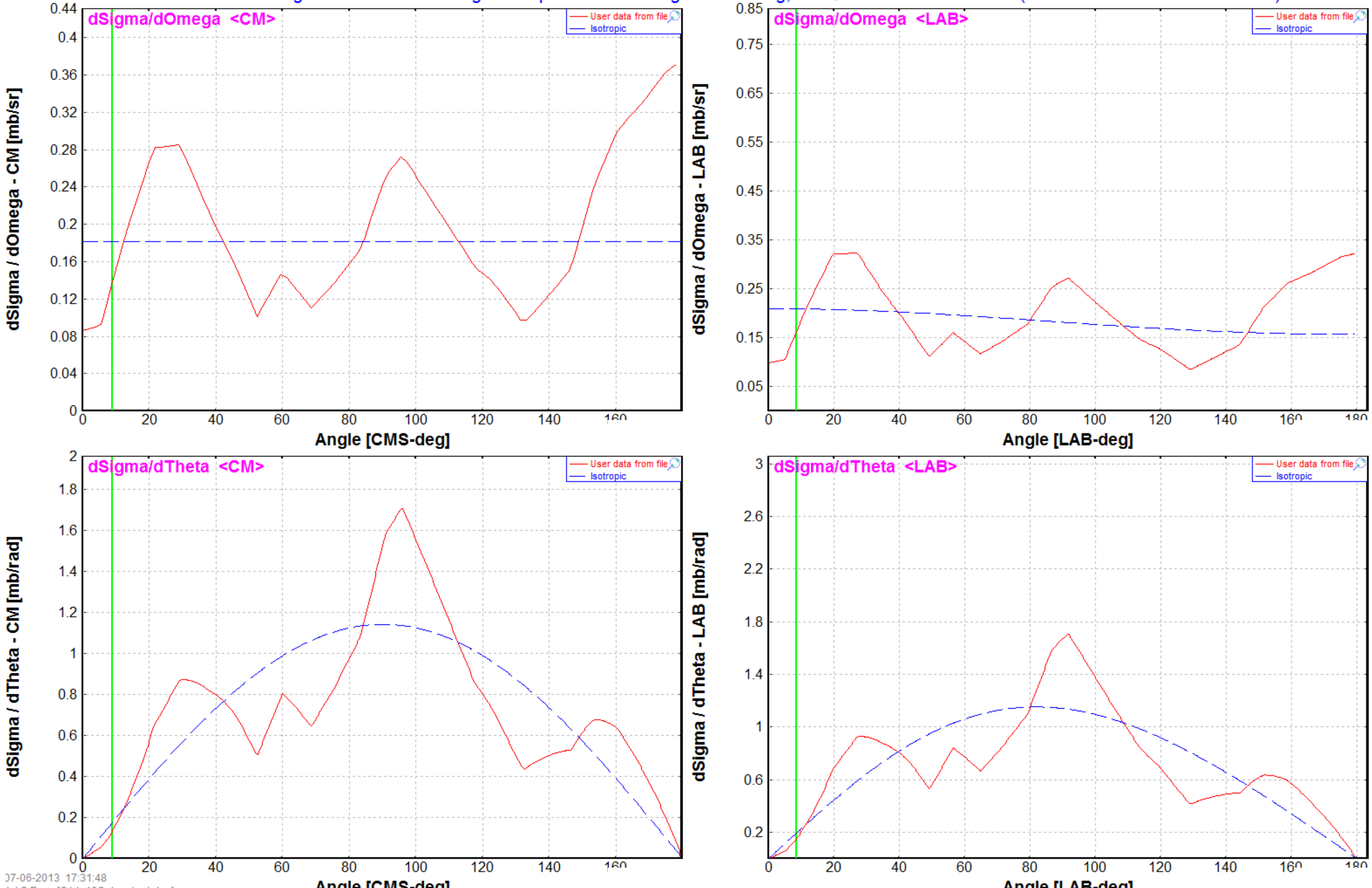
The UserDiffCS dialog plots : cross sections (file "19O_L0.96.txt", E*=0.96)

Differential Cross Section

^{2}H (6.0 MeV/u) + ^{18}O --> ^{1}H (+ ^{19}O)

User file: "19O_L0.96.txt"; Integrated Cross Section: 2.286 mb; Grazing angle in CMS [^{2}H+^{18}O]: 9.00 deg

Max.Angle in Lab: 180.00 deg corresponds to CM Angle 180.0 deg; Q reaction : 0.77 MeV (Excitations 0.0+0.0=>0.0+1.0)



MICHIGAN STATE UNIVERSITY LISE++

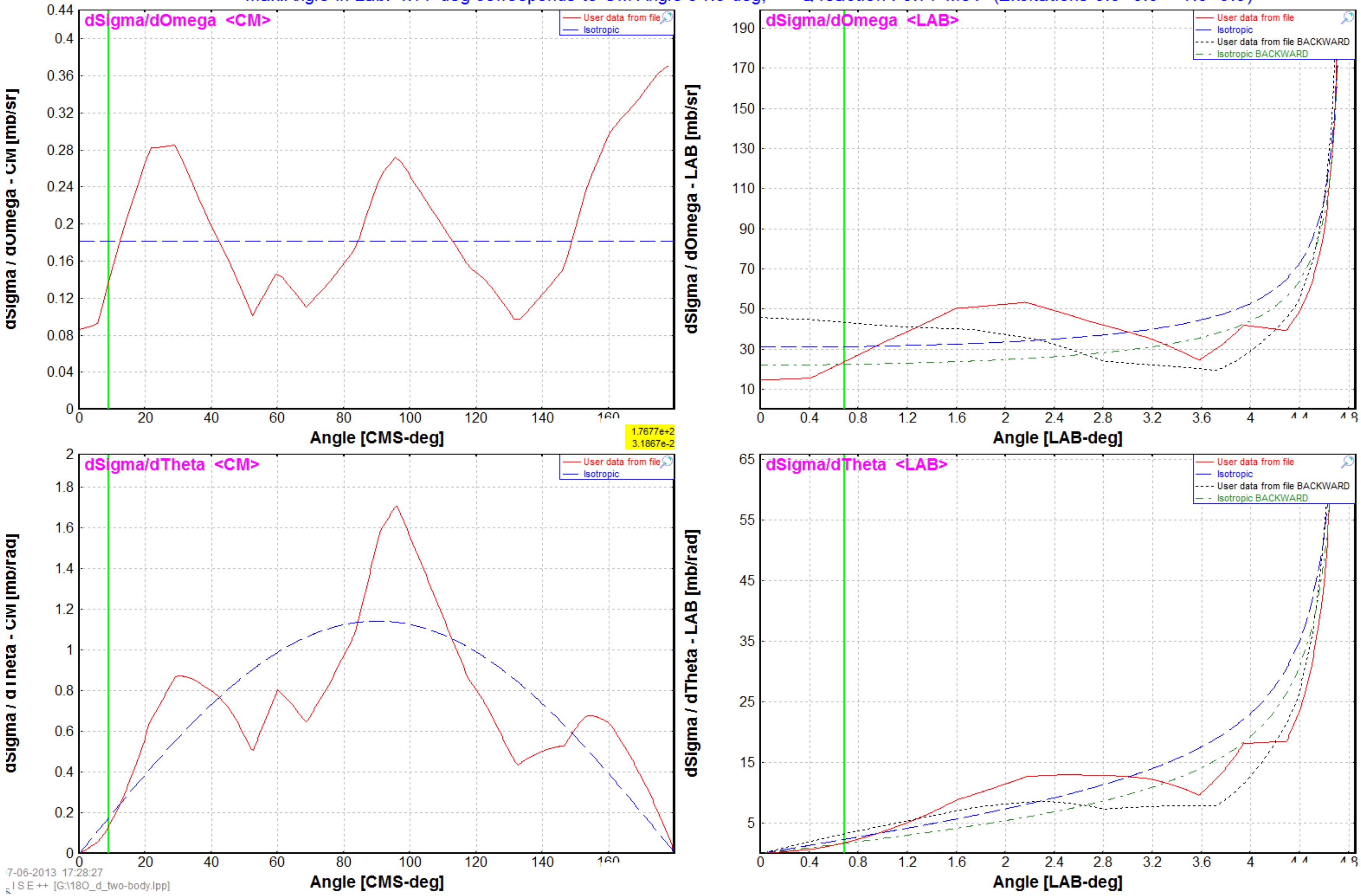
Inverse for test

Differential Cross Section

^{18}O (6.0 MeV/u) + ^{2}H --> ^{19}O (+ ^{1}H)

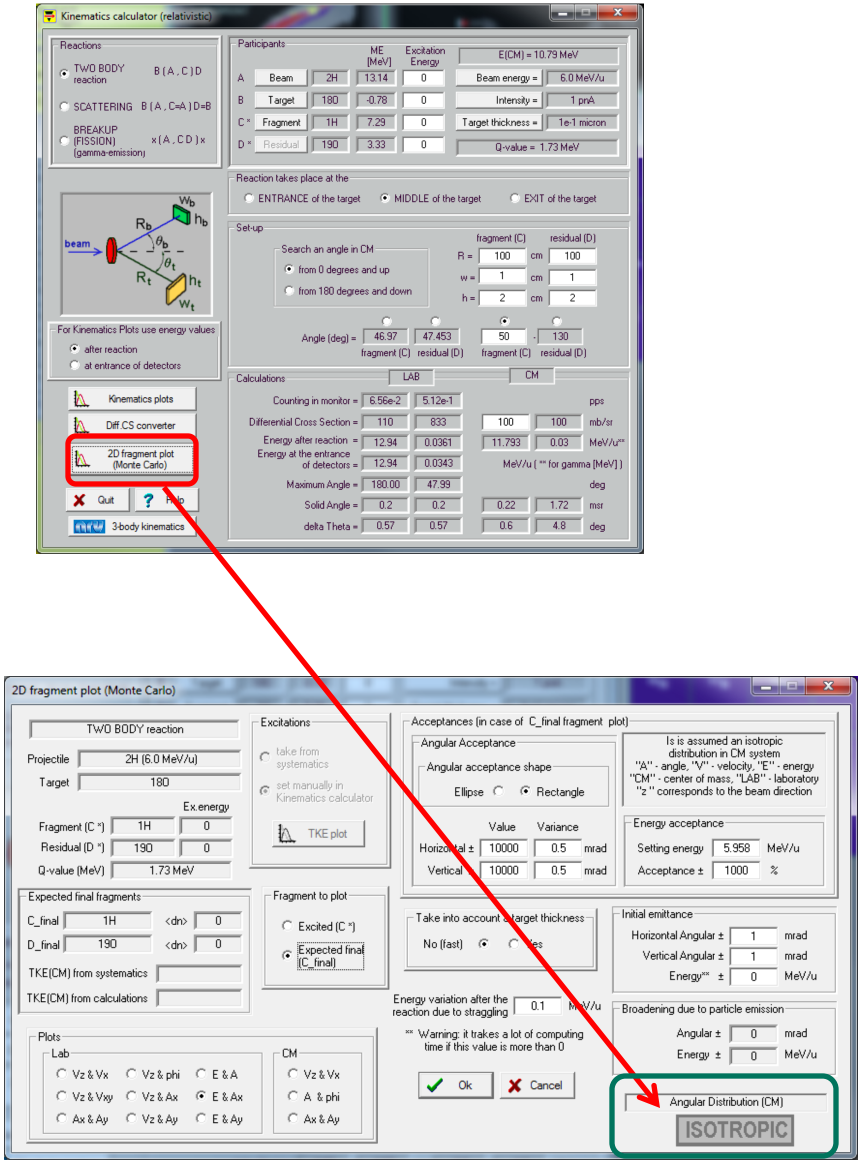
User file: "19O_L0.96.txt"; Integrated Cross Section: 2.286 mb; Grazing angle in CMS [^{18}O+ ^{2}H]: 8.93 deg

Max.Angle in Lab: 4.77 deg corresponds to CM Angle 94.9 deg; Q reaction : 0.77 MeV (Excitations 0.0+0.0=>1.0+0.0)

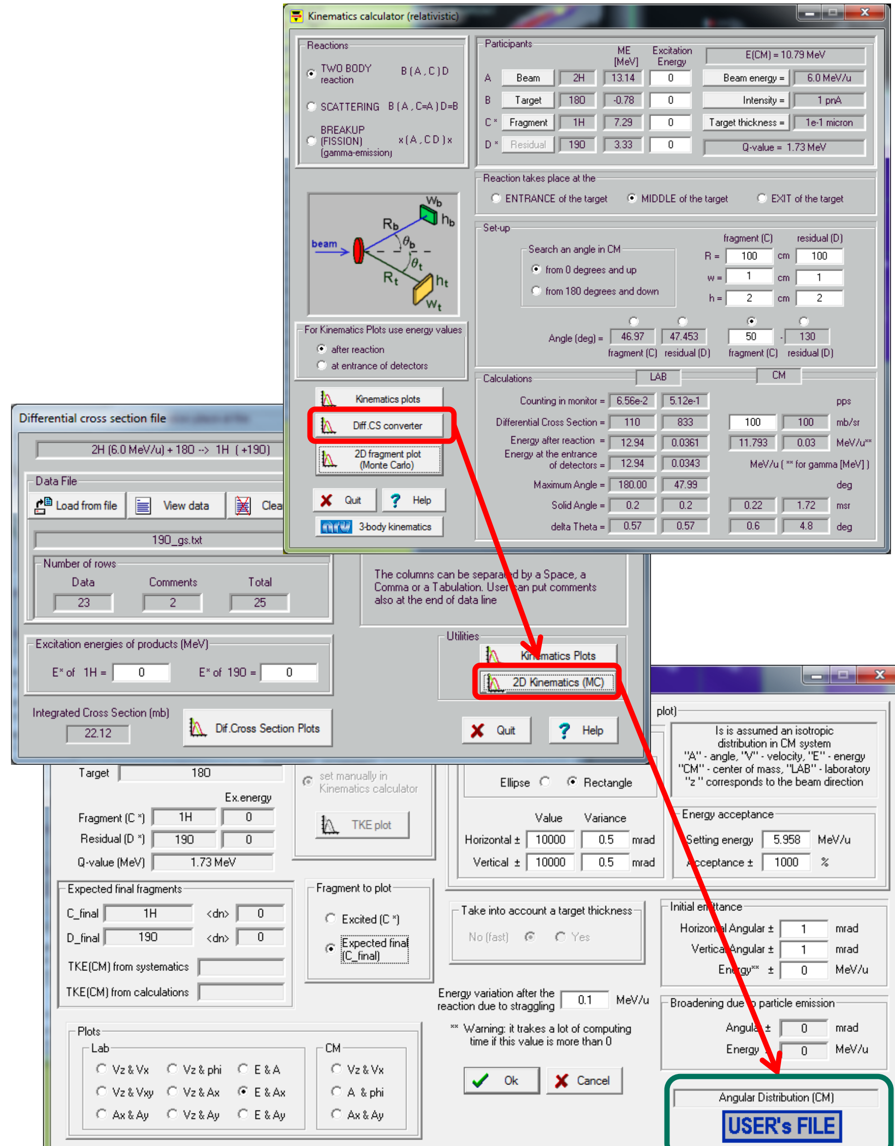


UserDiffCS in the MC 2d-kinematics

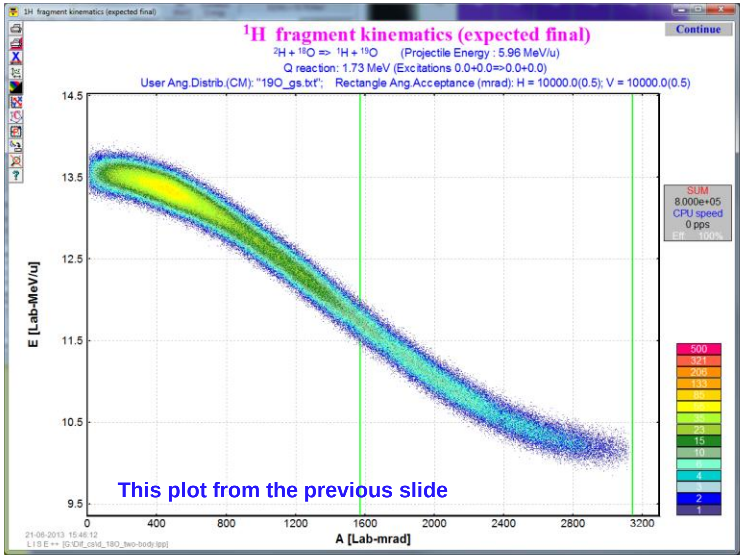
Isotropic



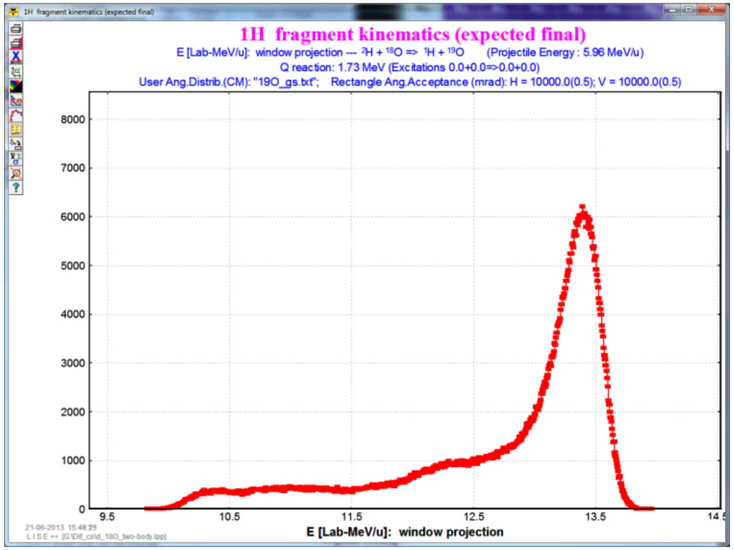
UserDiffCS

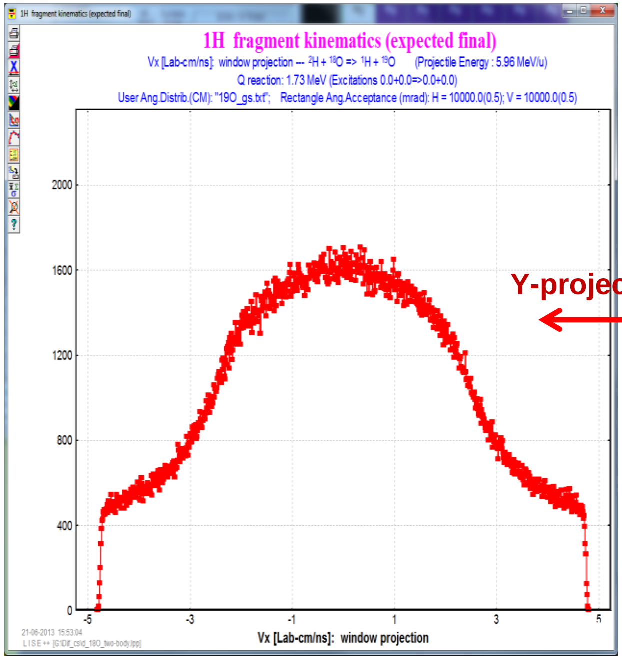


UserDiffCS in the MC 2d-kinematics : file “19O_gs.txt”, E*=0

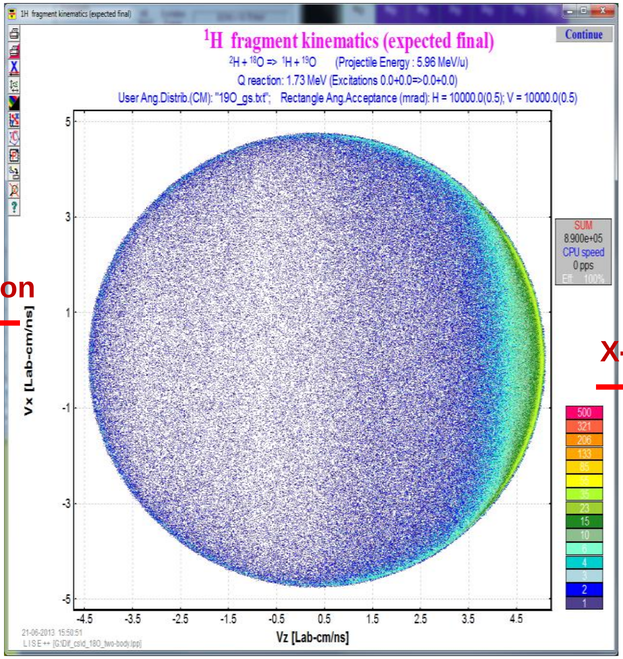


Y-projection

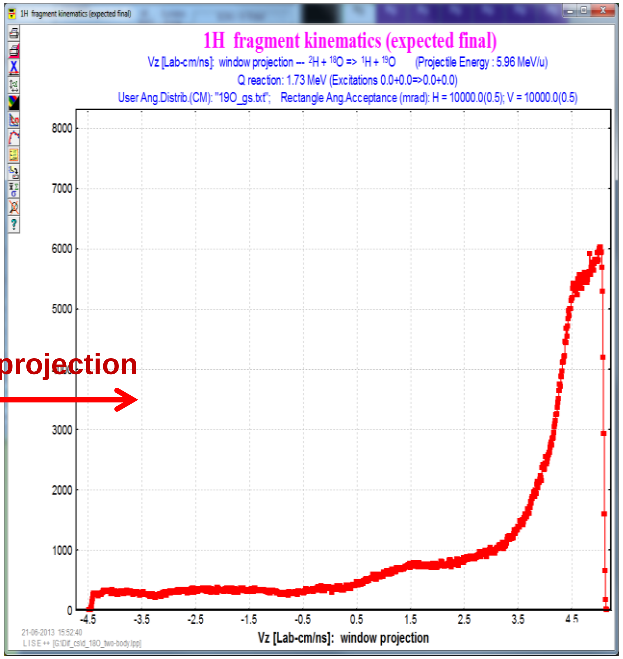




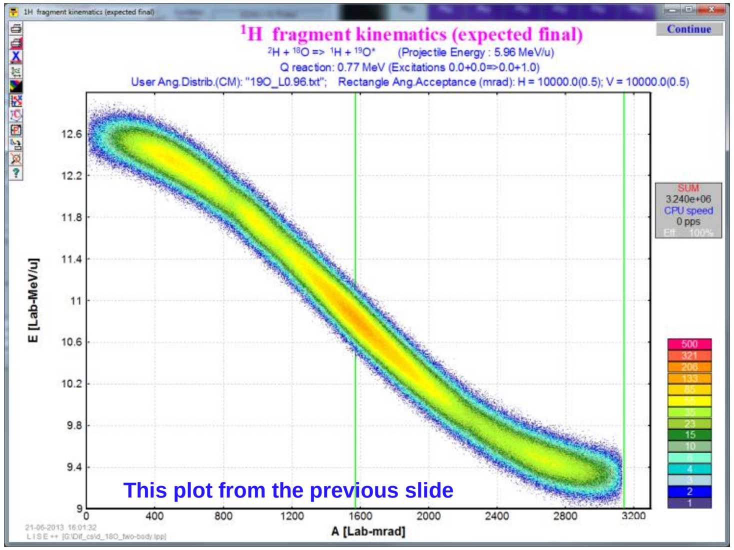
Y-projection



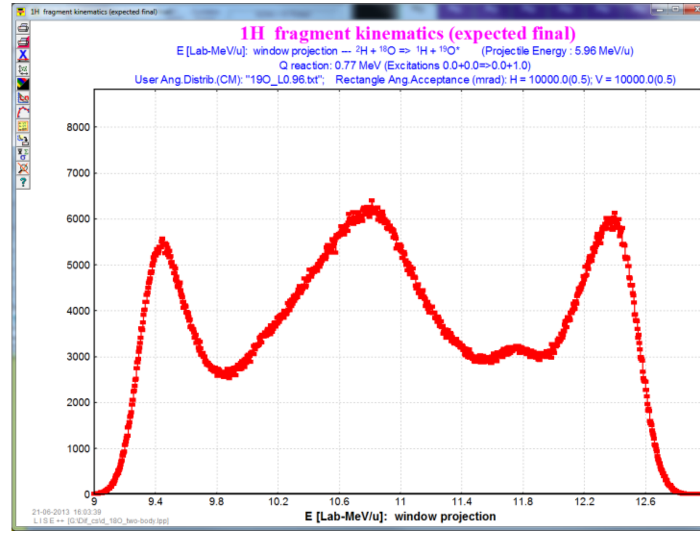
X-projection

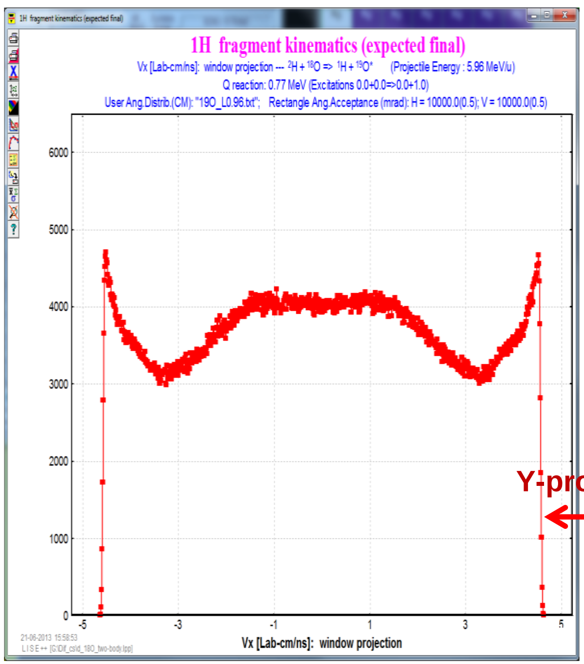


UserDiffCS in the MC 2d-kinematics : file “19O_L0.96.txt”, E*=0.96

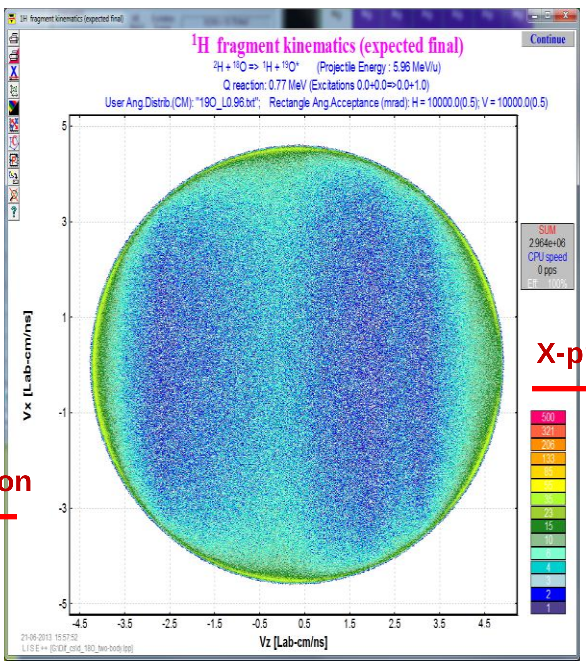


Y-projection

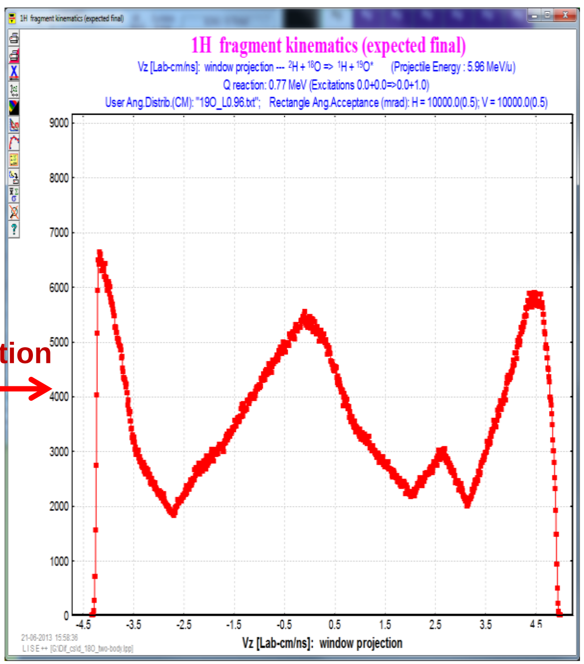




Y-projection

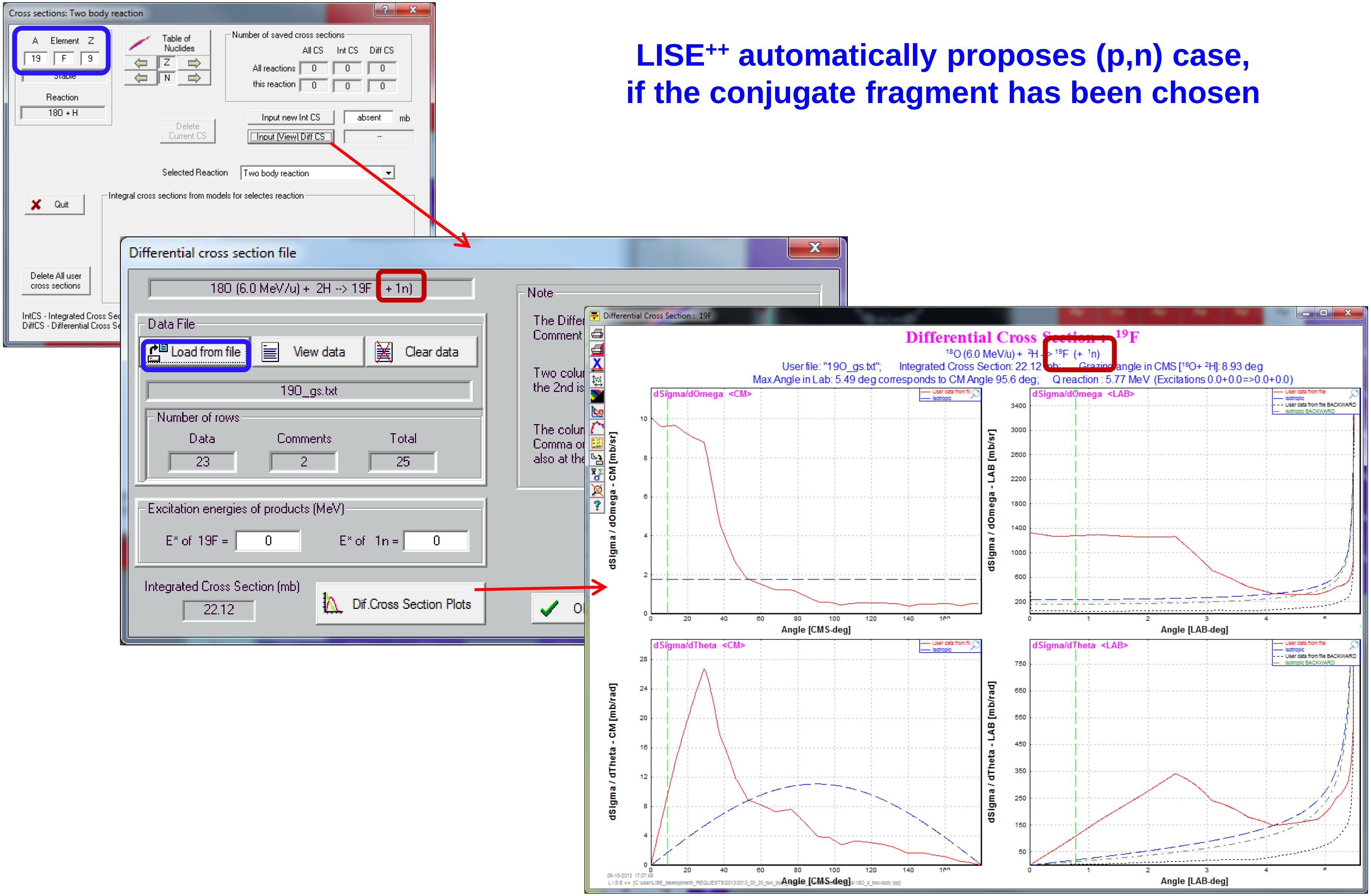


X-projection



Using (p,n) reaction in the DifCS dialogs (TwoBody reaction)

LISE++ automatically proposes (p,n) case, if the conjugate fragment has been chosen

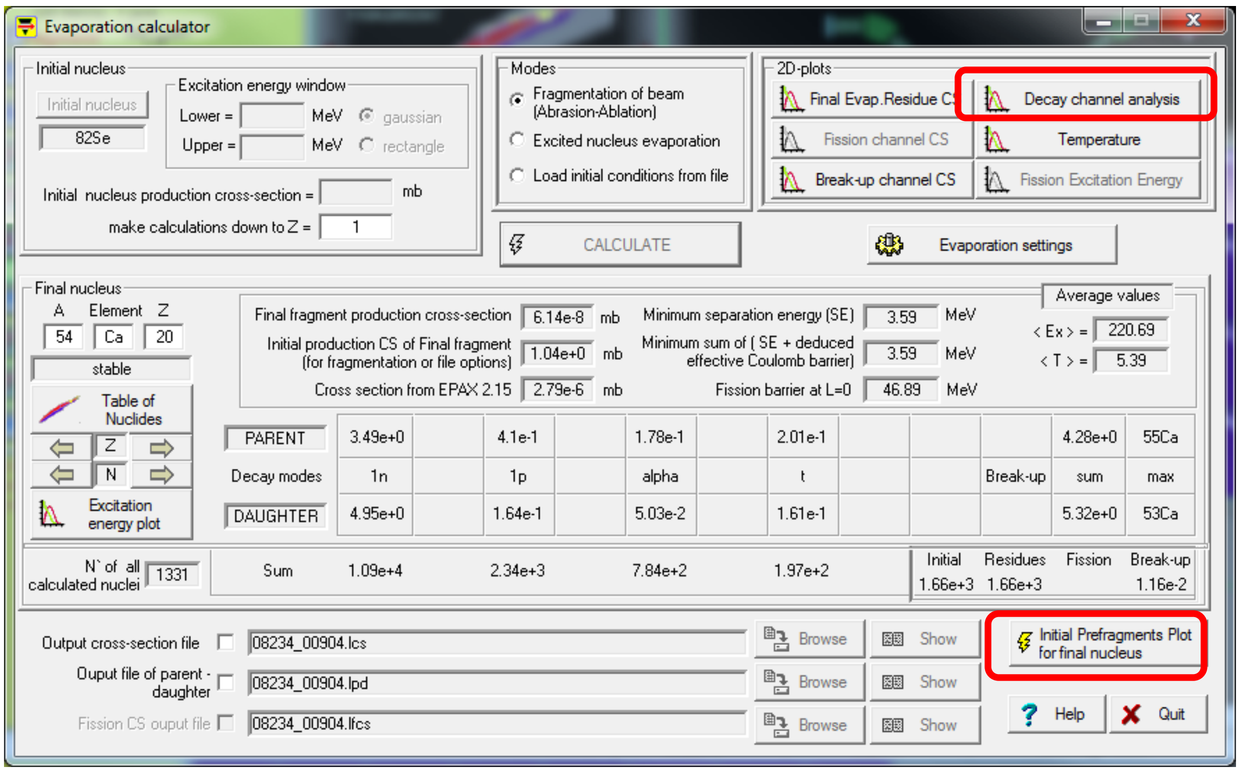


Physics : Abrasion-Ablation

LISE^{++} Abrasion-Ablation : 2012 update

During analysis of GSI's ^{238}U, RIKEN's ^{238}U, MSU's ^{82}Se experiments there was significant modification of LISE++ AA:

- **Improving/Fixing problems (interpolation, new methods),**
- **new properties (excitation energy thermalization and etc),**
- **new utility: Initial prefragments plot, Decay Analysis utility update,**
- **new mass tables (AME2011, GXPF1B), unknown masses extrapolation procedure update and so on**

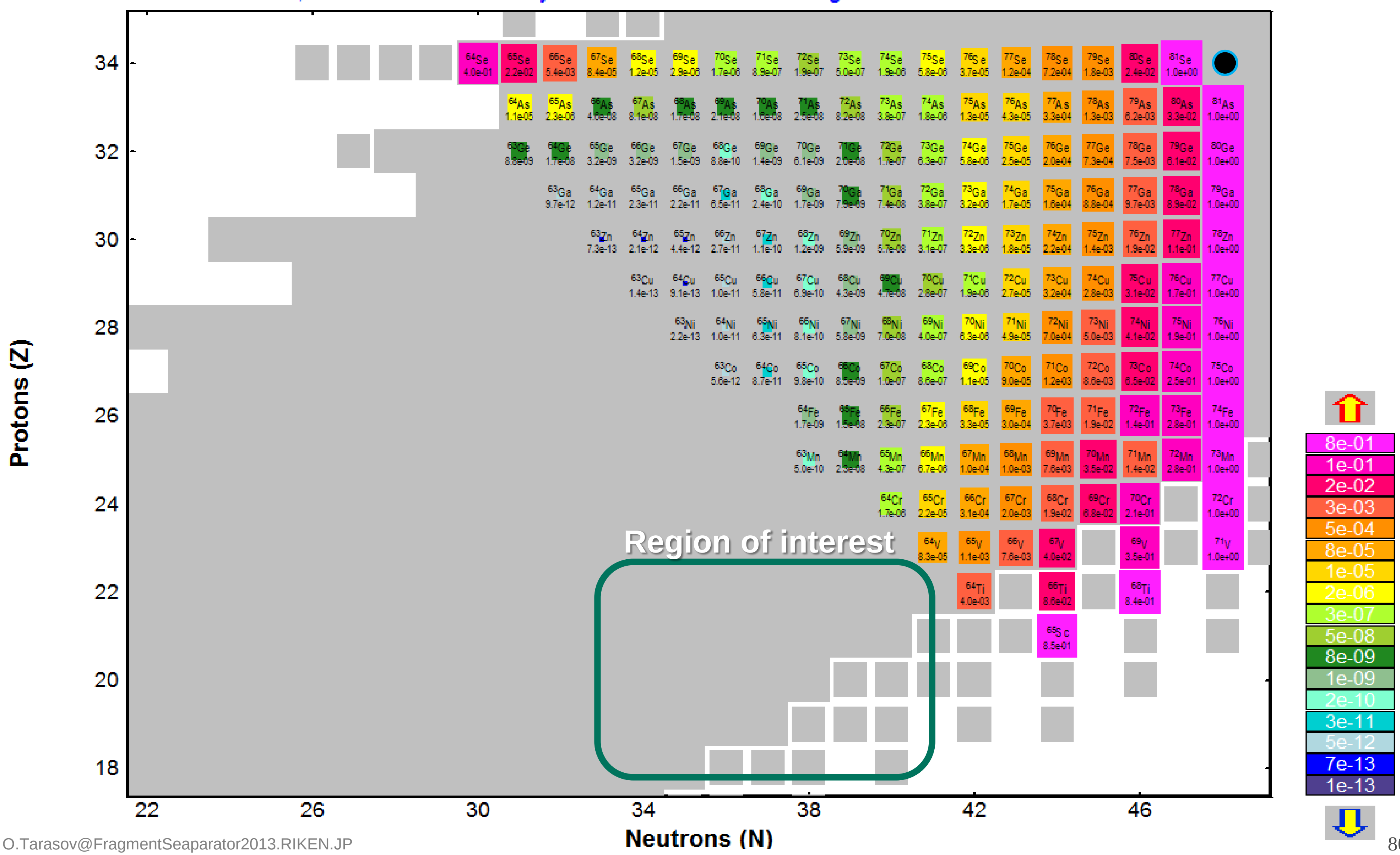


Current mode: Initial CS -> [S residue] / [Sr total]

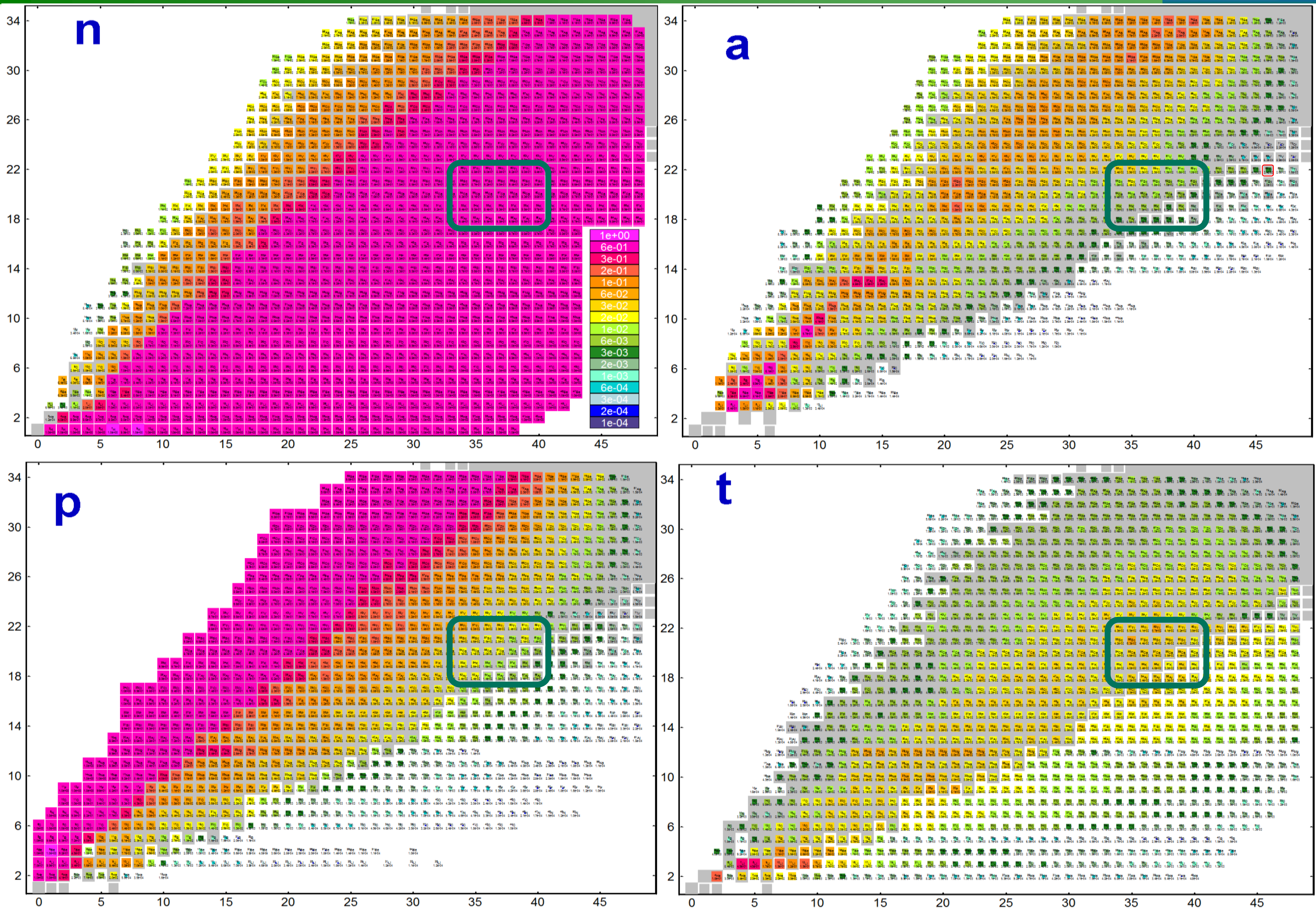
ABRASION-ABLATION - ^{82}Se + Be

Excit.Energy Method:< 2 >; <E*>:15.0*dA MeV Sigma:9.15; Coef^{Thermalization}=5.00e-22$^{MeV.s}$ DB$_1$="GXPF1B"

NP=64; SE:"DB1+Cal0" Density:"auto" GeomCor:"On" TunIg:"auto" ^{Fis}Bar=#1 Bar^{Fac}=1.00 Modes=$^{1010\ 1010\ 010}$



So evap-channel / So evap-total (one scale for all plots)



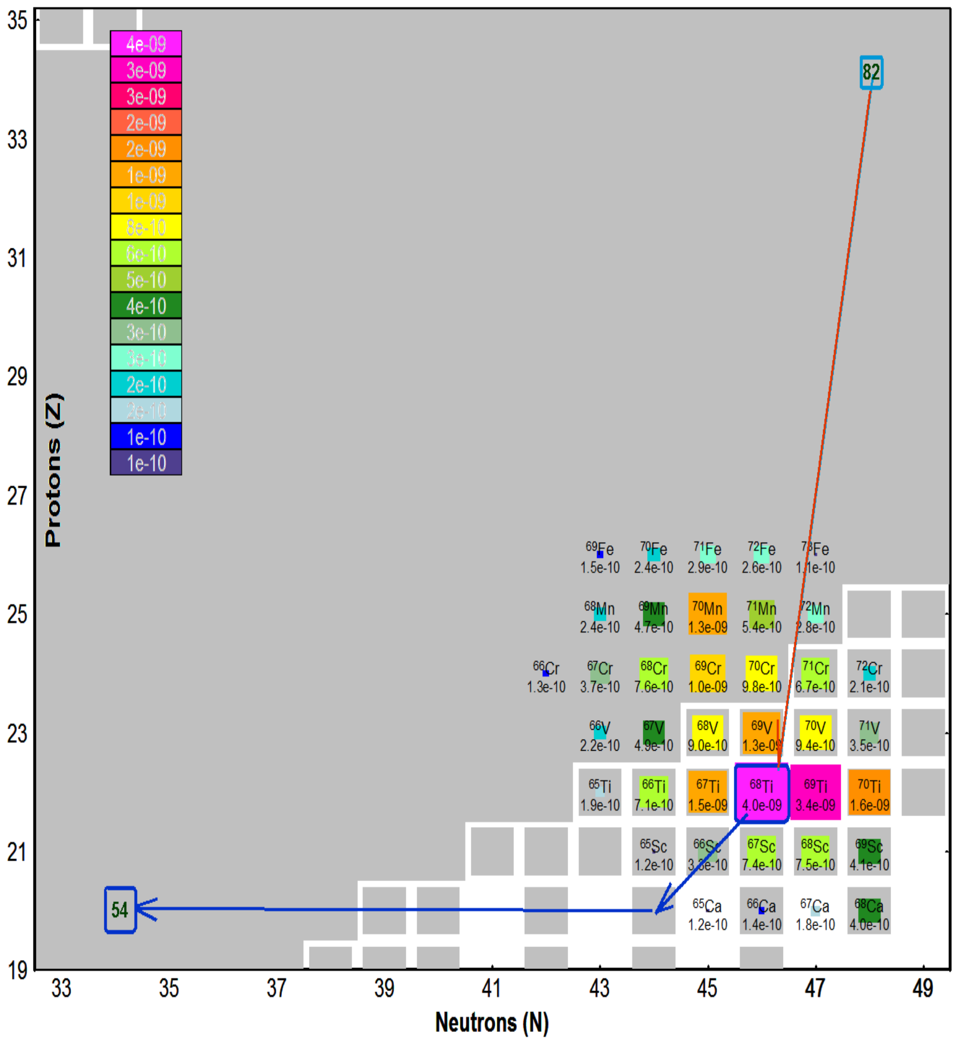
LISE++ Abrasion-Ablation: Initial prefragments plot (^{82}Se)

Initial Prefragments Plot for ^{54}Ca (2.78e-08 mb)

ABRASION-ABLATION - ^{82}Se + Be: more probable ^{68}Ti(4.02e-09 mb); <-dZ>=2.88 <-dN>=11.78

Excit.Energy Method:< 2 >; <E*>:15.0*dA MeV sigma:9.20; Thermal.Intr.Coef. = 5.00e-22 MeV*s

NP=64; SE:"DB1+Cal0" Density:"auto" Geom.Corr:"On" TunIg:"auto" FisBar=#1 BarFac=1.00 Modes=1010 1010 01(

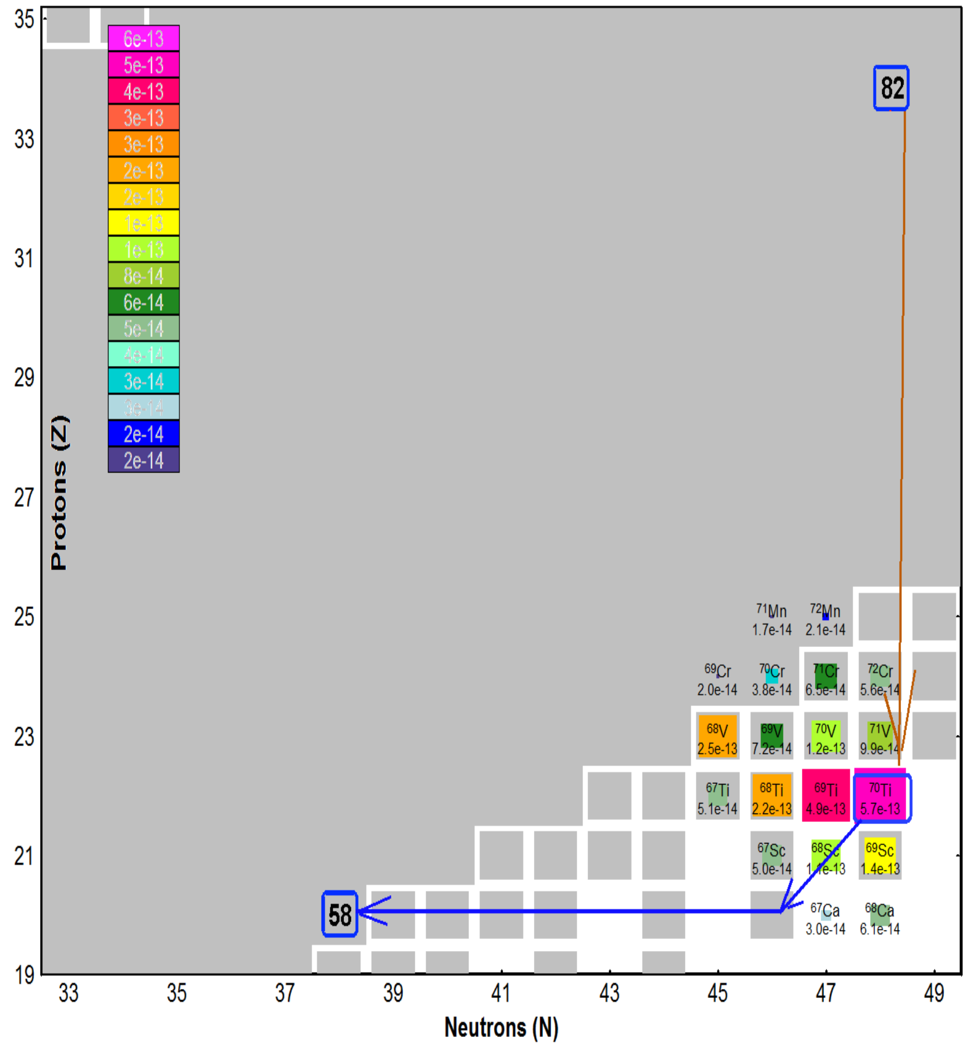


Initial Prefragments Plot for ^{58}Ca (2.57e-12 mb)

EVAPORATION - Compound nucleus ^{68}Ti: more probable ^{70}Ti(5.73e-13 mb); <-dZ>=2.27 <-dN>=8.89

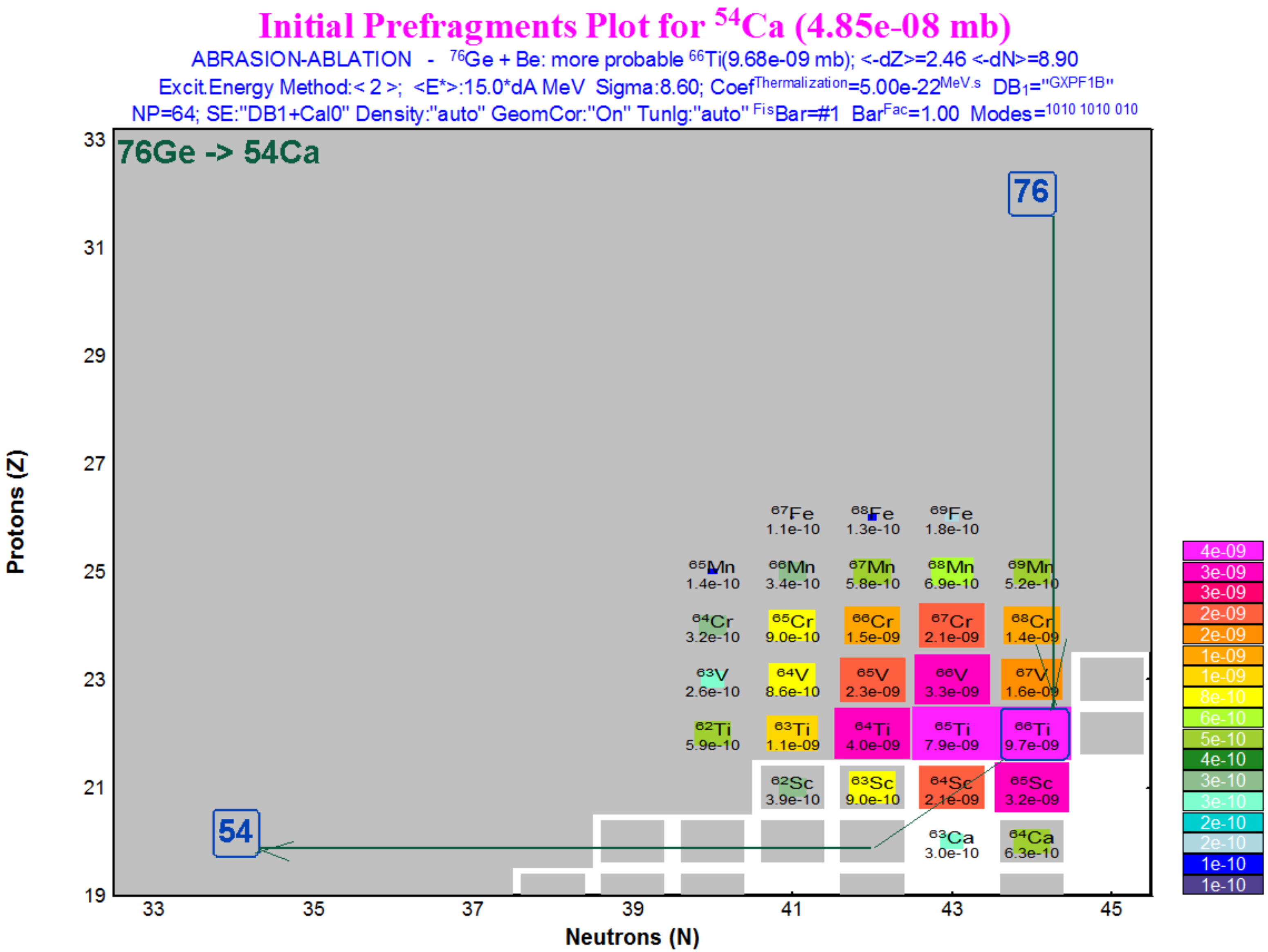
Excit.Energy: 149.0-207.0 MeV; Fus.CS: 0.0 mb; Fus.Barrier: 10.82 fm; h_omega = 2.0 MeV

NP=64; SE:"DB1+Cal0" Density:"auto" GeomCor:"On" TunIg:"auto" FisBar=#1 BarFac=1.00 Modes=1010 1010 010



More probable prefragments are Ti-isotopes (dZ=2)

LISE++ Abrasion-Ablation: Initial prefragments plot (^{76}Ge)



More probable prefragments are Ti-isotopes (dZ=2)

PACE 4

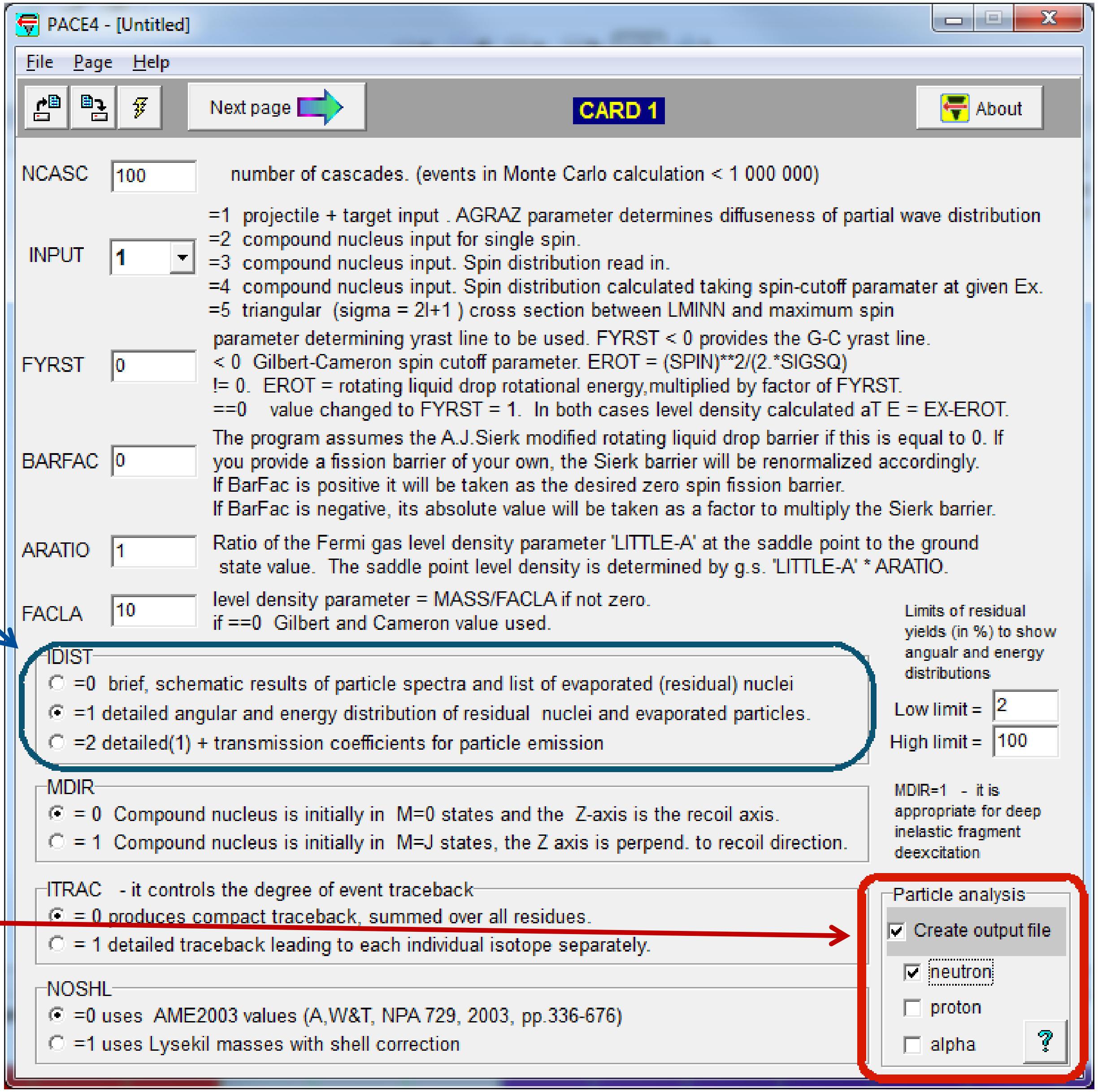
Detailed analysis of emitted particles in PACE4

PACE4 version 4.18

LISE++ package version 9.2.75

IDIST should be > 0 to have access to the "Particle analysis" group

"Particle analysis" group



The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:
http://www.nscl.msu/edu/lise

Particle analysis output file structure

Detailed analysis of Emitted particles: "Untitled.particles"

Decay Mode	N mode	N All	Chain	Z_f final	N_f final	Zc emitter	N_c emitter	J_c init	Jf final	M_Jc proj-n	Fission prob	Ex_i MeV	Ex_f MeV	Ep_Lab MeV	Ap_Lab deg
1	1	1	1	70	93	70	102	58	54	0	1.5e-03	143.1	126.5	6.5	115.0
1	2	2	2	68	90	70	102	24	21	0	4.5e-05	143.1	127.5	7.2	087.1
1	3	3	35	67	91	70	102	24	26	0	4.5e-05	143.1	131.5	1.7	136.6
1	4	4	81	66	91	70	102	24	23	0	4.5e-05	143.1	130.5	2.2	151.1
1	5	5	3	69	92	70	102	22	22	0	3.1e-05	143.1	132.5	3.5	056.4
1	6	6	23	70	91	70	102	22	21	0	3.1e-05	143.1	133.5	2.5	049.2
1	7	7	4	70	92	70	102	52	48	0	5.5e-04	143.1	129.5	6.9	059.0
1	8	8	33	70	92	70	102	52	46	0	5.5e-04	143.1	126.5	7.8	093.0
1	9	9	80	68	91	70	102	52	51	0	5.5e-04	143.1	133.5	1.9	065.5
1	10	10	100	69	93	70	102	52	47	0	5.5e-04	143.1	127.5	10.3	041.8
1	11	11	31	70	92	70	102	31	31	0	4.7e-05	143.1	132.5	3.8	051.1

Decay mode : type of particle emitted 1-n, 2-p, 3-alpha

N mode : number of emitted particle in this mode (for example "p")

N all : number of emitted particle in all modes (n,p,a)

Chain : Number of chain (cascade)

Z_f, N_f : Z and N of the final nucleus in the chain of decay

Z_c, N_c : Z and N of emitting nucleus *(if Z_c is negative, it means that the nucleus fissioned)*

J_c, J_f : initial and final spin indices for this particle emission indices for this particle emission

M_Jc : the projection of J_c on the Z-axis.

(Fractional spins are neglected for the projection. For J_c, J_f, the actual spin = J_c, J_f-1 in even mass nucleus, J_c, J_f-1/2 in odd mass nucleus)

Fisson prob : Fission probability

Ex_i : excitation energy at emitting level (MeV)

Ex_f : excitation energy at final level (MeV)

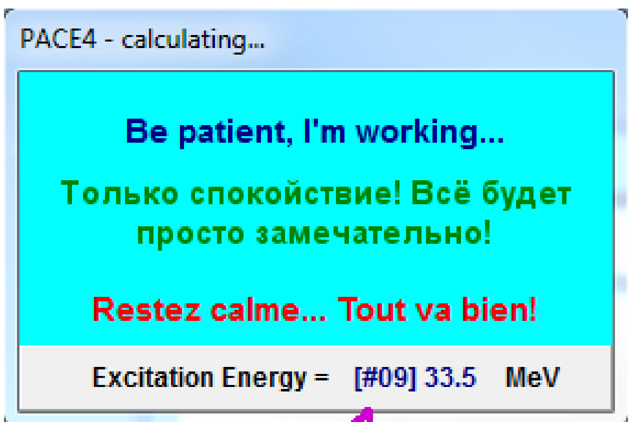
Ep_Lab : emitted particle energy in the Lab. System (MeV)

Ap_Lab : emitted particle angle in the Lab. System (degrees)

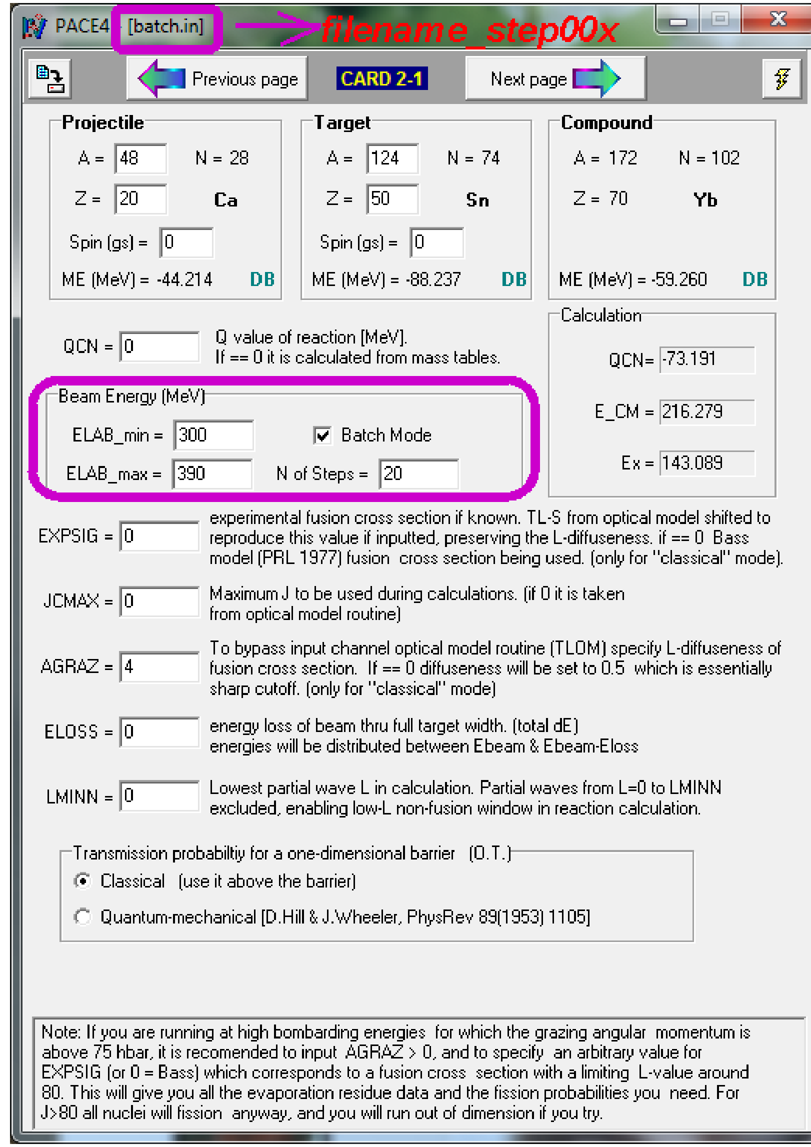
PACE4 version 4.19.2

LISE++ package version 9.2.108

06/14/2011



shows current step in the Batch mode



The code operates under MS Windows environment and provides a highly user-friendly interface.
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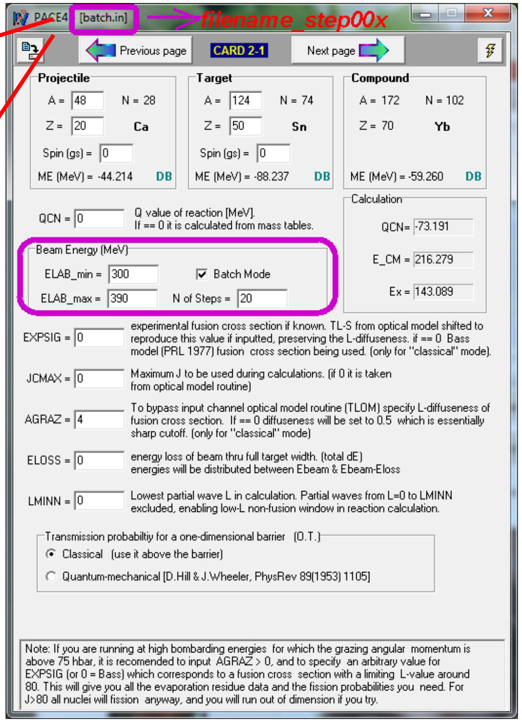
http://www.nscl.msu/edu/lise

Batch mode in PACE4

batch	in	170
batch	rtf	94,208
batch_step001	particles	1,606,052
batch_step001	rtf	107,244
batch_step002	particles	1,754,603
batch_step002	rtf	112,204
batch_step003	particles	1,851,573
batch_step003	rtf	121,202
batch_step004	particles	1,949,429
batch_step004	rtf	128,027
batch_step005	particles	2,060,912
batch_step005	rtf	124,967
batch_step006	particles	2,192,401
batch_step006	rtf	134,066
batch_step007	particles	2,306,423
batch_step007	rtf	124,422
batch_step008	particles	2,391,162
batch_step008	rtf	126,073

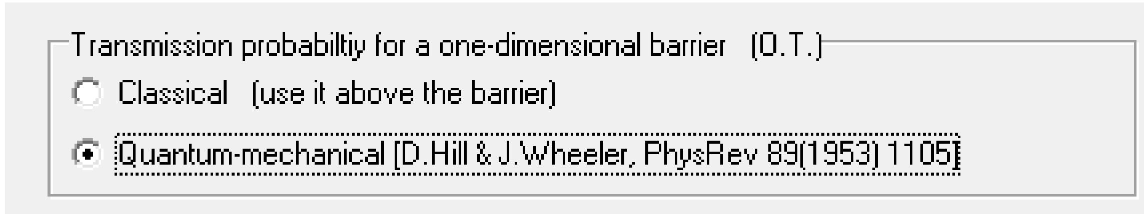
c:\Program Files (x86)\LISEbeta\CrossSections*.*

↑Name	Ext	Size
[..]		<DIR>
[PublishedData]		<DIR>
batch	cs4	637
batch_step001	cs4	927
batch_step002	cs4	985
batch_step003	cs4	1,101
batch_step004	cs4	1,217
batch_step005	cs4	1,246
batch_step006	cs4	1,362
batch_step007	cs4	1,478
batch_step008	cs4	1,622
batch_step009	cs4	637
batch_step010	cs4	753
batch_step011	cs4	782
batch_step012	cs4	898
batch_step013	cs4	782
batch_step014	cs4	869
batch_step015	cs4	956
batch_step016	cs4	810
batch_step017	cs4	956
batch_step018	cs4	927
batch_step019	cs4	1,014
batch_step020	cs4	1,130



Quantum-mechanical transmission update in PACE IV

PACE version : 4.20
In LISE++ package v.9.6.31
from 23-May-2013



1. R_fusion value has been used to calculate partial waves L in QM mode, in order to avoid "classical" subroutines in at energies below the barrier.
However this assumption gives some serious jumps (it will be shown later), and the code has been modified to avoid this problem, coming back above the barrier to the classical solution in QM mode.

2. Default value of AGRAZ which was equal to 4, now set to 2

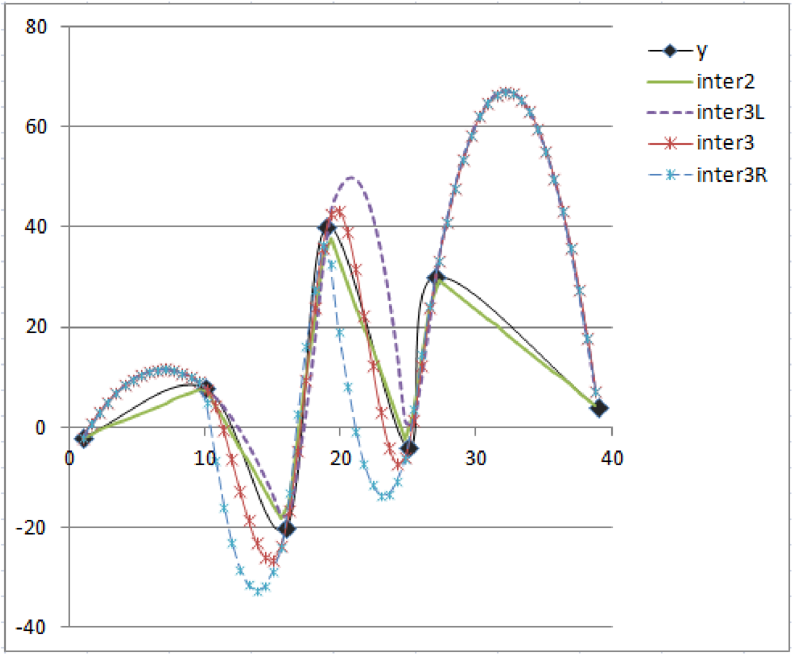
LISE for Excel

New functions:

- public **find_line** (x1,y1,x2,y2, **x**)
- public **find_parabola** (x1,y1,x2,y2,x3,y3, **x**)
- public **interpolate2** (Xarray, Yarray, **x**)
- private **interpolate3L** (Xarray, Yarray, **x**) **:** based on *find_parabola*. X is between 1st and 2nd parabola points
- private **interpolate3R** (Xarray, Yarray, **x**) **:** based on *find_parabola*. X is between 2nd and 3rd parabola points
- public **interpolate3** (Xarray, Yarray, **x**) **:** combination of interpolate3L and interpolate3R. **Recommended**

Xarray should be sorted!

-778 : count(Xarray) != count(Yarray)
-777 : at least one cell in Xarray is not value
-776 : Xarray order is wrong. Non-sorted
-775: count(Xarray) < 3
-774: x < min(Xarray)
-773: x > max(Xarray)
-771: at least one cell in Yarray is not value



See example "test_for_lise_excel.xlsx", Sheet "interpolation"

LISE for Excel : Operations with Matrices

New functions:

Function **MatrixElement** (ByRef M As Object, ByVal row As Integer, ByVal col As Integer) As Double

Function **GetSquareMatrixOrder** (ByRef M As Object) As Integer

Function **MatricesMult** (ByRef M1 As Object, ByRef M2 As Object, ByVal row As Integer, ByVal col As Integer) As Double

Function **MatrixVectorMult** (ByRef Matrix As Object, ByRef Vector As Object, ByVal row As Integer) As Double

Function **MatrixVectorSumSquare** (ByRef Matrix As Object, ByRef Vector As Object, ByVal row) As Double

See example "test_for_lise_excel.xlsx"
Sheet "matrices"

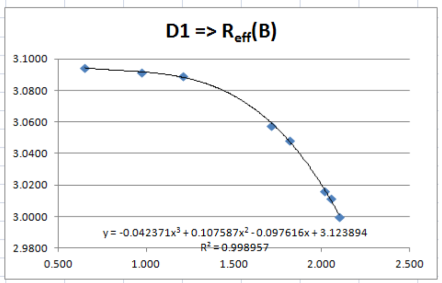
	1	2	3	4	5	6			1	2	3	4	5	6		
1	0.433	-0.751	0	0		0.852	OI - local		1.32	1.52	1.49	1.00	0	0.070		INIT
2	1.316	0.026	0	0		-17.06			X	A	Y	B	L	D		
3	0	0	1.188	-0.054		0.00										
4	0	0	4.445	0.641		0.00										
5					1											
6						1			SIGMAs							
									1	2	3	4	5	6		
1	0.495	-0.159				-0.683	IF- local		1.28	2.11	1.78	6.68	0	0.070	sigma-I	CALC
2	1.658	1.487				24.07										
3			0.937	0.103		0.00										
4			0.146	1.083		0.00										
5					1											
6						1										
	1	2	3	4	5	6			1	2	3	4	5	6		
1	0.005	-0.376				2.454	OF- global		0.60	3.98	2.35	7.49	0	0.070	sigma-G	CALC
2	2.674	-1.208				0.12										
3			1.572	0.016		0.00										
4			4.988	0.686		0.00										
5					1											
6						1										
		OF_global = IF_local x OI_local														

New functions (2011):

- public **A1900_R_Dipole** (N,B), where N – dipole number, B – magnetic field (T); return R in m
- public **A1900_Br_Dipole** (N,B), where N – dipole number, B – magnetic field (T); return Brho in Tm
- private **A1900_R_DipoleX** (B), where X – dipole number, B – magnetic field (T); return R in m
- private **A1900_Br_DipoleX** (B), where X – dipole number, B – magnetic field (T); return Brho in Tm m

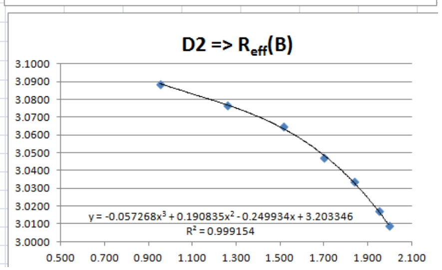
A1900 Dipole D1

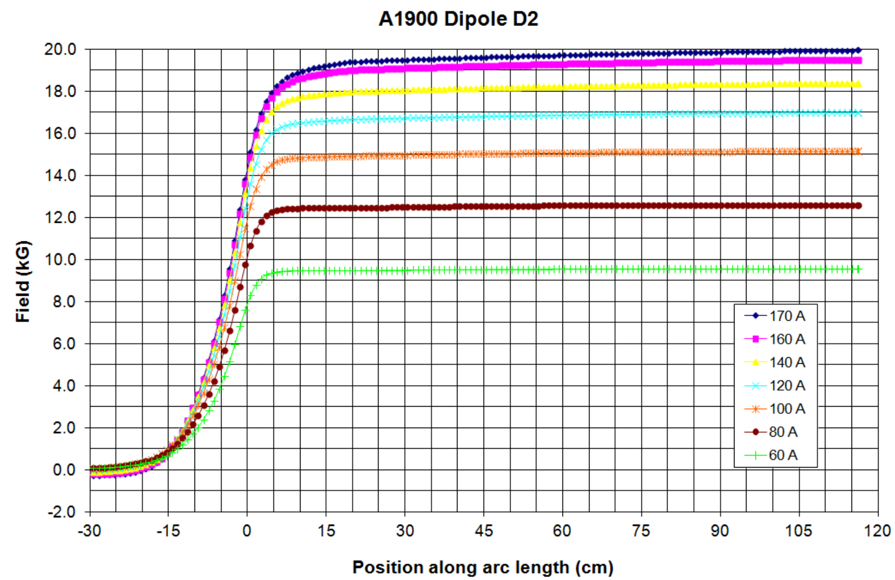
Hall Probe (Tesla)	Current (amps)	1/2 Effective Length (cm)	R eff (m) @ 45 deg
0.000			
0.653	40	121.511	3.0942
0.975	60	121.400	3.0914
1.211	75	121.297	3.0888
1.716	120	120.064	3.0574
1.822	135	119.708	3.0483
2.020	170	118.440	3.0160
2.057	180	118.258	3.0114
2.100	190	117.790	2.9995



A1900 Dipole D2

Hall Probe (Tesla)	Current (amps)	1/2 Effective Length (cm)	R eff (m) @ 45 deg
0.000			
0.954	60	121.302	3.0889
1.259	80	120.816	3.0766
1.513	100	120.352	3.0647
1.697	120	119.669	3.0473
1.837	140	119.147	3.0341
1.948	160	118.495	3.0175
1.994	170	118.176	3.0093





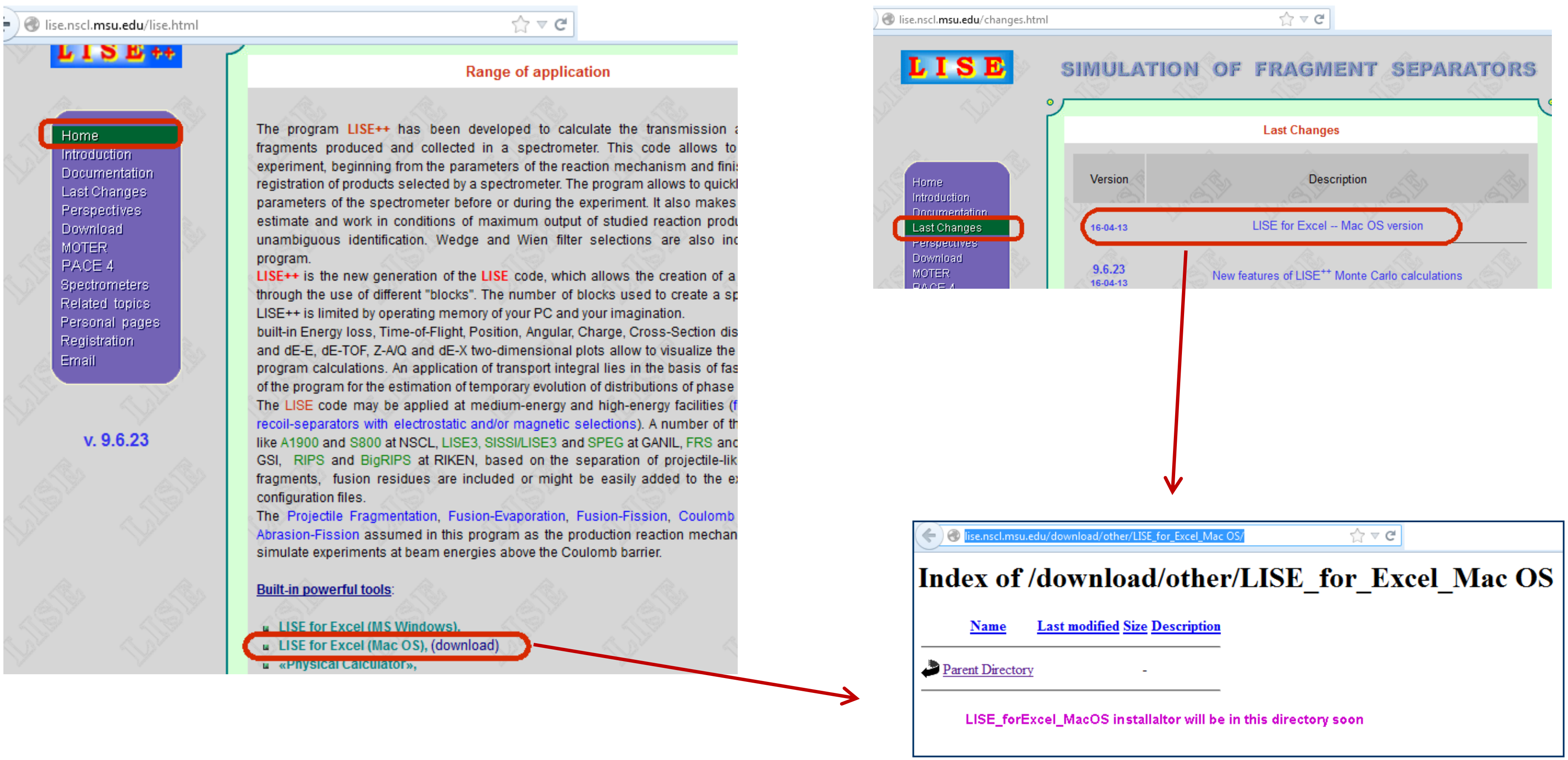
See example "test_for_lise_excel.xlsx"
Sheet "A1900_dipoles"

LISE for Excel – Mas OC version

Daniel has transported some LISE++ libraries to Mac OS,
and modified the LISE-Excell shell and its macros to operate under MaC OS.
It is a beta-version. Please, submit your remarks to Daniel (bazin@nscl.msu.edu)

http://lise.nscl.msu.edu/download/other/LISE_for_Excel_Mac OS/

Links to download the installer of "LISE_for_Excel" version for Mac OS from the LISE++ site



Configurations

NSCL A1900 configurations in LISE^{++}

version 9.2.106

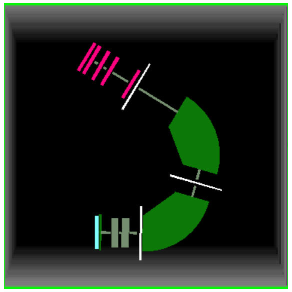
Segmented configurations:	*Number of blocks*	*Start*	*Stop*	*Optics order*	*Source maps*
A1900_2010.lcn	4	z15	z105	1	
A1900_segmented_COSY.lcn	4	z15	z105	5	link
Extended configurations:					
A1900_extended_COSY.lcn*	73	z15	z106	5	link
A1900_extended_COSY_only_Quads.lcn	73	z15	z106	5	link
A1900_extended_LISE.lcn	73	z15	z106	2	
A1900_I190_extended_LISE.lcn	113	z15	i190	2	link
A1900_S800BL_extended_LISE.lcn	157	z15	i250	2	
Final extended configuration (version 9.2.107):					
A1900_extended_COSY_S800BL_LISE.lcn*	73	z15	i250	5-2	

**- includes sextupoles and octupoles for A1900*

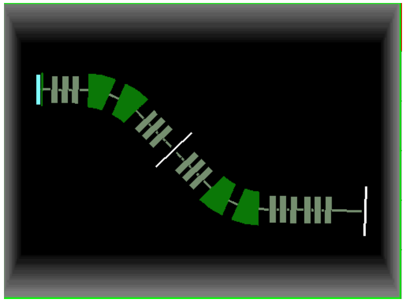
- *Extended_LISE versions (based on TRANSPORT calculations) have been created with use of TRANSPORT files obtained from J.Stetson,T.Ginter & D.Bazin*
- *Extended_ & Segmented_COSY versions (based on COSY maps) have been created with use of COSY files obtained from M.Portillo*

New Extended Configurations

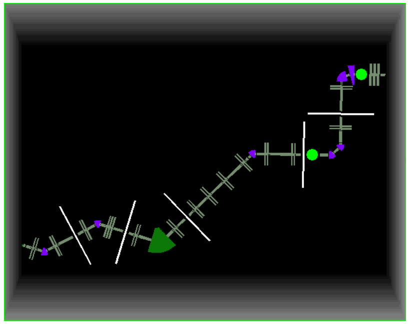
S800 - spectrograph



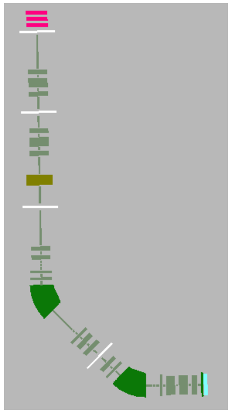
S800 beam-line



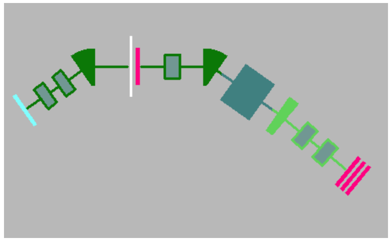
G-line



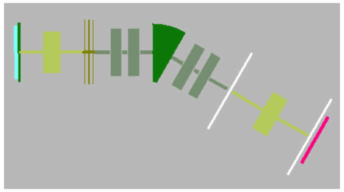
ACCULINNA2 @ FLNR



MARS @ TAMU



RESOLUT @ FSU



Future Extended Configurations ?

After E-bender & E-quad Development

FMA @ ARGONNE

DRAGON @ TRIUMF

S3 @ GANIL

MARS @ TAMU
+ compensating dipole

Beam physicists:

A2400 @ FRIB

SupeFRS @ GSI

FRS @ GSI

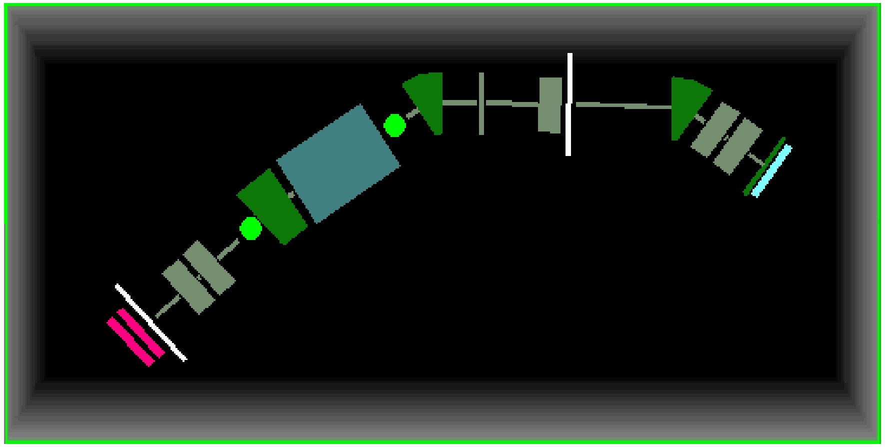
BigRIPS @ RIKEN

LISE3 @ GANIL

- almost finished

Configurations: MARS

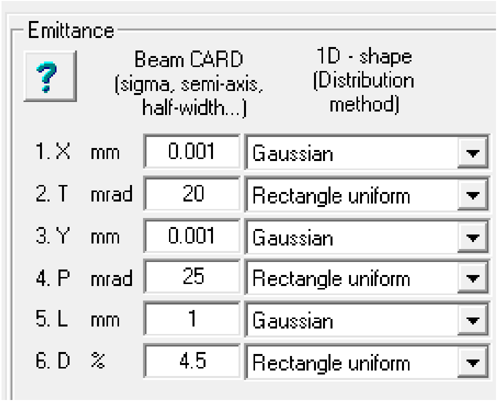
MARS spectrometer extended configuration in the LISE^{++} package



- Use of two rotation blocks for vertical selection performance
- Using regular the “dipole” block instead the “compensating dipole” block
- Vertical dipole parameters (angle, radius) were calculated manually
- Second order optics

Using Monte Carlo method
1st order
momentum acceptance:
sig(P) ~ 4.9%

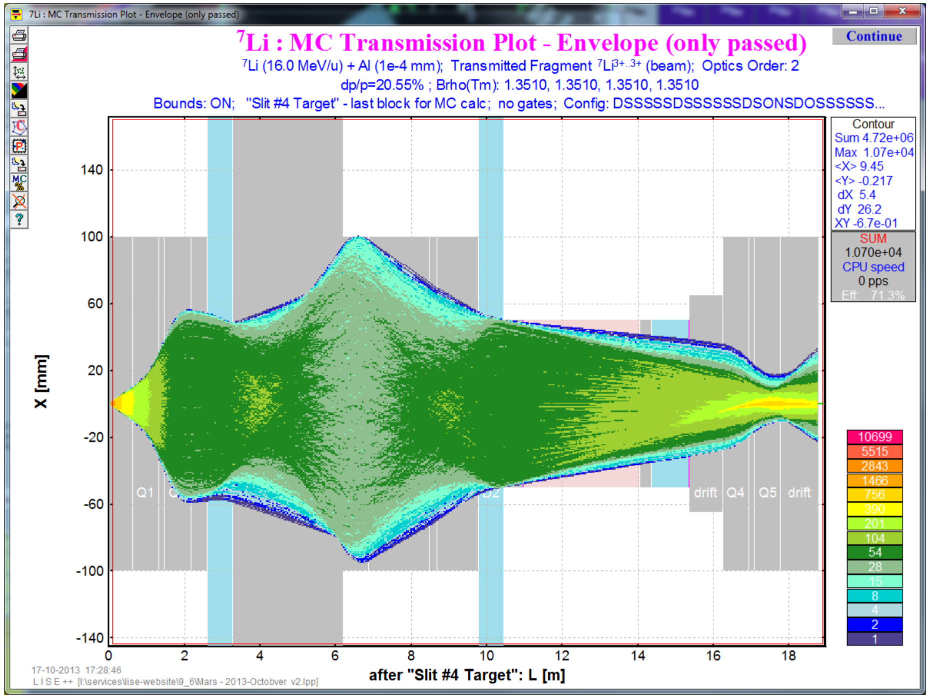
angular acceptance
T ~ 15 mrad, P ~ 35 mrad

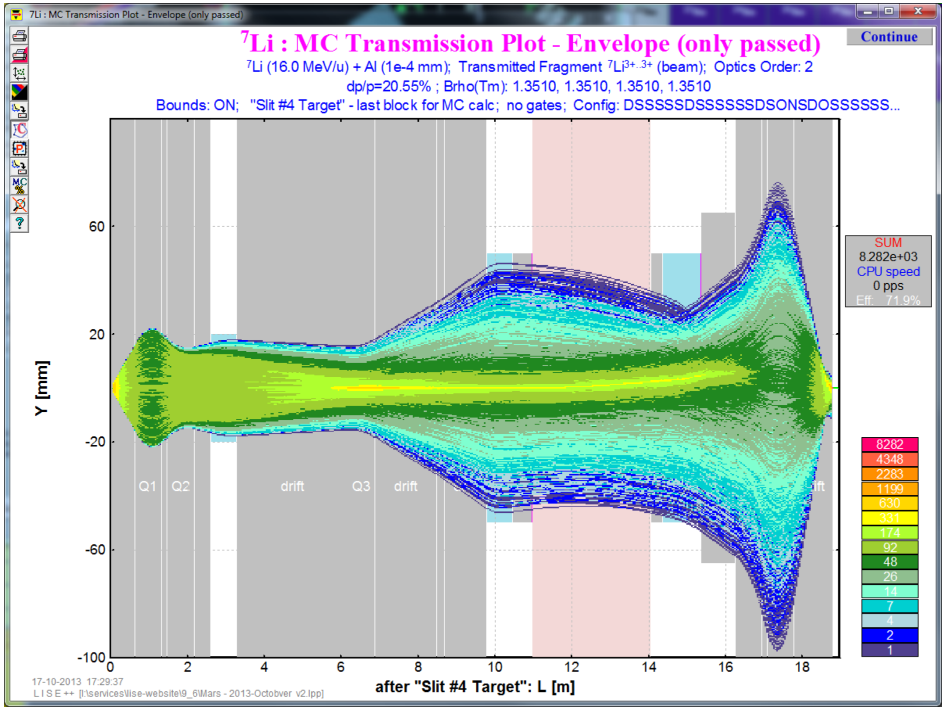


Monte Carlo method

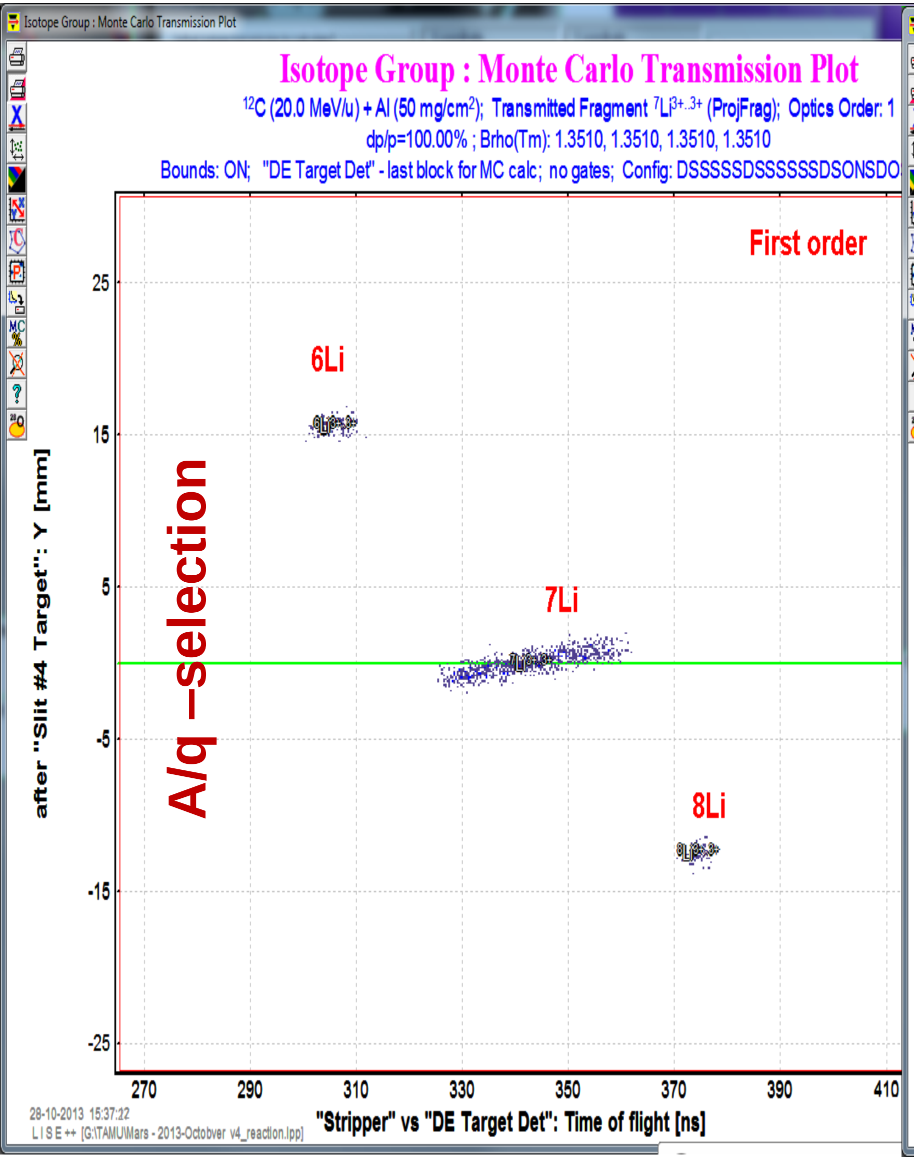
2nd order, transmission ~75%

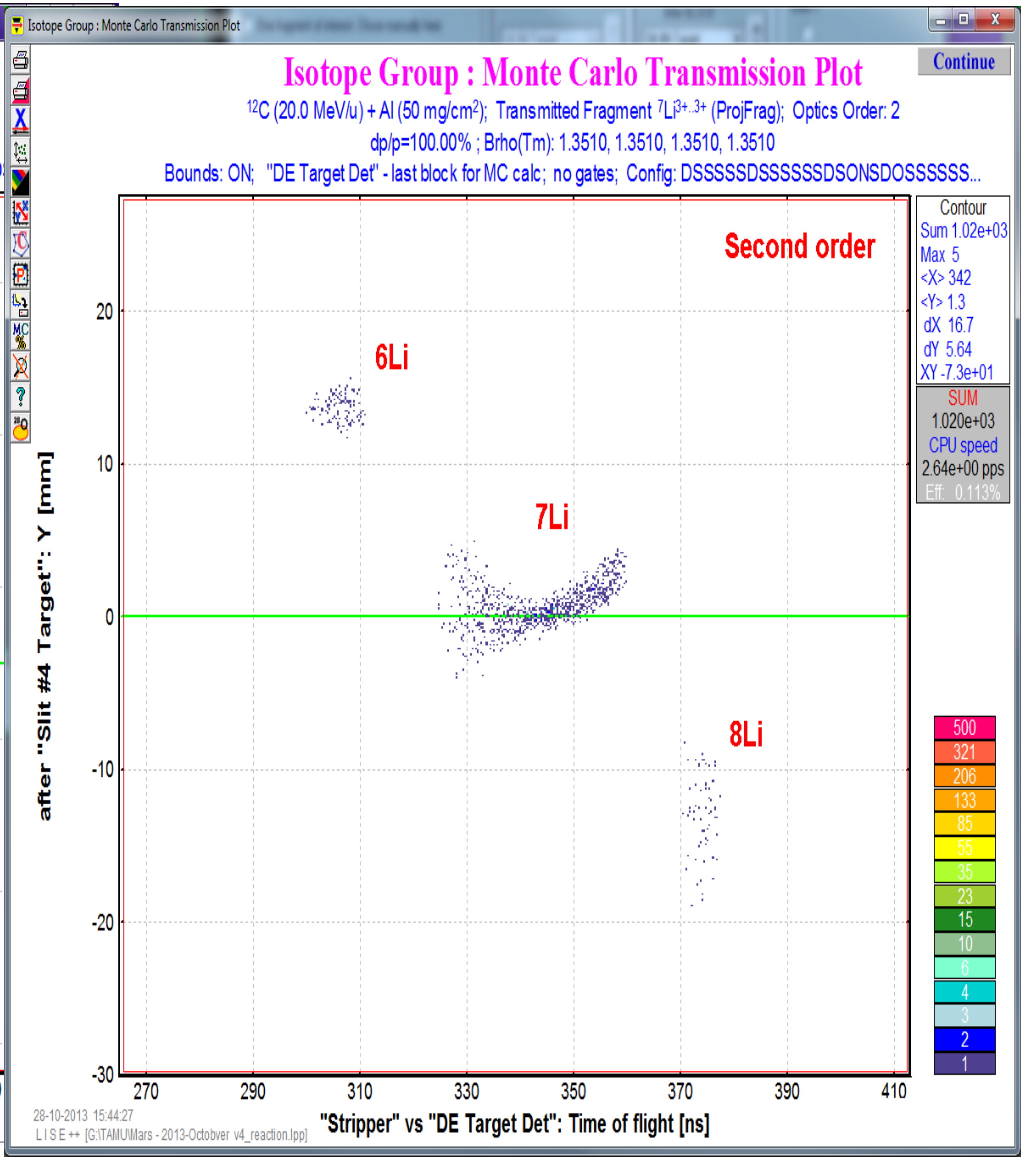
for sig(P) = 4.5%



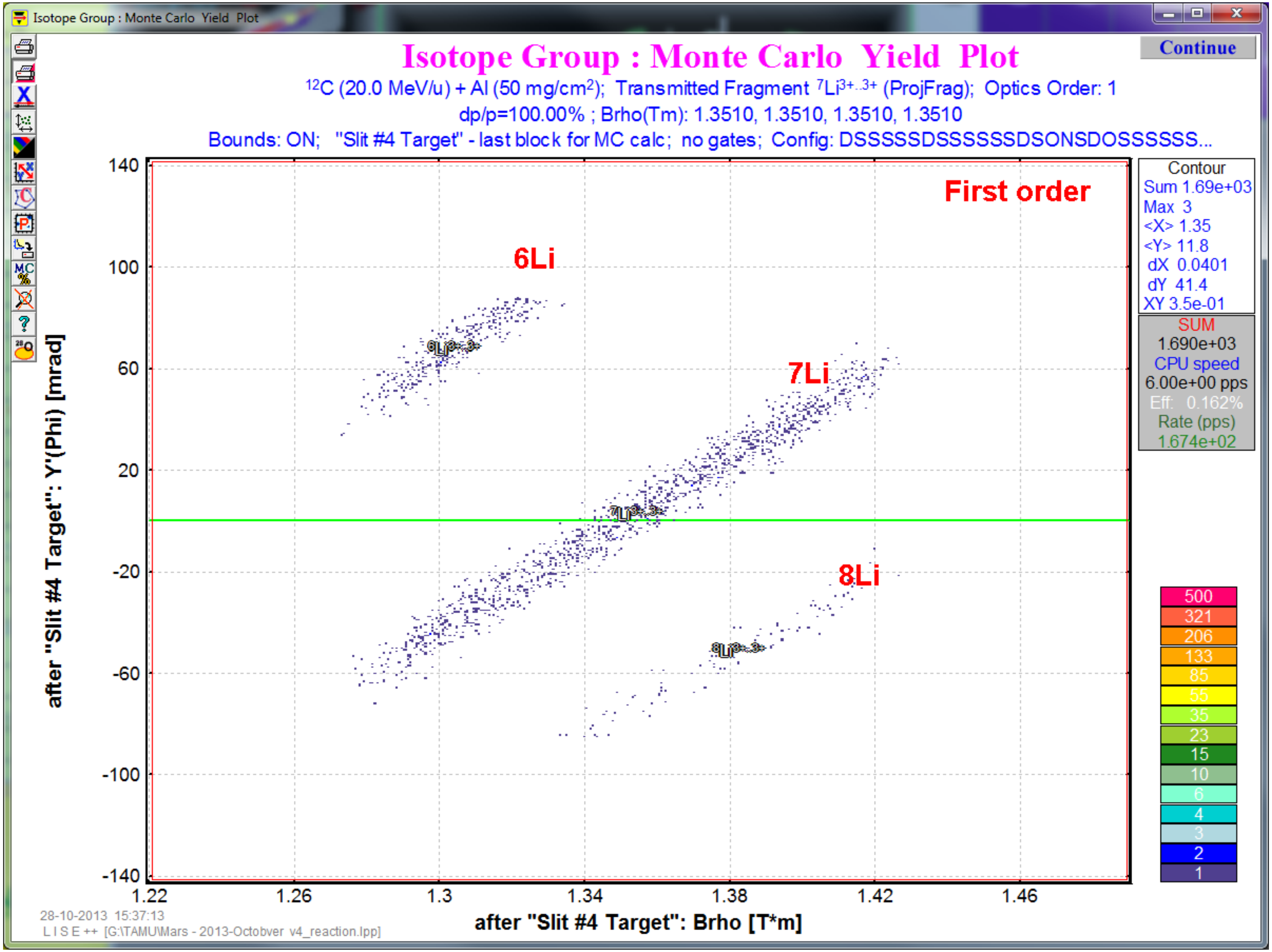


MARS spectrometer : Y (A/q –selection) vs. TOF



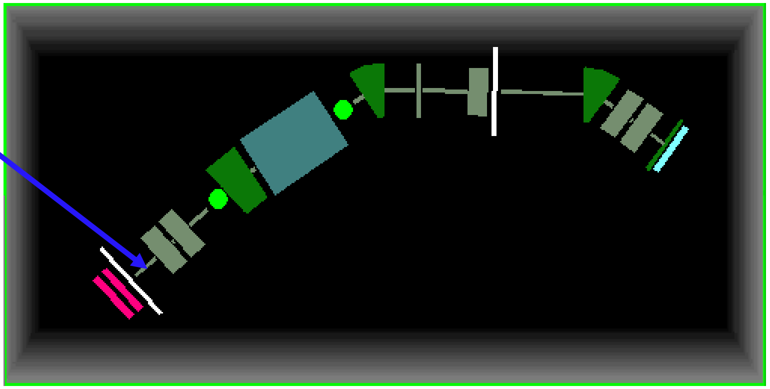


MARS spectrometer : Y' (Momentum–selection) vs. Brho (1st order)



dp/p total resolution with angular dispersion

If insert one more PPAC between the last Quad and FP



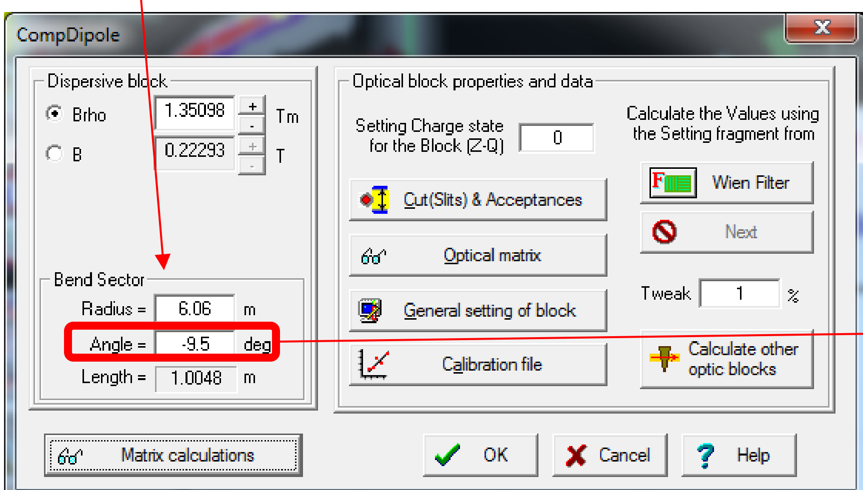
	MARS			S800 BL	
x, PPAC resolution	1	mm		1	mm
x, 2 PPACs resolution	1.414	mm		1.414	mm
distance between PPACs	0.5	m		1	m
angle	2.83	mrad		1.4	mrad
angular dispersion	11.8	mrad/%		53	mrad/%
dp/p-resolution	0.24%			0.03%	
dp/p-resolution from optics	0.50%				
total dp/p resolution	0.55%				

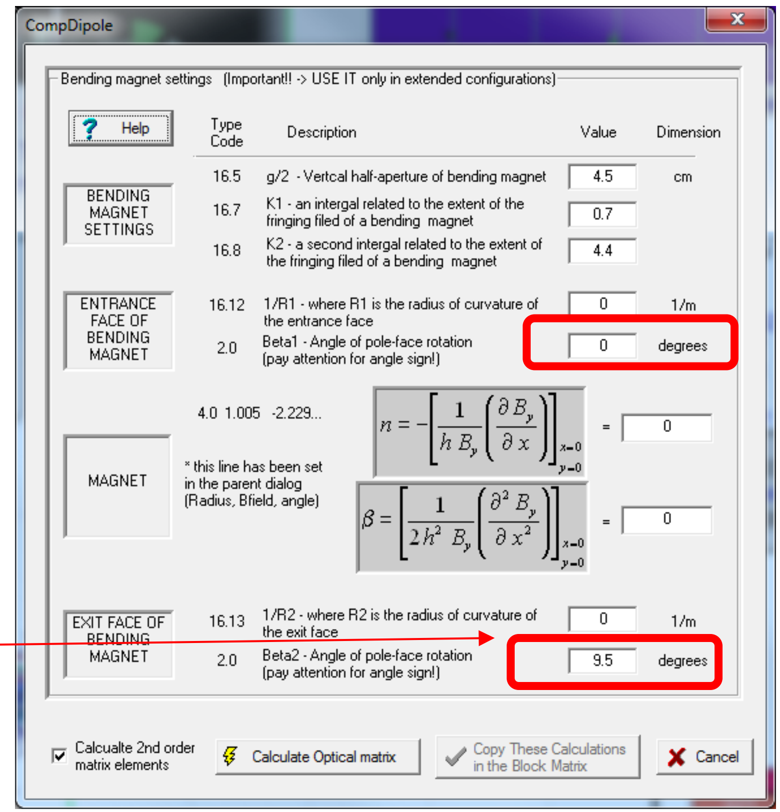
MARS spectrometer : compensating dipole settings

degrees	rad	sin	Length	Radius
			m	m
0.001	0.000	0.000	1	
0.5	0.009	0.009	1.000013	114.364
1.0	0.017	0.017	1.000051	57.241
1.5	0.026	0.026	1.000114	38.176
2.0	0.035	0.035	1.000203	28.639
2.5	0.044	0.044	1.000318	22.916
3.0	0.052	0.052	1.000457	19.101
3.5	0.061	0.061	1.000623	16.376
4.0	0.070	0.070	1.000813	14.332
4.5	0.079	0.078	1.001029	12.743
5.0	0.087	0.087	1.001271	11.471
5.5	0.096	0.096	1.001538	10.432
6.0	0.105	0.105	1.001831	9.565
6.5	0.113	0.113	1.002149	8.832
7.0	0.122	0.122	1.002493	8.204
7.5	0.131	0.131	1.002862	7.660
8.0	0.140	0.139	1.003257	7.184
8.5	0.148	0.148	1.003678	6.765
9.0	0.157	0.156	1.004125	6.392
9.5	0.166	0.165	1.004598	6.058
10.0	0.175	0.174	1.005096	5.758
10.5	0.183	0.182	1.00562	5.487

Assuming rectangle shape

NOTE: in the future LISE++ should calculate itself the angle to compensate dp/p dispersion with taking a shape into account





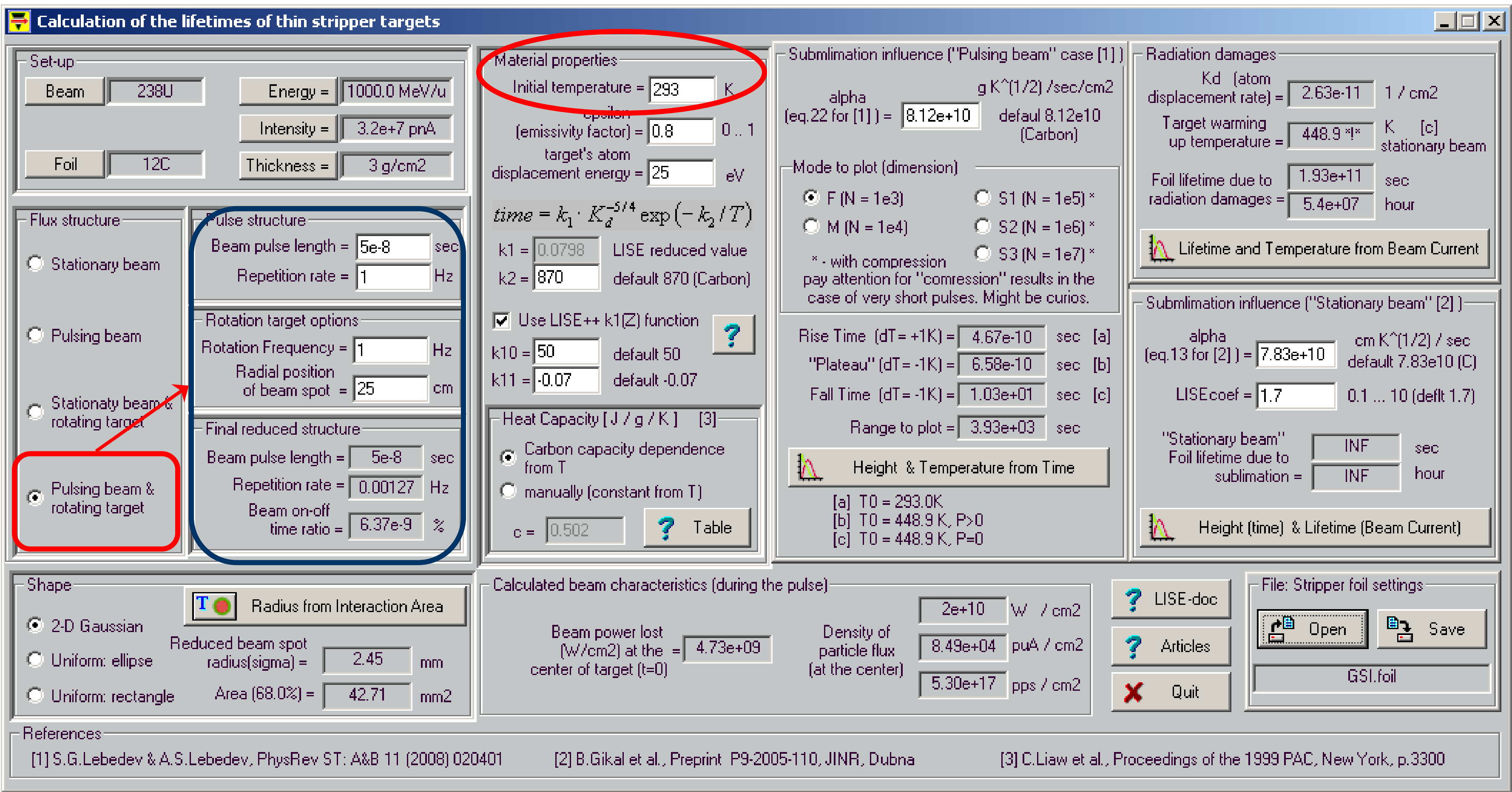
Utilities

Stripper Lifetime utility

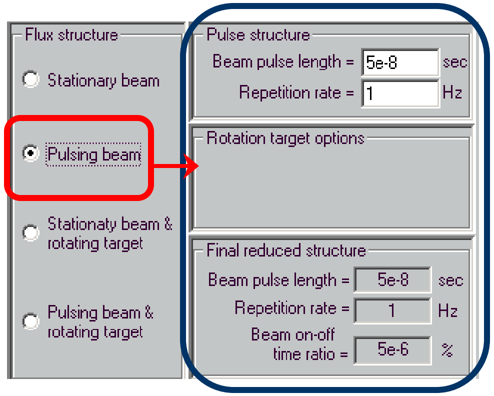
Inspired by the 4th F.-S. experts meeting

v. 9.2.38

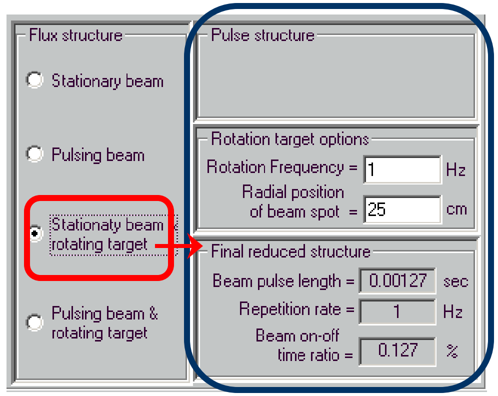
- **Target initial temperature**
- **Modification for "stationary beam" models in the case of pulsing beams**
- **Rotation target: modifications for a reduced beam pulse length**
- **New flux structure: Pulsing beam & rotating target**



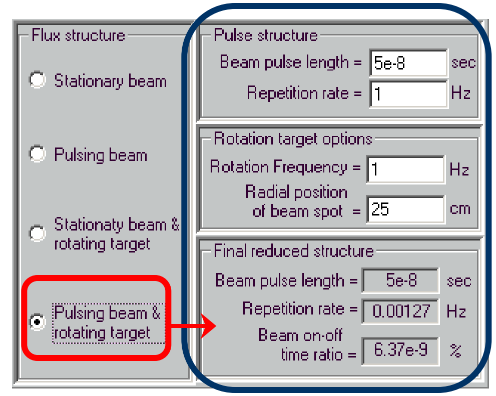
Pulsing beam



Rotating target



Pulsing beam + Rotating target



Probability with rotating target Is defined as X-spot size / Target Length = 0.127%,

where the target length is 2 Pi R,

Therefore distance between reduced "pulses" is 787 seconds, with the pulse length equal to 50 ns

N.A.Tahir et al., J. Phys. D: Appl. Phys. 38 (2005) 1828–1837.

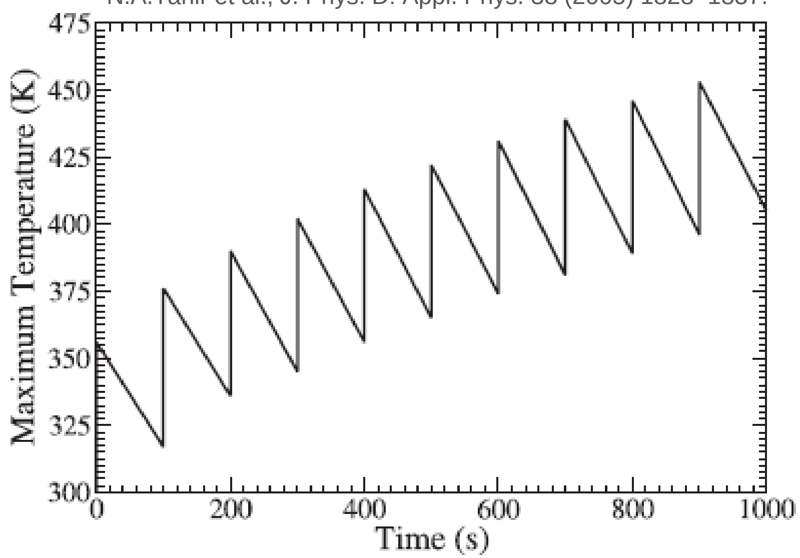
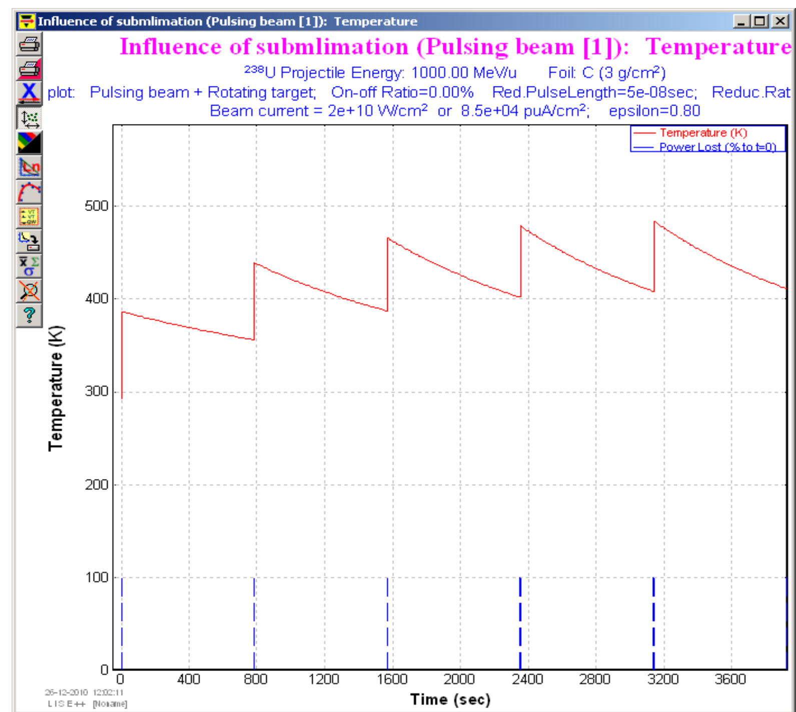


Figure 5. (*a*) Temperature versus time in the target during 1000 irradiations by a 1 GeV u^{-1} U bunch with $N = 10^{10}$ and $\tau = 50$ ns, $\sigma_x = 1$ mm and $\sigma_y = 6$ mm.

LISE++

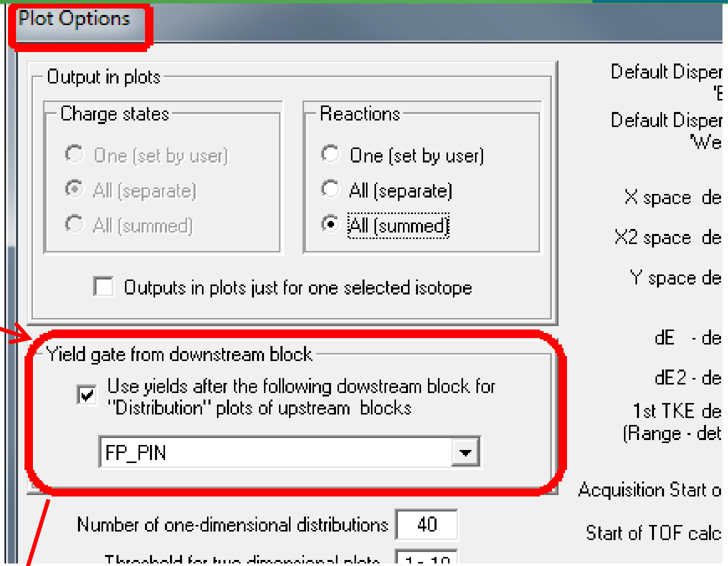


Yield Plot gated on downstream block (1)

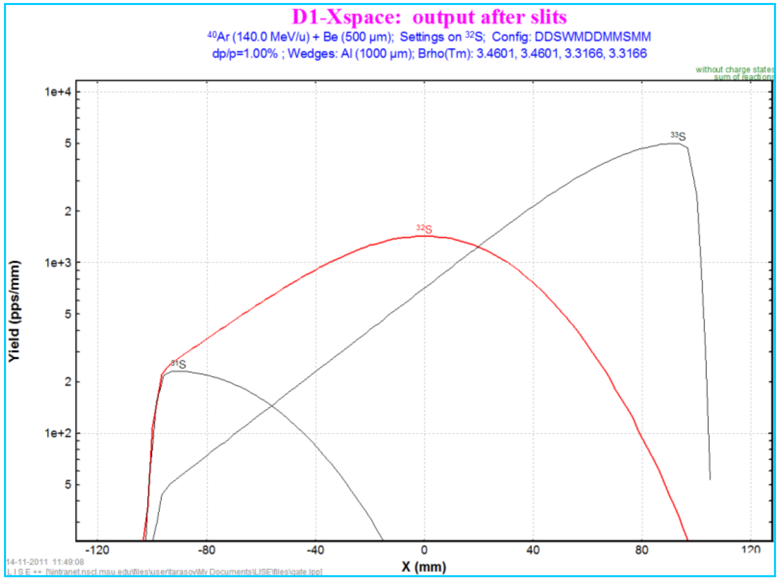
Inspired by the RIKEN experiment
^{238}U beam, November 2011

- **Only for "Distribution" method 1-D plots & 2-D PseudoMC plots**
- **For "Distribution" method just yield is gated, not a shape!**
- **Use the MC transmission dialog to see shape changes due to gates on downstream blocks**

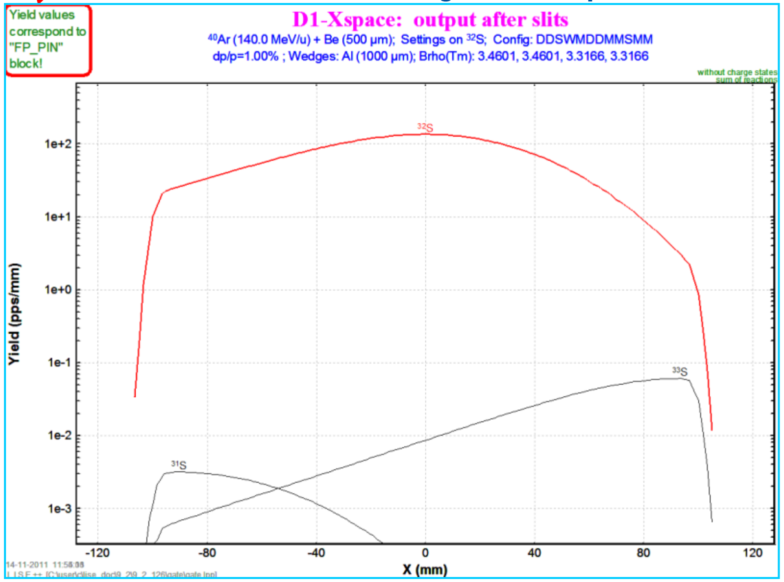
Example File: gate.lpp



No gates



With applied gate.
You should see a message in the top left corner

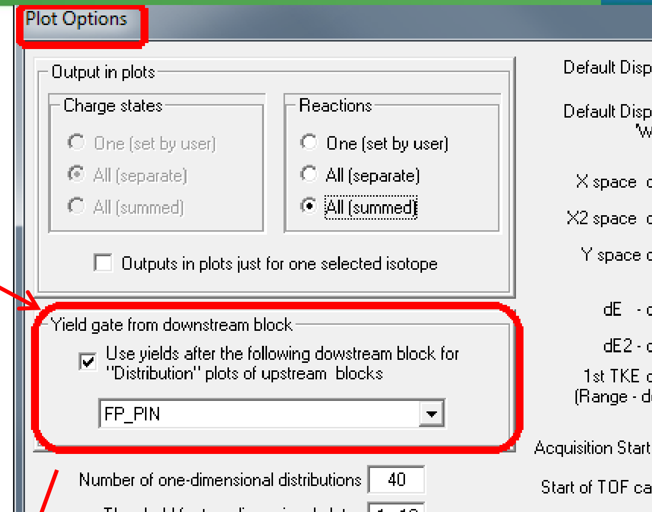


Yield Plot gated on downstream block (2)

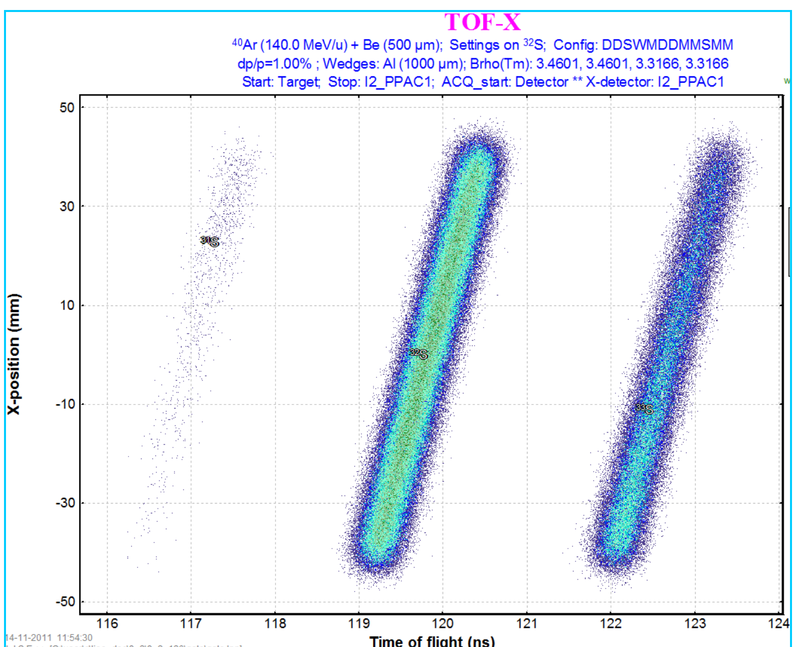
▪2-D PseudoMC plot

- For “Distribution” method just <u>yield</u> is gated, not a <u>shape</u>!
- Use the MC transmission dialog to see <u>shape</u> changes due to gates on downstream blocks

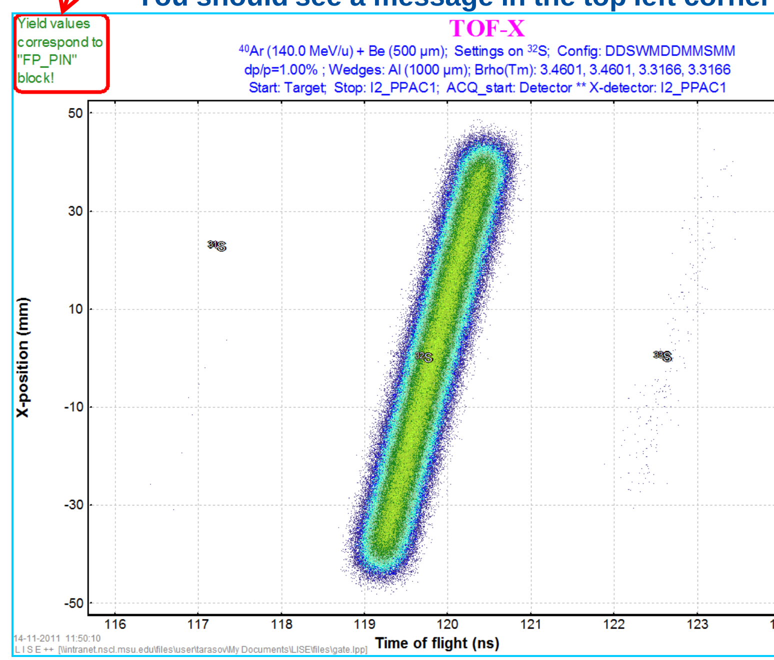
Example File: **<u>gate.lpp</u>**



No gates

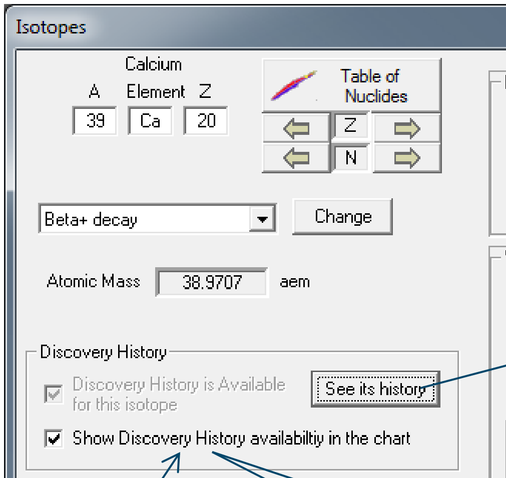


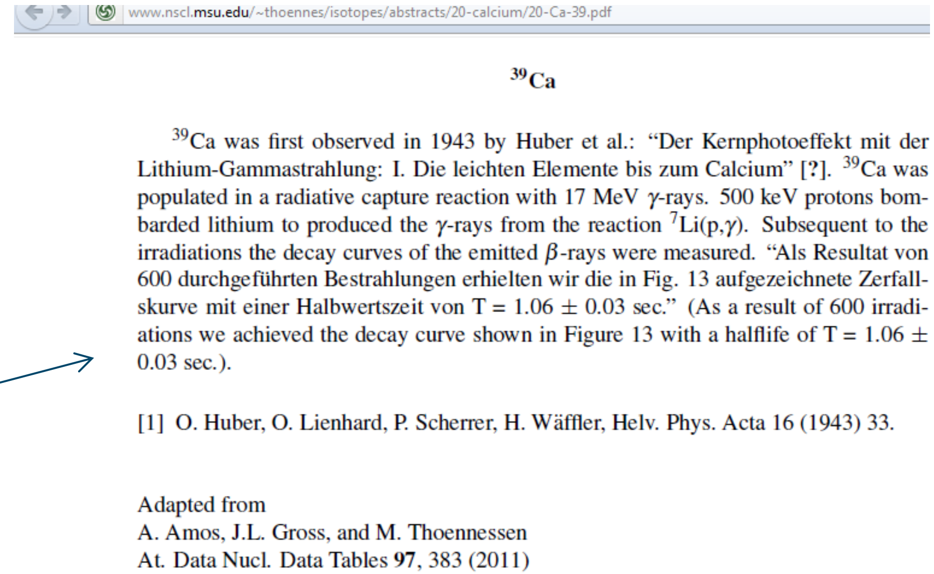
With applied gate.
You should see a message in the top left corner



History of isotope discovery

M.Thoennessen





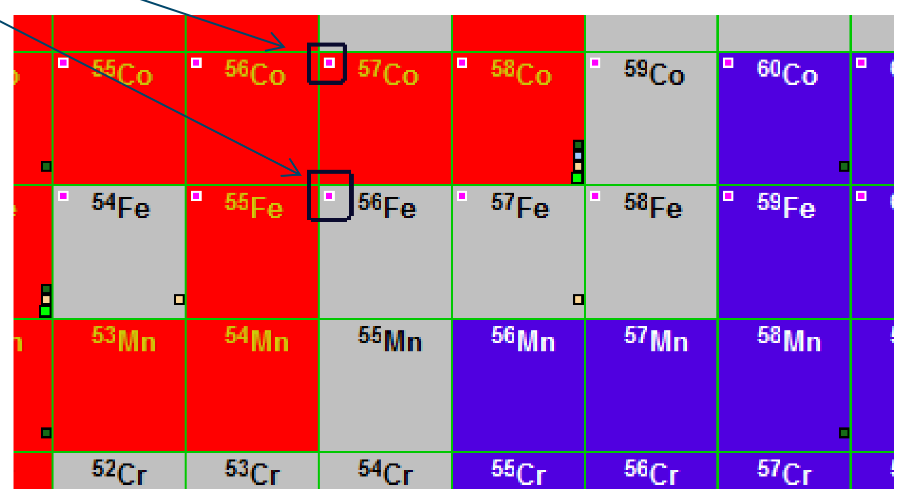
www.nscl.msu.edu/~thoennes/isotopes/abstracts/20-calcium/20-Ca-39.pdf

^{39}Ca

^{39}Ca was first observed in 1943 by Huber et al.: "Der Kernphotoeffekt mit der Lithium-Gammastrahlung: I. Die leichten Elemente bis zum Calcium" [?]. ^{39}Ca was populated in a radiative capture reaction with 17 MeV γ-rays. 500 keV protons bombarded lithium to produced the γ-rays from the reaction ^{7}Li(p,γ). Subsequent to the irradiations the decay curves of the emitted β-rays were measured. "Als Resultat von 600 durchgeführten Bestrahlungen erhielten wir die in Fig. 13 aufgezeichnete Zerfallskurve mit einer Halbwertszeit von T = 1.06 ± 0.03 sec." (As a result of 600 irradiations we achieved the decay curve shown in Figure 13 with a halflife of T = 1.06 ± 0.03 sec.).

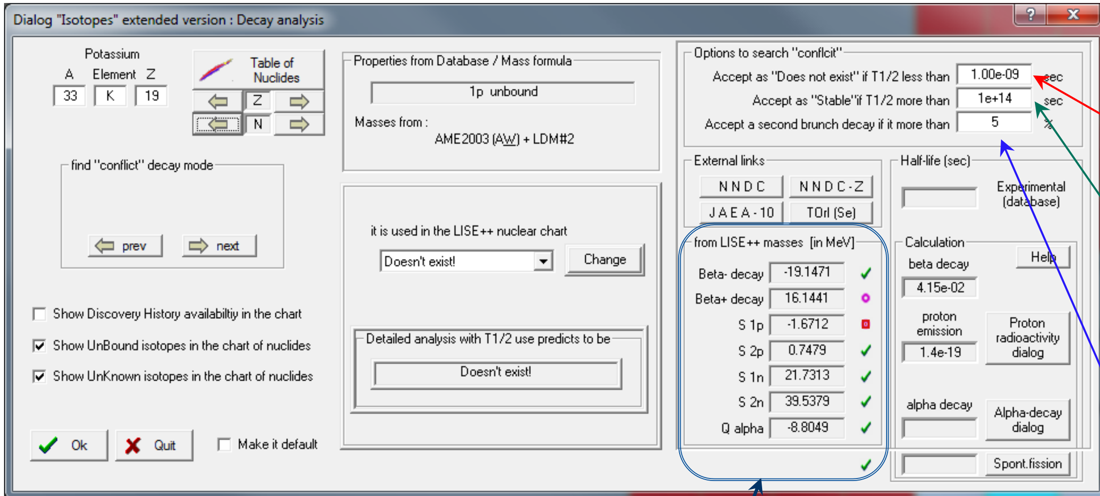
[1] O. Huber, O. Lienhard, P. Scherrer, H. Wäffler, Helv. Phys. Acta 16 (1943) 33.

Adapted from
A. Amos, J.L. Gross, and M. Thoennessen
At. Data Nucl. Data Tables **97**, 383 (2011)



Show discovery history availability in the chart of nuclides

"Decay analysis" dialog => modes: stable, decay or unbound



2nd step

If after 1st step the mode was set as "decay" then

Accept as "unbound" If half-life of this mode smaller than "does not exist" threshold

Accept as "stable" If half-life of this mode greater than "stable" threshold

1st step

According chosen mass model or database

Stable. No decay. Qa, b-, b+ <0, and S1n,S2n,S1p,S2p > 0

Decay. Qa , b-, b+ > 0, and S1p,S2p < 0

Unbound. Qa-CB>0, and S1p+CB,S2p+CB,S1n,S2n < 0, where CB – Coulomb Barrier

3rd step

- If more than 2 decay modes are present, than only two will be chosen based on short half-life
- if there are two bunches are present, then LISE++ accepts the second mode if its half-life no greater than 1st mode half-life value divided on "2nd branch value" or

$$[T1/2]_2 * coef < [T1/2]_1$$

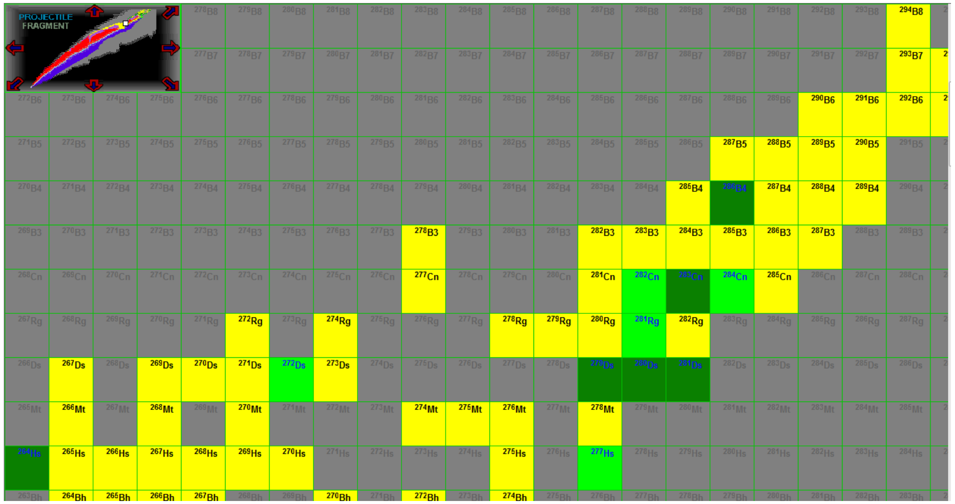
New decays :

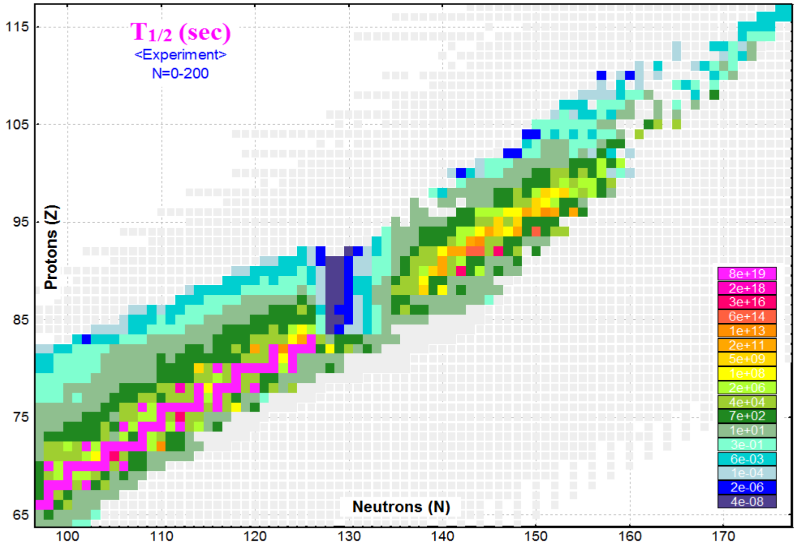
p & β+,   p & α, β- & α, SF & β+, SF & β-

New order of decay modes

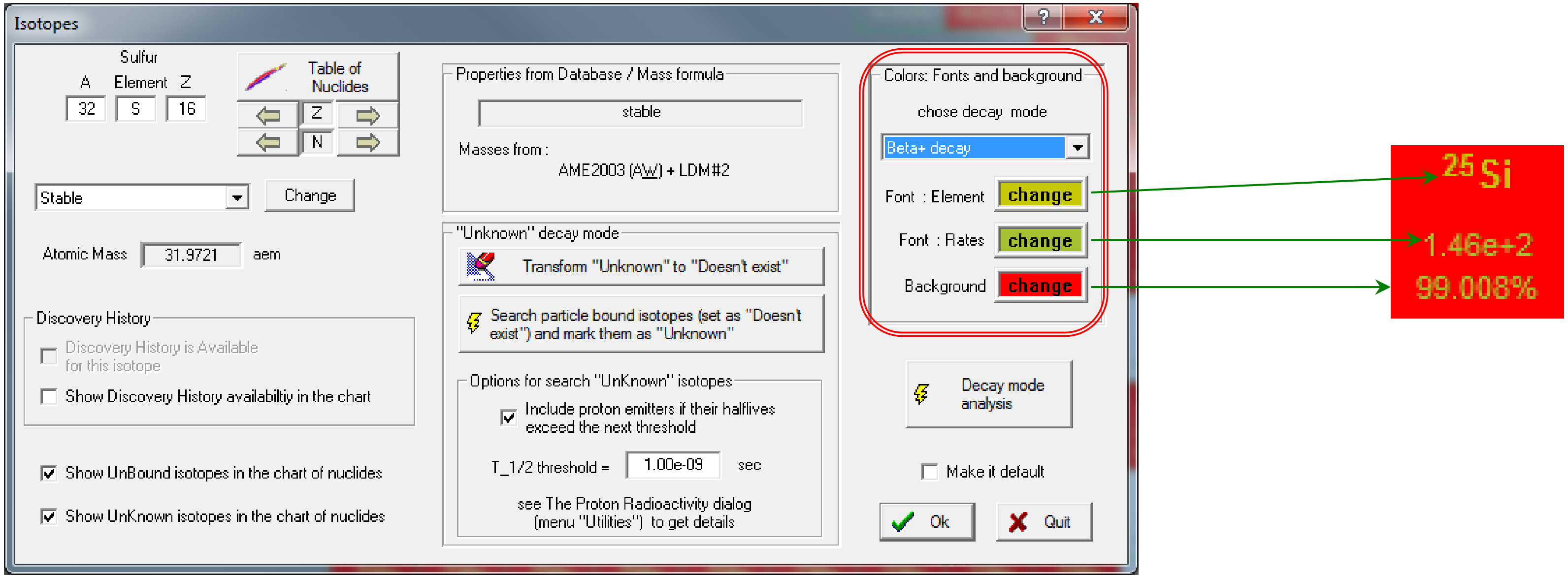
=> New iso-file : "table2012.iso" instead previous "table.iso")

Total Revision of Decay modes in the LISE++ chart of nuclides, and revision of half-lives of heavy elements



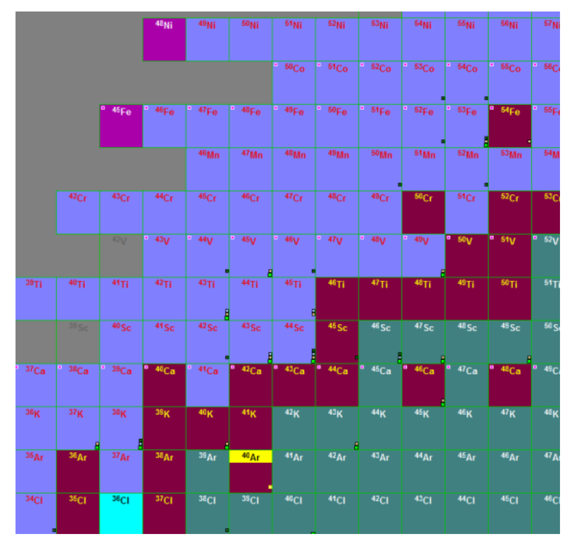


9.2.154 07/12/11 Color editing of the table of nuclides

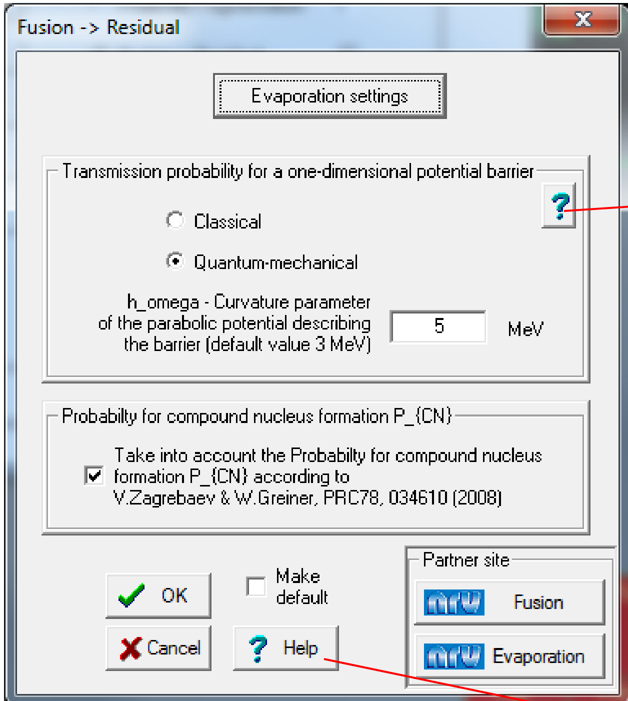


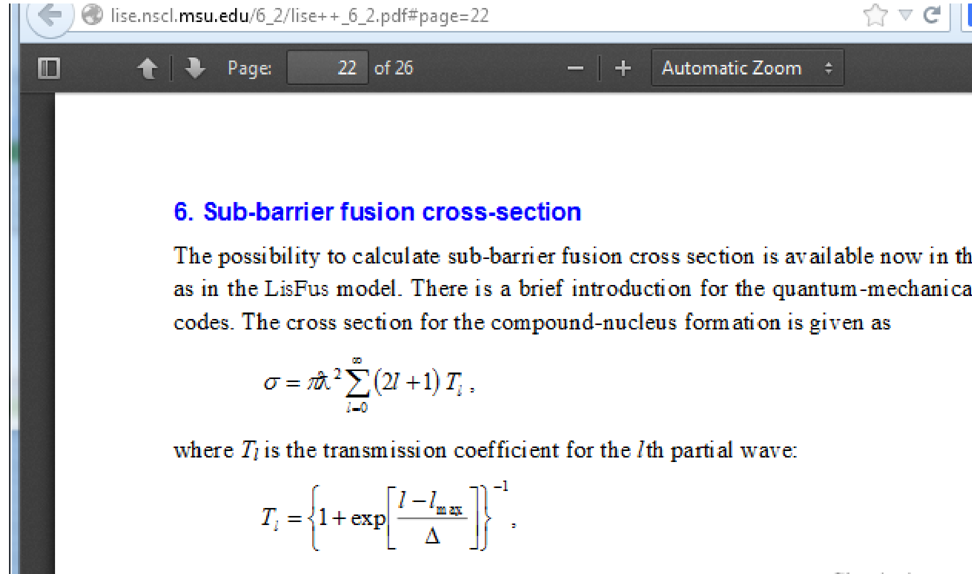
- Color modifications will be saved in the "lisepp.ini" file
  (if you have checked "make it default" in the "Isotopes" dialog)
- If you want to restore default LISE++ colors, then erase blocks
  [Decay_Font], [Decay_Background], [Decay_Label]
  in the "lisepp.ini" file

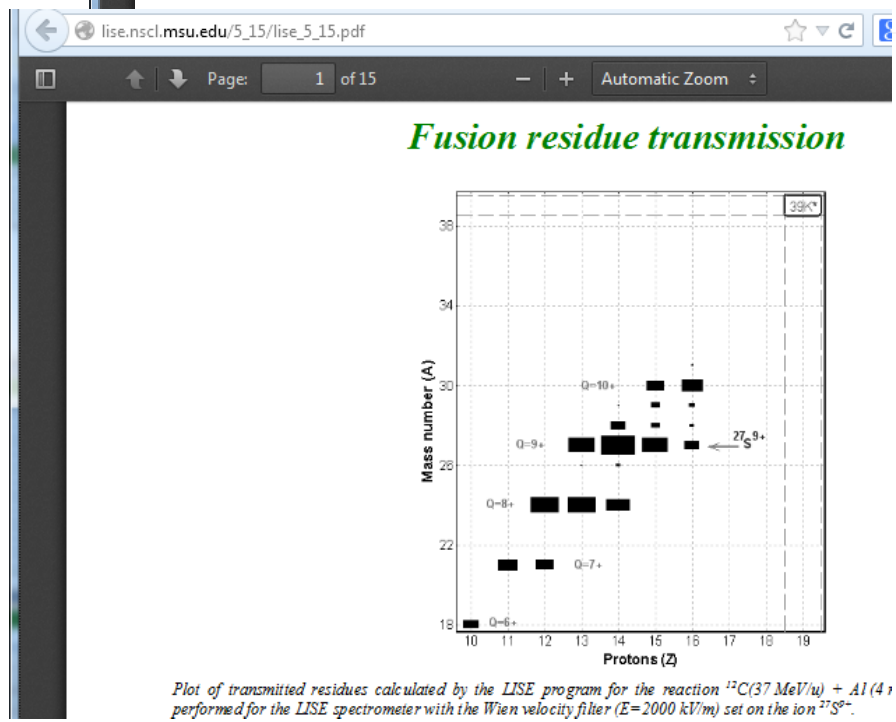
Example of user modifications



example



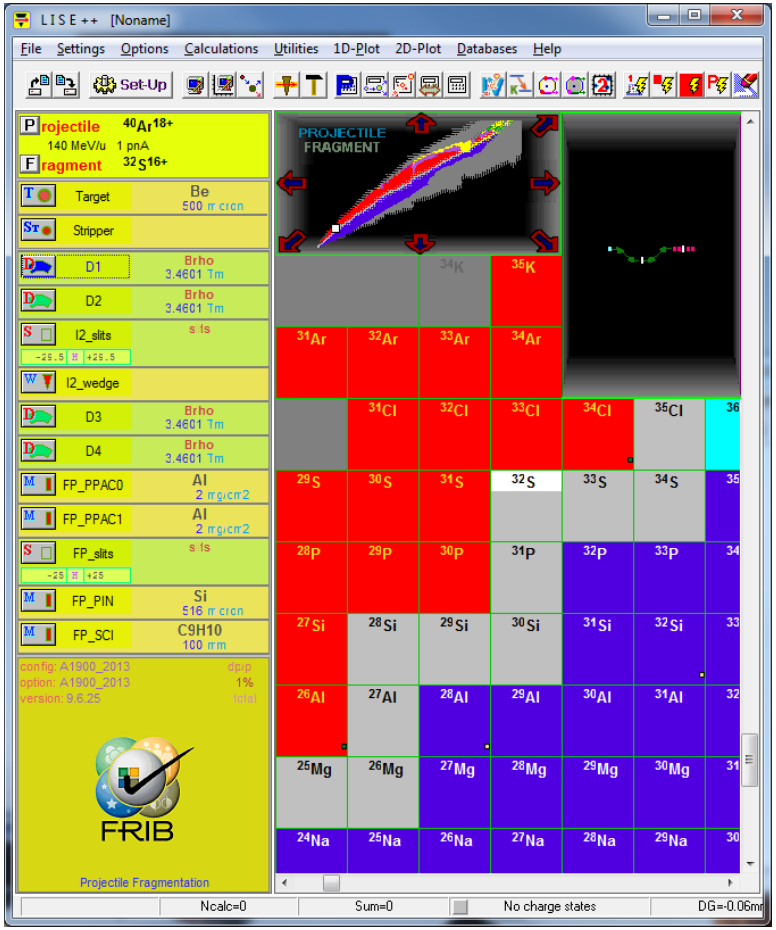


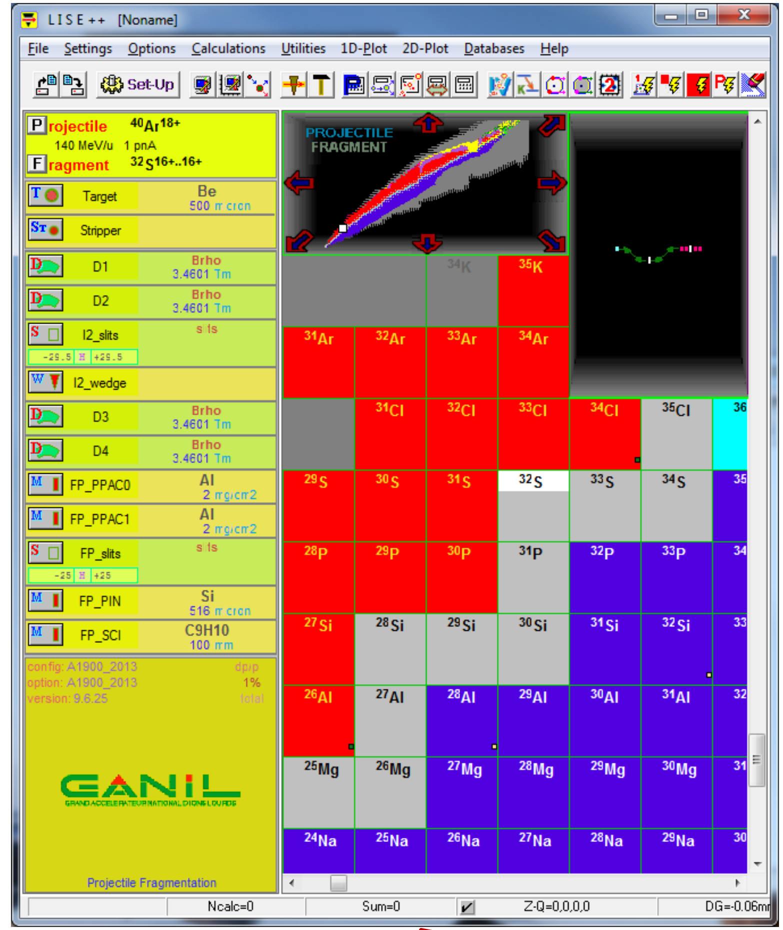


No F1-key help more

Easy way to change the charge state option

TB's request



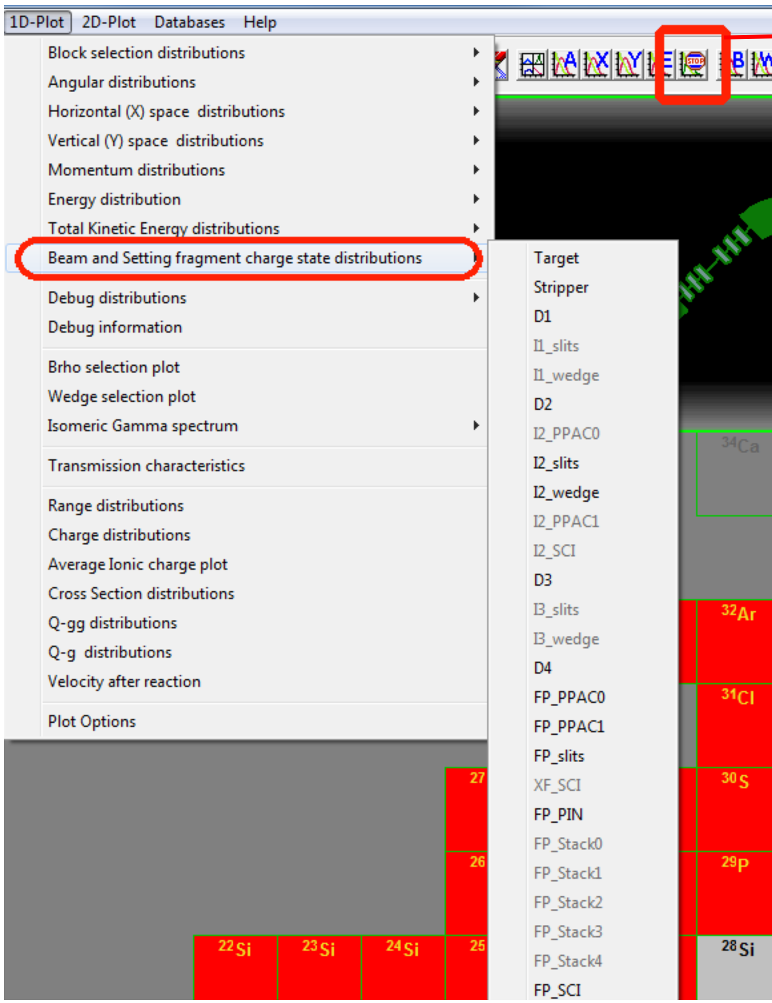


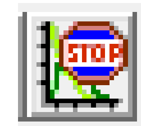
Use this CheckButton to change the change state option

Beam and Setting fragment charge state distributions

v.9.6.29
from 04/19/13

TB's request



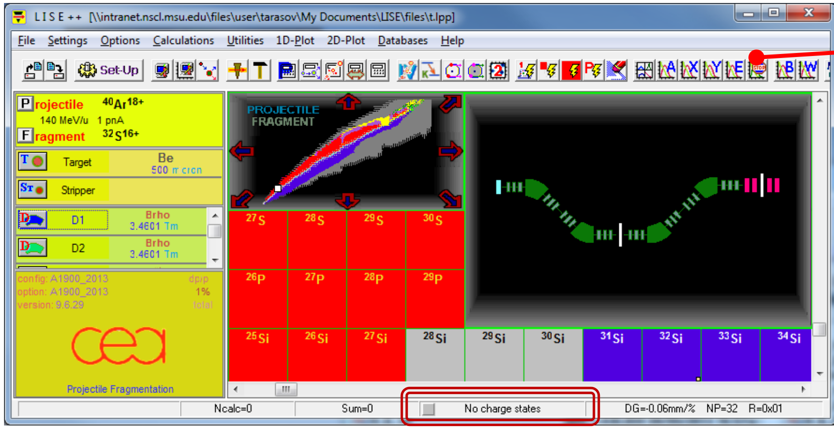


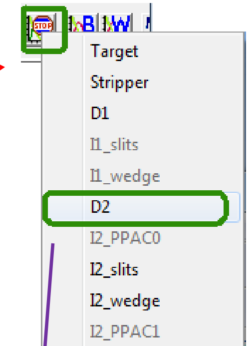
Actions:

1. Save the Charge State option
2. Set Charge State on
3. Insert the Faraday Cup after the selected block
4. Calculate beam projectile and setting fragment charge states transmission up to this Faraday cup
5. Find out a direction of the dispersive plane (X or Y)
6. Plot spatial distributions of ions in the dispersive plane
7. Delete the Faraday cup
8. Restore the Charge State Option

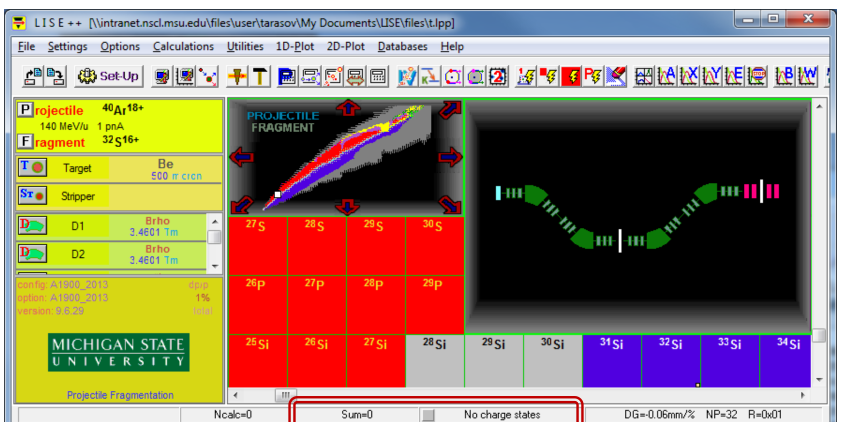
Beam and Setting fragment charge state distributions

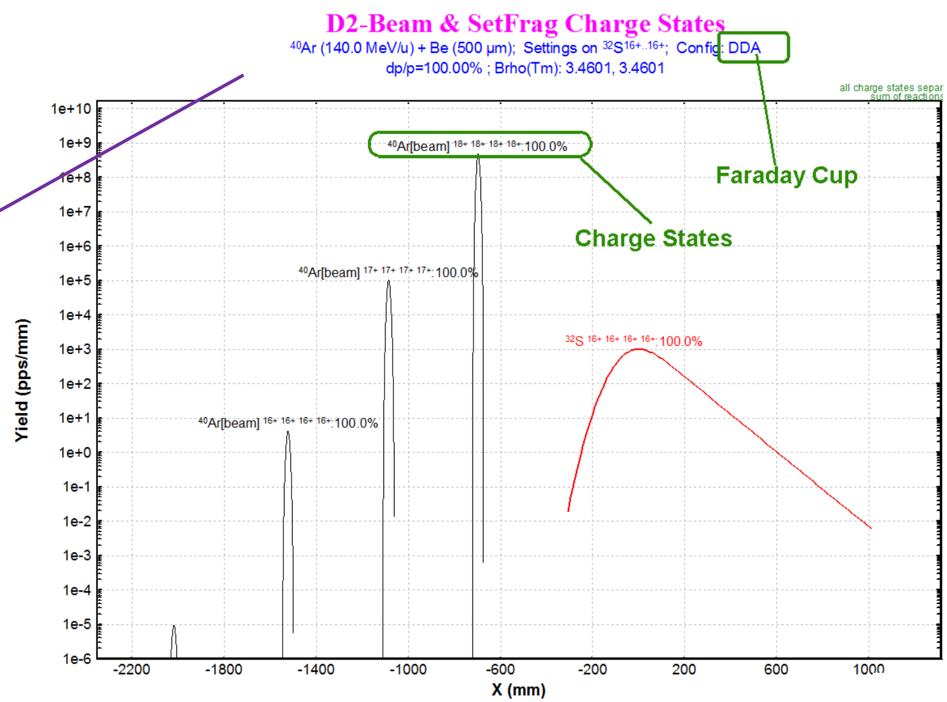
before





after

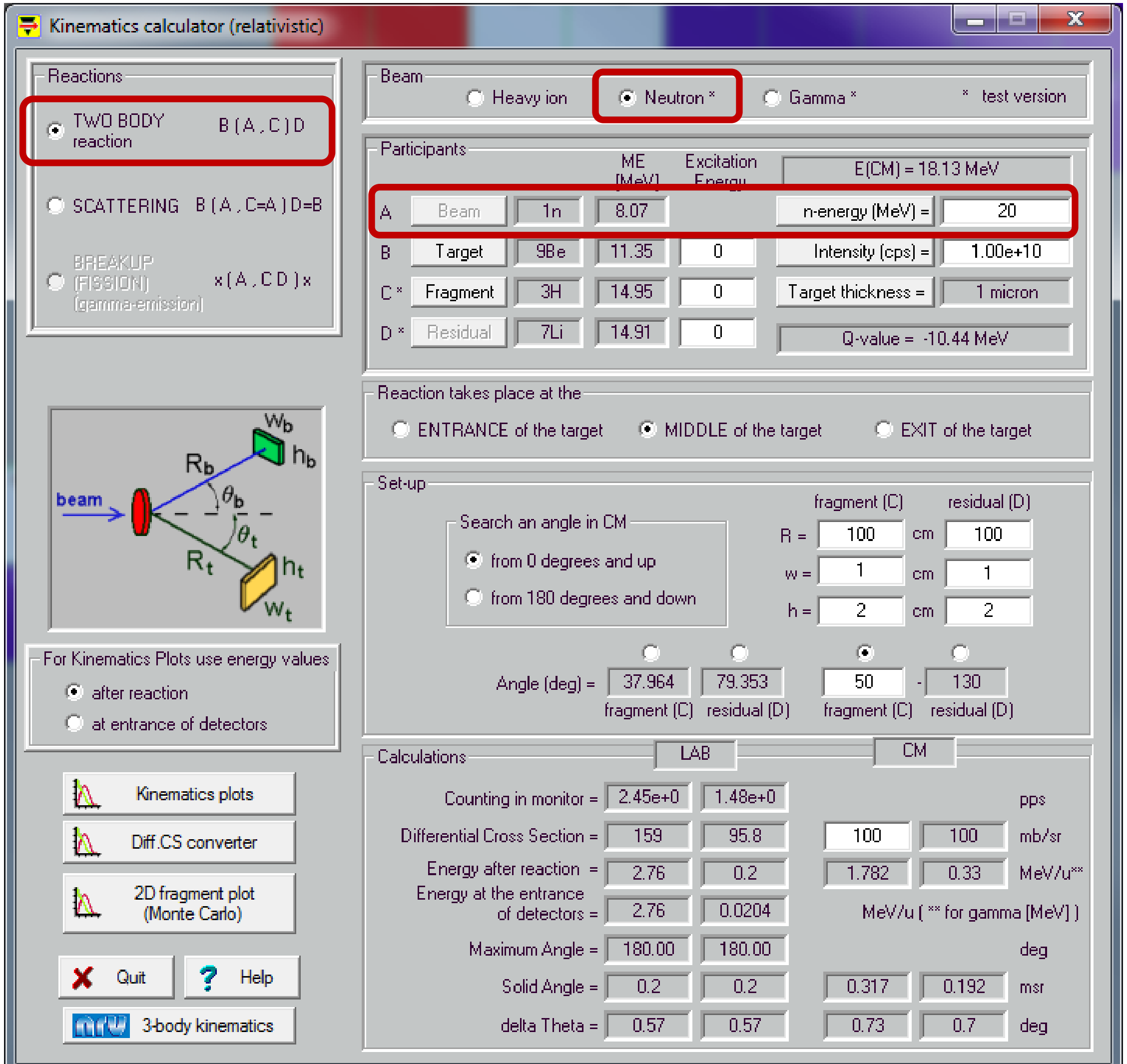




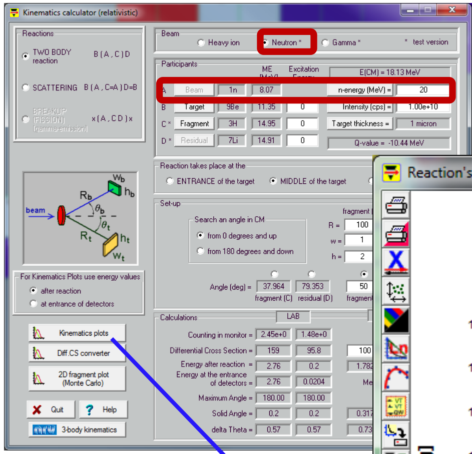
Utilities :

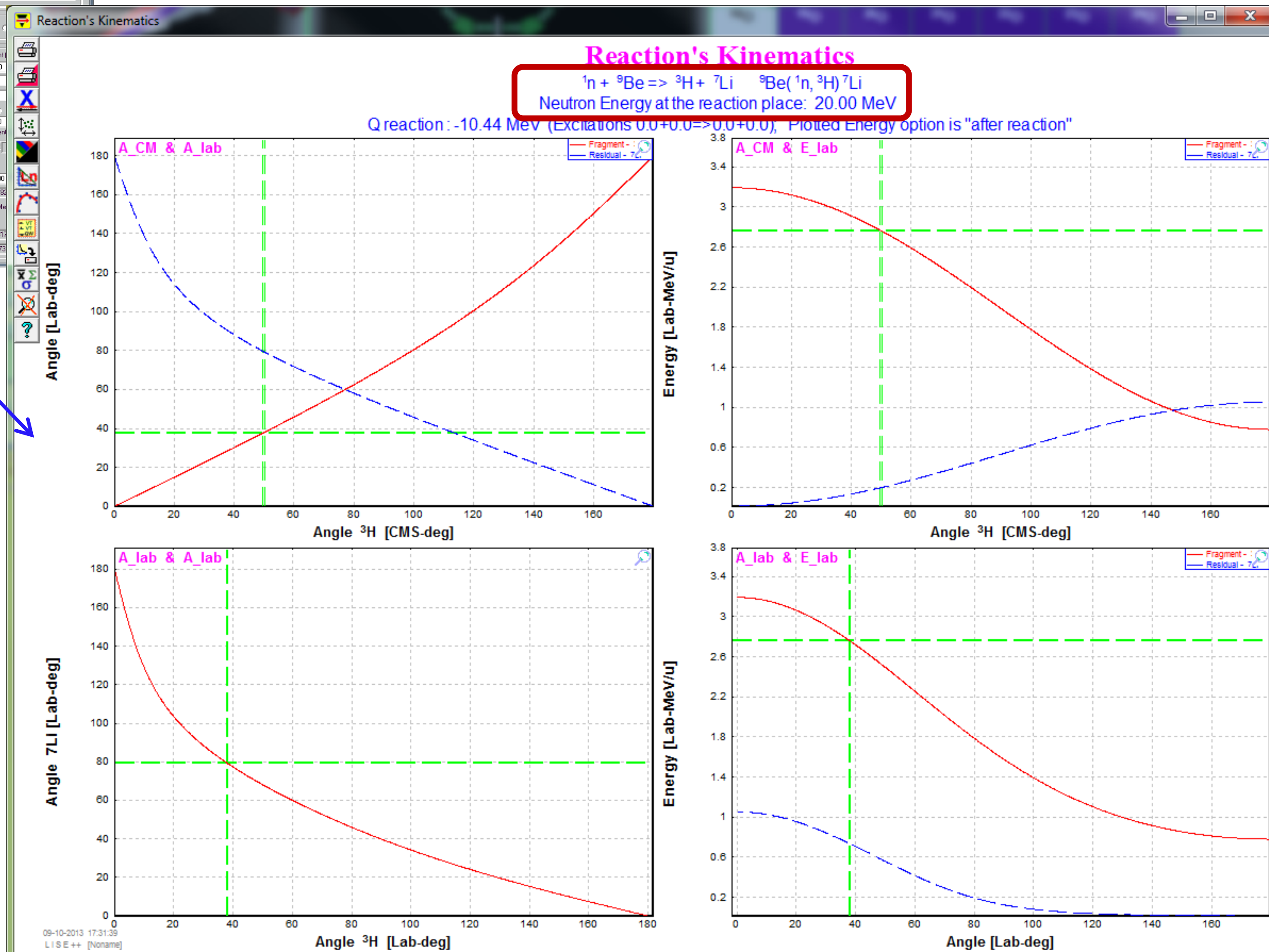
Neutron and Gamma induced reactions in the Kinematic Calculator

9.6.132 10/08/13

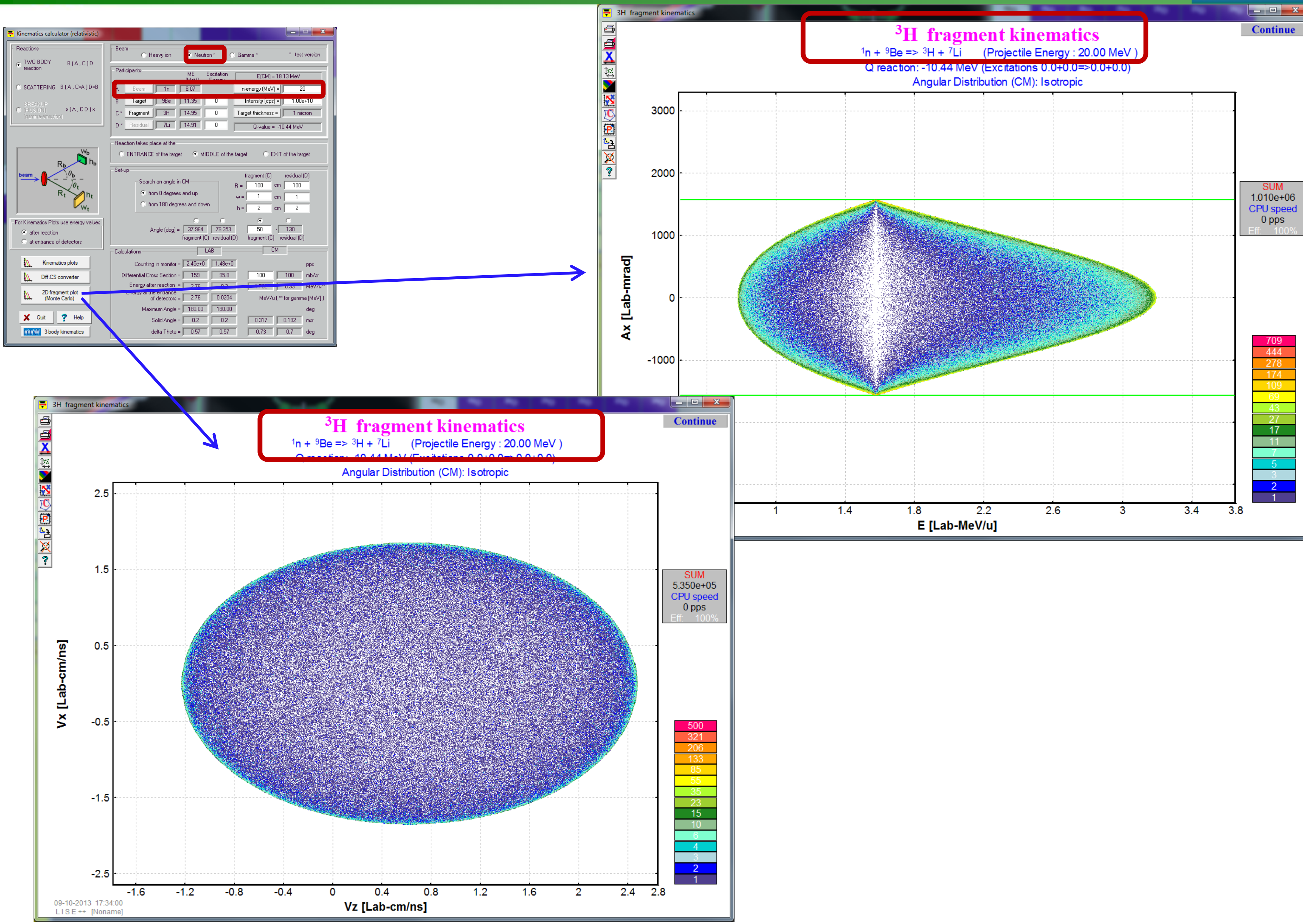


Neutron and Gamma induced reactions in the Kinematic Calculator





Neutron and Gamma induced reactions in the Kinematic Calculator



Database

The 2012 Atomic Mass Evaluation (AME2012)

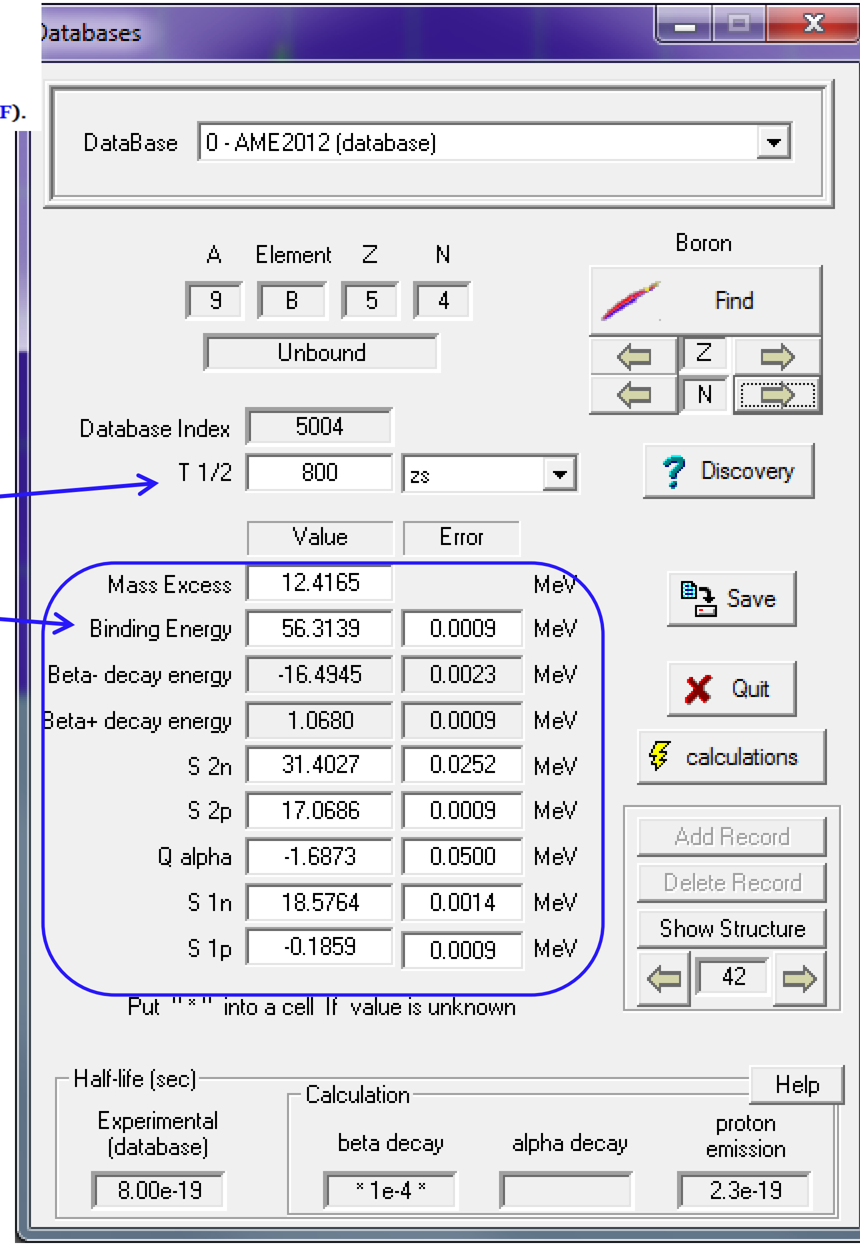
The evaluation has been published in Chinese Physics C 36 (2012) 1287-1602 (PDF), 1603-2014 (PDF).

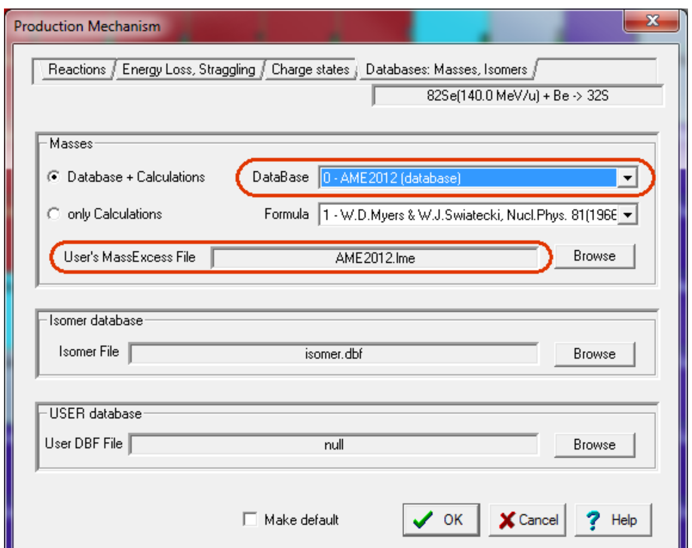
The 2012 Nubase Evaluation (Nubase2012)

The evaluation has been published in Chinese Physics C 36 (2012) 1157-1286 (PDF).

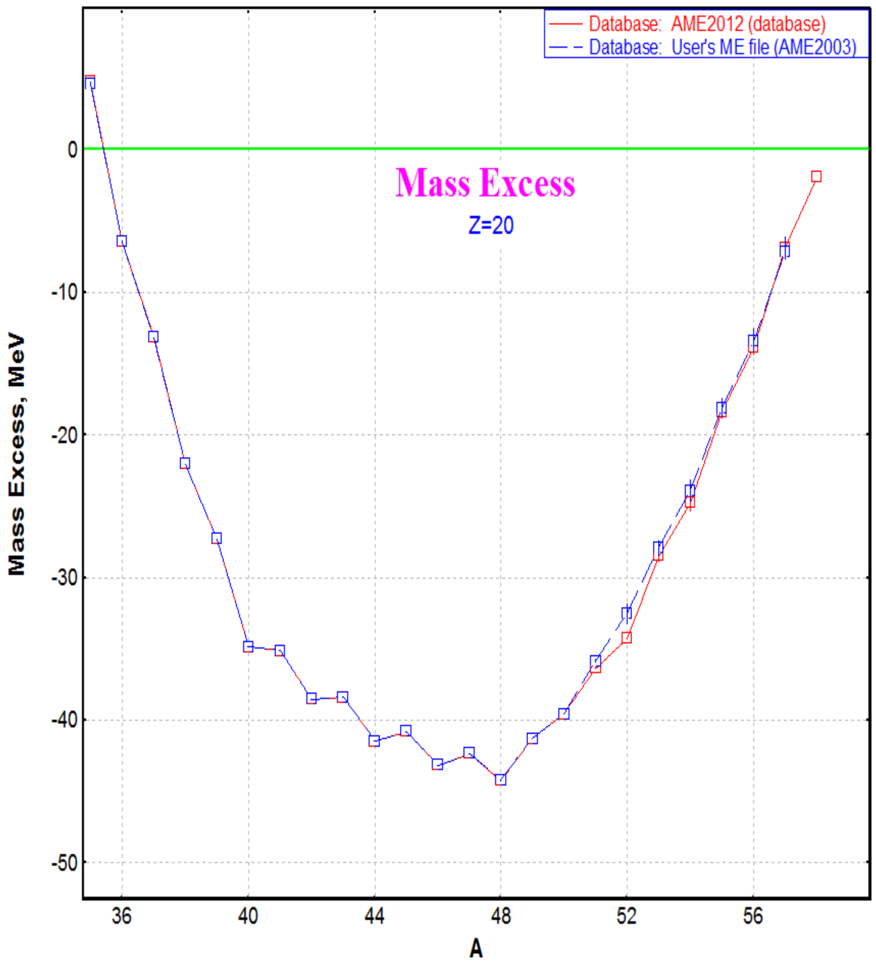
NUBASE 2012

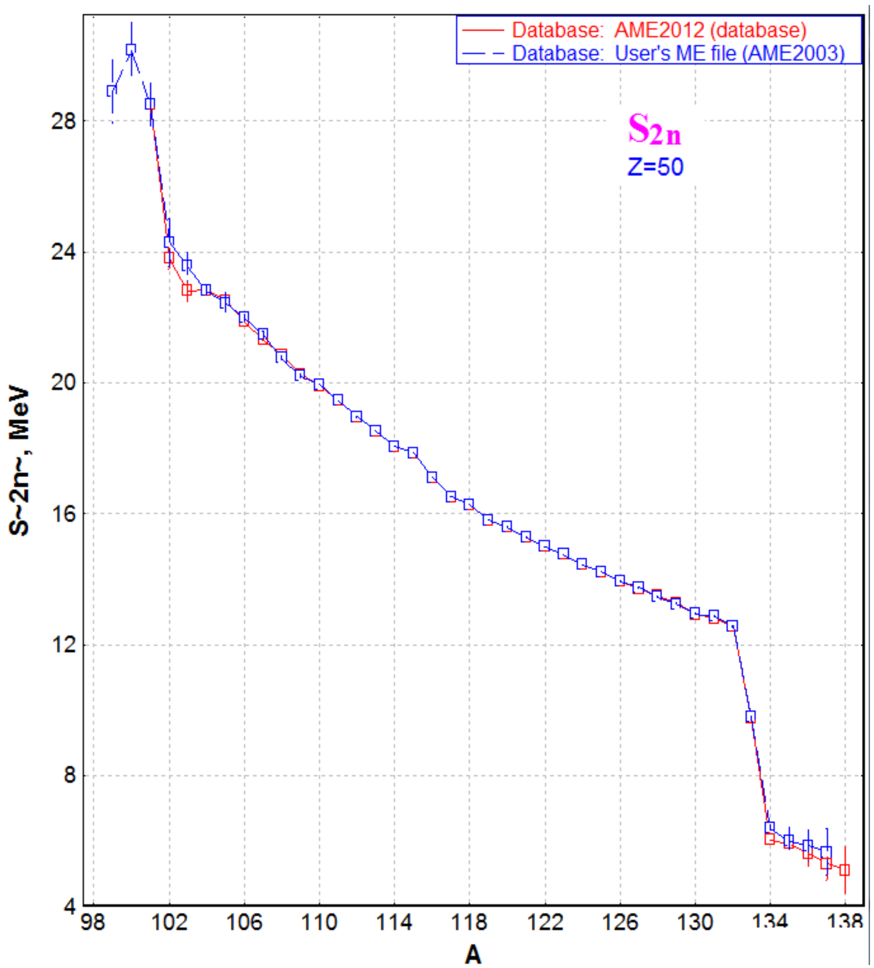
AME 2012



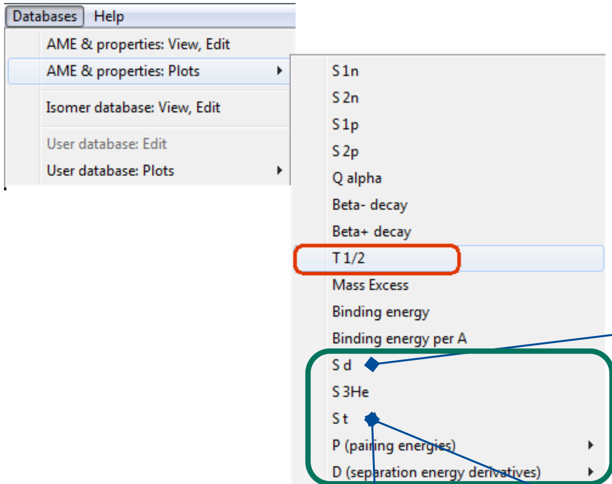


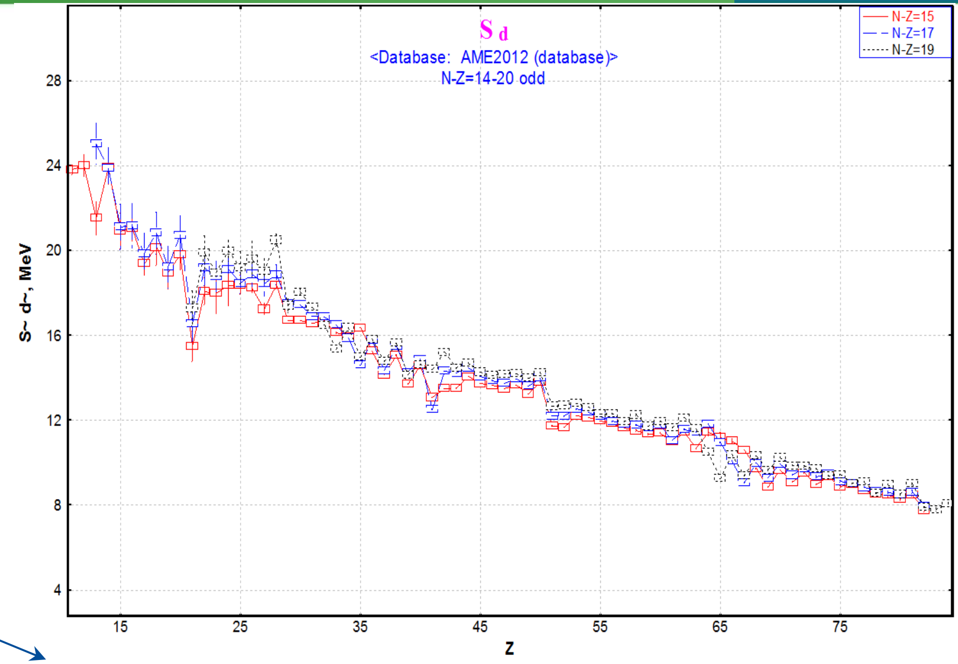
Comparison AME2003 & AME 2012 for Z=20 & 50

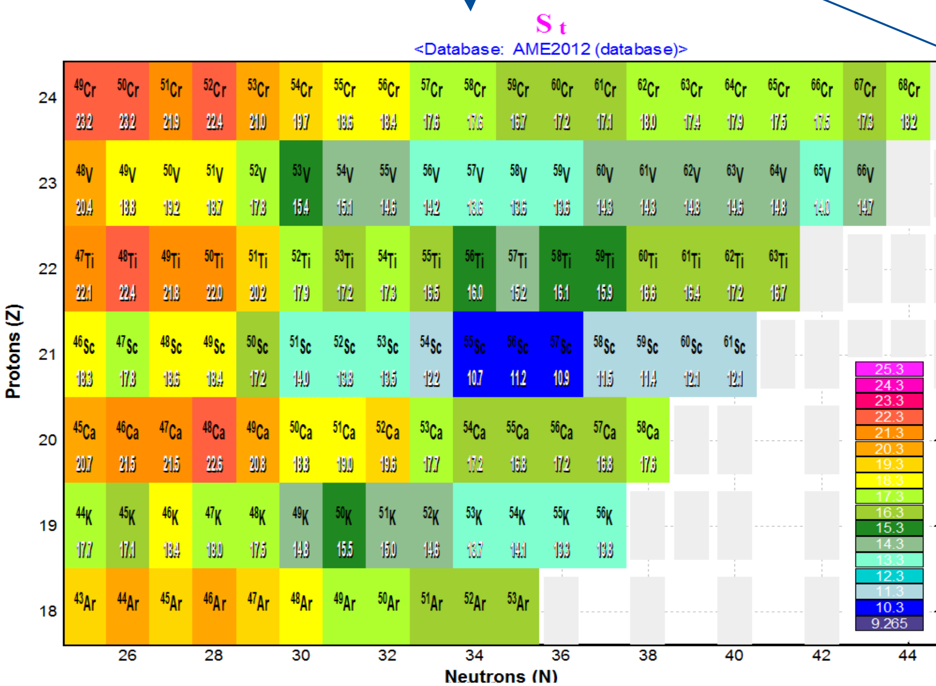


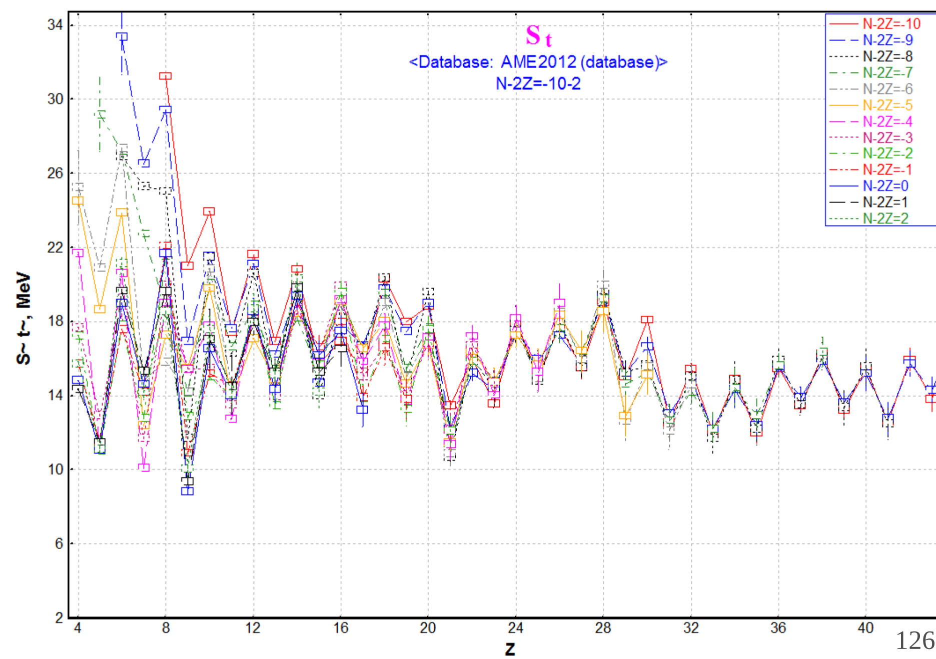


New Database plots (P_x, D_x, S_t, S_{3He}, S_d)

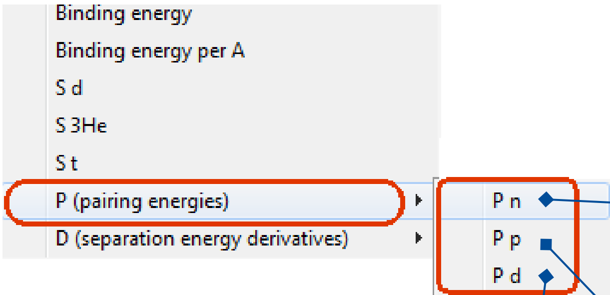


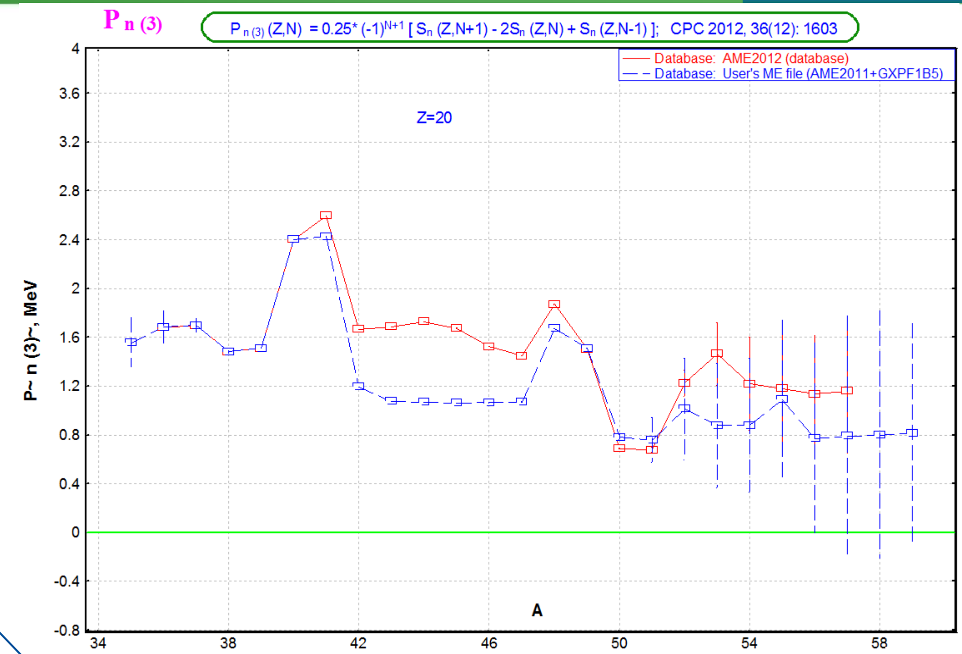


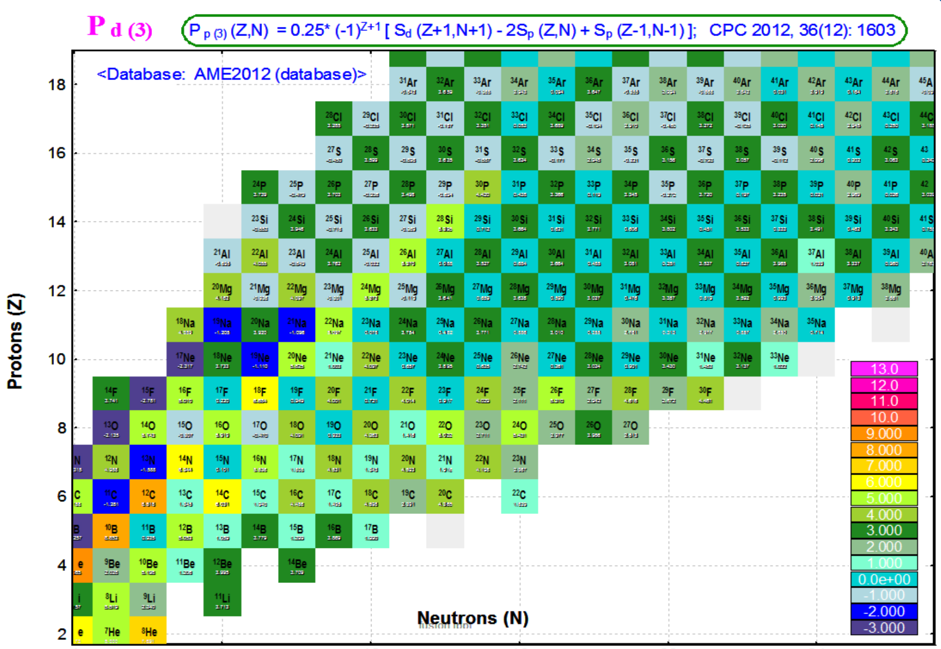


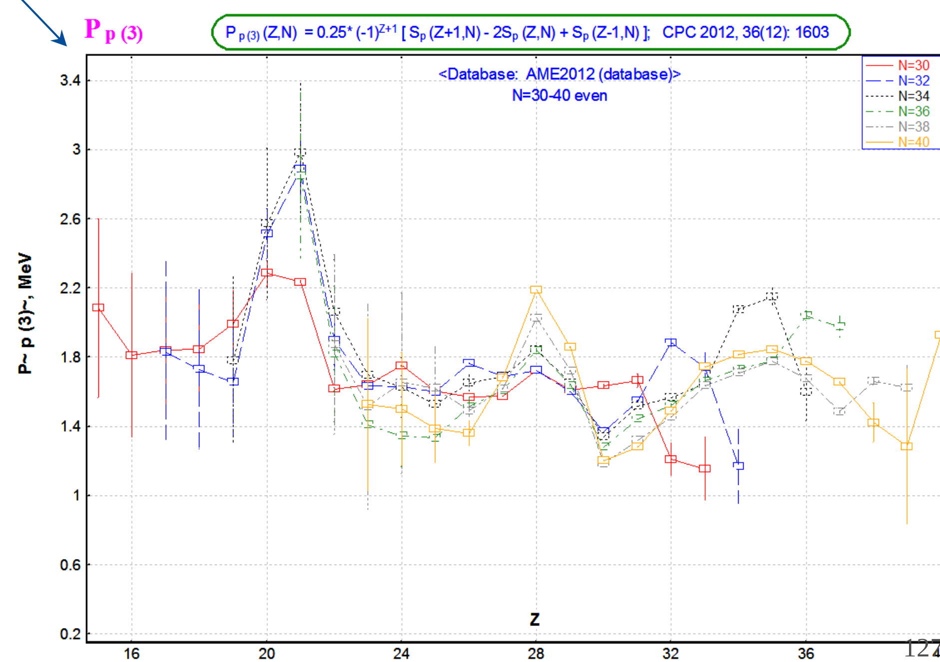


New Database plots : P_x

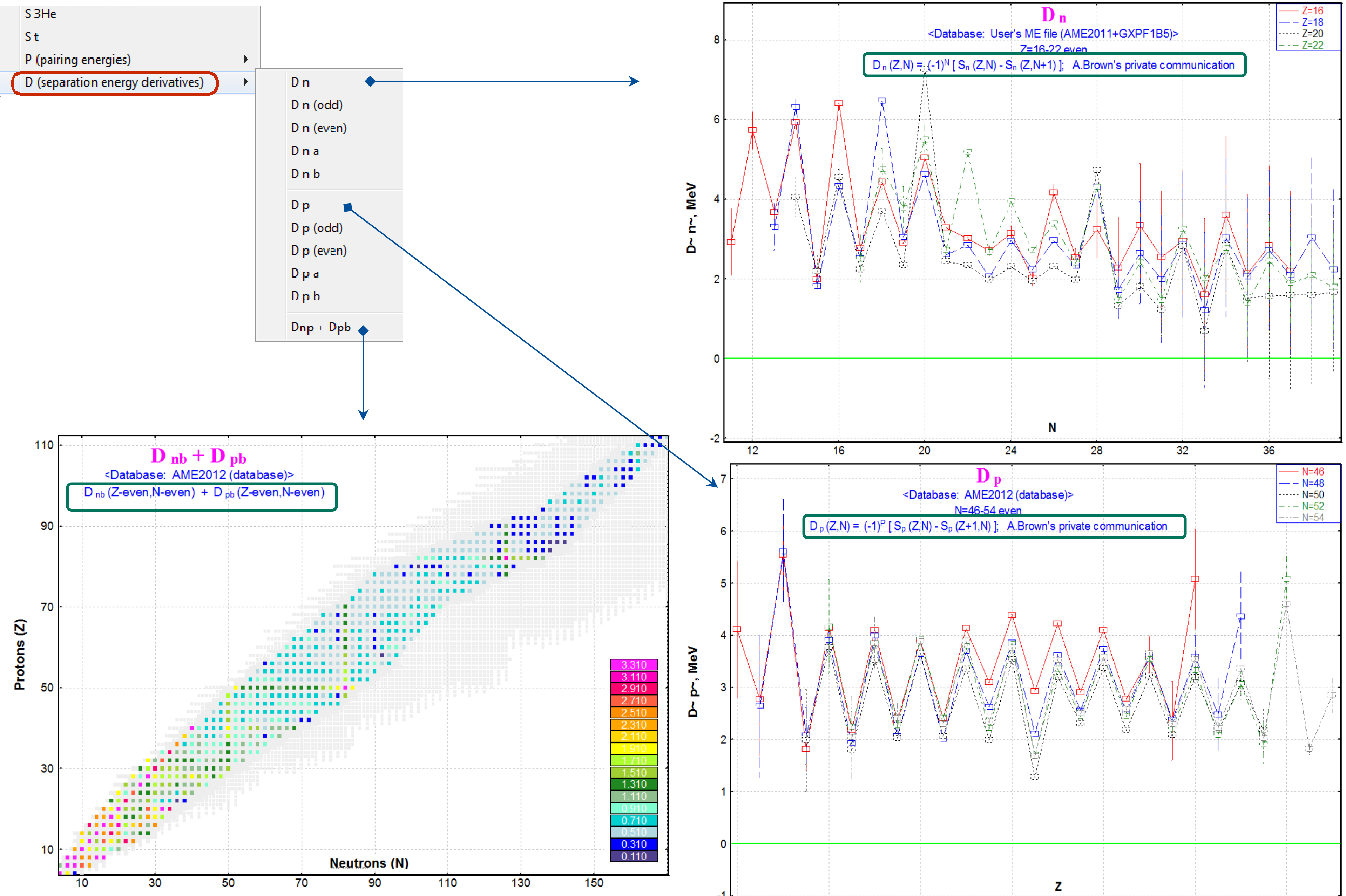








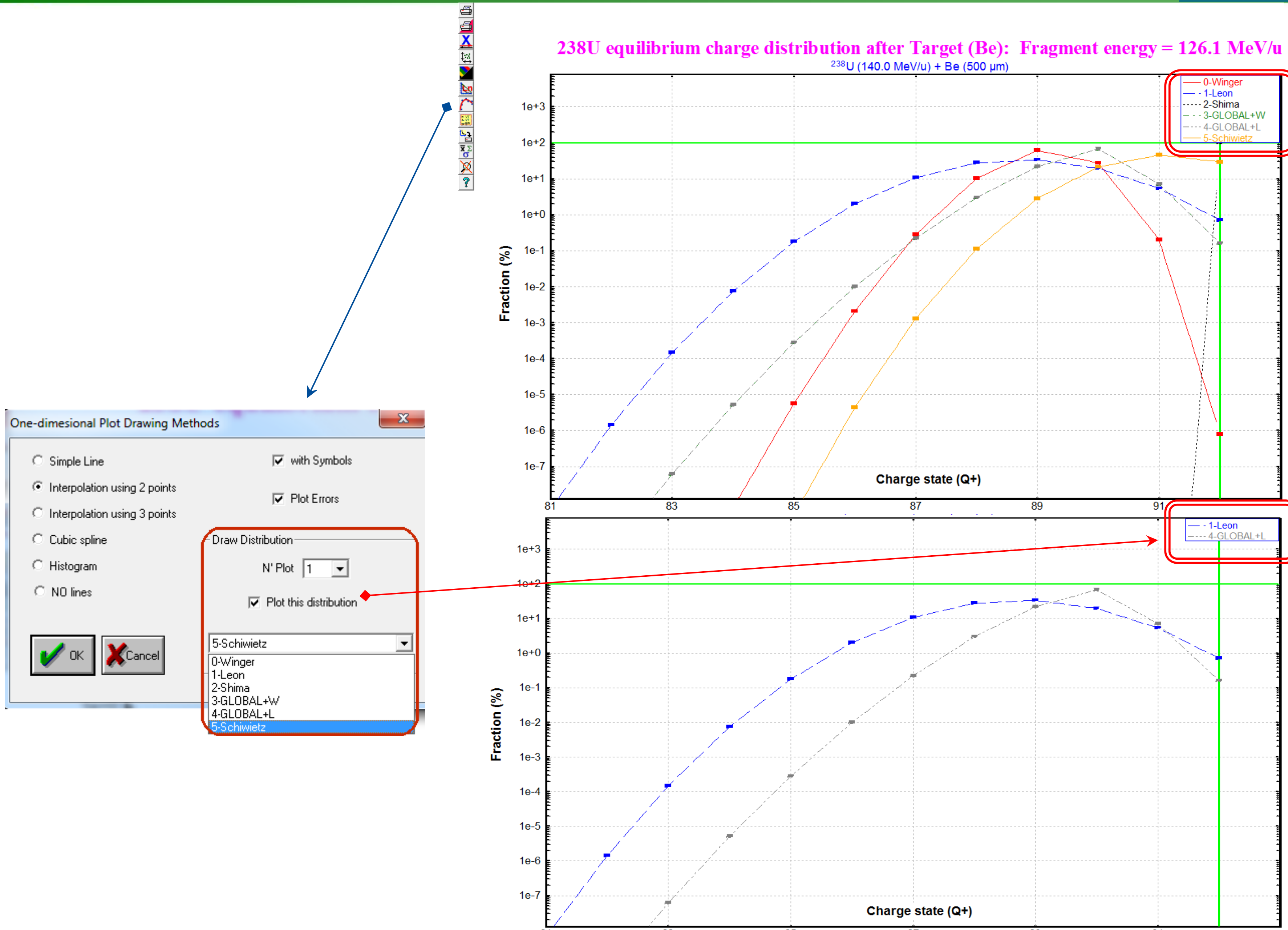
New Database plots : D_x



O.Tarasov@FragmentSeaparator2013.RIKEN.JP

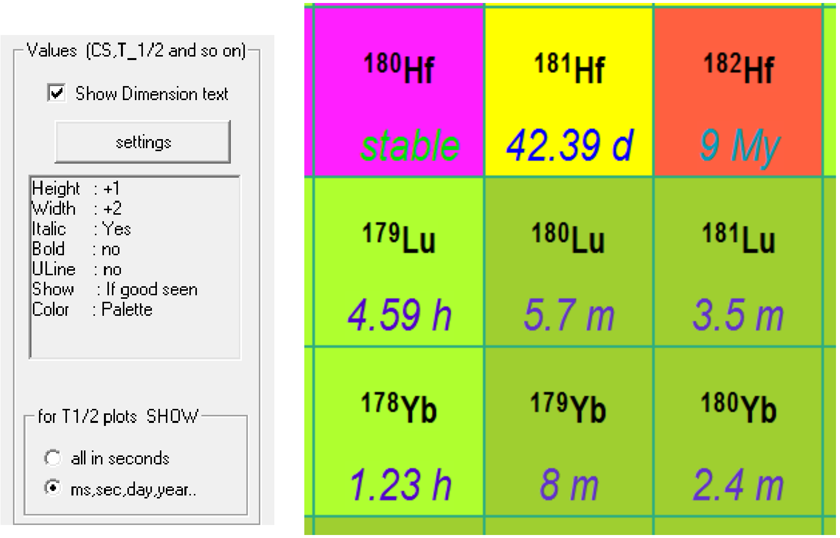
Plots

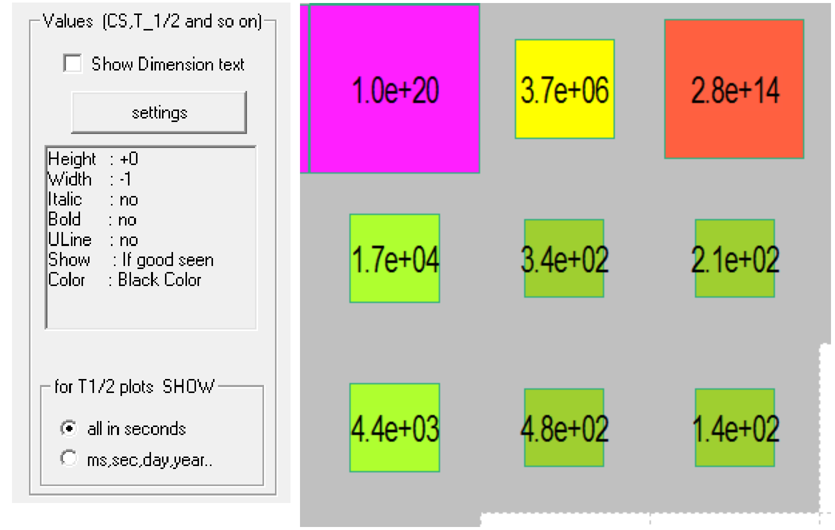
Option to draw selected plots

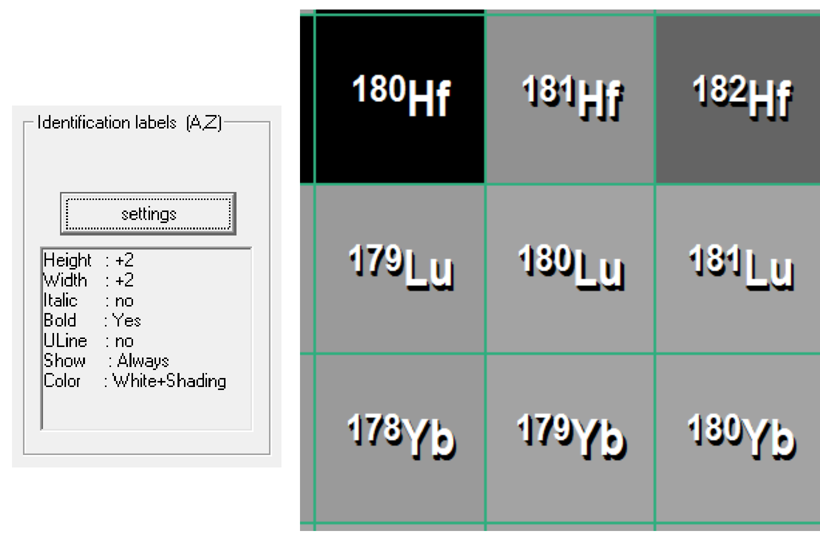


Plots: identification

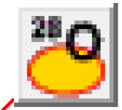
Nucleus identification in 2d-plot : Values, Dimension

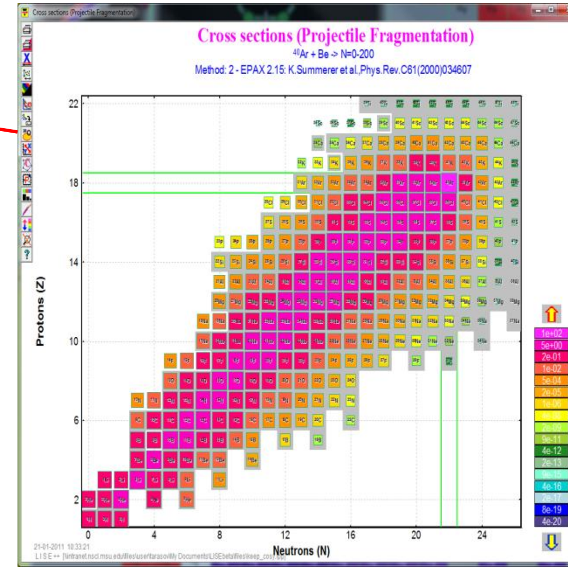


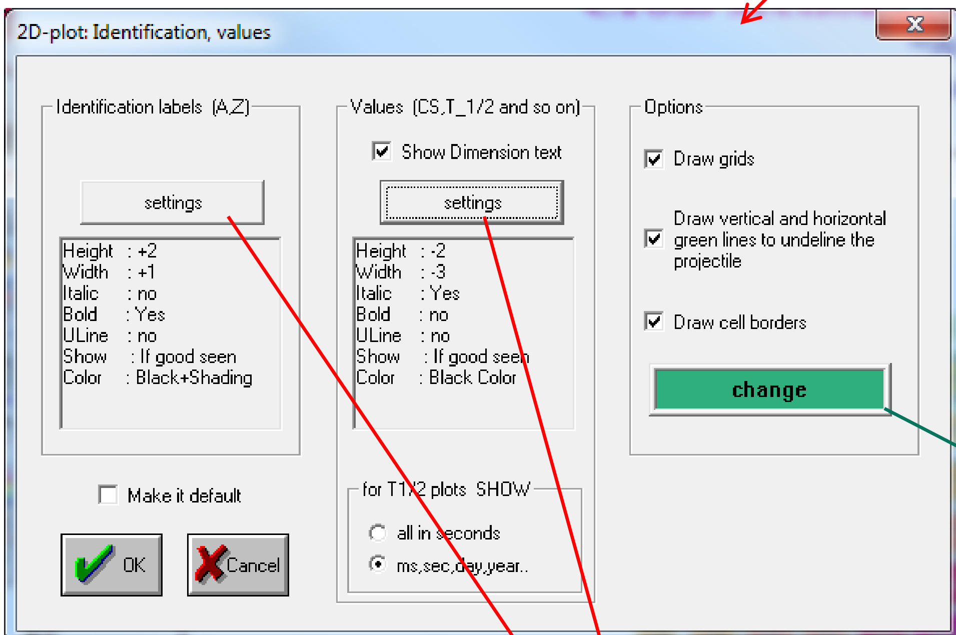


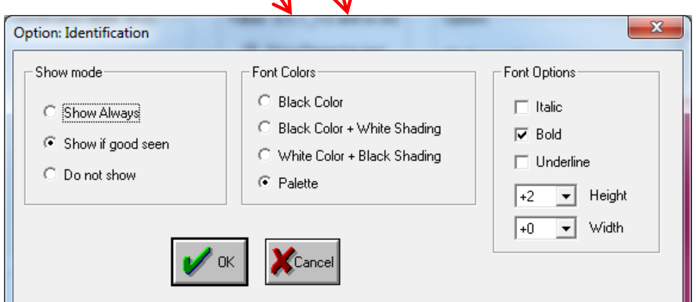


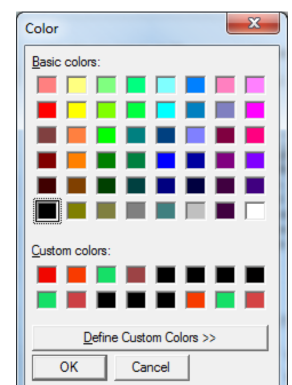
Nucleus identification in 2d-plot (so called RGD, mode =25,35)



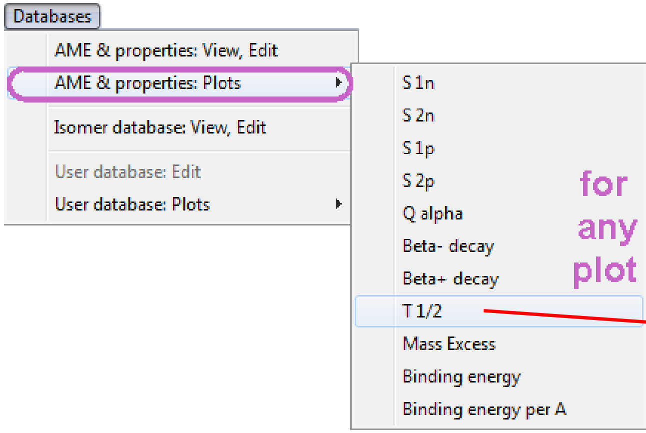


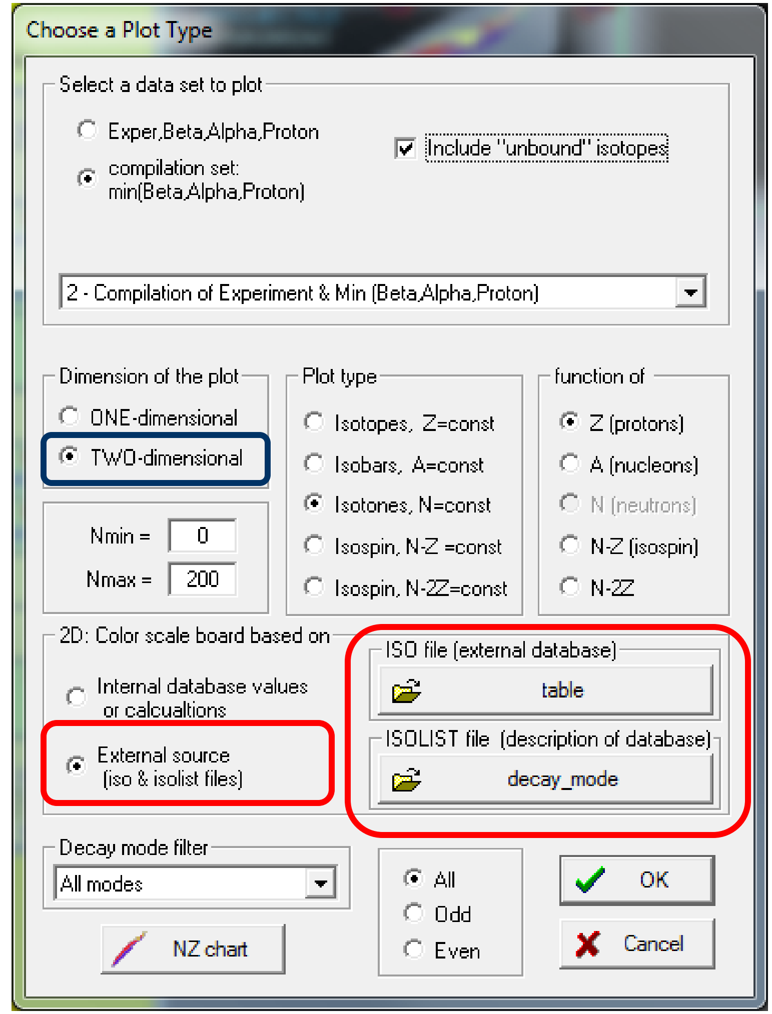






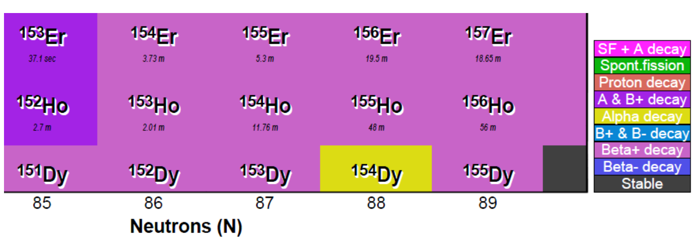
Customizable Chart of the Nuclides





Why in database plots?

LISE++ Database (based on AME2003) values or calculations could be joined with the user color board



Default location of ISO and ISOLIST files is the “My Documents\LISE\bin” directory

ISOLIST file

ASCII file

LISE++ reads first two columns

1st column is name (should be in quotation marks)
2nd column is color (decimal base)

\bin\decay_mode.isolist]

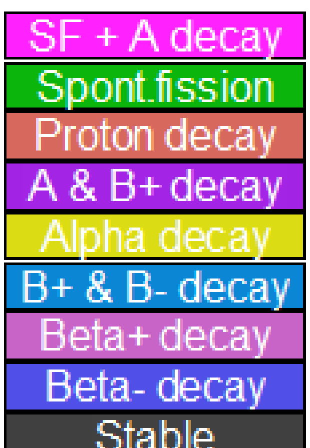
```
"Stable"        4210752
"Beta- decay" 15224912
"Beta+ decay" 13133000
"B+ & B- decay" 13993481
"Alpha decay"  1367260
"A & B+ decay" 15016867
"Proton decay"  6121687
"Spont.fission" 767243
"SF + A decay"  16720639
```

\bin\discovery_lab.isolist]

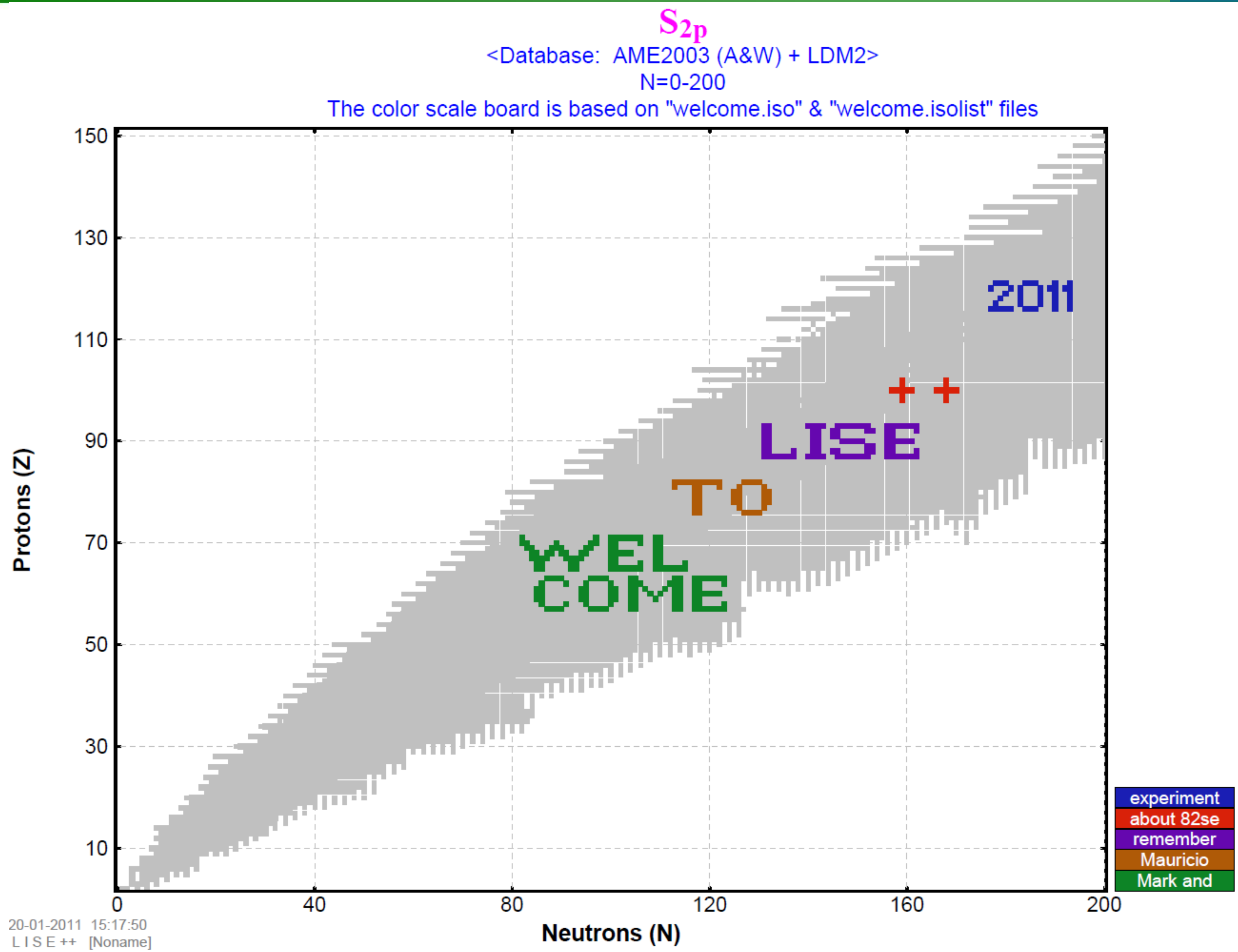
```
"MSU"       2523917
"GSI"       481967
"RIKEN"      11470694
"Dubna"      598489
"GANIL"      11804186
"Argonne"    12871363
"Cern"       10593035
"Oak Ridge" 2007034
"Berkeley"  3666870
"other"      6579300
```

welcome.isolist

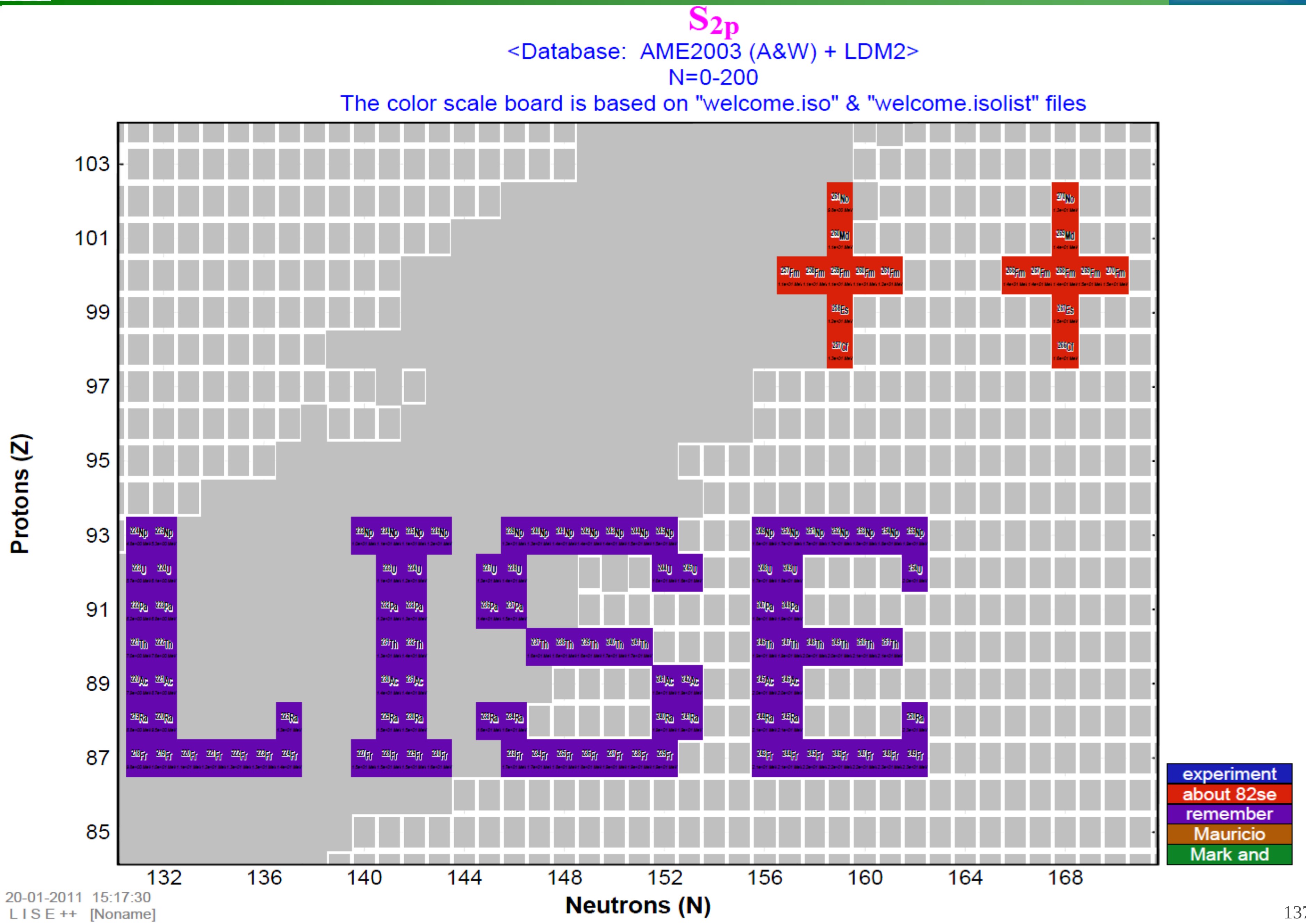
```
"2011"       2523917
"++"         481967
"LISE"       11470694
"to"         598489
"welcome"    11804186
```



Color board example



Color board example

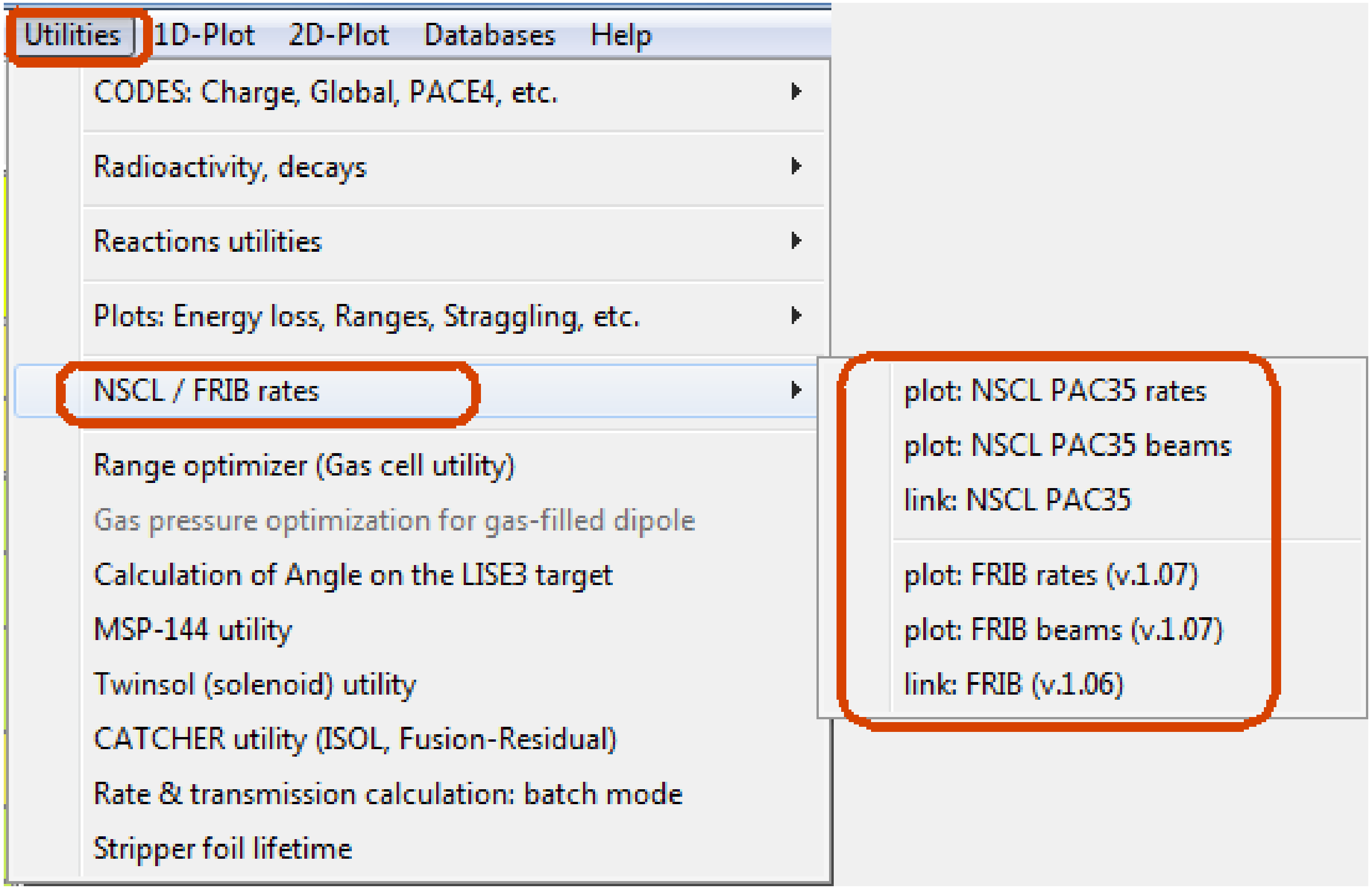


Plots :
NSCL and FRIB rates

LISE^{++} : NSCL and FRIB rate plots

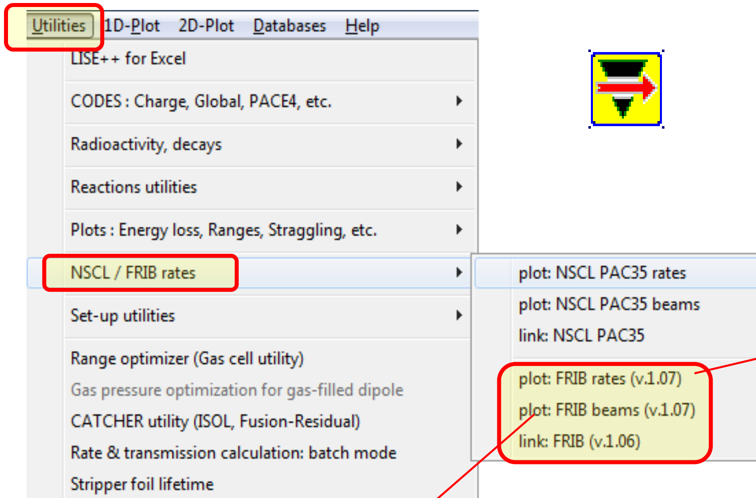
From 27.08.2012

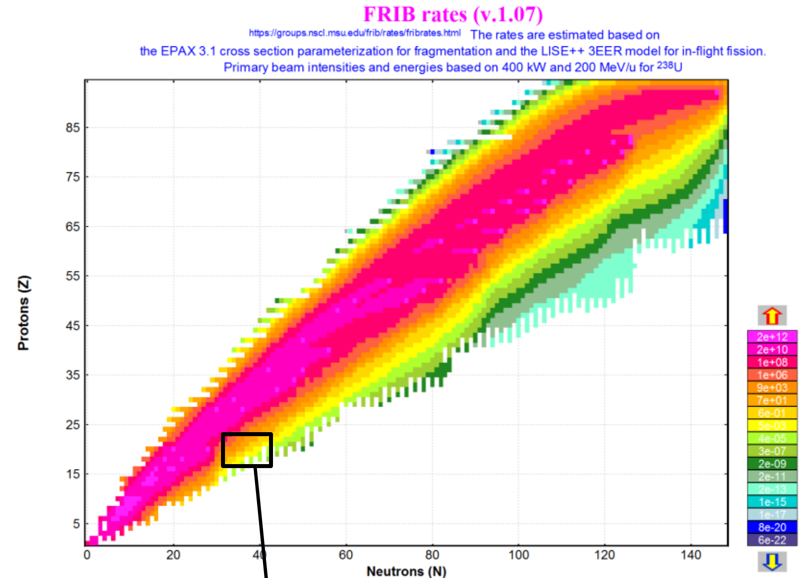
LISE^{++} version 9.4.34

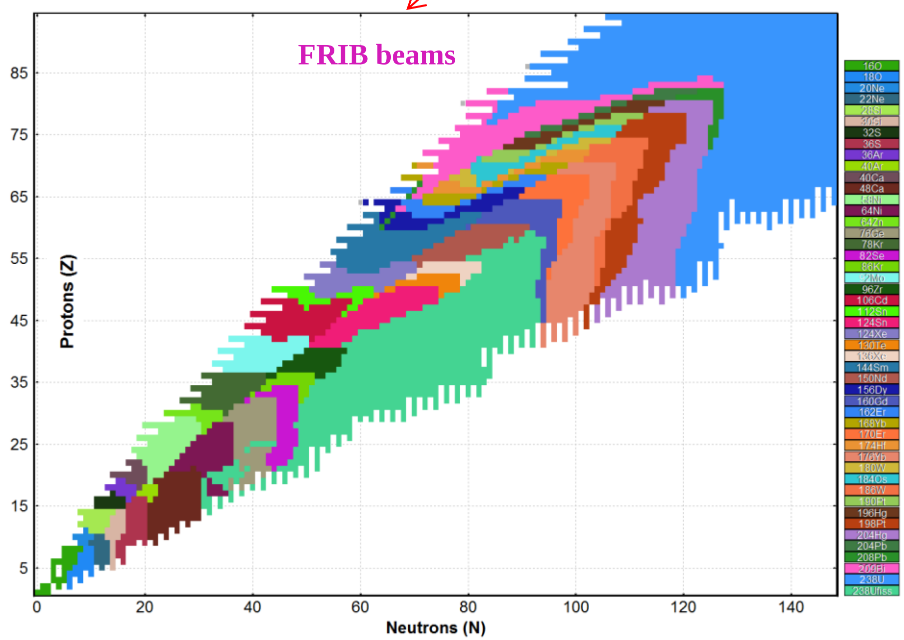


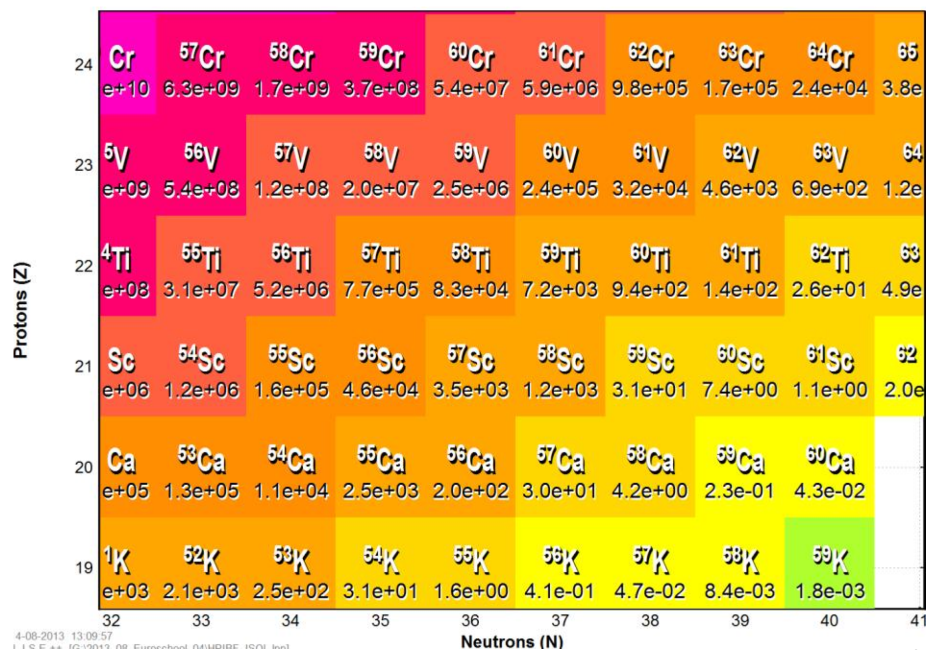
The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:
http://lise.nscl.msu.edu

Next Generation Facilities : Beams and Rates



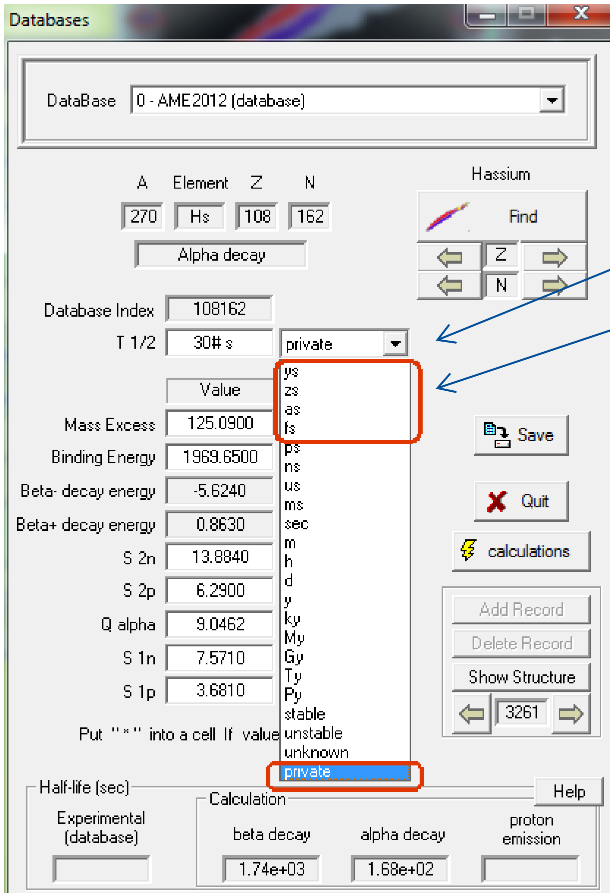




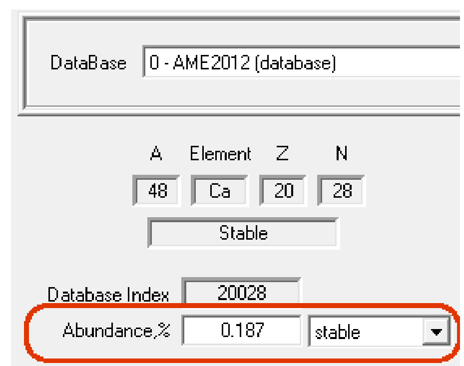


Plots :
Half-lives

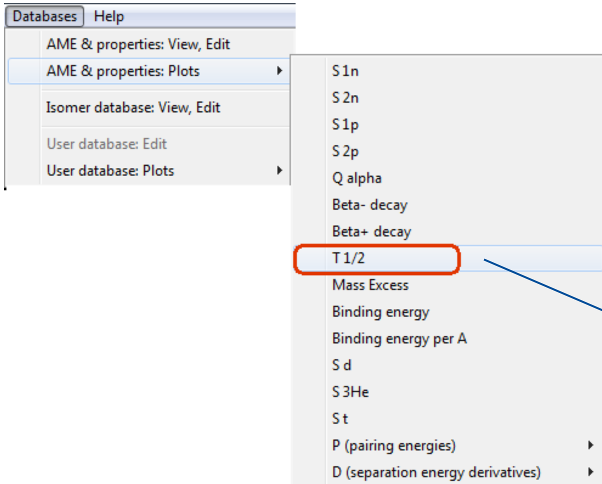
Half-life database: new features

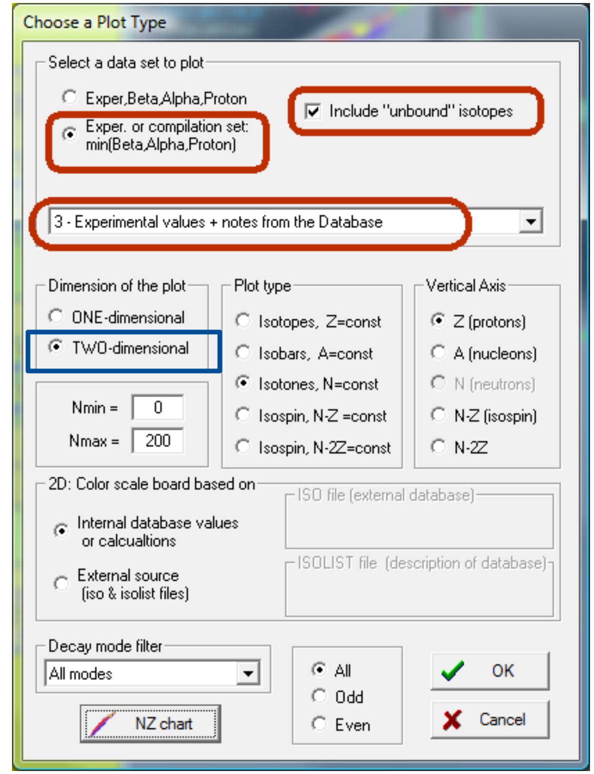


- **Private string**
- **New time scale**
- **Stable isotopes : Abundance**

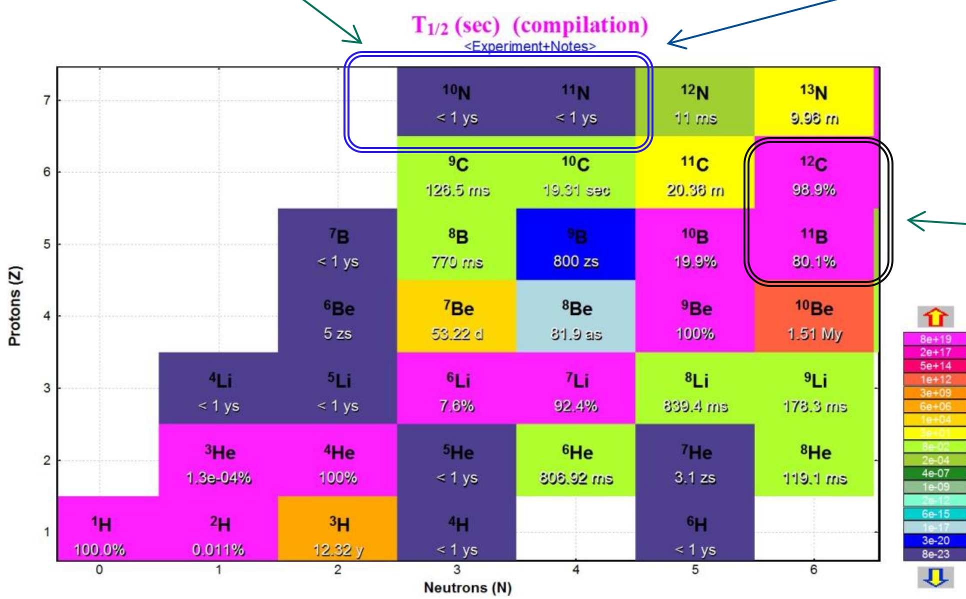


Plot "Private" strings in 2D plots

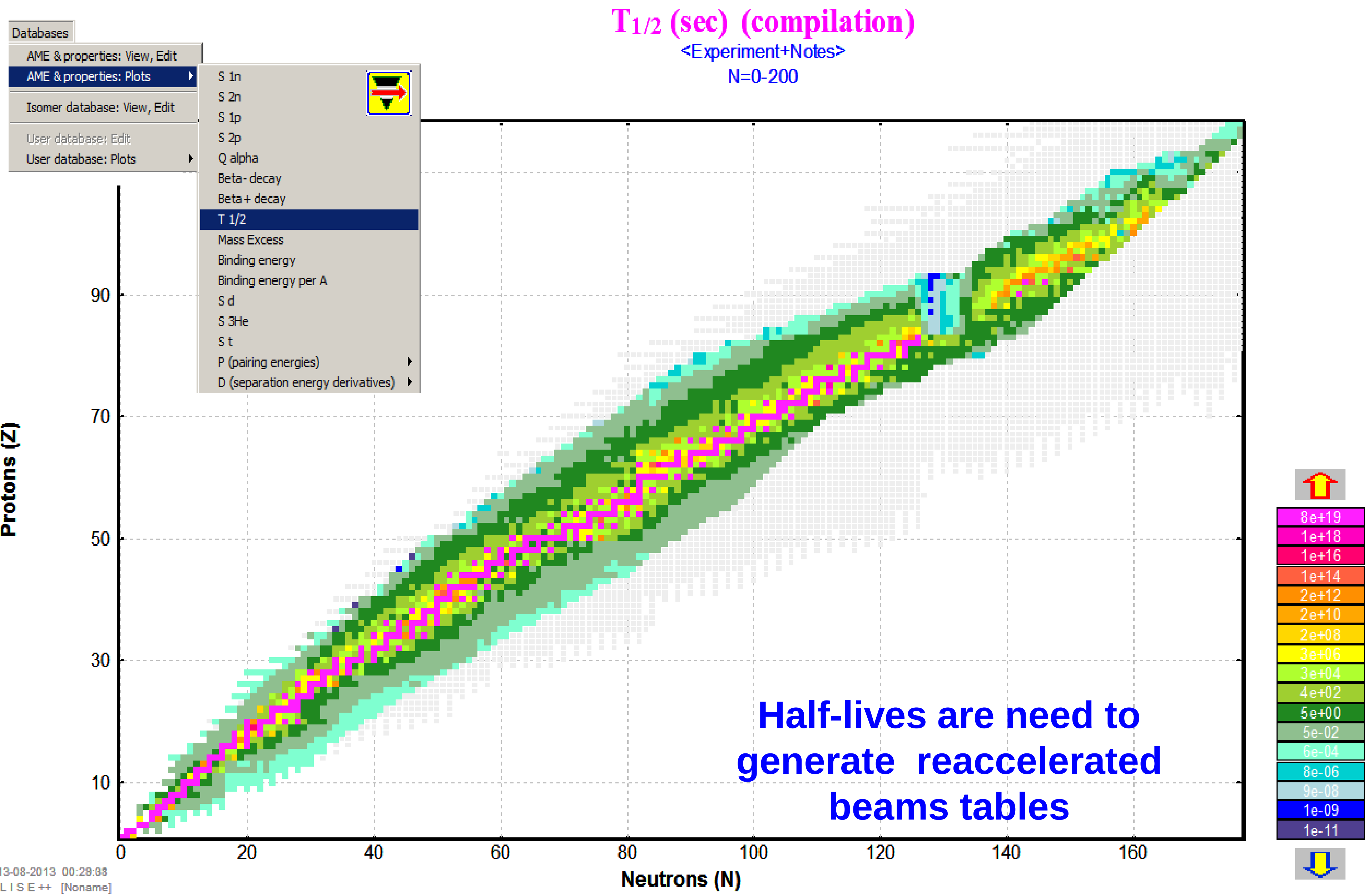




Private strings



Abundance (%)

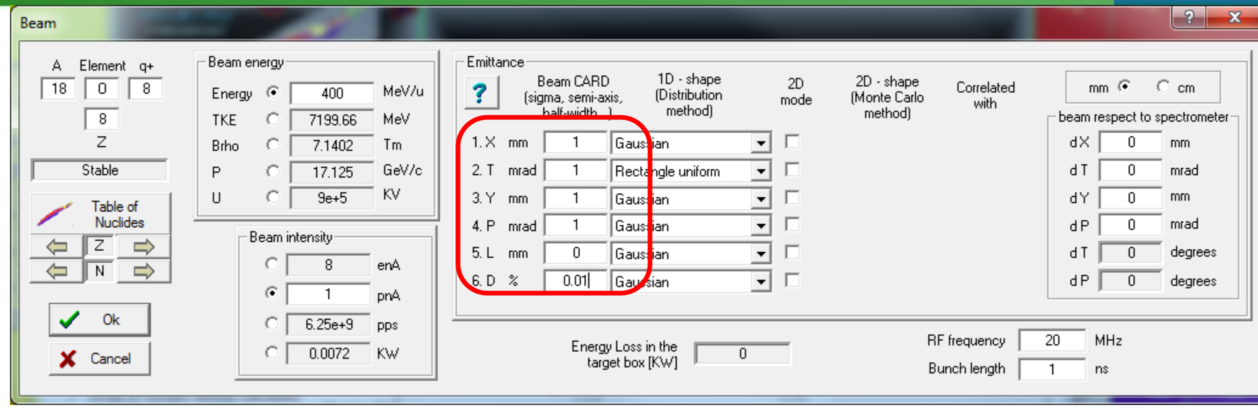


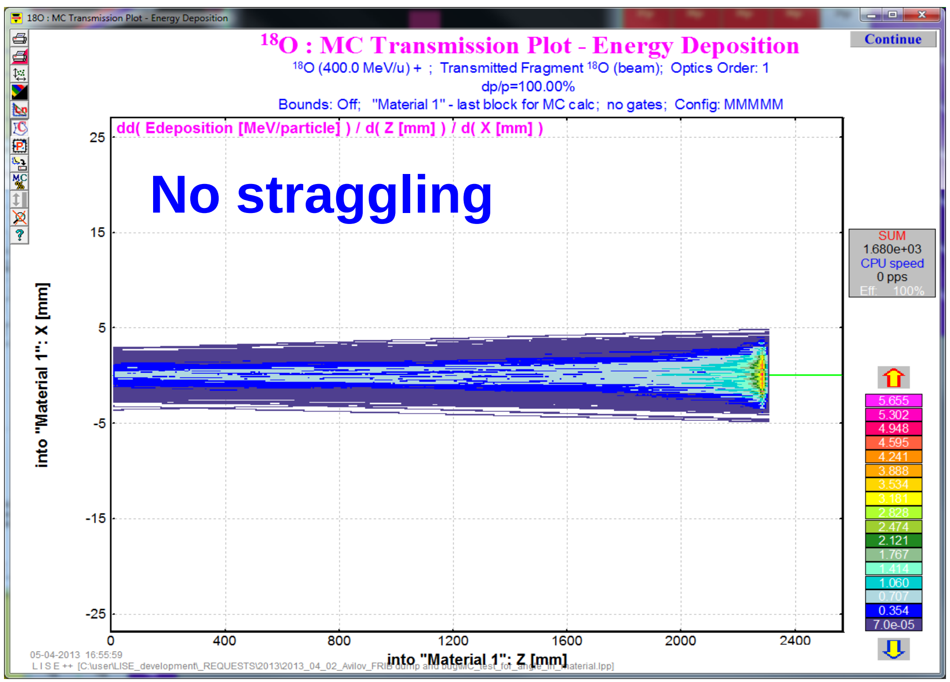
Half-lives are need to generate reaccelerated beams tables

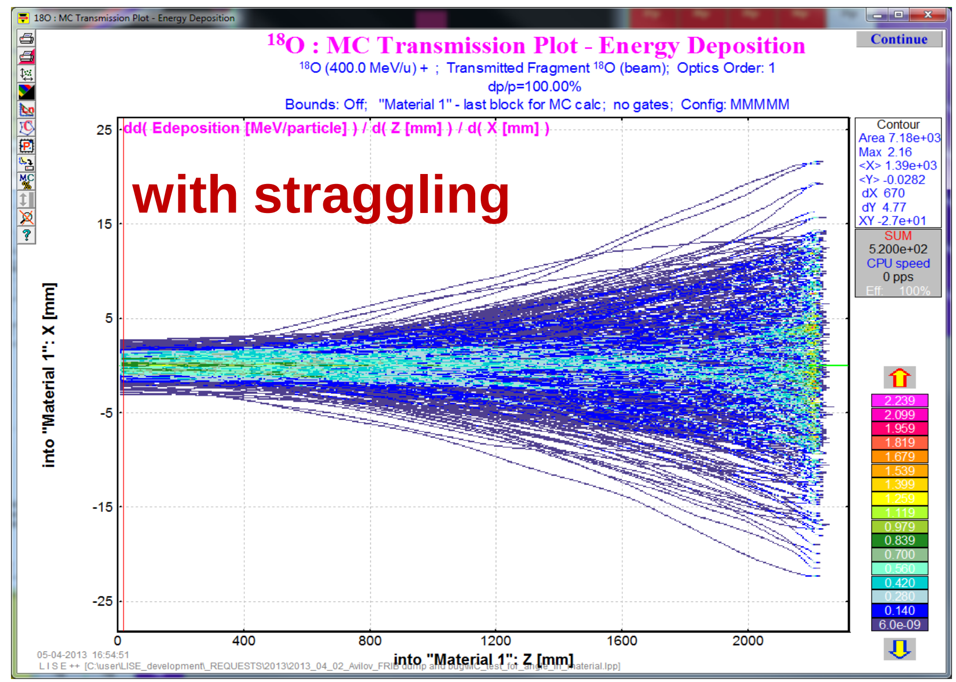
Improvement,
Fix of bugs

Fixed: Bug in the passing material subroutine @ MC mode

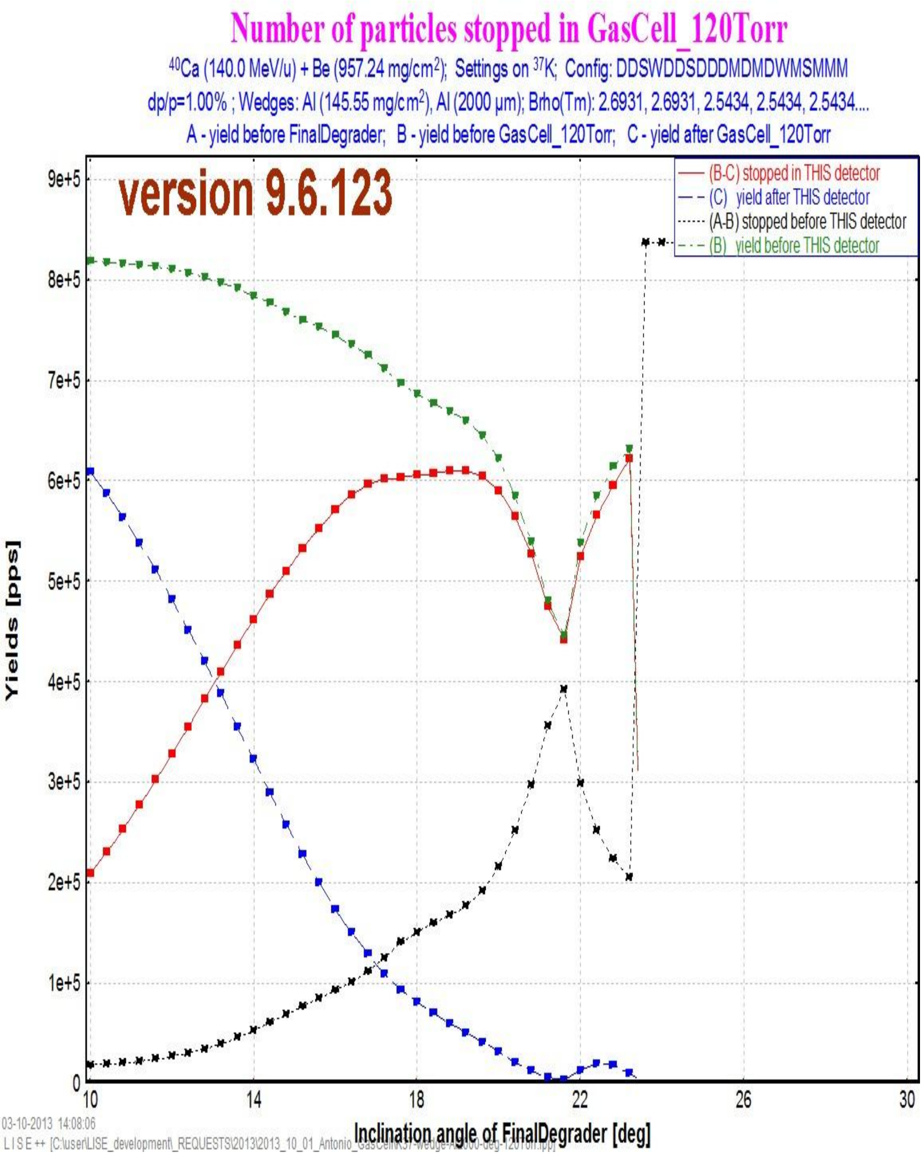
After revision

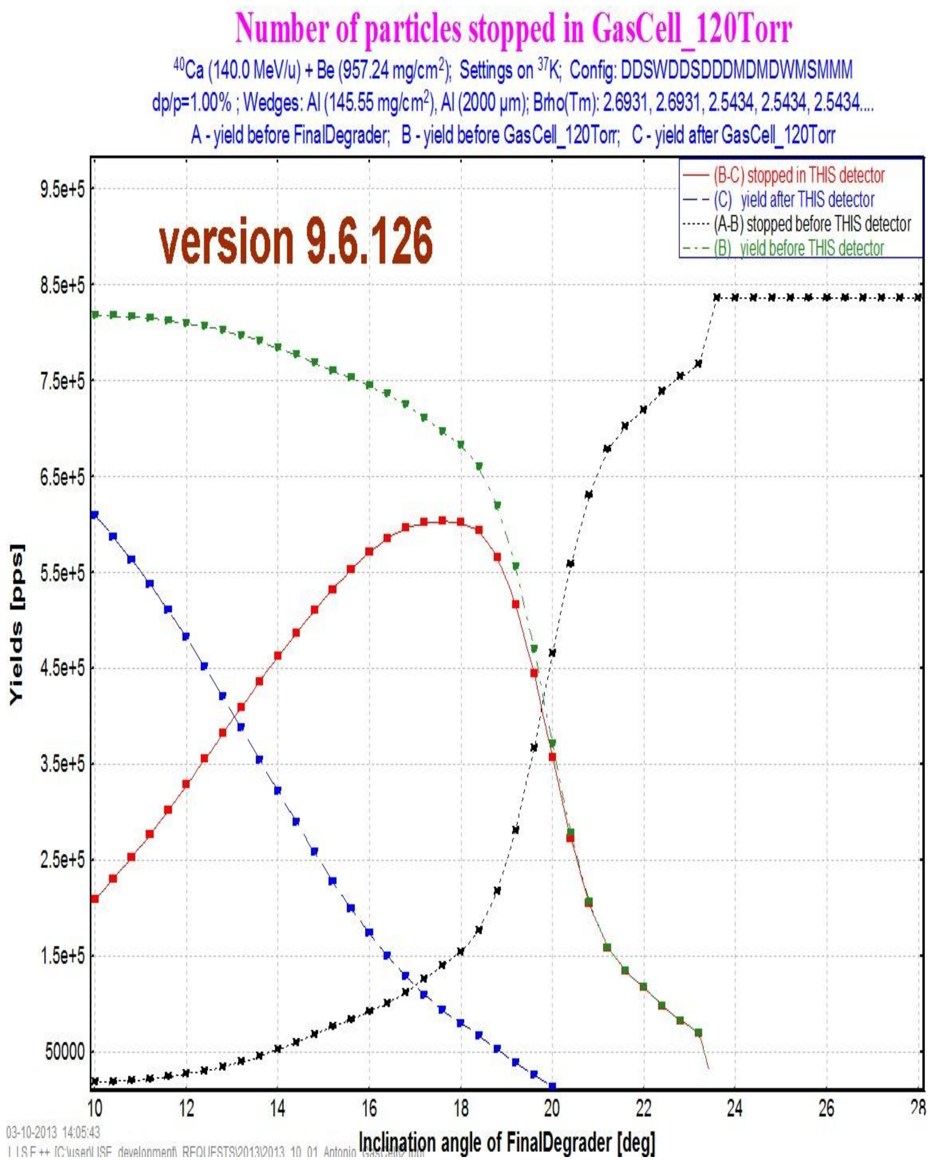




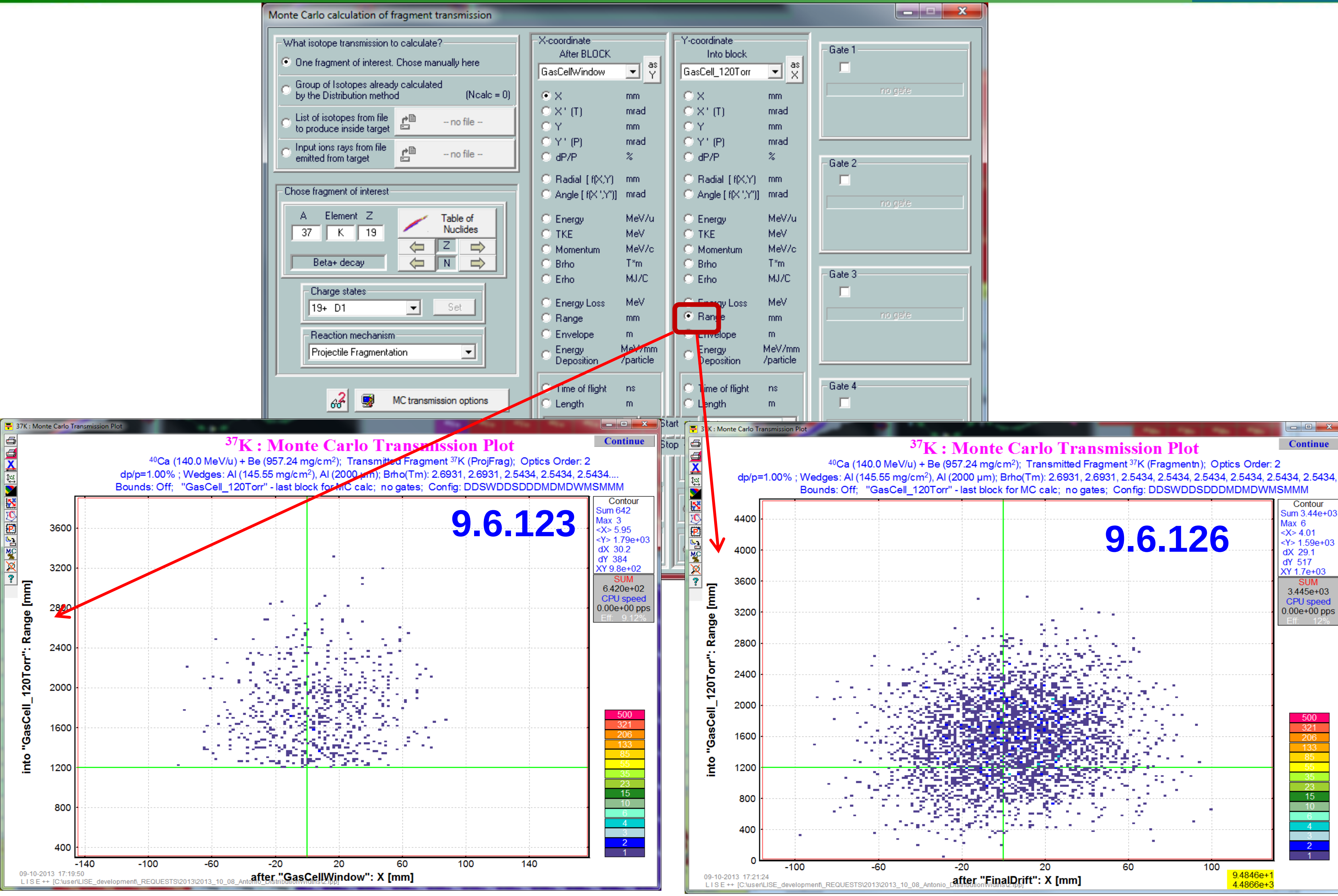


Gas Cell utility modification

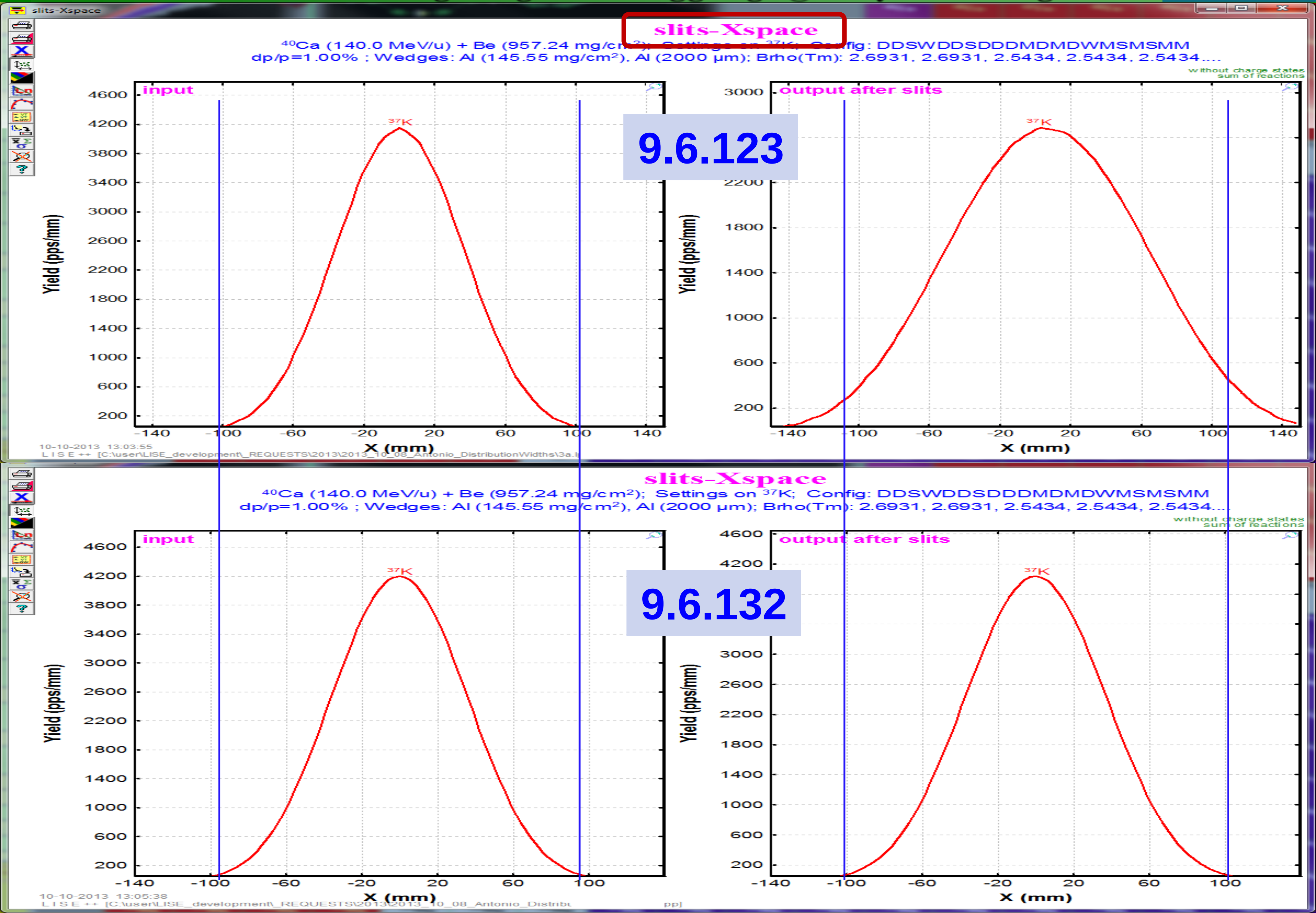




Correction in Monte Carlo Energy loss and Range plots



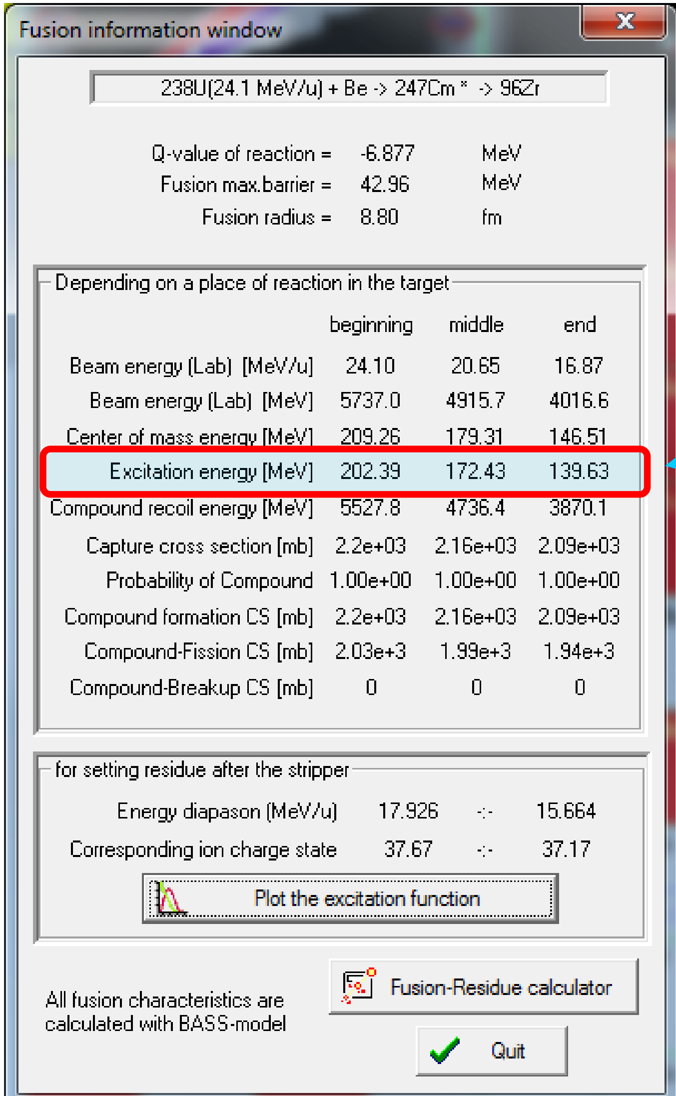
Corrections in transmission subroutines: modification for large angular straggling @ very low energies



Complications

Fusion reactions & thick targets
Abrasion-Fission (High Z)
Quad- and Sextupole fields
PF & proton drip-line

Experiment e547 @ GANIL


Fusion information window

238U(24.1 MeV/u) + Be -> 247Cm * -> 96Zr

Q-value of reaction = -6.877 MeV
Fusion max.barrier = 42.96 MeV
Fusion radius = 8.80 fm

Depending on a place of reaction in the target

	beginning	middle	end
Beam energy (Lab) [MeV/u]	24.10	20.65	16.87
Beam energy (Lab) [MeV]	5737.0	4915.7	4016.6
Center of mass energy [MeV]	209.26	179.31	146.51
Excitation energy [MeV]	202.39	172.43	139.63
Compound recoil energy [MeV]	5527.8	4736.4	3870.1
Capture cross section [mb]	2.2e+03	2.16e+03	2.09e+03
Probability of Compound	1.00e+00	1.00e+00	1.00e+00
Compound formation CS [mb]	2.2e+03	2.16e+03	2.09e+03
Compound-Fission CS [mb]	2.03e+3	1.99e+3	1.94e+3
Compound-Breakup CS [mb]	0	0	0

for setting residue after the stripper

Energy diapason (MeV/u)	17.926	-:-	15.664
Corresponding ion charge state	37.67	-:-	37.17

Plot the excitation function

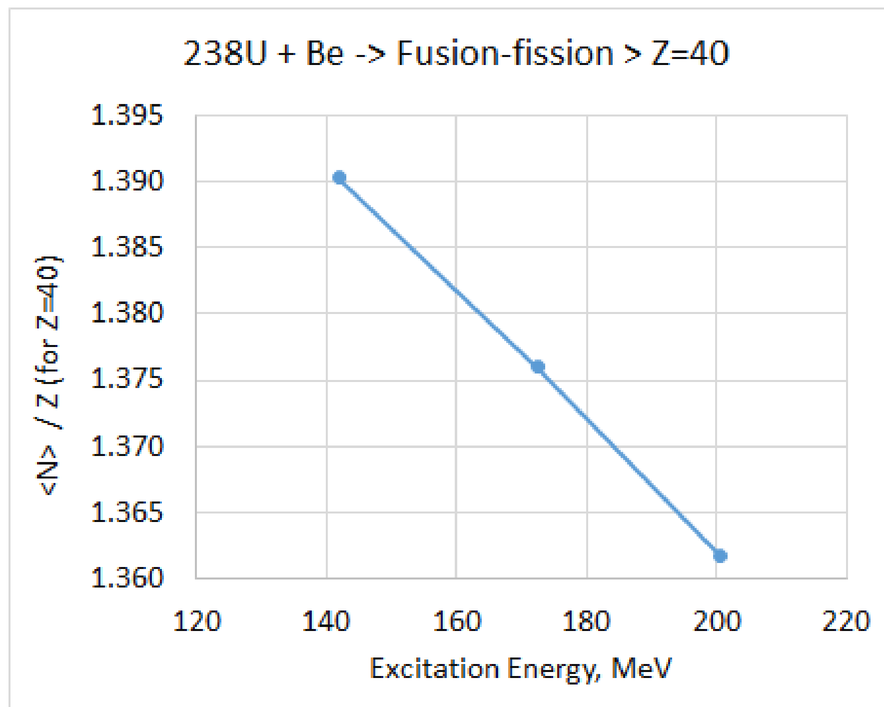
All fusion characteristics are calculated with BASS-model

Fusion-Residue calculator

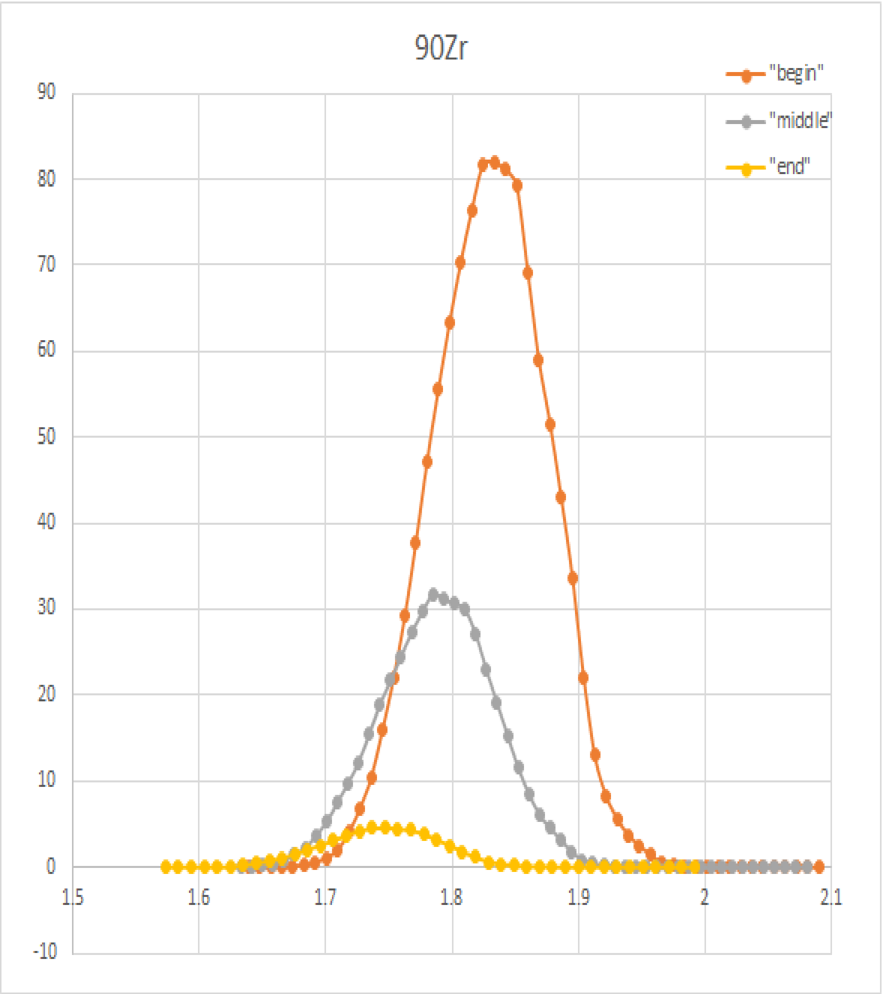
Quit

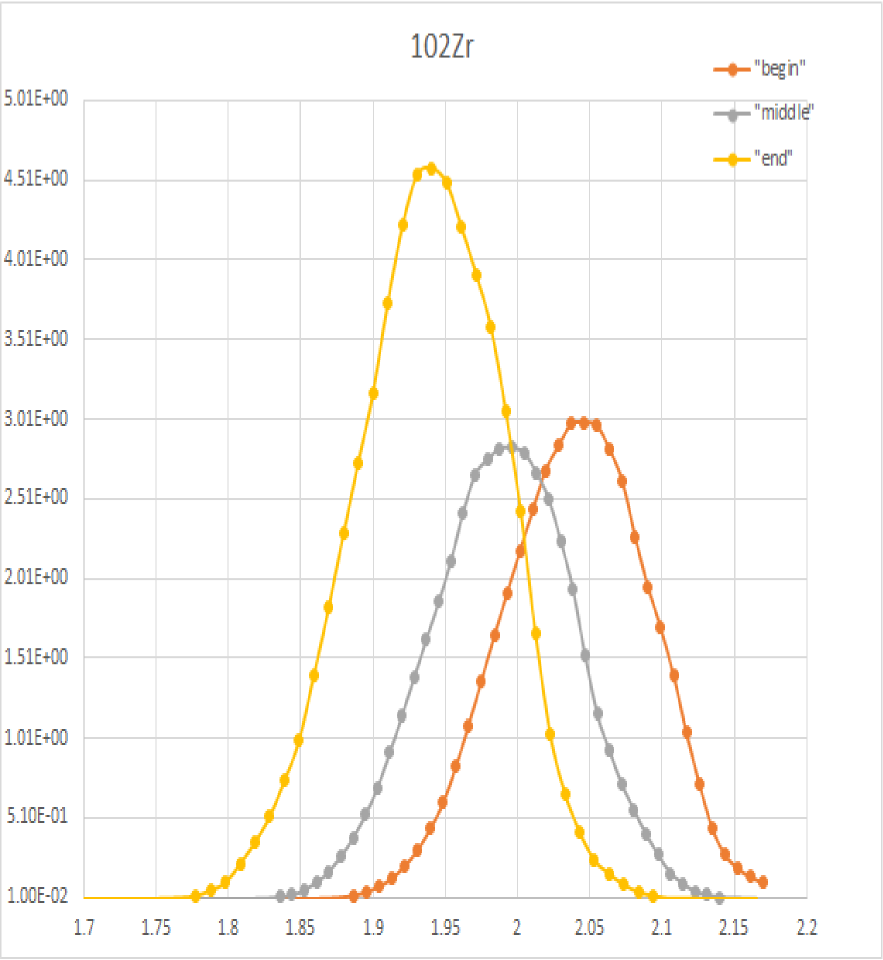
^{238}U(24.1MeV/u) + Be target (15 mg/cm^2) -> Fusion-Fission

Wide excitation energy range 139.6-202.4 MeV



^{238}U(24.1MeV/u) + Be target (15 mg/cm^2) -> Fusion-Fission



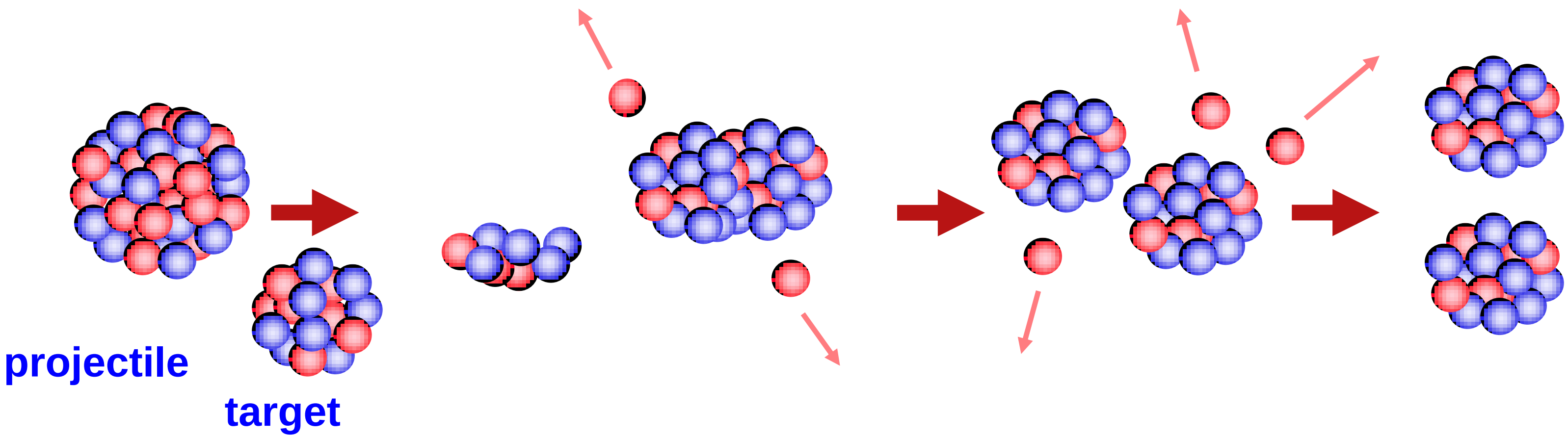


Finally the "slice" technique was used to analyze these data

Abrasion-Fission cross sections

Neutron-rich & High Z

Abrasion-Fission

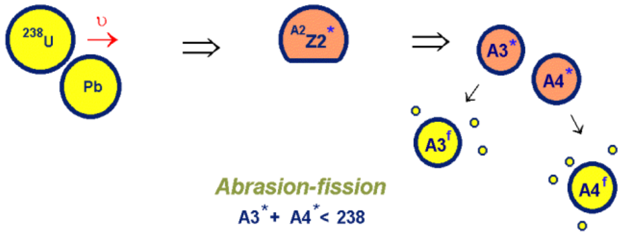


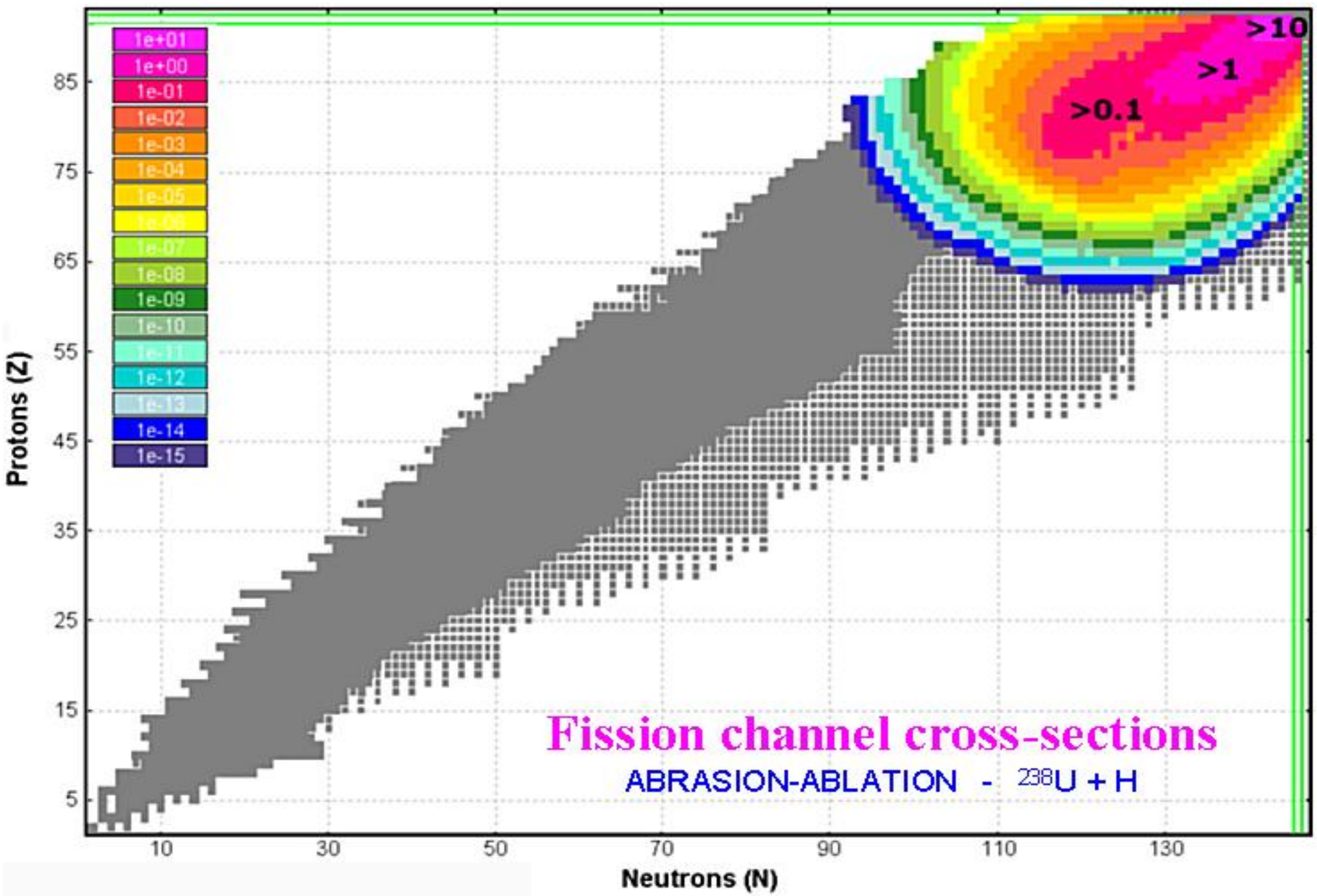
- LISE^{++} 3EER Abrasion-Fission model (analytical)

  Tech. Rep. MSUCL1300, NSCL, Michigan State University, 2005

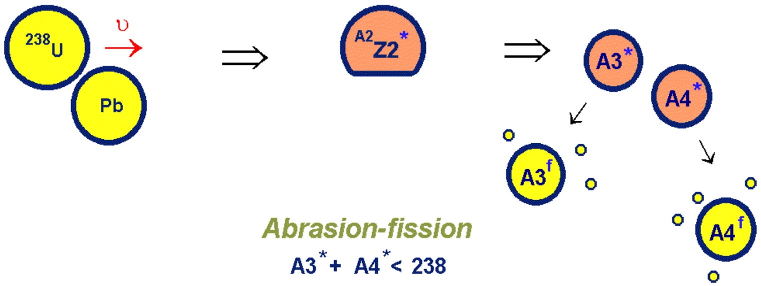
  http://lise.nscl.msu.edu/7_5/lise++_7_5.pdf

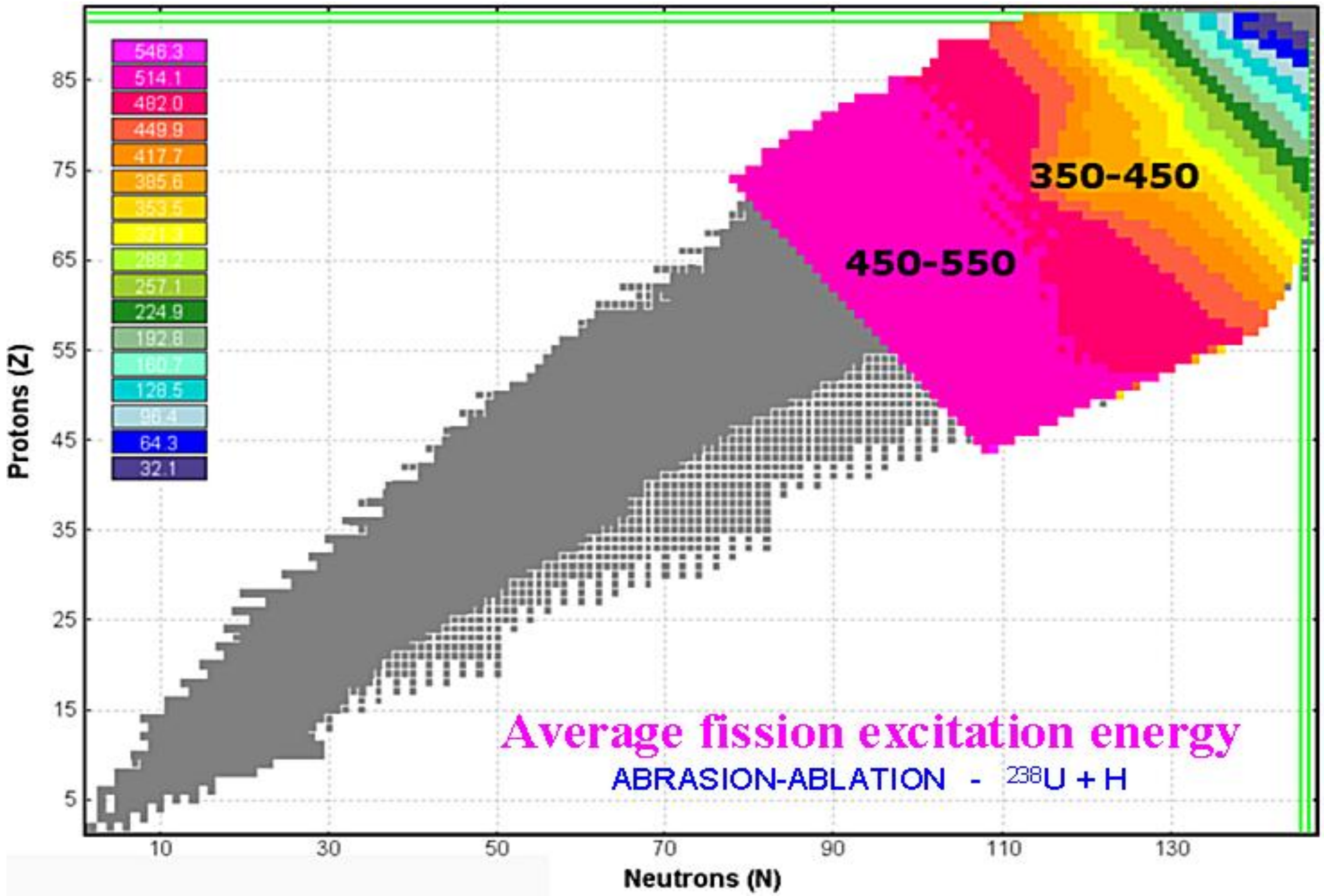
Abrasion-Fission : ocean of fissile nuclei



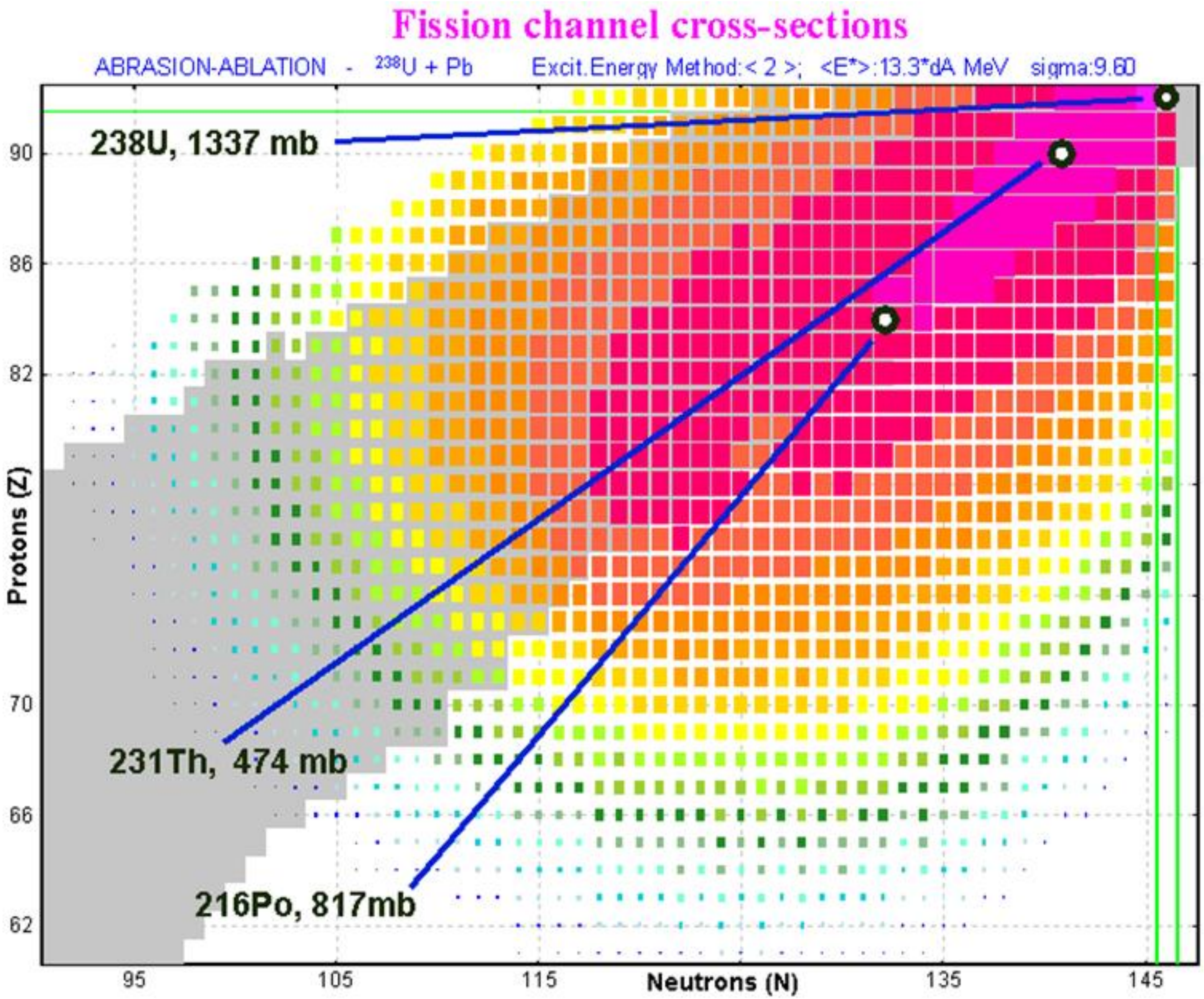


Abrasion-Fission : ocean of hot fissile nuclei

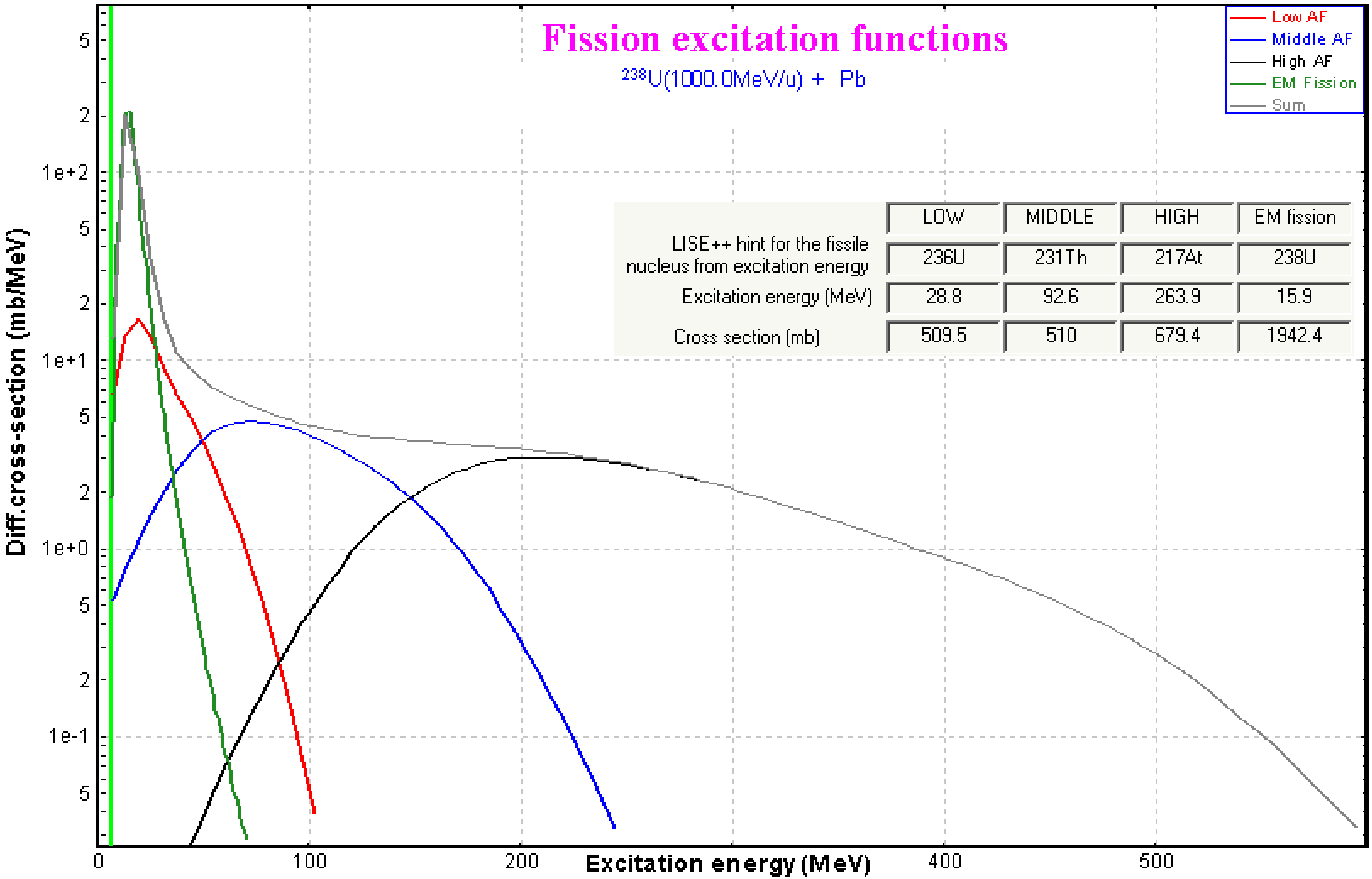




Abrasion-Fission : 3 EER model



Fission excitation functions

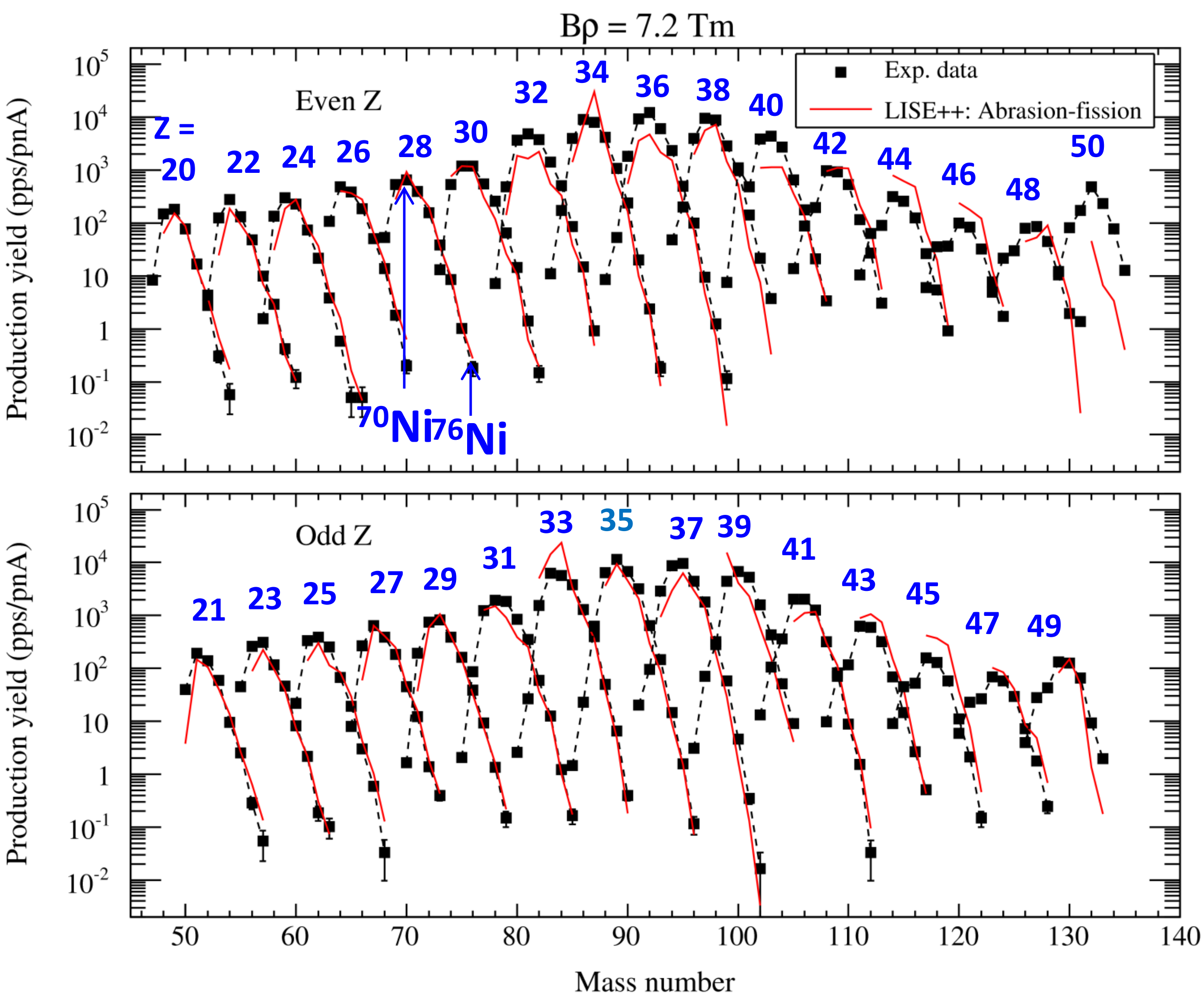


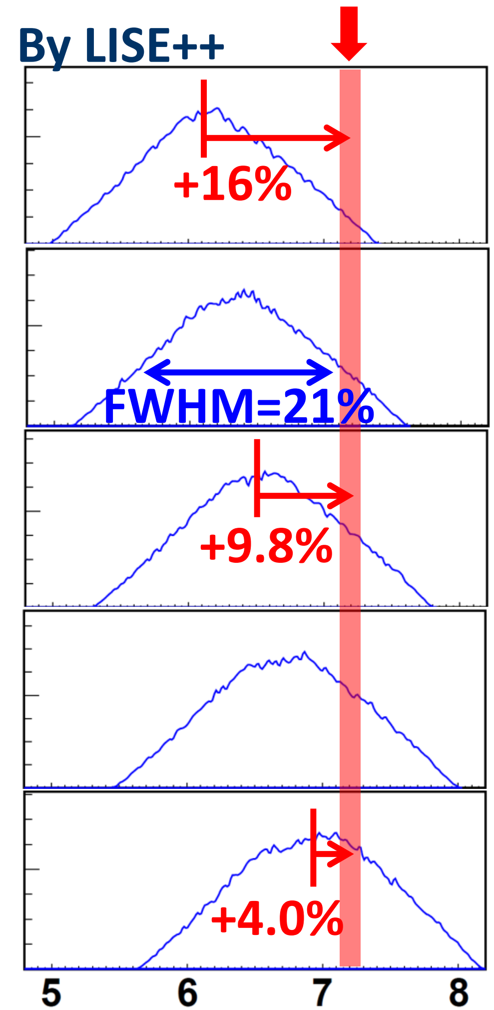
Production rates by ^{238}U + Be(7mm) at $B\rho = 7.249$ Tm

1 setting, no energy degraders used

$B\rho = 7.2$ Tm ± 1%

LISE++ Abrasion-Fission   Fairly good reproduction





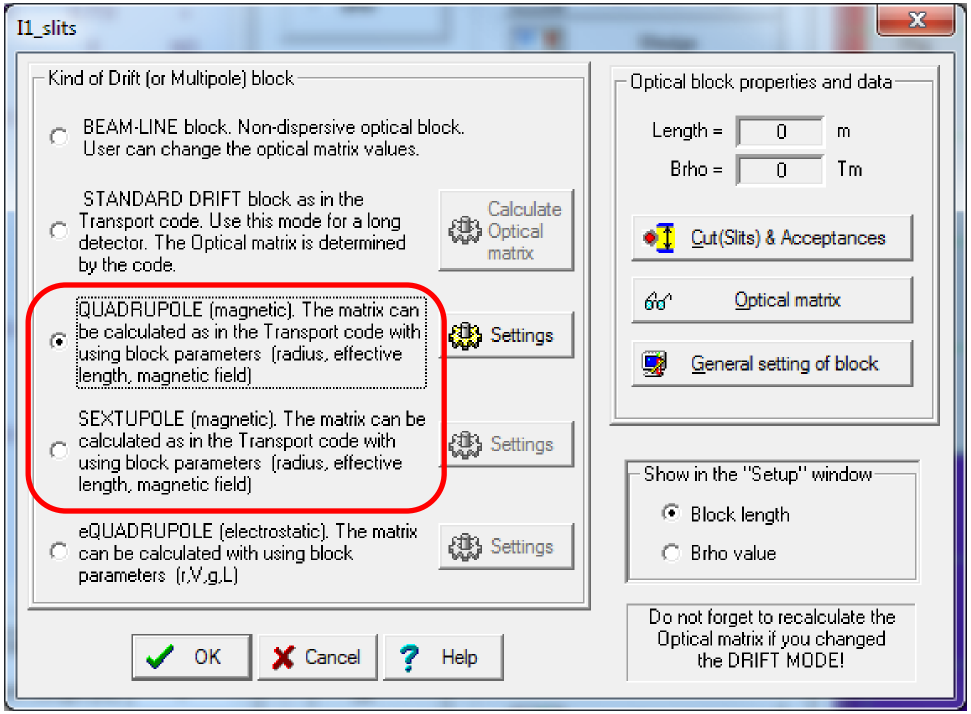
Courtesy of T.Kubo (BigRIPS, RIKEN)

Abrasion-Fission: MC Abrasion-Ablation

- ❑ Priorities : Quality (1) & speed (2)
- ❑ Recent GSI & RIKEN experiments Z=50-90
  - Cross sections? Excitation energy? Kinematics-transmission?
  - Abrasion-Ablation (for PF)
  - Abrasion-Fission (define EERs)
- ❑ MC solution for AA
- ❑ Take into account angular momentum
- ❑ Take into account models development
- ❑ New analytical AF model

Quadrupole and sextupole fields superposition

Quadrupole + Sextupole



So the A1900 fragment-separator has several multipoles (Q+S)

COSY Quad

```
Block: "Q021-1TC"    Matrices: "LOCAL"
                                                              trans

                          * TRANSFORM 1 *

  1 [X]:     +8.0149e-01  +4.0120e-02   0            0
  2 [T]:     -8.9145e+00  +8.0149e-01   0            0
  3 [Y]:      0            0           +1.2126e+00  +4.6010e-02
  4 [F]:      0            0           +1.0224e+01  +1.2126e+00
  5 [L]:      0            0            0            0
  6 [D]:      0            0            0            0

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

                          * TRANSFORM 2 *

  1    1:     0
  1    2:     0            0
  1    3:     0            0            0
  1    4:     0            0            0            0
  1    5:     0            0            0            0
  1    6:    +1.9166e-03  +2.8255e-05   0            0
----------------------------------------------------------------
  2    1:     0
  2    2:     0            0
  2    3:     0            0            0
  2    4:     0            0            0            0
  2    5:     0            0            0            0
  2    6:    +8.2866e-02  +1.9166e-03   0            0
----------------------------------------------------------------
  3    1:     0
  3    2:     0            0
  3    3:     0            0            0
  3    4:     0            0            0            0
  3    5:     0            0            0            0
  3    6:     0            0           -2.1981e-03  -3.0675e-05
----------------------------------------------------------------
  4    1:     0
  4    2:     0            0
  4    3:     0            0            0
  4    4:     0            0            0            0
  4    5:     0            0            0            0
  4    6:     0            0           -1.0905e-01  -2.1981e-03
----------------------------------------------------------------
  5    1:    -6.0266e-04
  5    2:    +1.7880e-04  -1.8788e-05
  5    3:     0            0           -7.1031e-04
  5    4:     0            0           -2.3517e-04  -2.4696e-05
  5    5:     0            0            0            0
  5    6:     0            0            0            0
----------------------------------------------------------------
```

LISE^{++} Quad

```
Block: "Q021-1TC"    Matrices: "LOCAL"
                                                              trans

                          * TRANSFORM 1 *

  1 [X]:     +8.0149e-01  +4.0120e-02   0            0
  2 [T]:     -8.9145e+00  +8.0149e-01   0            0
  3 [Y]:      0            0           +1.2126e+00  +4.6010e-02
  4 [F]:      0            0           +1.0224e+01  +1.2126e+00
  5 [L]:      0            0            0            0
  6 [D]:      0            0            0            0

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

                          * TRANSFORM 2 *

  1    1:     0
  1    2:     0            0
  1    3:     0            0            0
  1    4:     0            0            0            0
  1    5:     0            0            0            0
  1    6:    +1.9166e-03  +2.8255e-05   0            0
----------------------------------------------------------------
  2    1:     0
  2    2:     0            0
  2    3:     0            0            0
  2    4:     0            0            0            0
  2    5:     0            0            0            0
  2    6:    +8.2866e-02  +1.9166e-03   0            0
----------------------------------------------------------------
  3    1:     0
  3    2:     0            0
  3    3:     0            0            0
  3    4:     0            0            0            0
  3    5:     0            0            0            0
  3    6:     0            0           -2.1981e-03  -3.0675e-05
----------------------------------------------------------------
  4    1:     0
  4    2:     0            0
  4    3:     0            0            0
  4    4:     0            0            0            0
  4    5:     0            0            0            0
  4    6:     0            0           -1.0905e-01  -2.1981e-03
----------------------------------------------------------------
  5    1:     0
  5    2:     0            0
  5    3:     0            0            0
  5    4:     0            0            0            0
  5    5:     0            0            0            0
  5    6:     0            0            0            0
----------------------------------------------------------------
```

COSY Sext

```
Block: "Q021-1TC"    Matrices: "LOCAL"
                                                              trans

                         * TRANSFORM 1 *

  1 [X]:     +1.0000e+00  +4.3000e-02  0            0
  2 [T]:     0            +1.0000e+00  0            0
  3 [Y]:     0            0            +1.0000e+00  +4.3000e-02
  4 [F]:     0            0            0            +1.0000e+00
  5 [L]:     0            0            0            0
  6 [D]:     0            0            0            0

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

                         * TRANSFORM 2 *

  1    1:    -1.3696e-03
  1    2:    -3.9263e-05  -4.2207e-07
  1    3:    0            0            +1.3696e-03
  1    4:    0            0            +3.9263e-05  +4.2207e-07
  1    5:    0            0            0            0
  1    6:    0            0            0            0
-----------------------------------------------------------------
  2    1:    -6.3704e-02
  2    2:    -2.7393e-03  -3.9263e-05
  2    3:    0            0            +6.3704e-02
  2    4:    0            0            +2.7393e-03  +3.9263e-05
  2    5:    0            0            0            0
  2    6:    0            0            0            0
-----------------------------------------------------------------
  3    1:    0
  3    2:    0            0
  3    3:    +2.7393e-03  +3.9263e-05  0
  3    4:    +3.9263e-05  +8.4415e-07  0            0
  3    5:    0            0            0            0
  3    6:    0            0            0            0
-----------------------------------------------------------------
  4    1:    0
  4    2:    0            0
  4    3:    +1.2741e-01  +2.7393e-03  0
  4    4:    +2.7393e-03  +7.8525e-05  0            0
  4    5:    0            0            0            0
  4    6:    0            0            0            0
-----------------------------------------------------------------
  5    1:    0
  5    2:    0            -2.1500e-05
  5    3:    0            0            0
  5    4:    0            0            0            -2.1500e-05
  5    5:    0            0            0            0
  5    6:    0            0            0            0
-----------------------------------------------------------------
```

LISE++ Sext

```
Block: "S021-1TC"    Matrices: "LOCAL"
                                                              transp

                         * TRANSFORM 1 *

  1 [X]:     +1.0000e+00  +4.3000e-02  0            0
  2 [T]:     0            +1.0000e+00  0            0
  3 [Y]:     0            0            +1.0000e+00  +4.3000e-02
  4 [F]:     0            0            0            +1.0000e+00
  5 [L]:     0            0            0            0
  6 [D]:     0            0            0            0

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

                         * TRANSFORM 2 *

  1    1:    -1.3696e-03
  1    2:    -3.9263e-05  -4.2207e-07
  1    3:    0            0            +1.3696e-03
  1    4:    0            0            +3.9263e-05  +4.2207e-07
  1    5:    0            0            0            0
  1    6:    0            0            0            0
-----------------------------------------------------------------
  2    1:    -6.3704e-02
  2    2:    -2.7393e-03  -3.9263e-05
  2    3:    0            0            +6.3704e-02
  2    4:    0            0            +2.7393e-03  +3.9263e-05
  2    5:    0            0            0            0
  2    6:    0            0            0            0
-----------------------------------------------------------------
  3    1:    0
  3    2:    0            0
  3    3:    +2.7393e-03  +3.9263e-05  0
  3    4:    +3.9263e-05  +8.4415e-07  0            0
  3    5:    0            0            0            0
  3    6:    0            0            0            0
-----------------------------------------------------------------
  4    1:    0
  4    2:    0            0
  4    3:    +1.2741e-01  +2.7393e-03  0
  4    4:    +2.7393e-03  +7.8525e-05  0            0
  4    5:    0            0            0            0
  4    6:    0            0            0            0
-----------------------------------------------------------------
  5    1:    0
  5    2:    0            0
  5    3:    0            0            0
  5    4:    0            0            0            0
  5    5:    0            0            0            0
  5    6:    0            0            0            0
```

COSY Quad

```
Block: "Q021-1TC"    Matrices: "LOCAL"
                                                    trans

                 * TRANSFORM 1 *

 1 [X]:  +8.0149e-01  +4.0120e-02  0            0
 2 [T]:  -8.9145e+00  +8.0149e-01  0            0
 3 [Y]:  0            0            +1.2126e+00  +4.6010e-02
 4 [F]:  0            0            +1.0224e+01  +1.2126e+00
 5 [L]:  0            0            0            0
 6 [D]:  0            0            0            0
-----------------------------------------------------------

                 * TRANSFORM 2 *

 1  1:   0
 1  2:   0            0
 1  3:   0            0            0
 1  4:   0            0            0            0
 1  5:   0            0            0            0
 1  6:   +1.9166e-03  +2.8255e-05  0            0
-----------------------------------------------------------
 2  1:   0
 2  2:   0            0
 2  3:   0            0            0
 2  4:   0            0            0            0
 2  5:   0            0            0            0
 2  6:   +8.2866e-02  +1.9166e-03  0            0
-----------------------------------------------------------
 3  1:   0
 3  2:   0            0
 3  3:   0            0            0
 3  4:   0            0            0            0
 3  5:   0            0            0            0
 3  6:   0            0            -2.1981e-03  -3.0675e-05
-----------------------------------------------------------
 4  1:   0
 4  2:   0            0
 4  3:   0            0            0
 4  4:   0            0            0            0
 4  5:   0            0            0            0
 4  6:   0            0            -1.0905e-01  -2.1981e-03
-----------------------------------------------------------
 5  1:   -6.0266e-04
 5  2:   +1.7880e-04  -1.8788e-05
 5  3:   0            0            -7.1031e-04
 5  4:   0            0            -2.3517e-04  -2.4696e-05
 5  5:   0            0            0            0
 5  6:   0            0            0            0
-----------------------------------------------------------
```

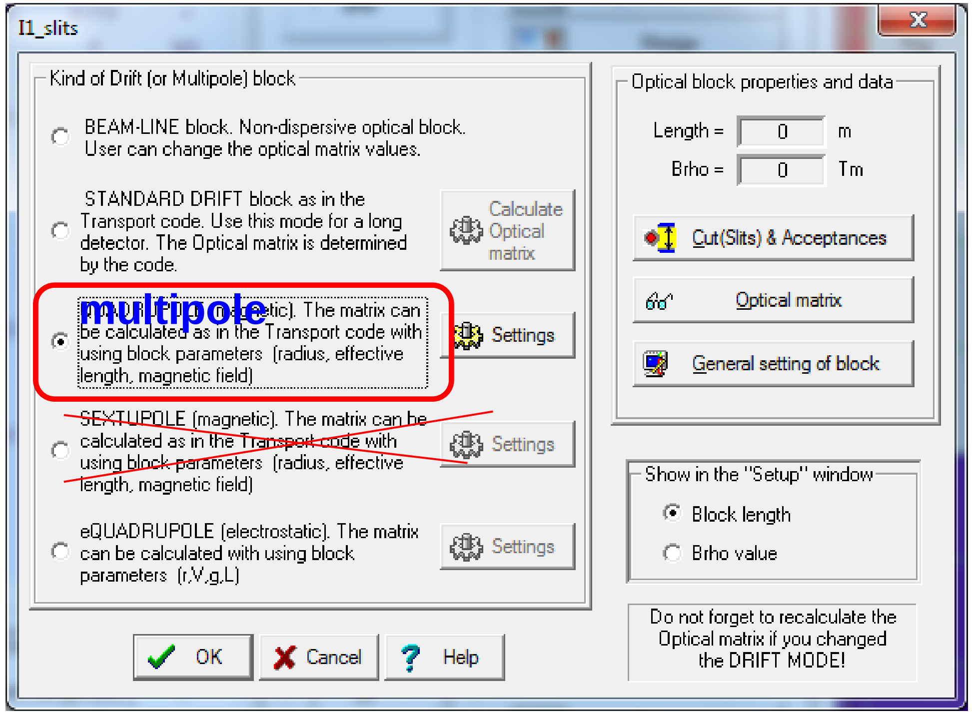
COSY Quad+Sext

```
1-1TC"    Matrices: "LOCAL"
                                                 tran

                 * TRANSFORM 1 *

+8.0149e-01  +4.0120e-02  0            0
-8.9145e+00  +8.0149e-01  0            0
0            0            +1.2126e+00  +4.6010e-02
0            0            +1.0224e+01  +1.2126e+00
0            0            0            0
0            0            0            0
-----------------------------------------------------------

                 * TRANSFORM 2 *

-1.2358e-03
-3.5392e-05  -3.9404e-07
0            0            +1.4211e-03
0            0            +4.1788e-05  +4.3998e-07
0            0            0            0
+1.9166e-03  +2.8255e-05  0            0
-----------------------------------------------------------
-5.1565e-02
-2.2965e-03  -3.5392e-05
0            0            +6.8716e-02
0            0            +3.0378e-03  +4.1788e-05
0            0            0            0
+8.2866e-02  +1.9166e-03  0            0
-----------------------------------------------------------
0
0            0
+2.8292e-03  +4.1674e-05  0
+3.8417e-05  +8.5545e-07  0            0
0            0            0            0
0            0            -2.1981e-03  -3.0675e-05
-----------------------------------------------------------
0
0            0
+1.3559e-01  +3.0193e-03  0
+2.6391e-03  +8.0091e-05  0            0
0            0            0            0
0            0            -1.0905e-01  -2.1981e-03
-----------------------------------------------------------
-6.0266e-04
+1.7880e-04  -1.8788e-05
0            0            -7.1031e-04
0            0            -2.3517e-04  -2.4696e-05
0            0            0            0
0            0            0            0
```

COSY Sext

```
1-1TC"    Matrices: "LOCAL"
                                                 tran

                 * TRANSFORM 1 *

+1.0000e+00  +4.3000e-02  0            0
0            +1.0000e+00  0            0
0            0            +1.0000e+00  +4.3000e-02
0            0            0            +1.0000e+00
0            0            0            0
0            0            0            0
-----------------------------------------------------------

                 * TRANSFORM 2 *

-1.3696e-03
-3.9263e-05  -4.2207e-07
0            0            +1.3696e-03
0            0            +3.9263e-05  +4.2207e-07
0            0            0            0
0            0            0            0
-----------------------------------------------------------
-6.3704e-02
-2.7393e-03  -3.9263e-05
0            0            +6.3704e-02
0            0            +2.7393e-03  +3.9263e-05
0            0            0            0
0            0            0            0
-----------------------------------------------------------
0
0            0
+2.7393e-03  +3.9263e-05  0
+3.9263e-05  +8.4415e-07  0            0
0            0            0            0
0            0            0            0
-----------------------------------------------------------
0
0            0
+1.2741e-01  +2.7393e-03  0
+2.7393e-03  +7.8525e-05  0            0
0            0            0            0
0            0            0            0
-----------------------------------------------------------
0
0            -2.1500e-05
0            0            0
0            0            0            -2.1500e-05
0            0            0            0
0            0            0            0
```

A.



B. Second order 2.5.*.* in LISE++ are zeros. Is it important?

C. Check the effect between matrix (Q+S) and (matrix(Q)+matrix(S) for the A1900 case

PF momentum Distributions

Proton drip-line

See the next presentation

Requests, Feedback

LISE++ user requests, the code support : high priority

Evidently a lot of simple questions : version for MAC, why, when and so on…

Serious requests: bugs, configuration questions-analysis-requests , questions-presentations on 10 pages,
then answer needs some power point presentation, LISE++ file

Name	E	Size	↓Date	Attr
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[2011_01_24		DIR>	01/28/2011 15:25	—
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[2011_04_02		DIR>	04/18/2011 16:44	—
[2011_07_22		DIR>	07/29/2011 15:16	—
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[2011_12_In		DIR>	12/16/2011 15:48	—

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[2013_03_11..]	<DIR>	04/02/2013 12:31 —
[2013_03_13..]	<DIR>	03/27/2013 12:12 —
[2013_03_14..]	<DIR>	03/19/2013 14:47 —
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[2013_03_18..]	<DIR>	03/20/2013 12:38 —
[2013_03_18..]	<DIR>	04/08/2013 10:06 —
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[2013_03_21..]	<DIR>	03/22/2013 10:55 —
[2013_03_22..]	<DIR>	03/28/2013 14:42 —
[2013_03_25..]	<DIR>	03/26/2013 13:07 —
[2013_03_26..]	<DIR>	03/26/2013 13:07 —
[2013_03_26..]	<DIR>	03/26/2013 13:09 —
[2013_04_02..]	<DIR>	04/03/2013 16:51 —
[2013_04_02..]	<DIR>	04/12/2013 16:22 —
[2013_04_08..]	<DIR>	04/08/2013 10:40 —
[2013_05_09..]	<DIR>	06/25/2013 13:42 —
[2013_05_23..]	<DIR>	12/06/2013 12:08 —
[2013_05_28..]	<DIR>	06/21/2013 12:37 —
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[2013_11_18..]	<DIR>	11/18/2013 13:58 —

1/19/2012
In the context of my present activity, I would be interesting in using the LISE++ for my application at **CERN**.
……. input; in particular, if the LISE++ code is applicable to simulate the **antiproton** transport through a spectrometer line. ………

recent

3/12/2013
I am currently looking at cancer therapy approaches such as **implanting nanospheres containing radioactive materials into specific locations within a tumor site** (e.g., the blood vessels supplying the tumor). …..

Set a bond as a target. I assumed Ca (3 mm). Just behind a bond we set a material "Brain" (Water 10 cm). You can input more realistic chemical formula (up to 5 components)

3/19/2013
Thank you very much. LISE++ appears to offer considerable flexibility and could be very useful in my research. …. The code also appears to run considerably faster than a code I wrote to investigate energy deposition from internal radiation generating devices. Attached is a recent paper to illustrate the types of items that I am investigating.

3/20/2013
It has been a while since we last communicated and I was wondering if there has been any progress with respect to including **angular distributions in the two body reaction mechanism** for LISE. Also is there a possibility of including **regular Rutherford scattering**, as you see it in the kinematics calculator? In other words, if we choose two-body for the outgoing nucleus being the same as the projectile, then instead of being isotropic distribution, we could have option of using the rutherford scattering distribution peaked at forward angles. Finally, I was wondering if there is a plan to **include excitation energy of the outgoing nucleus in two-body reaction mode**.

3/25/2013
I am beginner for using LISE. I really appreciate your work. It is amazing. Could LISE model the independent and / or cumulative photofission fragment yields of delayed gamma rays precursors?

The LISE++ code was designed to estimate yields of produced fragments passed through a fragment-separator.
In your case of photofission it is possible only use LISE++ for preliminary cross section calculations.

3/26/2013 Thanks, it is also beneficial to me.

LISE++ development strategy

High priority

- Bugs fix (if they do still exist ☺)
- Requests
  - FRIB fragment separator group
  - A1900 fragment separator group
  - FRIB "isotope" group
- User support
- Tasks from the accepted high priority list

Low priority

- Requests
  - Outside
- Tasks from the accepted low priority list

Medium priority

- Documentation
- Requests
  - Local (MSU)
  - Collaborations
- Tasks from the accepted medium priority list
- Sufficient improvement of existent utilities

Strategy

- Engage users in the creation and use of the extended configurations
- Do not create utilities based on outside requests, which wont be widely used

Perspectives

Minimization for quad fields

- **Creation new block : “minimization”**
  (not used for transmission calculations)
- **Quadrupole option (checkbox) “use for minimization”**
- **Implementation of minimization procedure**
- **First order optics, analytical solution**
- **First step: only quad fields**

additionally

Utility for storage rings?

Factor for low-energy charge state models?

LISE^{++} site : future development

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EXOTIC BEAM PRODUCTION WITH FRAGMENT SEPARATORS

- Home
- Introduction
- Documentation
- Last Changes
- Perspectives
- Download
- MOTER
- PACE 4
- Spectrometers
- Related topics
- Personal pages
- Registration
- Email

Future developments of LISE^{++}

Link to get the list of tasks from 6-DEC-2013

Scheduled works done out in 2013

Global tasks (first priority)

- Evaporation cascade: create Monte Carlo version
- ADA (Abrasion-Dissipation-Ablation) model creation
- Implementation of Intranuclear cascade (INC) model in LISE^{++} Windows
- The "MOTER" code development
- High order optics calculation: improvement, adaptation GICOSY format

Local tasks

2013 LISE++ tasks : done

10/10/2013 7:05 PM

LISE++ development done

Subject	Priority	Status	new	Order	Time
LongTerm					
LISE for Mac EXCEL	high	done	X	1	1.5 weeks
Two-body reactions : user differential cross section - utilities	high	done	X	5.1	1.5 week
Two-body reactions : user differential cross section - using in transmission calculations	high	done	X	5.3	1 week
ShortTerm					
Help links from dialogs on the LISE++ site	high	done	X	2	2 days
Two or more locations for the MC output file	high	done	X	3.2	2 days
Input source of ions @ MC (A,Z,q,E,E*,dt,x,x',y,y')	high	done	X	3.3	2 days
Corrections in PACE4's Quantum-Mechanical mode	high	done	X	4	2 days
Two-body reactions : manually set excitation energy of fragment	high	done	X	5.2	3 days
Develop a subroutine to calculate a reduced dispersion for large values of dP/P	high	done		6.1	< 4 days
Improvement of existent blocks : Electrostaticx dipole, transport solution	high	done	X	6.2	< 5 days
Creation of Electrocstatic Quad (see Drift block)	high	done	X	6.3	< 3 days
New block : SHIFT (position & direction of optical axis)	high	done	X	6.4	< 3 days
MC Gates : A,Z,Q, A/q	medium	done		3.1	< 2 days
MC gates procedure optimization for speed	medium	done	X	3.4	1 day
Easy way to change the charge state option	medium	done	X		< 1 day
Beam and setting fragment charge state distributions @ selected point	medium	done	X		1 day
neutron channel in Two-body reaction in the "User Diff.CS" case	medium	done		7	4 days
Kinematics calculator: g, n	low	done	X	7.1	2 days

2014 LISE^{++} long term tasks

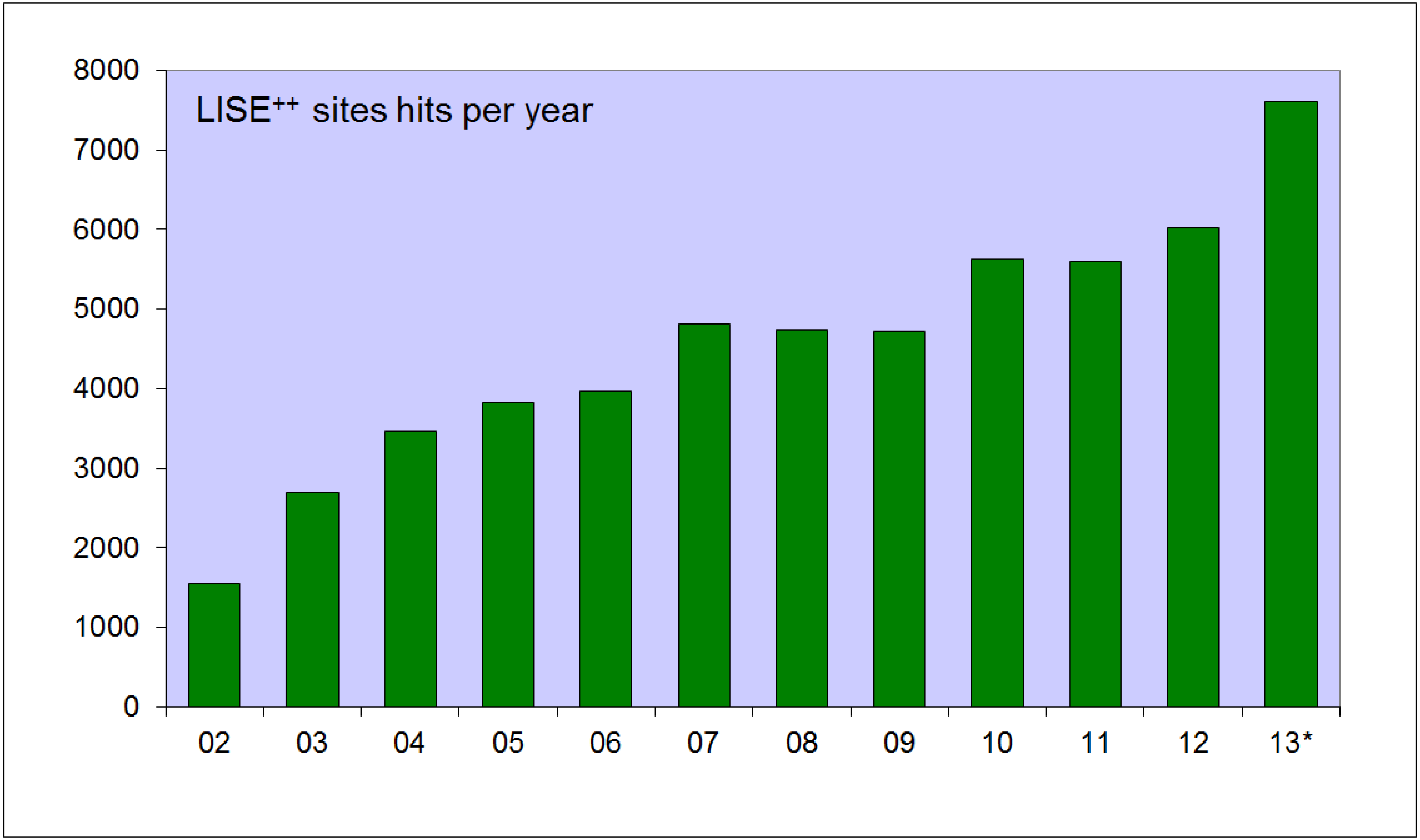
Subject	Priority	Status	new	Order	Time
LongTerm					
Evaporation cascade: improvement, create Monte Carlo version	high			1	1 month
Abrasion-Ablation: create Monte Carlo version	high			2	2 weeks
Abrasion-Fission: create Monte Carlo version	high			3	2 weeks
Abrasion-Fission: new analytical model. Calculations (CS, E*,TKE) are kept in files	high		X	4	1 month
Time in the distribution4 class (RF-buncher, RF-kicker)	medium		X		1-2 weeks
Custom shape degrader optimization in MC mode for high order optics	medium				< 2 weeks
Input angles in wedge in MC mode	medium				< 1 week
ETACHA implementation	medium				1.5 months
ADA (Abrasion-Dissipation-Ablation) model creation	medium				2 months
Implementation of Intranuclear cascade (INC) model in LISE++ Windows	medium				3 months
Minimization in LISE++ (light version -- only for quad fields)	medium				1 months
Minimization in LISE++ (TRANSPORT, MC, Ray tracing cases)	medium				2 months
Write full LISE++ documentation	medium				3 months
Ray tracing in LISE++	low				1 year
New compliler, New Shell	low				6 months
PACE4 generator of one event (creation dll-library)	low				< 1 week
PACE4 in MC LISE++ (using PACE4 dll-library)	low				< 1 week
The "MOTER" code development	low				1 year
Energy loss in PACE4	low				< 1 week
Three-body kinematics relativistic calculator	low				1 month
Water wedge procedure (wedge with one moving plane and filled by liquid)	low				< 2 weeks
Trochoidal Mass Separator	low		X		1-2 weeks
Calculation of composition from time of isotope implanted in detectors	low		X		1-2 weeks

2014 LISE++ short term tasks

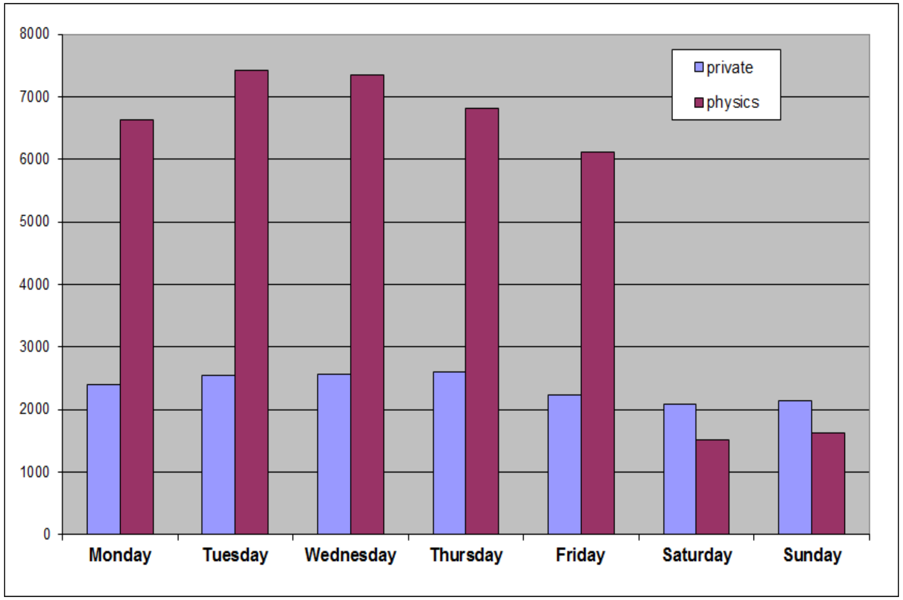
Subject	Priority	Status	new	Order	Time
ShortTerm					
Superposition Quadrupole and Sextupole fileds in LISE++	high		X	1	< 2 days
Improvement of existent blocks : Compensating dipole	high		X	2	< 5 days
MARS fragment-separator & Compensating dipole	high		X	3	< 5 days
Improvement of existent blocks : gas-filled dipole	high		X	4	< 5 days
Gas-filled dipole : rays-tracing mode in MC	high		X	5	< 5 days
Gates for analytical solutions (like done for MC)	medium		X		< 2 days
Cross section for stripper	medium				< 2 days
Create possibility to Insert a material before the target	medium		X		2 days
Rutherford scattering of the primary beam (transmission)	medium		X		< 2 days
User database: import, edit, plot	low				< 5 days
Wedge (including curved profile wedge) inclination	low				< 4 days
Brho method to measure T1/2 (MC: possibility of decay in flight)	low				< 5 days
High order optics calculation: improvement, adaptation GICOSY format	low				< 3 days
MOCADI <-> LISE++ converter	low				< 4 dyas
Transport <-> LISE++ converter	low				< 2 days
m-rad dimensions for LISE++ optics	low				< 2 dasy
Problem with Projectile Fragmentation in the Catcher utility	low				< 1 day
Simulation reactions in Si-telescope in MC mode	low				< 4 days

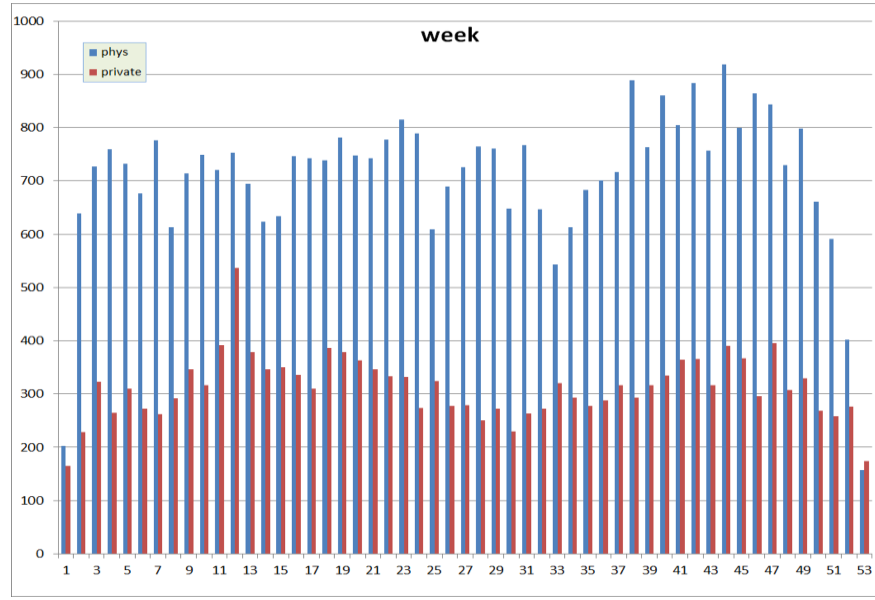
Statistics

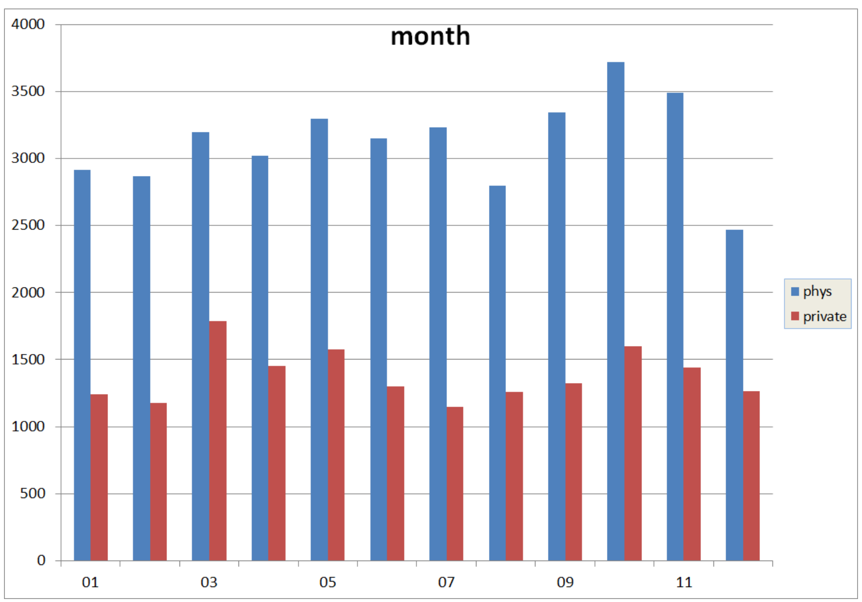
Statistics by year

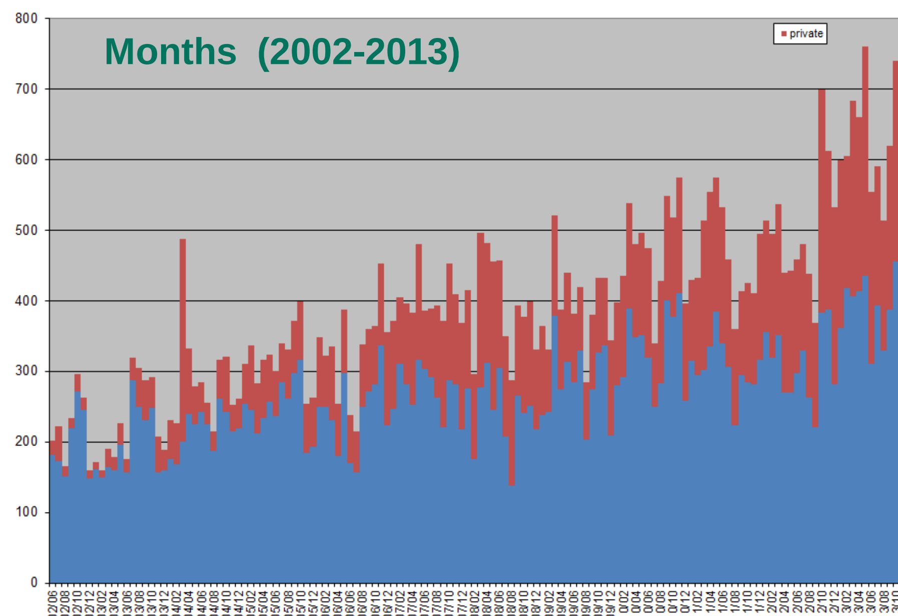


Statistics : day, week, month

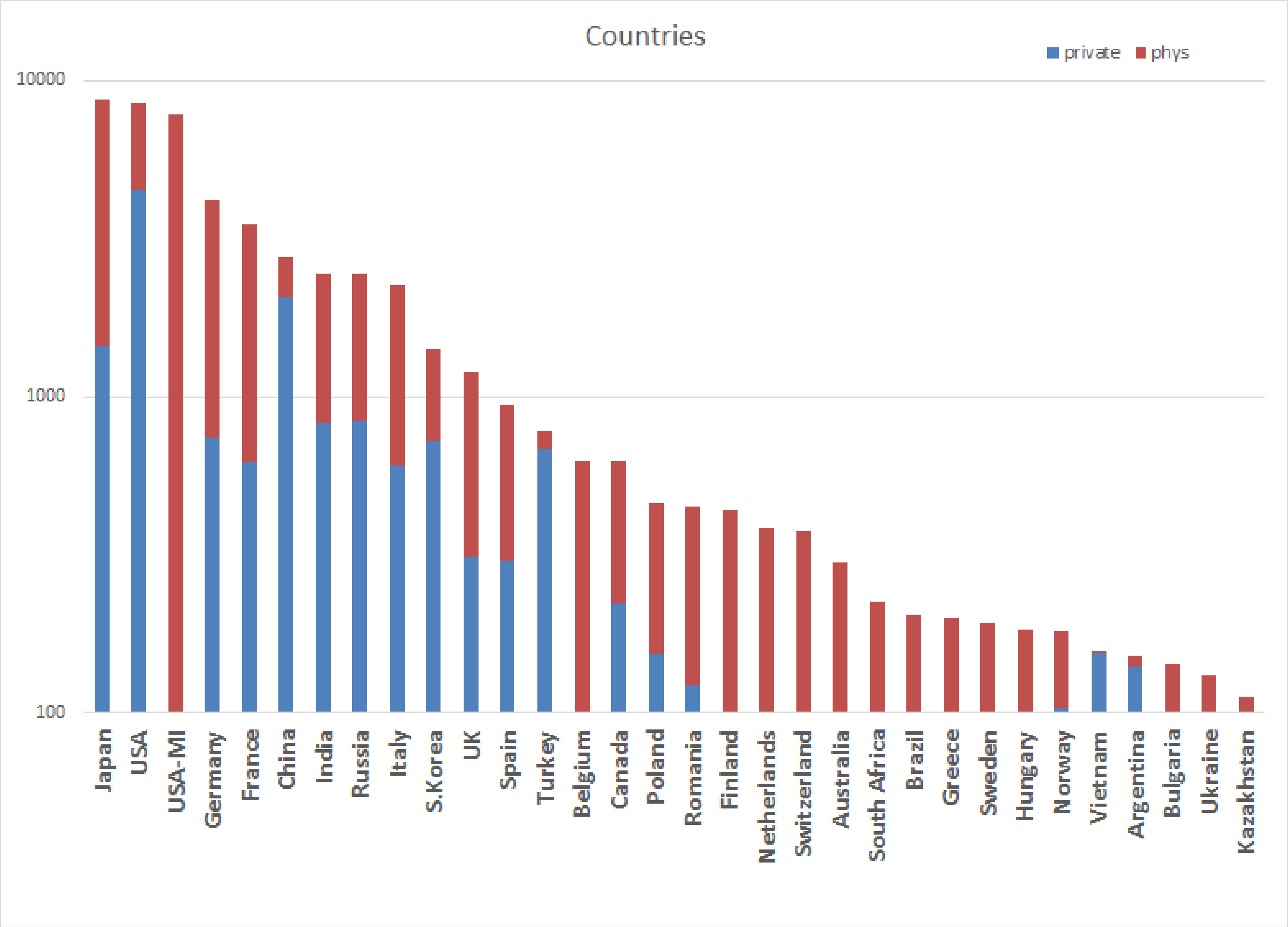








Statistics : country



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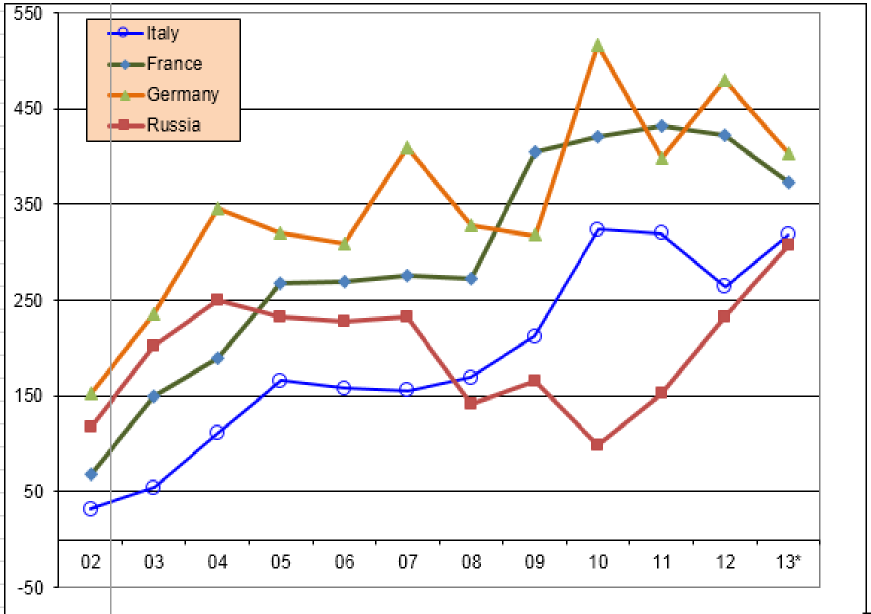
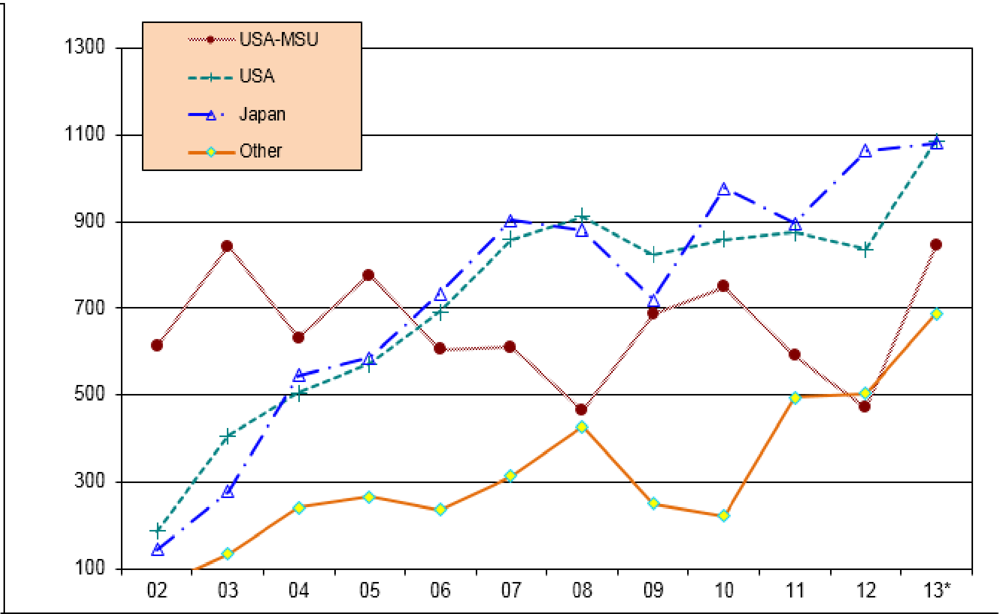
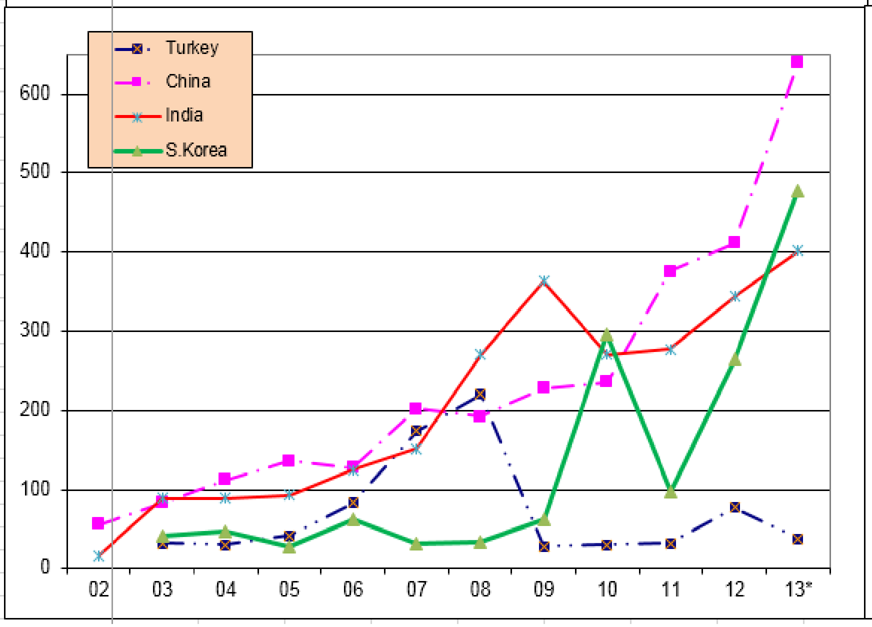
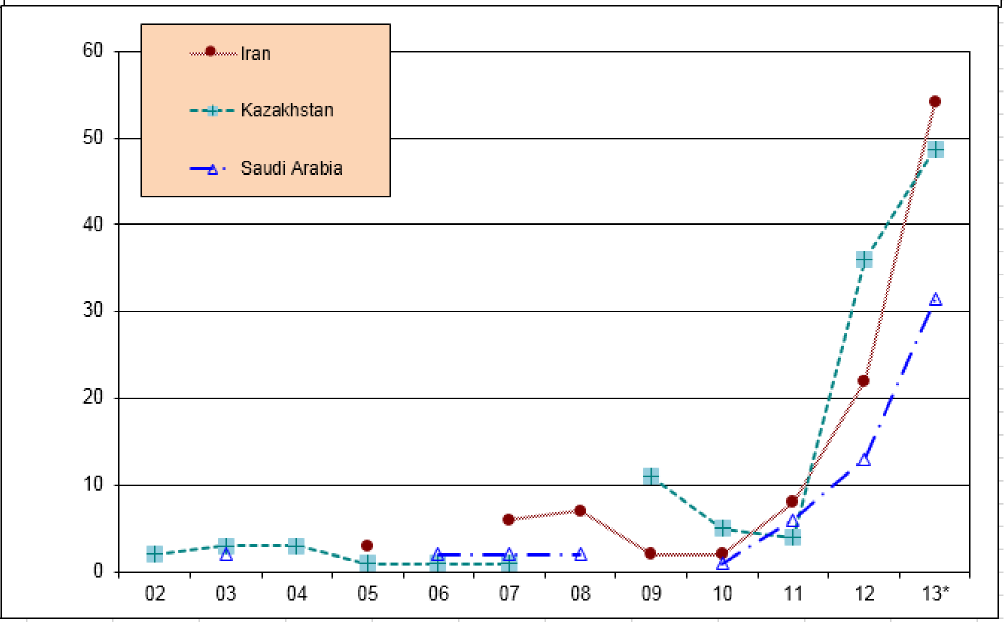
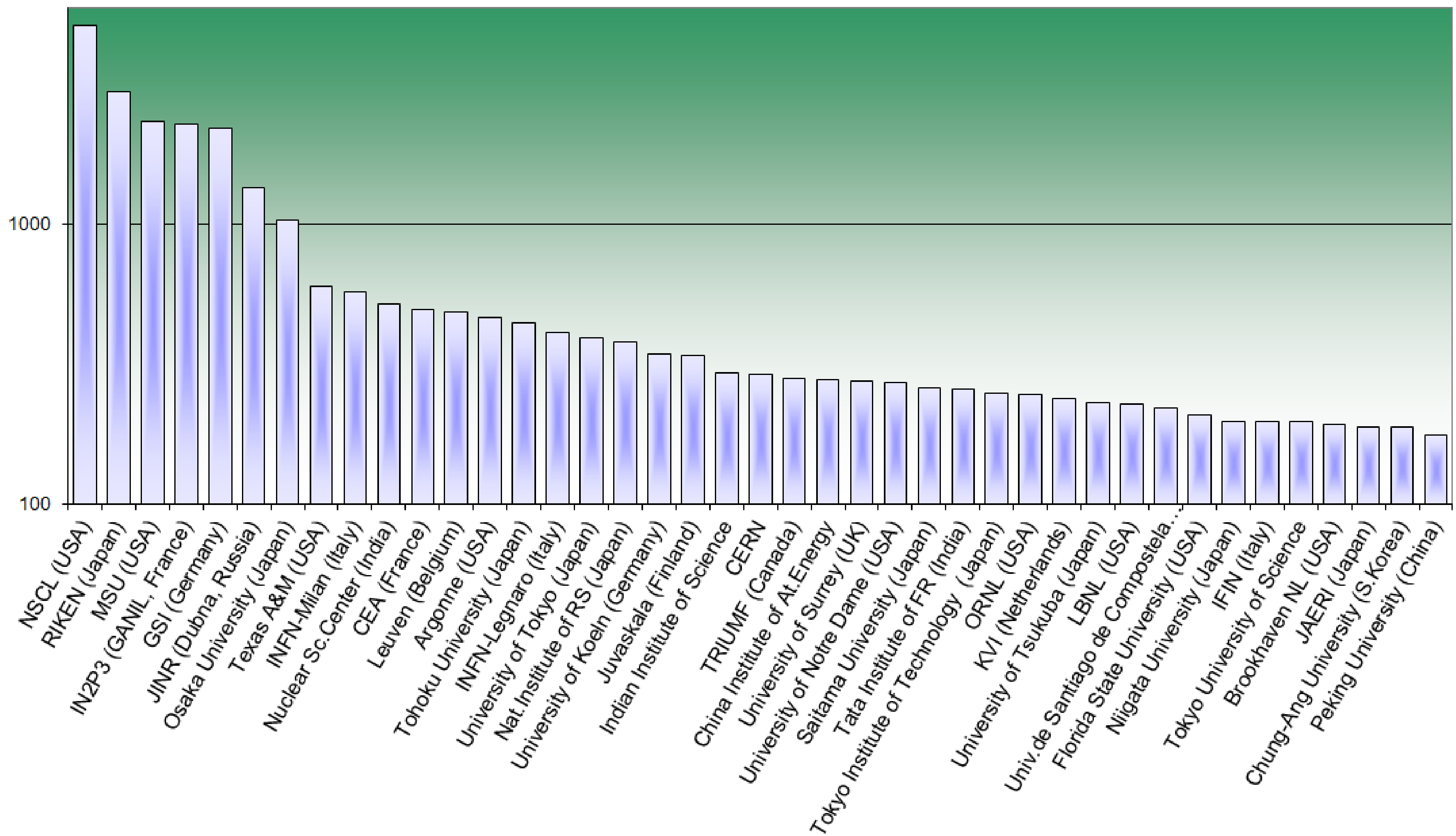








Statistics : Laboratory



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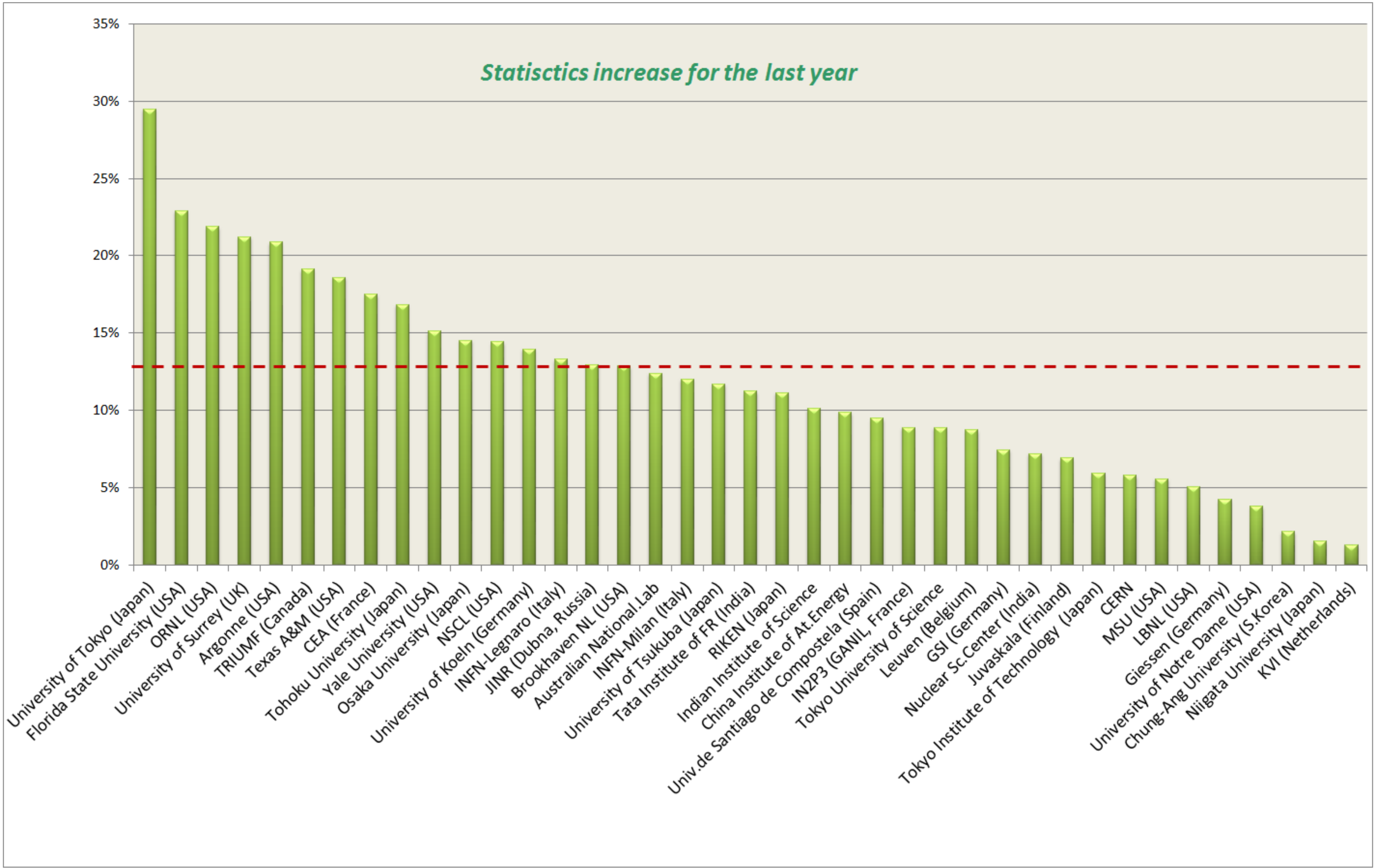
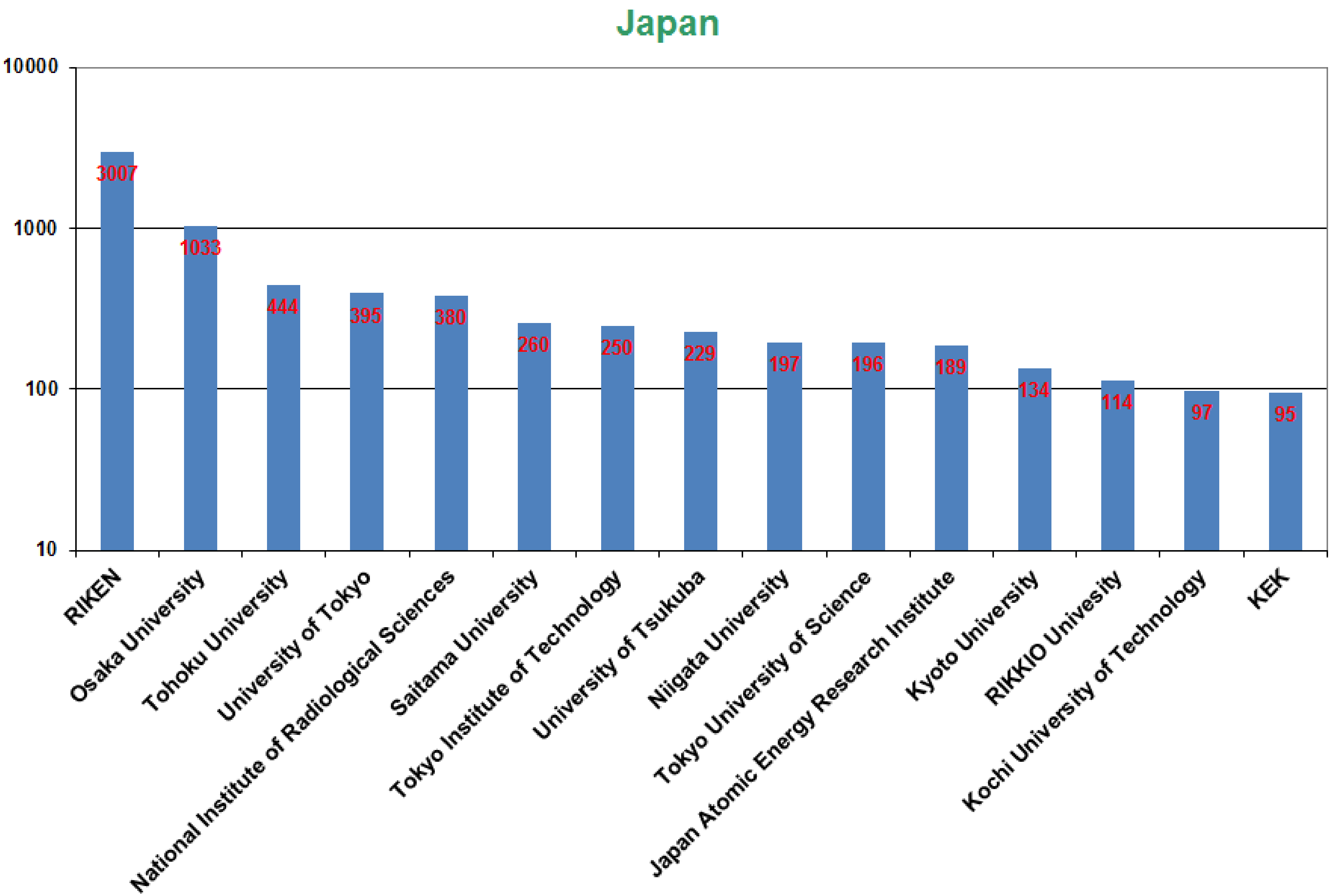


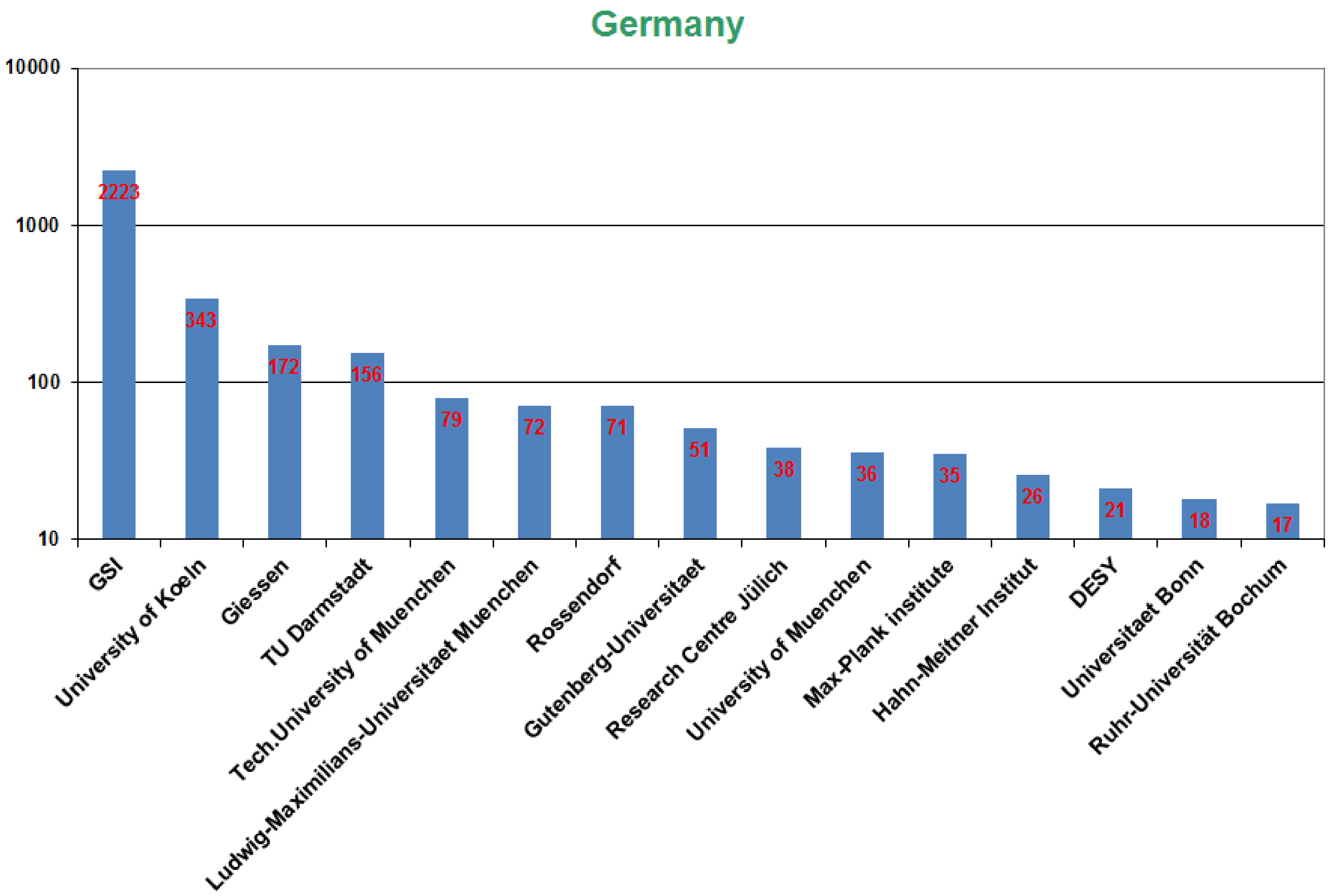
Statistics : 2013 / Total

#	country	Total	2013*	2013* / Total
1	Uzbekistan	18	20	90%
2	Morocco	18	28	64%
3	Hong Kong	12	19	63%
4	Saudi Arabia	29	57	51%
5	Iran	50	100	50%
6	Malaysia	8	16	50%
7	Pakistan	18	39	46%
8	Kazakhstan	45	112	40%
9	Chile	6	15	40%
10	Egypt	18	50	36%
11	Philippines	5	14	36%
12	Iraq	11	31	35%
13	Thailand	11	32	34%
14	S.Korea	441	1410	31%
15	Portugal	25	81	31%
16	Vietnam	47	158	30%
17	Armenia	13	47	28%
18	Slovakia	15	56	27%
19	Poland	105	462	23%
20	Spain	210	942	22%
21	China	591	2754	21%
22	Slovenia	3	14	21%
23	Indonesia	4	19	21%
24	Bulgaria	28	142	20%
25	Brazil	40	204	20%
26	Greece	37	200	19%
27	Serbia	12	69	17%
28	Romania	78	452	17%
29	Australia	50	298	17%
30	Hungary	30	183	16%
31	Colombia	3	19	16%
32	Sweden	30	193	16%
33	Ukraine	20	131	15%
34	India	371	2462	15%
35	UK	181	1202	15%
36	Canada	92	626	15%
37	South Africa	32	226	14%
38	*Grand Total*	*7025*	*54047*	*13%*
39	Italy	294	2264	13%
40	USA	1003	8532	12%
41	Russia	284	2453	12%
42	Japan	999	8726	11%
43	Austria	8	76	11%
44	USA-MI	781	7826	10%
45	France	345	3517	10%
46	Croatia	8	84	10%
47	Denmark	8	87	9%
48	Germany	372	4187	9%
49	Belgium	53	627	8%
50	Argentina	12	152	8%
51	Czech	6	80	8%
52	Switzerland	28	375	7%
53	Lithuania	1	15	7%
54	Peru	1	15	7%
55	Finland	29	440	7%
56	Norway	11	182	6%
57	Algeria	2	35	6%
58	Israel	3	66	5%
59	Turkey	35	784	4%
60	Netherlands	7	383	2%

Statistics : Japan



Statistics : Germany



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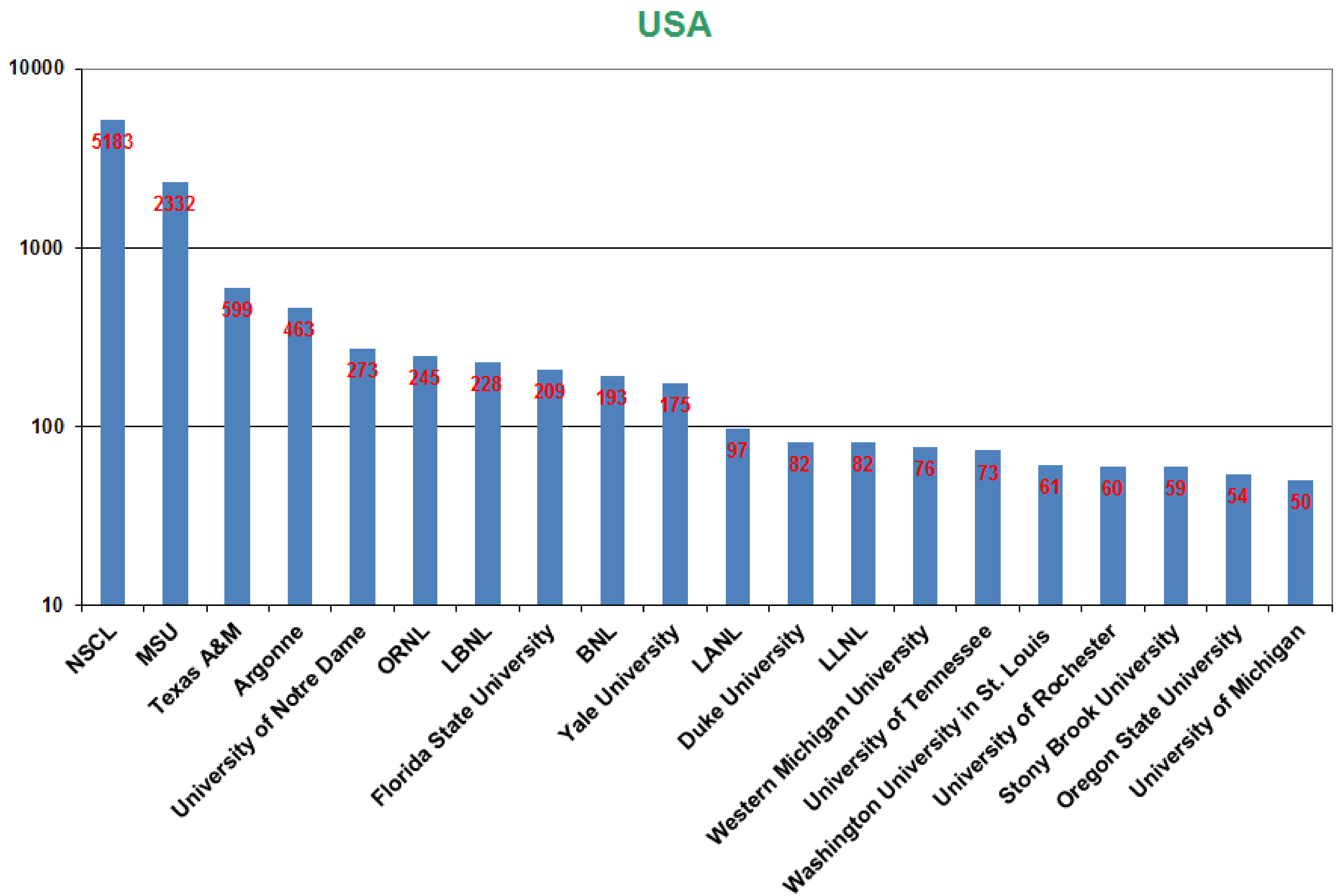

Conclusion

Would like to thank

colleagues

for
Inspiring
discussions,
feedbacks,
requests,
advices,
collaborations

Acknowledgements

Thank you for choosing our company!

We appreciate your business

Comfort

Speed

Quality

Large Variety of destinations