



# Translation and export of COSY maps to LISE: Extended block configurations

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**ENERGY**

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Science

# Outline

- Introduction to COSY scripts developed to
  - generate LISE compatible maps
  - generate LISE commands to create a beamline lattice
- New link is available with info on how to setup “extended” LISE blocks
- An example is illustrated

# New subroutines

- Subroutines in COSY script language have been developed
  - To generate LISE readable maps in .MAP files
    - » PROCEDURE CONVERT\_PM\_FORMAT
    - » FUNCTION TRIM\_RIGHT
    - » PROCEDURE PTWT
    - » PROCEDURE PM\_LISE
  - And also to generate LISE commands that construct the beamline lattice
    - » PROCEDURE LISE\_BLOCKSTR\_SLIT
    - » PROCEDURE LISE\_BLOCKSTR\_DRIFT
    - » PROCEDURE LISE\_BLOCKSTR\_M5
    - » (and some others)
- An example script that uses some of these codes has been made available

# Link to new instructions and code

**Some tools for COSY and LISE**

This web site contains tools that can be used as subroutines in the [COSY INFINITY](#) code system. The main purpose is to show how to output maps for use in ion transport applications such as, [LISE](#) and [MOCADI](#).

The methods described here are intended for beam transport simulation of ions. The transport calculations are based on COSY's "Beam Physics Package" for calculating maps based on the Taylor Model. These maps can then be used to compute the effect of particle optical elements on phase space components of particles, such as position, angle and spin, as described at the COSY website and various references therein. Much of the work has been supported by [Michigan State University](#) through the [NSCL](#) and [FRIB](#) facilities.

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- COSY to MOCADI map conversion and command builder  
[COSY to MOCADI.fox](#)
- COSY to LISE map conversion  
[COSY to LISE maps.fox](#)
- COSY generator of LISE-extended type blocks  
[COSY to LISExteded.pptx](#)  
[COSY Blocks LISE code generate 2012.fox](#) Updated 2015 June for LISEv9.9.4\_NSCL  
[COSY Blocks LISE code generate 2015.fox](#) Updated 2015 June for LISEv9.9.4\_NSCL  
Example of generating LISE scripting for the A1900 separator. The model includes the beam blocker (or dump) after the first dipole. The map terms go up to 5th order.
  - [A1900 NO FF LISEext.pdf](#) Slides of results
  - [A1900 NO FF LISEext.fox](#) COSY optics model of A1900
  - [A1900 2014 BeamDump Order5.lpp](#) Resulting condensed LISE model
  - [A1900ext 2014 BeamDump Order5.lpp](#) Resulting extended LISE model

This document

Simplified examples

# Output from script

- Below are snapshots of output given when the script is executed
  - Note that subdirectory 'lise\_ext/' needs to be created before run time

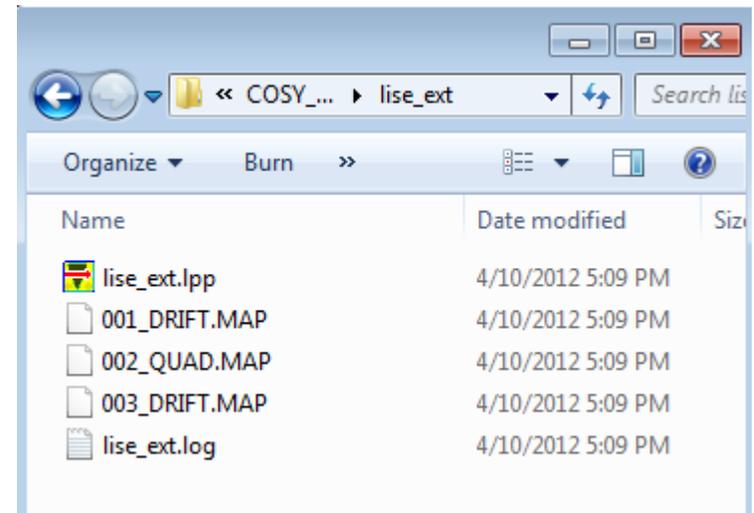
```
xterm
/projects/a2400/cosy8fortran/cosy

*****
*
*  COSY  INFINITY  *
*
*   FOXY LANGUAGE SYSTEM  *
*
*   VERSION  8.1  *
*
*   (C) MSU 2002  *
*
*****

GIVE SOURCE FILE NAME WITHOUT EXTENSION .FOX
COSY_Blocks_LISE_code_generate

--- BEGINNING COMPILATION
--- BIN FILE READ: COSY
--- BEGINNING EXECUTION
Called LISE_EXTENDED_OUT.
  Output maps to .LISE and commands for .lpp file ...
(subdirectory lise_ext/ must exist)
SYSTEM STARTS:
start: Tue Apr 10 17:12:18 EDT 2012
stop:  Tue Apr 10 17:12:19 EDT 2012
sodium: ./COSY_to_LISEextended$
```

Below is the list of files generated



# lise\_ext.log

- The file 'lise\_ext.log' is generated
  - It is not needed to generate the LISE application and only serves to list information about the blocks that have been generated
  - The first three columns give the following information:
    - » Fname = Name of .MAP file generated for a block in the lattice
    - » Mtype = type of block (e.g. DRIFT, QUAD, dipole)
    - » Len[m] = Length of block taken up along the optic axis
  - Additional columns are some times available
    - » For example, to give the corresponding x and y aperture dimensions of the block
  - Type of output can be modified
    - » Commands exist at each corresponding PROCEDURE LISE\_...

```
lise_ext.log (Wintranetfiles\projects\la2400\MP\2012_02_FullSep_n_HEB\COSY_to_LISExtended\lise_ext\
1 FName           MType Len[m]
2 001_DRIFT.MAP DRIFT 0.300000
3 002_QUAD.MAP QUAD 0.300000 1 0.100000 0.100000
4 003_DRIFT.MAP DRIFT 0.400000
```

# lise\_ext.Ipp

- The file 'lise\_ext.Ipp' is generated
  - It contains the commands that needs to

Each block must have a corresponding letter entry in the "BlockStructure" string

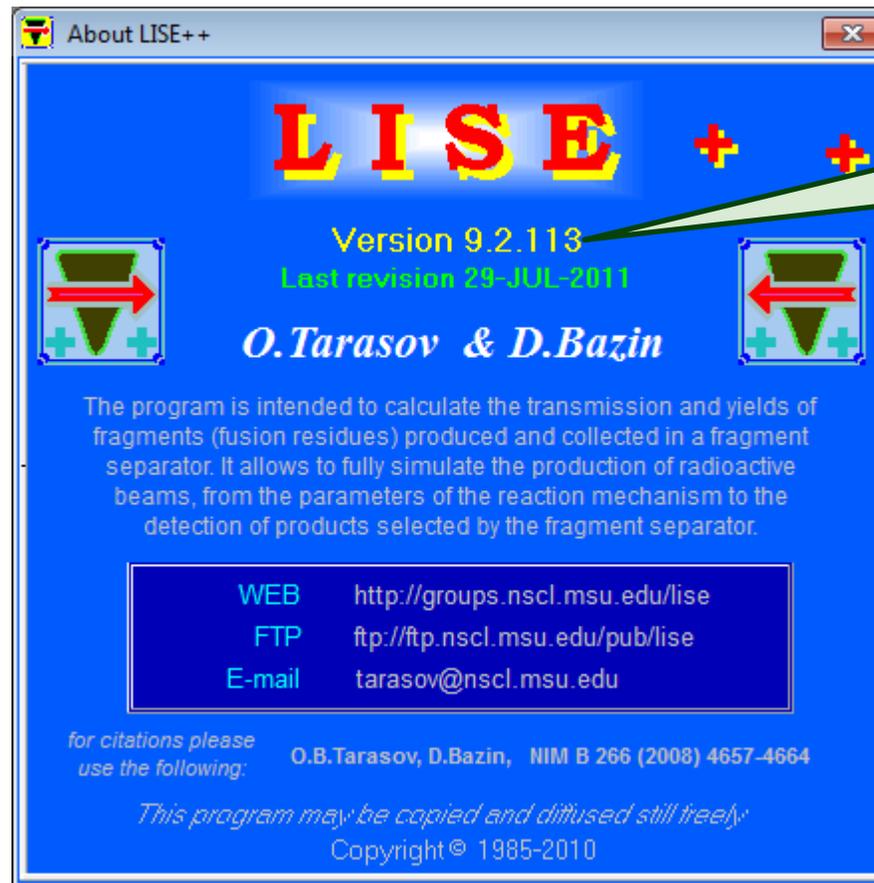
Directory name will likely need to be replaced with the full path where the files exist. For example, replace all "lise\_ext/" with "C:\myfiles\" using a text editor

The final line has the "BlockStructure" string and needs to be cut to replace the one in the "blank" LISE file.

```
lise_ext.Ipp (\\intranetfiles\projects\la2400\MPI_2012_02_FullSep_n_HEBI\COSY_to_LISE\ext\lise_
1 {===== BLOCK Drift only =====}
2 [S1_General]
3 Name = Dr001,1
4 Available = 1
5 Length = 0.300000          m
6 COSY file = lise_ext/001_DRIFT.MAP
7 [S1_slits]
8 Shape = 0
9 X_action = 0,0,0
10 X_size = 1, -10.00, -10.00, 10.00, 10.00
11 Y_action = 0,0,0
12 Y_size = 1, -10.00, -10.00, 10.00, 10.00
13
14 {===== BLOCK Quad =====}
15 [S2_General]
16 Name = Quad002,1
17 Available = 1
18 Length = 0.300000          m
19 SecondOrder = 1
20 ThirdOrder = 1
21 COSY file = lise_ext/002_QUAD.MAP
22 [S2_slits]
23 Shape = 1
24 X_action = 1,0,1
25 X_size = 1, -100.00, -100.00, 100.00, 100.00
26 Y_action = 1,0,1
27 Y_size = 1, -100.00, -100.00, 100.00, 100.00
28 [S2_AngAcceptance]
29 X-Use = 0
30 Y-Use = 0
31 [S2_DriftSettings]
32 Mode = 2
33 ShowLength = 0
34 Length_effective = 0.300000E+00
35 MagneticField = 0.200000E+01
36 Radius = 0.100000E+02
37 Include 2nd order = 1
38 CalculteAuto = 1
39 CorrespondBrho = 0.100000E+01
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41 {===== BLOCK Drift only =====}
42 [S3_General]
43 Name = Dr003,1
44 Available = 1
45 Length = 0.400000          m
46 COSY file = lise_ext/003_DRIFT.MAP
47 [S3_slits]
48 Shape = 0
49 X_action = 0,0,0
50 X_size = 1, -10.00, -10.00, 10.00, 10.00
51 Y_action = 0,0,0
52 Y_size = 1, -10.00, -10.00, 10.00, 10.00
53
54 BlockStructure = $$$
```

# LISE++ versions to use

- Consider using LISE version 9.2.107 and beyond



Version used when at the time of making this example

# Example of “blank” lise file

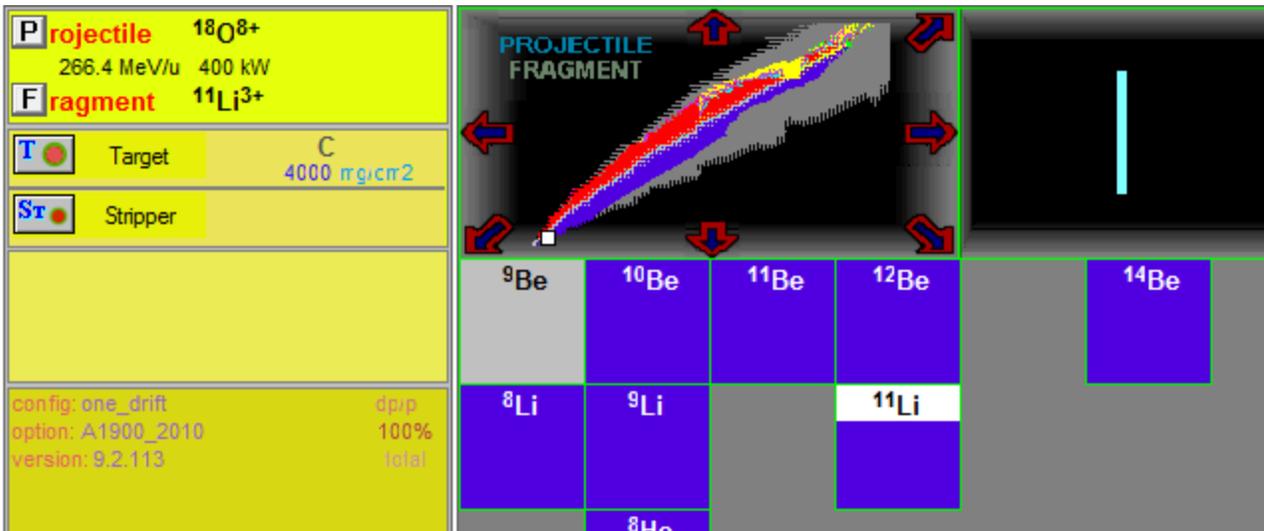
Start file shall have no blocks other than the beams, target and stripper. “BlockStructure” string should be empty.

```

blank.lpp (\\intranet\files\projects\la2400\MP\_2012_02_FullSep_n_HEB\COSY_to_LISExteded\
1 Version 9.3.3
2
3 {===== Main Part =====}
4 [general]
5 File =
6   \\intranet\files\projects\la2400\MP\_2012_02_FullSep_n_HEB\fr
7   Date = 07-02-2012
8   Time = 16:05:04
9   Configuration = other\one_drift.lcn
10  Optionsfile = A1900_2010.lopt
11  Title = one_drift
12  BlockStructure =
13 [settings]
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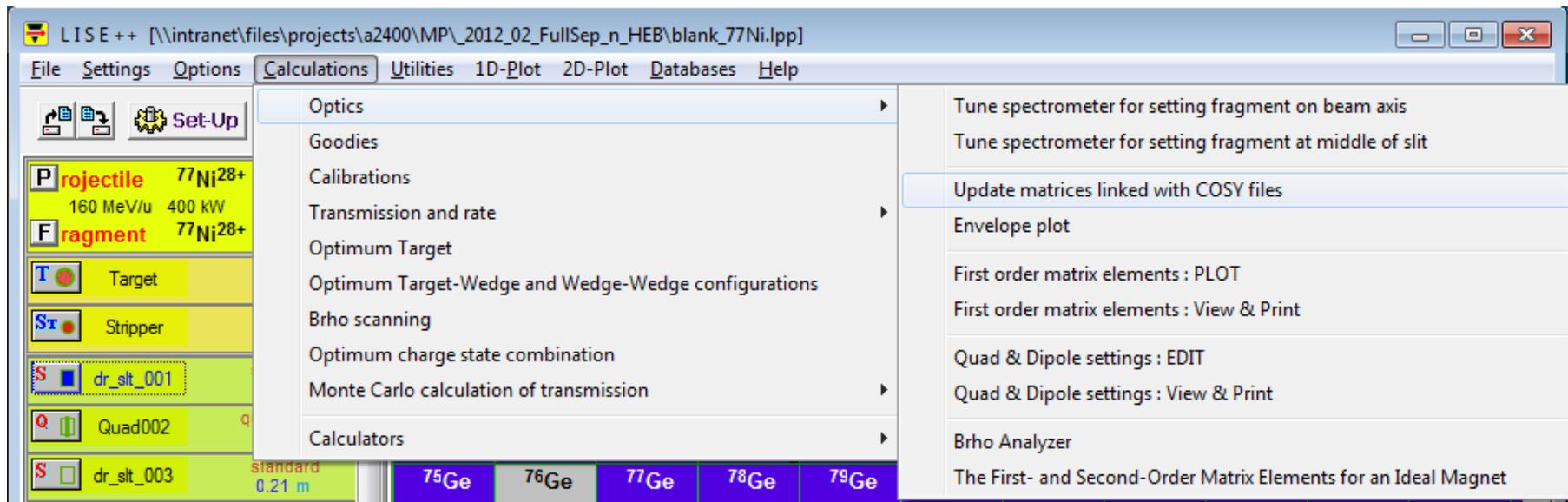
Copy and insert all block code in “lise\_ext.lpp” to the end of this file (except for the ‘BlockStructure’ line)



This step can be skipped in newer ...2015.fox version

# Loading matrices

- Once the new .lpp file has been established
  - Open the file .lpp file with LISE
  - Select “Update matrices...” so that LISE will upload the true maps (initially existing maps are only placeholders).
  - The message “Link is broken! No file!” means the path in the .lpp file needs to be corrected.
    - » Be sure path is compatible with the version of Windows that is being used.



NOTE: Menu and submenu items have changed in newer versions of LISE.

# Verify the final matrix

- Inspect the final “Global matrix” to ensure that the final map elements are the expected ones from the COSY output (in TRANSPORT coordinates)

Optical matrix - Dr003

$G_i = L_i * G_{i-1}$   
G - Global, L - Block (Local)

Dimension: mm  cm

Matrices: Block (local)  Global

Second Order LOCAL matrix: Non  Exist  only for Monte Carlo transmission

Block matrix:

1. X	1	0.4	0	0	0	0
2. T	0	1	0	0	0	0
3. Y	0	0	1	0.4	0	0
4. F	0	0	0	1	0	0
5. L	0	0	0	0	1	0
6. D	0	0	0	0	0	1

/[mm] /[mrad] /[mm] /[mrad] /[mm] /[%]  
Det = 1.00000

Global matrix:

0.67848	0.85916	0	0	0	0	[mm]
-0.58216	0.73669	0	0	0	0	[mrad]
0	0	1.33863	1.14721	0	0	[mm]
0	0	0.61816	1.27681	0	0	[mrad]
0	0	0	0	1	0	[mm]
0	0	0	0	0	1	[%]

/[mm] /[mrad] /[mm] /[mrad] /[mm] /[%]  
Det = 1.00000

Beam (sig): 3.0124, 2.5832, 4.2853, 4.3143, 0, 0.15

Drift (space) Link to COSY map  003\_DRIFT.MAP

Ok Cancel Help Spectrometer matrix

- Add the other needed blocks manually (such as degrader or detector materials)

# Summary

- This code has been tested with FRIB separator applications
- A small application script is available as an example of how to use the code
  - [https://www.msu.edu/~portill2/cosy\\_tools/](https://www.msu.edu/~portill2/cosy_tools/)  
→COSY generator of LISE-extended type blocks

# What is new?

- The ...2015.fox version has updated subroutines that
  - Allow strings to be entered to name a block (past version used enumeration of blocks to automatically assign names)
  - Allows drift blocks to be created without the need to import a map
  - Default slit settings that are more in line with newer LISE versions
  - Includes commands that write global maps to .LISE files to generate condensed versions of the system
- Other optional features that may need to be commented out
  - Lines using command SYSCMD and other custom commands need to be commented out (if not using the custom version)
  - Custom commands allow
    - » Skipping of steps, such as replacing the directory name where the maps reside
    - » Use of shaped degraders in the optics code that use ATIMA for matter interactions
    - » Write ready to open LISE script file called `lise_skeleton.lpp`
  - NOTE: Leaving out these tools still gives a working example, but requires more steps (as described in previous slides)