

Extracting Matrices in LISE

- Open the extended LISE file (available in the LISE distribution package: `\My Documents\LISEcute\files\examples\FRIB\eARIS\eL_ARIS_k3cb2.lpp`).
 - This file uses the most common optics setting used in ARIS: momentum compression in the pre-separator and high transmission in the C-Bend.
- Next, set your experimental configuration up (primary beam, energy, and power; fragment setting; target thickness; wedges, if applicable, etc.)
- Then, read in the saveset for the run you want to analyze:
 - Utilities → Set-up utilities → Load ARIS experimental settings

The screenshot displays the LISE++ software interface. The main window shows a periodic table with the element ^{82}Se highlighted in yellow. The Utilities menu is open, showing options like 'Load ARIS experimental settings', 'ARIS Beam Dump', and 'Load A1900 experimental settings'. The left sidebar contains experimental parameters: Projectile ($^{82}\text{Se}^{34+}$, 228 MeV/u, 20 kW), Fragment (^{65}Ti), Target (^{12}C 8 mm), and various slits and quadrupoles. The bottom status bar shows parameters like 'Ncalc=1', 'Sum=7.140e-6', 'DG=4.38mm%', 'NP=64', and 'R=0x1'.

Extracting Matrices in LISE

- In the dialog box that pops up, browse for the saveset you want to use.
- Once selected, click the “Read data” button below.

Load ARIS settings

ARIS configuration

This utility works properly with "e_ARIS_v*.lpp" file (extended configuration)

1. Load default eARIS(k3) configuration

1a. Browse & Load eARIS configuration

ARIS saveset file

Default printout directory: /projects/lisedevl_Shane/Experiments/24605_82Se_07-2024/

2. Browse saveset file: 2024_07_17_12h47m51_Run2515.bt

Run title

3. Read data

ARIS configuration settings

Exit, Quit, Help

Run title

3. Read data

Title: ARIS 2024_07_17_12h47m51.bt -- Wed 17 Jul 2024 12:47:51
"Run 2515: 65Ti with wedge shifted by 2 mm towards thicker"
Exp# 24605 [O. Tarasov] "20 kW Se-82 Beam Test"
Primary beam: 82 Se (Z=34) 228.0 MeV/nuc; D1000 Target: C 8.000 mm 500.0 rpm

ARIS configuration settings

Dipole values loading

- Load only Brho value
- Load Brho value and "frozen" radius from saveset. Calculate block matrix
- Load B-NMR field, get Radius from calibration. Calculate block matrix

	Values	use	Values	use
Projectile =	82Se	<input type="checkbox"/>	Dipole fields =	N = 7 (8) <input checked="" type="checkbox"/>
Production Target =	C 8.00 mm	<input type="checkbox"/>	Quadrupole fields =	N = 42 (42) <input checked="" type="checkbox"/>
Wedge (D1184) =	empty	<input type="checkbox"/>	Sextupole fields =	N = 33 (42) <input checked="" type="checkbox"/>
D1184 slit =	+50.0 : -50.0	<input checked="" type="checkbox"/>	DB1 detectors =	<input type="checkbox"/> <input checked="" type="checkbox"/>
DB1 vert slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB3 detectors =	<input type="checkbox"/> <input checked="" type="checkbox"/>
DB2 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB4 detectors =	<input type="checkbox"/> <input checked="" type="checkbox"/>
DB4 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB5 detectors =	<input type="checkbox"/> <input checked="" type="checkbox"/>
DB5 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	Use Quadrupole fudging factors	<input type="checkbox"/>
DB5 vert slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	Manual additional quadrupole field factor (default 0.9702)	<input type="checkbox"/>

4. Load values into code & Calculate matrices

Save current quad fields to scratch

Exit, Quit, Map plot, Help

Extracting Matrices in LISE

- There are several options for dipole settings: Brho only, Brho and 'frozen' radii from saveset, and B-NMR field, radius from calculation.
 - Brho and frozen radius are the most commonly used.

Leave these boxes unchecked, as they may mess up the primary beam settings and/or the fragment settings.

If there is slit information, it will appear here.

The screenshot shows the 'ARIS configuration settings' window. At the top, there is a 'Run title' section with a '3. Read data' button and a 'Title' field containing: 'ARIS 2024_07_17_12h47m51.bt -- Wed 17 Jul 2024 12:47:51', 'Run 2515: 65Ti with wedge shifted by 2 mm towards thicker', 'Expt# 24605 [O. Tarasov] "20 kW Se-82 Beam Test"', and 'Primary beam: 82 Se (Z=34) 228.0 MeV/nuc; D1000 Target: C 8.000 mm 500.0 rpm'. Below this is the 'Dipole values loading' section with three radio buttons: 'Load only Brho value' (unchecked), 'Load Brho value and "frozen" radius from saveset. Calculate block matrix' (checked and circled in green), and 'Load B-NMR field, get Radius from calibration. Calculate block matrix' (unchecked). To the right of this section is a button '4. Load values into code & Calculate matrices' which is circled in green. Below the radio buttons is a table of settings:

	Values	use		Values	use
Projectile =	82Se	<input type="checkbox"/>	Dipole fields =	N = 7 (8)	<input checked="" type="checkbox"/>
Production Target =	C 8.00 mm	<input type="checkbox"/>	Quadrupole fields =	N = 42 (42)	<input checked="" type="checkbox"/>
Wedge (D1184) =	empty	<input type="checkbox"/>	Sextupole fields =	N = 33 (42)	<input checked="" type="checkbox"/>
D1184 slit =	+50.0 : -50.0	<input checked="" type="checkbox"/>	DB1 detectors =		<input checked="" type="checkbox"/>
DB1 vert slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB3 detectors =		<input checked="" type="checkbox"/>
DB2 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB4 detectors =		<input checked="" type="checkbox"/>
DB4 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	DB5 detectors =		<input checked="" type="checkbox"/>
DB5 horiz slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	Use Quadrupole fudging factors		<input type="checkbox"/>
DB5 vert slit =	-100.0 : +100.0	<input checked="" type="checkbox"/>	Manual additional quadrupole field factor (default 0.9702)		<input type="checkbox"/>

At the bottom right of the window are buttons: 'Save current quad fields to scratch', 'Exit', 'Quit', 'Map plot', and 'Help'.

Make sure to load the values into LISE and calculate the new matrices!

These will input the magnetic fields from the saveset.

Extracting Matrices in LISE

- Once the saveset has been implemented, you may extract the transfer matrices you desire.
- Go to Experimental Settings → Optics → Calculate matrices between two selected blocks

The screenshot shows the LISE software interface. The 'Experimental Settings' menu is open, and the 'Optics' option is selected. The 'Optics' submenu is visible, showing options like 'Tune spectrometer for the setting fragment on beam axis', 'Gamma registration', 'Setting Fragment', 'Tune spectrometer for the primary beam', 'OPTIMIZATION (optical element parameters fitting)', 'Manual recalculation of e-blocks matrices (only for Experts!)', 'Update matrices linked with COSY files', 'Multipole: set Action for all multipoles if Brho-value changes', 'Envelope plot', 'First order matrix elements: Plot', 'First order matrix elements: View & Print', 'Calculate matrix between two selected blocks', 'Comparison of Quadrupole field settings', 'Brho (Erho) Analyser', and 'The First- and Second- Order Matrix Elements for an Ideal Maget'. The background shows a periodic table of elements with some cells highlighted in red and blue. The status bar at the bottom shows 'show disabled blocks', 'charge states', 'Ncalc=1', 'Sum=7.140e-6', 'DG=4.38mm/%', 'NP=64', and 'R=0x1'.

The dialog window titled 'Matrix calculation between two blocks' is shown. It has two dropdown menus for '1st block' and '2nd block'. The '1st block' is set to 'DB4_PPAC0 <=> FS_F3S1:POSD_D1758' and the '2nd block' is set to 'DB5_PPAC1 <=> FS_F3S2:POSD_D1853'. There is a 'Dimension' section with two radio buttons: 'mm / mrad' (selected) and 'cm / mrad'. Below this, it says 'Both blocks will be included in calculation'. At the bottom, there are two buttons: 'Calculate' (with a lightning bolt icon) and 'Quit' (with a checkmark icon).

- This dialog window will allow you to select the two blocks you wish to calculate the matrix between.
- mm/mrad is the most common units to use.
- If you don't see the blocks you want, go to Spectrometer Design and ensure they are enabled.

Extracting Matrices in LISE

Matrix from DB3_PPAC1 (FS_F2S2:POSD_D1663) to DB4_PPAC0 (FS_F3S1:POSD_D1758)
Number of blocks: 21; Length: 9.50463 m

transport format [mm-mrad]

```
* TRANSFORM 1 *
1 [X]:  -1.7803e+00  +8.9367e-01  0  0  0  +2.3272e+01
2 [T]:  +1.6204e-01  -6.4306e-01  0  0  0  -2.8103e-01
3 [Y]:  0  0  -1.1337e+00  -3.5053e-01  0  0
4 [F]:  0  0  +8.8480e-01  -6.0850e-01  0  0
5 [L]:  +3.2707e-01  -1.4714e+00  0  0  +1.0000e+00  -1.0761e+00
6 [D]:  0  0  0  0  0  +1.0000e+00
```

```
-----
* TRANSFORM 2 *
1 1:  -3.2324e-05
1 2:  +3.7187e-04  -4.7336e-04
1 3:  0  0  -8.1684e-05
1 4:  0  0  -3.7679e-04  -1.9245e-03
1 5:  0  0  0  0  0
1 6:  +1.0113e-02  +2.8771e-02  0  0  0  -2.2392e-01
```

```
-----
2 1:  +8.6894e-06
2 2:  -8.7659e-05  -1.6549e-04
2 3:  0  0  +1.0051e-06
2 4:  0  0  +6.1326e-05  +1.8666e-04
2 5:  0  0  0  0  0
2 6:  -1.8102e-03  -6.3868e-03  0  0  0  +2.1920e-03
-----
```

- The output will look like the example to the left.
- The top matrix is the first order transfer matrix, while the ones below it are the second order matrices.
- This example is the transfer matrix between DB3 PPAC1 and DB4 PPAC0.

Transporting to PID SpecTcl format

/user/arisdaq/PID/Develop/v27/calibrations/matrix

CB2_Dip34_run2515.tcl

```
#----- Dip34 exp 24605 db3.ppac1 - db4.ppac0
puts -nonewline "matrix CB2_Dip34 run 2515*"
#-----
set aris.Dip34.brho0 5.30480;

set aris.Dip34.matr.xx -1.7803;
set aris.Dip34.matr.xa 0.89367;
set aris.Dip34.matr.xd 23.272;

set aris.Dip34.matr.ax 0.16204;
set aris.Dip34.matr.aa -0.64306;
set aris.Dip34.matr.ad -0.28103;

set aris.Dip34.matr.yy -1.1337;
set aris.Dip34.matr.yb -0.35053;

set aris.Dip34.matr.by 0.88480;
set aris.Dip34.matr.bb -0.60850;

set aris.Dip34.matr.lx 0.32707;
set aris.Dip34.matr.la -1.4714;
set aris.Dip34.matr.ld -1.0761;

set aris.Dip34.b_use_x 2; # "-1,0,1,2"); // -1 not use, 0- ppac0, 1-p
set aris.Dip34.e_use_x 0; # "-1,0,1,2"); // -1 not use, 0- ppac0, 1-p
set aris.Dip34.b_use_a 1;
set aris.Dip34.e_use_a 0;

set aris.Dip34.delta_method 0; # forward

#-----
puts " end CB2_Dip34 **"
```

CB2_Dip45_run2515.tcl

```
#----- Dip45 e24605 db4.ppac0 db5.ppac1
puts "matrix CB2_Dip45 run 2515 *"
#-----
set aris.Dip45.brho0 5.30340;
#-----
set aris.Dip45.matr.xx -0.68635;
set aris.Dip45.matr.xa -0.12382;
set aris.Dip45.matr.xd 15.739; #

set aris.Dip45.matr.ax 0.0094403;
set aris.Dip45.matr.aa -1.4553;
set aris.Dip45.matr.ad 0.029456;

set aris.Dip45.matr.yy -0.39847;
set aris.Dip45.matr.yb -0.32287;

set aris.Dip45.matr.by 1.5201;
set aris.Dip45.matr.bb -1.2779;

set aris.Dip45.matr.lx 0.016880;
set aris.Dip45.matr.la -2.2901;
set aris.Dip45.matr.ld -1.0753;

#-----
set aris.Dip45.b_use_x 0; # "-1,0,1,2"); // -1 not use, 0- ppac0, 1-ppac1, 2
set aris.Dip45.e_use_x 2; # "-1,0,1,2"); // -1 not use, 0- ppac0, 1-ppac1, 2
set aris.Dip45.b_use_a 0;
set aris.Dip45.e_use_a 1;

set aris.Dip45.delta_method 1; # reverse
```

/user/arisdaq/PID/Develop/v27/calibrations/

pid.tcl

```
} else { ;# 2500-2540 e24605 82Se

    set aris.db3.z ${aris.db3.ppac1.z}
    set aris.db4.z ${aris.db4.ppac0.z}
    set aris.db5.z ${aris.db5.ppac1.z}

    source ./calibrations/matrix/CB2_Dip34_run2515.tcl
    source ./calibrations/matrix/CB2_Dip45_run2515.tcl
}
```



Facility for Rare Isotope Beams

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