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

---

Stripper Lifetime (version 8.3.6)

- **Introduction**
- **Principal Papers**
- **Dialog**
  - Beam settings
  - Shape
  - 2D-Gaussian dialog
  - Material properties
  - Sublimation [1]
  - Sublimation [2]
  - Radiation damages
- **Pulsing beam**
  - Pulse shape
  - Mode to plot
  - Radiation damages
- **Comparison with experimental data**
  - $^{40}$Ar @ Dubna : Radiation damages
  - $^{20}$Ne @ Dubna : Radiation damages
  - $^{112}$Sn @ MSU : Radiation damages
  - $^{238}$U @ MSU : ?
  - H- @ BNL [1] : sublimation

---

Versions 8.3.1 – 8.3.4

- **Plot dialog**: button "NZ chart"
- **MC dialog**: Rays generator
- **2D plot Contour**: new value <XY>

---

Influence of sublimation (Pulsing beam [1]): Temperature

$^{218}$Po Projectile Energy: 7.68 MeV/amu  Foil C (0.4 mg/cm$^2$)

Left plot: Pulsing beam  On-off Ratio = 50.00%  Pulse length = 0.05 sec  Repetition rate = 10 sec$^{-1}$

Beam current = 1.8e+04 W/cm$^2$  or 8.5 puA/cm$^2$, epsilon=0.40  Lifetime = 232 sec

---

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
Stripper lifetime utility in LISE++

Why in LISE++?

- Recent experiments with heavy beams (U,Pb) show necessity of such calculations
- Easy data entry (Beam, Target dialogs)
- Energy loss models implemented in the code can be used to estimate beam power lost in targets
- In-built mathematical apparatus (integration and so on)
- Graphic library developed in the LISE++ package to plot obtained results

In collaboration with Felix Marti

References:
2. B. Giraf et al., Precint P9-2005-110, JINR, Dubna
Principal papers

Calculations of Lifetime of Charge-Exchanging Carbon Targets in Intense Heavy Ion Beams

B.N. Gikal, G.G. Gubbekjan, V.I. Kazachok, D.V. Kamanin

Abstract: Influence of the radiation damage and sublimation effects on the lifetime of carbon targets used for the accelerated ion beam extraction from cyclotrons by the charge-exchanging method is considered. The theoretical models permit evaluation of the carbon target lifetime depending on their and ion beam parameters are presented both for radiation damage and sublimation effects. It is shown that for the U-400 cyclotron carbon targets 50 μg/cm² thick and for the ion beam flux density up to 100 pμA/cm² the main effect defining the carbon target lifetime is the radiation damage. If the carbon target thickness and the ion beam flux density are greater, the target lifetime is defined already by the sublimation effect. In this connection “casting pipes” can be formed in the target, affecting on the mean energy and the energy distribution dispersion of the ion beam led through the target. Comparison of measured and calculated target lifetimes is carried out.

The investigation has been performed at the Fleron Laboratory of Nuclear Reactions, JINR.
Communications of the Joint Institute for Nuclear Research, Dubna, 2005

Calculation of the lifetimes of thin stripper targets under bombardment of intense pulsed ions

S.G. Lebedev 1 and A.S. Lebedev 2

1Institute for Nuclear Research of the Russian Academy of Sciences, 90th October Anniversary Prospect, 7a, Moscow, 117332, Russia
2Lomonosov Moscow State University, Faculty of Calculus Mathematics and Cybernetics, Vavilov St., GSP-2, Moscow, 119992, Russia

Received 10 June 2007; published 11 February 2008

The problems of stripper target behavior in the nonstationary intense particle beams are considered. The historical sketch on studies of radiation damage failure of carbon targets under ion bombardment is presented. The simple model of target evaporation under intensive pulsing beam is supposed. Lifetimes of stripper targets under intensive nonstationary beams can be described by two failure mechanisms: radiation damage accumulation and evaporation of the target. At the maximum temperatures less than 2500 K the radiation damage dominates; at temperatures above 2500 K the mechanism of evaporation of the foil prevails. The proposed approach has been applied to the description of stripper foils behavior in Brookhaven National Laboratory linac and Spallation Neutron Source conditions.

DOI: 10.1103/PhysRevSTAB.11.020401 PACS numbers: 29.27.-a, 81.40.Np, 85.70.Ka

CALCULATION OF THE MAXIMUM TEMPERATURE ON THE CARBON STRIPPING FOIL OF THE SPALLATION NEUTRON SOURCE

C.J. Liaw, Y.Y. Lee, J. Alessi, J. Tuzuzolo, BNL, Upton, NY 11973

Abstract

The maximum temperatures expected on both 220 μg/cm² and 400 μg/cm² carbon foils, used to strip the 1 GeV H beam at injection into the accumulator ring of the Spallation Neutron Source (SNS), were determined by finite-element analysis. This beam will have a pulse length of 1 ms with a repetition rate of 60 Hz and an average current over a single beam pulse of 18.2 mA. The foil size will be 10 mm x 30 mm and will be mounted in a 20 cm diameter stainless steel beam pipe in the injection 2μg/cm² foil. A 225 μg/cm² thick carbon foil was tested to verify the analysis result. More testing to determine foil lifetime is planned.

2 THERMAL ANALYSIS OF THE CARBON STRIPPING FOIL

The carbon foil (10 mm x 30 mm) will be mounted in a 20 cm diameter stainless steel beam pipe in the injection area of SNS. Fig. 1 shows the layout of SNS injection foil and the model that was used for the thermal analysis.
Dialog : Beam settings

- Set-up
  - Beam: 112Sn
  - Energy: 19.3 MeV/u
  - Intensity: 2000 mA
  - Thickness: 0.5 mg/cm²

- Target
  - Density: 2.253 g/cm³
  - Z, Element, Mass:
    - 12C, 12, 12.011
    - Si, 14, 28.095

- Beam parameters
  - Beam energy: 10.86 MeV/u
  - Beam intensity: 2000 mA
  - Beams: 1. X: 0.5 mm
  - Beam CARD (signs): 3. Y: 0.5 mm

- Energy Loss in the target box (KVA): 14.31

- Beam shape parameters for all three modes (gaussian, ellipse, rectangle)

- LISE++ fragment separator target
Dialog : Beam options (stationary / pulsing)

Beam options:
- Stationary beam
- Pulsing beam
- Stationary beam & rotating target

Beam options:
- Stationary beam
- Pulsing beam
- Stationary beam & rotating target

Beam options:
- Stationary beam
- Pulsing beam
- Stationary beam & rotating target

Pulse structure:
- Beam pulse length = 0.01 sec
- Repetition rate = 10 Hz

Pulse structure:
- Beam pulse length = 0.00015 sec
- Rotation Frequency = 10 Hz
- Radial position of beam spot = 10 cm

Beam on-off time ratio

\[ \tau = \frac{R_{\text{reduced}}}{\pi \nu R_{\text{pos}}} \]

Reduced Radius = \( \sqrt{\text{beam.x} \cdot \text{beam.y}} \)

Beam on-off time ratio is applied for Radiation damages normalization.
Dialog: Shape settings

Beam settings

- Beam CARD (sigma)
  - X: 1 mm
  - Y: 1 mm

Shape

- 2D Gaussian: Reduced beam spot radius (sigma) = 1 mm, Area (50%) = 14.52 mm²
- Uniform: ellipse: Semi-axis "a" = 1 mm, Semi-axis "b" = 1 mm, Area = 3.14 mm²
- Uniform: rectangle: Length "L" = 2 mm, Width "W" = 2 mm, Area = 4 mm²

Calculation of flux distribution parameters

\[
f(t) := \frac{1}{2\cdot\pi\cdot\sigma^2} \exp\left(-\frac{t^2}{2\cdot\sigma^2}\right)
\]

\[
\int_{-\infty}^{\infty} 2\cdot\pi\cdot r\cdot f(r) \, dr = 1
\]

\[
\sigma = \text{ReducedRadius}
\]
**Dialog : Material properties**

- **Material properties**
  - Spallation (corrosion factor) = 0.8
  - Target's atom displacement energy = 25 eV

- **Heat Capacity (J / g / K)**
  - Carbon capacity dependence [3] from T
  - Manually [constant from T]
  - c = 0.502

It is used only in ”Sublimation influence” [1]

**Carbon**
- [2] 0.5, 0.8; [3] 0.8

**Equations**
- [1] \( t = 50K_d^{(S/4)} \exp \left( -\frac{870}{T} \right) \)
- [2] \( \tau = 23K_d^{(S/4)} \cdot \exp\left(-\frac{870}{T}\right) \)

\( K_d \) – atom displacement rate

---

**Heat capacity**

Heat capacity (symbol: \( C \))—as distinct from specific heat capacity—is the measure of the heat energy required to raise the temperature of the object by one degree Celsius for each gram of material in the object; for example, a bottle of water has a greater heat capacity than a bottle of alcohol of the same volume.

Heat capacity is usually expressed in units of J/K (or J/°C), subject to the caveats and exceptions detailed in 55-gallon drum has an average heat capacity of 347 kJ/K.

The uncertainty of an object's measured quantity is rarely better than one percent and this places an upper limit to the precision at which the measurement was made, e.g. "25° C, 195 KPa." In most cases, it is relative uncertainty that it renders this data unusable. An exception would be when an object has an accurately stated exception would be when the defined state varies significantly from standard conditions.

**Table of specific heat capacities**

<table>
<thead>
<tr>
<th>Substance</th>
<th>Phase</th>
<th>( C_p ) J g(^{-1}) K(^{-1})</th>
<th>( CP_s ) J mol(^{-1}) K(^{-1})</th>
<th>( CV_s ) J mol(^{-1}) K(^{-1})</th>
<th>Volumetric heat capacity J cm(^{-3}) K(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air (sea level, dry, 8 °C)</td>
<td>gas</td>
<td>1.0035</td>
<td>39.97</td>
<td>20.7643</td>
<td></td>
</tr>
<tr>
<td>Air typical room conditions</td>
<td>gas</td>
<td>1.122</td>
<td>20.19</td>
<td>20.05</td>
<td></td>
</tr>
<tr>
<td>Aluminium</td>
<td>solid</td>
<td>0.897</td>
<td>24.2</td>
<td>2.422</td>
<td></td>
</tr>
<tr>
<td>Ammonia</td>
<td>liquid</td>
<td>4.700</td>
<td>90.88</td>
<td>3.263</td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>solid</td>
<td>0.207</td>
<td>25.2</td>
<td>1.386</td>
<td></td>
</tr>
<tr>
<td>Argon</td>
<td>gas</td>
<td>0.6303</td>
<td>20.762</td>
<td>12.471</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>solid</td>
<td>0.328</td>
<td>24.6</td>
<td>1.878</td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>solid</td>
<td>1.02</td>
<td>16.4</td>
<td>3.367</td>
<td></td>
</tr>
</tbody>
</table>

Dialog: Sublimation [1]

Integration of stiff set of differential equations (temperature and thickness) by Runge-Kutta method

\[ \frac{dT}{dt} = \frac{1}{C(T)h(t)} \left[ P(t) + 2\varepsilon\sigma_0 T_0^4 - 2\varepsilon\sigma_0 T^4(t) \right] \]
\[ \frac{dh(t)}{dt} = -8.12 \times 10^{10} \exp\left(-\frac{83500}{T}\right) \sqrt{T} \]

4 integration region with different steps in order to
- Make faster, plot more pulses
- and in the same time avoid unstable behavior

N: LISE\textsuperscript{++} distribution dimension. How many points will be used for integration
S1: only each 10\textsuperscript{th} calculated point will be plotted
S2: only each 100\textsuperscript{th} point
S3: only each 1000\textsuperscript{th} point

Influence of sublimation (Pulsing beam [1]): Temperature

\( ^{111}\text{Sn} \) Projectile Energy: 10.96 MeV/u
Fall: C (0.5 mg/cm\textsuperscript{2})
Left plot: Pulsing beam. On-off ratio = 30.00%. Pulse length = 0.1 sec. Repetition rate = 3 sec\textsuperscript{-1}
Beam current = 0.1±0.03 W/cm\textsuperscript{2} or 7.5 pA/cm\textsuperscript{2}; epsilon=0.80

Critical region with different steps in order to
- Make faster, plot more pulses
- and in the same time avoid unstable behavior

Target warming up temperature = 2184.2 K
### Dialog: Sublimation [1] – modes to plot

<table>
<thead>
<tr>
<th>Mode</th>
<th>Stationary</th>
<th>Pulsing (30% on-off time ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>7.59E+00</td>
<td>3.00E+00</td>
</tr>
<tr>
<td>M</td>
<td>7.79E+01</td>
<td>2.87E+01</td>
</tr>
<tr>
<td>S1</td>
<td>7.82E+02</td>
<td>2.69E+02</td>
</tr>
<tr>
<td>S2</td>
<td>7.82E+03</td>
<td>2.69E+03</td>
</tr>
<tr>
<td>S3</td>
<td>7.82E+04</td>
<td>2.69E+04</td>
</tr>
<tr>
<td>Lifetime</td>
<td>6.80E+03</td>
<td>~ 3E+04</td>
</tr>
</tbody>
</table>

#### Settings

**Calculation of the lifetimes of thin stripper targets**

**Influence of sublimation (Pulsing beam [1])**

- Projectile Energy: 10.86 MeV/u
- Foil: C (0.5 mg/cm²)

Left plot: Pulsing beam, On-off Ratio = 30.00%, Pulse length = 0.1 sec, Repetition rate = 3 sec⁻¹

Beam current = 7.2e+03 W/cm² or 5.9 puA/cm², epsiton=0.40
Dialog: Pulsing beam example – “F” mode
Dialog : Pulsing beam example – “M” mode

Temperature vs. Time

Foil thickness vs. Time
Dialog: Pulsing beam example – “S1” mode

Temperature

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>Temperature (K)</th>
<th>Power Lost (% to I=0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1e+3</td>
<td>1e+3</td>
</tr>
<tr>
<td>40</td>
<td>2e+3</td>
<td>2e+3</td>
</tr>
<tr>
<td>80</td>
<td>3e+3</td>
<td>3e+3</td>
</tr>
<tr>
<td>120</td>
<td>4e+3</td>
<td>4e+3</td>
</tr>
<tr>
<td>160</td>
<td>5e+3</td>
<td>5e+3</td>
</tr>
<tr>
<td>200</td>
<td>6e+3</td>
<td>6e+3</td>
</tr>
<tr>
<td>240</td>
<td>7e+3</td>
<td>7e+3</td>
</tr>
</tbody>
</table>

Foil thickness

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>Thickness (mg/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.39</td>
</tr>
<tr>
<td>40</td>
<td>0.41</td>
</tr>
<tr>
<td>80</td>
<td>0.43</td>
</tr>
<tr>
<td>120</td>
<td>0.45</td>
</tr>
<tr>
<td>160</td>
<td>0.47</td>
</tr>
<tr>
<td>200</td>
<td>0.49</td>
</tr>
<tr>
<td>240</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Dialog: Pulsing beam example – “S2” mode

Temperature vs. Time (sec)

- Temperature (K)
- Power Lost (% to t=0)

Foil thickness vs. Time (sec)

- 112Sn
Dialog: Pulsing beam example – “S3” mode

![Graph of Temperature vs. Time](image1)

- Temperature (K)
- Power Lost (% to I=0)

![Graph of Foil Thickness vs. Time](image2)

- Thickness (mg/cm²)
- ¹¹²Sn

**Lifetime**
Dialog: Stationary beam example – “S2” mode

Temperature

- Temperature (K)
- Power Lost (% to t=0)

Foil thickness

- 127Sn

Mode

Lifetime
Integration by Euler's method with exponential step

\[
\frac{dh(t)}{dt} = -\alpha \cdot \frac{\exp\left(\frac{-B}{\beta \cdot \sqrt{\ln(h(t))}}\right)}{\sqrt{\beta \cdot \ln(h(t))}}.
\]

where \( q = 0.242 \frac{A \cdot \mu_{\text{C}}}{\rho \cdot \sqrt{M} \cdot 2} \). In the case of carbon foil (\( \mu_{\text{C}} = 12 \text{ g/mol} \), \( \rho = 2 \text{ g/cm}^3 \)) it is

\[
\alpha \approx 7.83 \cdot 10^{10} \text{ [cm K}^{1/2} / \text{s}].
\]

Influence of sublimation (Stationary beam [2])

Projectile Energy: 10.96 MeV/u  Foil: C (0.5 mg/cm²)
Left plot: power lost = 1.6e+02 W/cm² corresponds to current = 7.2e+03 W/cm² or 5.9 puA/cm²
epsilon = 0.40  Method [2]: \( \alpha = 7.8e+10 \text{ cm K}^{1/2} \text{ sec}^{-1} \)
For agreement with [1]

$$\beta = \sqrt{P \cdot \text{LISEcoef} \cdot h_0 \cdot \varepsilon \cdot \sigma_0 \cdot 2}$$

LISEcoef = 1.7

Influence of sublimation (Stationary beam [2]): Lifetime(\(\epsilon\))

Projected Energy: 7.8 MeV/\(\mu\) - Foil 0.06 mg/cm²
Left bottom plot: power test = 41 W/m², corresponds to current = 9.7 x 10³ W/m² or 0.53 pA/m²
\(\epsilon = 0.01\) Method [2]: alpha = 7.8 x 10⁻¹ cm²/(keV·sec⁻¹)}
Dialog: Radiation damages

[K]'s algorithm was used

\[ K_d = \frac{S_n \Phi}{2E_D}, \quad t = 50K_d^{-5/4} \exp\left(-\frac{870}{T}\right). \]

where \( P [\text{W/cm}^2] \) is the beam power lost in a target, calculated by means of the LISE++ code.
$^{40}\text{Ar}^{5+}$ 5 MeV/u  Emiss. = 0.8
Beam size = 0.5 cm$^2$  thick=50 μg/cm$^2$

![Graph showing lifetime vs. average current](v.8.3.6 http://groups.nscl.msu.edu/lise/8_3/Dubna_40Ar.lpp)
![Graph showing lifetime vs. average current](v.8.3.11 http://groups.nscl.msu.edu/lise/8_3/Dubna_40Ar.foil)
$^{20}\text{Ne}$ @ Dubna: Radiation damages

$^{20}\text{Ne}$ (5 MeV/u)  
Emiss. = 0.8

Beam size = 0.5 cm$^2$  
Thick = 50 $\mu$g/cm$^2$

![Graph showing lifetime vs. average current](image)
$^{112}\text{Sn}^{17+}$ $10.86$ MeV/u @ MSU : Competition

$^{112}\text{Sn}$ $10.86$ MeV/u
Beam size = 4 mm$^2$ (rectangle) C-thick=600 ug/cm$^2$
LISE++ version 8.3.6

Log10( j / [puA/cm$^2$]) vs. Lifetime, sec

- $\text{Sublimation}[1]$ e=0.8
- $\text{Sublimation}[2]$ e=0.8
- Radiation damages k1=50
- experiment

v.8.3.6 http://groups.nscl.msu.edu/lise/8_3/MSU_112Sn.lpp
v.8.3.11 http://groups.nscl.msu.edu/lise/8_3/MSU_112Sn.foil
112\text{Sn}^{17+} \; 10.86 \text{ MeV/u} \; @ \text{MSU} : \text{Competition}

112\text{Sn} \; 10.86 \text{ MeV/u}

Beam size = 4 \text{ mm}^2 \; (rectangle) \; \text{C-thick} \; 600 \; \mu \text{g/cm}^2

LISE++ version 8.3.6
112Sn $^{17+}$ 10.86 MeV/u @ MSU : Radiation damage

Beam size = 4 mm$^2$ (rectangle) C-thick 600 µg/cm$^2$

LISE++ version 8.3.6

F.Marti: radiation damage has proved experimentally
238 U 30+ 7.68 MeV/u 1euA
C-thick 600 µg/cm²
LISE++ version 8.3.6

- Sublimation[2] e=0.8
- Radiation damages k1=50
- experiment

Log10( j / [puA/cm²])

Lifetime, sec

- hour
- minute

4mm² rectangle
1mm² rectangle or 3mm²
Gauss 95%

v.8.3.11. http://groups.nscl.msu.edu/lise/8_3/MSU_238U.foil
TABLE I. The parameters of $^1$H$^-$ beams

<table>
<thead>
<tr>
<th>Energy</th>
<th>Duration of an impulse</th>
<th>Frequency</th>
<th>The maximal current</th>
<th>The beam size</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNL linac</td>
<td>750 keV</td>
<td>0.5 ms</td>
<td>6.7 Hz</td>
<td>2.02/2.2 mA</td>
</tr>
</tbody>
</table>

**Influence of sublimation (Pulsing beam [1]): Temperature**

$^1$H Projectile Energy: 0.75 MeV/µu  
Foil: C (0.23 mg/cm$^2$)

Left plot: Pulsing beam  
On-off Ratio = 0.34%  
Pulse length = 0.0005 sec  
Repetition rate = 6.7 sec$^{-1}$

Beam current = $2.2 \times 10^4$ W/cm$^2$ or 3e+04 pA/cm$^2$;  
ε = 0.80

**FIG. 1.** A temperature field of a BNL linac target in the first second of work at a pulse current of 2 mA.

Ref [1]  

v.8.3.11 http://groups.nscl.msu.edu/lise/8_3/BNL_H_750KeV_2mA.foil
FIG. 2. Nonlinear foil thickness decreasing caused by the reduction of temperature at the BNL linac pulse current of 3 mA.

FIG. 3. (Color) Deformation of a temperature field in a target of BNL linac, caused by the decreasing of the foil thickness due to its evaporation.
v.8.3.3. Plot dialog: button "NZ chart"

Set the next parameters:
"2D", X="N", Y="Z", "N"=0-200
LISE++ MC output rays file can be used for other programs as COSY, MOCADI, MOTER
Rays generator @ Monte Carlo dialog

**32S : Monte Carlo Transmission Plot**

40Ar (140.0 MeV/µ) + Be (500 µm); Trasmitted Fragment 32S (Fragmentn)

dp/p=1.00% ; Wedges: 0; Brho(Tm): 3.4571, 3.4571, 3.4571, 3.4571

"D3" - last block for MC calculation, no gate; Configuration: DDSWDDMMSMM

- The gate condition works also in this mode
- The status dialog appears
- "X vs. dp/p" plot for block selected in the dialog
- Stop after passing the set number of rays
- User can see fragment transmission
- It is possible to continue calculations
**v. 8.3.2. Rays generator @ Monte Carlo dialog**

**Default:** “Lise/files” directory  
**File Extension:** “*.ray”

---

### Excel Table

<table>
<thead>
<tr>
<th>X [cm]</th>
<th>X(Theta) [mrad]</th>
<th>Y [cm]</th>
<th>Y(Phi) [mrad]</th>
<th>dP/P (%)</th>
<th>R [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0454</td>
<td>-2.9339</td>
<td>0.041939</td>
<td>2.6000</td>
<td>0.36006</td>
<td>1.0452</td>
</tr>
<tr>
<td>-0.62407</td>
<td>-2.21149</td>
<td>-0.071384</td>
<td>-38.4544</td>
<td>-0.16432</td>
<td>-0.62814</td>
</tr>
<tr>
<td>-0.45322</td>
<td>-6.23973</td>
<td>-0.061536</td>
<td>36.6090</td>
<td>-0.062179</td>
<td>-0.45736</td>
</tr>
<tr>
<td>1.1834</td>
<td>4.92951</td>
<td>0.065015</td>
<td>43.2289</td>
<td>0.38254</td>
<td>1.1847</td>
</tr>
<tr>
<td>1.3136</td>
<td>5.86401</td>
<td>0.04414</td>
<td>18.4055</td>
<td>0.48319</td>
<td>1.3145</td>
</tr>
<tr>
<td>0.38401</td>
<td>12.187</td>
<td>-0.069189</td>
<td>-11.979</td>
<td>0.32617</td>
<td>0.33117</td>
</tr>
<tr>
<td>-0.31787</td>
<td>-6.55783</td>
<td>-0.092923</td>
<td>6.8669</td>
<td>-0.037499</td>
<td>-0.33117</td>
</tr>
<tr>
<td>0.61317</td>
<td>2.13641</td>
<td>-0.069638</td>
<td>-22.51</td>
<td>0.22156</td>
<td>0.52208</td>
</tr>
<tr>
<td>1.5034</td>
<td>5.5325</td>
<td>-0.075181</td>
<td>-3.2167</td>
<td>0.47211</td>
<td>1.5363</td>
</tr>
<tr>
<td>0.52666</td>
<td>3.3507</td>
<td>0.0034279</td>
<td>13.961</td>
<td>0.09457</td>
<td>0.52666</td>
</tr>
<tr>
<td>0.1938</td>
<td>6.8746</td>
<td>0.091224</td>
<td>52.402</td>
<td>0.006442</td>
<td>0.21084</td>
</tr>
<tr>
<td>1.0425</td>
<td>2.4169</td>
<td>0.085873</td>
<td>4.2017</td>
<td>0.39238</td>
<td>1.0461</td>
</tr>
<tr>
<td>0.43377</td>
<td>5.041</td>
<td>-0.049084</td>
<td>-37.984</td>
<td>0.14268</td>
<td>0.44151</td>
</tr>
<tr>
<td>0.061541</td>
<td>8.5067</td>
<td>0.040272</td>
<td>-30.947</td>
<td>0.046927</td>
<td>0.073631</td>
</tr>
<tr>
<td>-0.8519</td>
<td>2.3531</td>
<td>-0.13151</td>
<td>-15.543</td>
<td>-0.40507</td>
<td>-0.86199</td>
</tr>
<tr>
<td>1.3844</td>
<td>2.3848</td>
<td>-0.18947</td>
<td>-40.325</td>
<td>0.43835</td>
<td>1.3845</td>
</tr>
<tr>
<td>-0.1149</td>
<td>-3.1566</td>
<td>-0.044649</td>
<td>-30.67</td>
<td>-0.042744</td>
<td>-0.12334</td>
</tr>
<tr>
<td>0.7207</td>
<td>5.0311</td>
<td>0.019036</td>
<td>-25.555</td>
<td>0.15604</td>
<td>0.7292</td>
</tr>
<tr>
<td>1.1521</td>
<td>-2.0187</td>
<td>-0.036332</td>
<td>39.998</td>
<td>0.43229</td>
<td>1.152</td>
</tr>
<tr>
<td>-0.56236</td>
<td>2.433</td>
<td>-0.09753</td>
<td>10.679</td>
<td>0.23075</td>
<td>-0.57075</td>
</tr>
<tr>
<td>0.652466</td>
<td>-2.019</td>
<td>-0.12158</td>
<td>26.767</td>
<td>0.20971</td>
<td>0.47519</td>
</tr>
<tr>
<td>-1.0622</td>
<td>2.058</td>
<td>0.075115</td>
<td>-35.593</td>
<td>-0.40461</td>
<td>-1.0648</td>
</tr>
</tbody>
</table>
v. 8.3.1. 2D plot Contour : new calculated value <XY>

32S : Monte Carlo Transmission Plot

\[40^{\text{Ar}} (140.0 \text{ MeV/\text{u}}) + \text{Be (500 \text{ \mu m}) ; Trasmitted Fragment} \ 32^{\text{S}} \ 16^+ \ 16^+ \ 16^+ \ (\text{Fragmentn}) \]
\[dp/p=1.00\% ; \text{Wedges: 0}; \rho \text{ho(Tm): 3.4571, 3.4571, 3.4571, 3.4571} \]

\(<XY> = (x-<x>)(y-<y>)\)

M.Portillo’s request
LISE++ development steps in the near future

- Densities in LISE.xls (D.Morrissey)
- Stripper foil lifetime utility: keeping parameters in LISE++ foil file (*.foil)
- Finish analysis with the Stripper foil lifetime utility

Comparison with experimental data

\[ ^{112}\text{Sn} \quad @ \text{MSU} \]
\[ ^{238}\text{U} \quad @ \text{MSU} \]
\[ \text{H}^+ \quad @ \text{BNL} \]
\[ \text{H}^+ \quad @ \text{SNS} \]

Analysis of some parameters

- Current, Interaction area
- Foil thickness
- Beam energy
- Emissivity factor
- Heat capacity
- Alpha
- \( k_1, k_2 \)
- Rotation target frequency

- Q3D configuration file (S.Lukyanov)
- Solenoid block (D.Morrissey)
- LISE++ site
  - FSEM08 presentation
  - Stripper foil lifetime utility
  - MOTER