**Working under Optics**

**LISE++ beta v.9.2.33**

- Update of links with COSY maps
- Automatic calculation of Drift-block (quadrupoles, sextupoles) matrices, new options
- New utility dialog: "The First- and Second-Order Matrix Elements for an Ideal Magnet"
- Dipole (dispersive block): Transport solution (1st and 2-nd orders) including fringing fields
- Edge effect option for transmission calculation (the "Option" dialog)
- Analyzing ROOT histogram files by the BI code
- Corrections, Some Improvements
- Requests to increase
- LISE++ development priorities

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](http://www.nscl.msu.edu/lise)
Update of links with COSY maps

9.2.23 11/17/10 Update COSY links

Turn off this checkbox in order to kill this link
Update of links with COSY maps

- default directory is **\My Documents\LISE\files**

- [https://www.msu.edu/~portill2/cosy_tools/](https://www.msu.edu/~portill2/cosy_tools/)

the algorithms in the COSY language that are required to be used for writing readable higher order maps in LISE++ from M.Portillo
Drift block matrices (Quadrupoles, Sextupoles...)

9.2.22 11/15/10 Calculate automatically Drift-block matrices
9.2.24 11/18/10 New option for quadrupoles: keep matrices, calculate fields

9.2.21 and older

9.2.22

For example, if Brho has been changed, and option “keep matrix” was set
New utility dialog: "The First- and Second-Order Matrix Elements for an Ideal Magnet"
and so on...
Bending magnet (dipole) example
### Quadrupole example

1. **Matrix Elements for a Pure Quadrupole Field**

   For a pure quadrupole, the matrix elements are derived from those of the general case by letting $\beta = 0$, $k_x^2 = k_y^2$ and $k_y^2 = -k_x^2$, where

   \[ k_x^2 = -\frac{\hbar^2}{m} = \frac{B_y}{a}(l/B) \]

   \[ k_y^2 = \frac{\hbar^2}{m} = \frac{B_x}{a}(l/B) \]

   \[ k_{xy} = \frac{\hbar}{m} = \frac{B_{xy}}{a}(l/B) \]

#### Quadrupole & Sextupole settings

- Angle of the bend: 19.98 degrees
- Radius of curvature: 10 cm
- Corresponding Beta-value: 3.336 Tm

#### Quadrupole & Sextupole

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#### Transform 1

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### New utility dialog: "The First- and Second-Order Matrix Elements for an Ideal Magnet"
9.2.32 Dipole (dispersive block): Transport solution of 1st and 2-nd orders including fringing fields

LISE++ dispersive block : Transport solution

Entrance Face + Bending Magnet + Exit Face

Three optical arrays (1\textsuperscript{st} and 2\textsuperscript{nd}) inside the dispersive block class are calculated the final dispersive block matrices, which will be used in transmission calculations.
**Bending magnet.**

**Solution from the new utility dialog: "The First- and Second-Order Matrix Elements for an Ideal Magnet"**

**Entrance face**

The results of these calculations yield the following matrix elements for the fringing fields of the entrance face of a bending magnet:

\[
\begin{align*}
R_{11} &= 1 \\
R_{12} &= 0 \\
T_{111} &= -(h/2) \tan^2 \beta_1 \\
T_{133} &= (h/2) \sec^2 \beta_1 \\
R_{31} &= -(1/f_x) = -h \tan \beta_1 \\
R_{31} &= 1 \\
T_{211} &= (h/2R_1) \sec^2 \beta_1 = -h^2 \tan \beta_1 \\
T_{212} &= h \tan^2 \beta_1 \\
T_{216} &= -h \tan \beta_1 \\
T_{322} &= h^2(n + 1/2 + \tan^2 \beta_1) \tan \beta_1 - (h/2R_1) \sec^2 \beta_1 \\
T_{334} &= -h \tan^2 \beta_1 \\
R_{40} &= 1 \\
R_{41} &= 0 \\
T_{313} &= h \tan \beta_1 \\
R_{40} &= -(1/f_y) = -h \tan (\beta_1 - \psi_1) \\
R_{41} &= 1 \\
T_{413} &= -(h/R_1) \sec^2 \beta_1 + 2h^2 \sin \beta_1 \\
T_{414} &= -h \tan^2 \beta_1 \\
T_{433} &= -h \sec^2 \beta_1 \\
T_{446} &= h \tan \beta_1 - h \psi_2 \sec^2 (\beta_1 - \psi_1) \\
\end{align*}
\]

(57)

All nonlisted matrix elements are equal to zero. The quantity \(\psi_1\) is the correction to the transverse focal length when the finite extent of the fringing field is included.\(^{(9)}\)

\(\psi_1 = K/kg \sec \beta_1 (1 + \sin^2 \beta_1) + \) higher order terms in (kg)

**Exit face**

The matrix elements for the fringing fields of the exit face of a bending magnet are:

\[
\begin{align*}
R_{11} &= 1 \\
R_{12} &= 0 \\
T_{111} &= (h/2) \tan^2 \beta_2 \\
T_{133} &= -(h/2) \sec^2 \beta_2 \\
R_{21} &= -1/f_x = -h \tan \beta_2 \\
R_{22} &= 1 \\
T_{211} &= (h/2R_2) \sec^2 \beta_2 - h^2(n + 1/2 + \tan^2 \beta_2) \tan \beta_2 \\
T_{212} &= -h \tan^2 \beta_2 \\
T_{216} &= -h \tan \beta_2 \\
T_{222} &= h^2(n - 1/2 + \tan^2 \beta_2) \tan \beta_2 - (h/2R_2) \sec^2 \beta_2 \\
T_{334} &= h \tan^2 \beta_2 \\
R_{33} &= 1 \\
R_{34} &= 0 \\
T_{323} &= -h \tan^2 \beta_2 \\
R_{43} &= -1/f_y = -h \tan (\beta_2 - \psi_2) \\
R_{44} &= 1 \\
T_{413} &= -(h/R_2) \sec^2 \beta_2 + h^2(2n + \sec^2 \beta_2) \tan \beta_2 \\
T_{414} &= -h \tan^2 \beta_2 \\
T_{433} &= -h \sec^2 \beta_2 \\
T_{446} &= h \tan \beta_2 - h \psi_2 \sec^2 (\beta_2 - \psi_2) \\
\end{align*}
\]

(58)

All nonlisted matrix elements are zero.

\(\psi_2 = K/kg \sec \beta_2 (1 + \sin^2 \beta_2) + \) higher order terms in (kg)

and \(K\) is evaluated for the exit fringing field.
Richard W. Pobell

9.2.33 12/10/10  Edge cut effect option for transmission calculation (the "Option" dialog)

Recommended to turn off the “edge effect” for extended configurations to prevent decrease of transmission due to multiple cut of tails.
Edge effect for transmission distribution cuts

Using "Edge effect"

D1-Xspace: output before slits
$^{40}\text{Ar} (140.0 \text{ MeV/\mu}}) + \text{Be (500 \mu m)}$; Settings on $^{40}\text{Ar}$; Config: DGSWCDM1MS1M
$\text{dp} = 1.00 \%$; Wedges: 0; Bragg(Tm): 3.8685, 3.8685, 3.8685, 3.8685

D1-Xspace: output after slits
$^{40}\text{Ar} (140.0 \text{ MeV/\mu}}) + \text{Be (500 \mu m)}$; Settings on $^{40}\text{Ar}$; Config: DGSWCDM1MS1M
$\text{dp} = 1.00 \%$; Wedges: 0; Bragg(Tm): 3.8685, 3.8685, 3.8685, 3.8685

No "Edge effect"
ROOT histogram vs. BI code in LISE++

9.2.18 10/07/10
9.2.21 10/26/10

Analyzing 1D-histogram ROOT files by the BI code
Analyzing 2D-histogram ROOT files by the BI code

```c
//========= Macro generated from object: h02/Z:Am3Q
//=== by ROOT version 5.26/00
TH2F *h02 = new TH2F("h02","Z:Am3Q",512,-35,-10,512,40,70);
```
```
h02->SetBinContent(40,1);
h02->SetBinContent(61,1);
h02->SetBinContent(63,2);
h02->SetBinContent(64,1);
h02->SetBinContent(67,3);
h02->SetBinContent(73,1);
h02->SetBinContent(77,1);
h02->SetBinContent(79,3);
h02->SetBinContent(80,2);
```

………………
ROOT histogram vs. BI code in LISE++
Requests to increase... v.9.2.8-33

9.2.9 09/01/10  Request to increase a number of isotopes for MC group  // MP

9.2.12 09/03/10  Number of possible MC generator rays has been increased to 1 000 000  // MP

9.2.19 10/14/10  Increasing number of rows in the “Show Transmission” window, as well string size to avoid crash  // MH

9.2.30 11/30/10  Increasing possible number of blocks from 94 to 194  // MP
9.2.8 08/27/10  Corrections in MC transmission calculation against crash in reaction place with negative energy // MP

9.2.10 09/02/10  Energy loss in detector, where particle is stopped

9.2.11 09/02/10  Normalization in Energy deposition for group of isotopes // MP

9.2.13 09/07/10  New isotopes history added for Z=26,27,48,56 // MT

9.2.14 09/15/10  New isotopes history added for Z=23,36,47; neutron-rich observed isotopes line updated for Z=63-92 // MT

9.2.15 09/15/10  Corrections for TKE-calculations in pseudo MC plot // JB

9.2.16 09/23/10  MC - List of isotopes: modification to pass the target block for initialization // MP

9.2.17 10/05/10  correction: crash with rotation blocks in PseudoMC mode

9.2.20 10/20/10  Mouse position: fonts; no initial identification in the case of a lot of isotopes

9.2.25 11/21/10  correction: indexation in dynamical submenu has been changed // MP

9.2.26 11/24/10  correction: links to COSY matrices // MP

9.2.27 11/24/10  correction: the transmission statistics dialog
## LISE++ development priorities

<table>
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<tr>
<td>&gt;&gt;&gt; ADA (Abrasion-Dissipation-Ablation) model creation</td>
<td>LongTerm project</td>
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<tr>
<td>&gt;&gt;&gt; ETACHA implementation</td>
<td>LongTerm project</td>
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<td>&gt;&gt;&gt; Evaporation cascade: create Monte Carlo version</td>
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<td>&gt;&gt;&gt; Develop a subroutine to calculate a reduced dispersion for large values of dP/P</td>
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<td>&gt;&gt;&gt; Implementation of Intranuclear cascade (INC) model in LISE++ windows</td>
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<td>&gt;&gt;&gt; Ray tracing in LISE++</td>
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<td>&gt;&gt;&gt; The &quot;MOTER&quot; code development</td>
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<td>&gt;&gt;&gt; Custom shape degfrader optimization in MC mode for high order optics</td>
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<tr>
<td>&gt;&gt;&gt; Minimization in LISE++ (which can be used for MC, TRANSPORT, Ray tracing cases)</td>
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<td>Quadrupoles: option matrix or field calculations</td>
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<td>Second order matrix for dipole and entrance and exit face of dipoles</td>
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<td>Ideal magnet solution (tabulation) : first and second order</td>
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<td>High order : write documentation and put source for COSY files</td>
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<td>Target thickness defect</td>
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<td>Discovery of isotopes : utilities, database, plots</td>
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<td>Wedge (including curved profile wedge) inclination</td>
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<td>Write full LISE++ documentation</td>
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<td>Fission without angular acceptances: low transmission for analytical solution</td>
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<td>Three-body kinematics relativistic calculator</td>
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<tr>
<td>Water wedge procedure (wedge with one moving plane and filled by liquid)</td>
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