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- // 14.4.4 05/08/20
- // * Goodies dialog: **DONE!**
- // * d_Calibration dialog : **DONE!**
- // * d_Setup (spectrometer design) : redesign 95%, connection 30%

- // old LISE win-help has been ported to pdf and word files
- // these files should be edited and used later for links from dialogs
- // <http://lise.nsl.msu.edu/doc/help/LISE.docx>
- // <http://lise.nsl.msu.edu/doc/help/LISE.pdf>

Block	Given Name	Z-q	Length, m	Enable
1	Target	Target		+
2	Stripper	Stripper		+
3	Delay	Delay 1	0	NO
4	Shift	Shift 1	0	NO
5	Rotate	Rotate 1	0	NO
6	Dipole	D1	8.719	+
7	Fit	Fit XX	0	+
8	Drift	I1_slits	0	+
9	Wedge	I1_wedge		NO
10	Dipole	D2	8.767	+
11	Material	I2_PPAC0		NO
12	FaradayCup	FaradayCup 1		NO
13	Drift	I2_slits	0	+
14	Wedge	I2_wedge		+
15	Material	I2_PPAC1		NO
16	Material	I2_SCI		NO
17	Dipole	D3	8.767	+
18	Drift	I3_slits	0	NO
19	Wedge	I3_wedge		NO

Calculation utilities

A: 38, Element: Cl, Z: 17

Charge states: 17+ D1

AFTER

Energy	16.545	MeV/u
sig.(Energy)	0.186	MeV/u
Brho	1.3134	Tm
Energy Straggling	0.1024	MeV/u
Angular Straggling	5.5058	mrاد
Velocity	5.5763	cm/ns
Beta	0.186	
Rest after reactions	97.779	%

after FP_PIN

Range to: Si

	63.924	mg/cm ²
	275.393	micron

Energy Loss to: C 5 mg/cm²

	37,099	MeV
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calculated by "Ellipse" method

INTO

into FP_PIN

Energy	570.084	MeV
sig.(Energy)	5.265	MeV
Energy Straggling	0.0614	MeV/u
Angular Straggling	5.2654	mrاد
Loss due to reactions in this material (%)	0.69	

Time of Flight

Start of TOF: Target

Stop of TOF: FP_PIN

Time of Flight	693.531	ns
sig.(TOF)	1.11	ns
Length	52.793	m

Calibration with primary beam charge states

Beam Energy from Brho1 & Beam charge state

Charge state of the 19 after target

Beam Energy before target 148.735 MeV/u

Target Thickness from Brho 1 & Beam charge state

Charge state of the 17 after target

Target Thickness 598.929 mg/cm² 3237.455 micron

//-----
 // 14.4.5 05/09/20
 // * d_Setup (spectrometer design) : redesign 100%, connection 75%
 // * d_Mechanism : redesign 80%, connection 20%

Block	Given Name	Z-q	Length, m	Enable
Target	Target			+
Stripper	Stripper			+
Delay	Delay 1	0		NO
Shift	Shift 1	0		NO
Rotate	Rotate 1	0		NO
Dipole	D1	0	8.719	+
Fit	Fit XX	0		+
Drift	I1_slits	0		+
Wedge	I1_wedge			NO
Dipole	D2	0	8.767	+
Material	I2_PPAC0			NO
FaradayCup	FaradayCup 1			NO
Drift	I2_slits	0		+
Wedge	I2_wedge			+
Material	I2_PPAC1			NO
Material	I2_SCI			NO
Dipole	D3	0	8.767	+
Drift	I3_slits	0		NO
Wedge	I3_wedge			NO
Dipole	D4	0	9.39	+

Selected block: Wedge

Enable: Let call automatically: Block name: I2_wedge

Block Length [m]: 0 Length after this block [m]: 17.486 Sequence number: 14

Total Number of Blocks: 39 Length [m]: 125.32

Production Mechanism

Reactions Energy Loss, Straggling Charge states Databases: Masses, Isomers

$^{18}\text{Ca} (140.0 \text{ MeV/u}) + \text{Be} \rightarrow 42\text{S}$

Reactions

Projectiles: $A_1 Z_1$, $A_2 Z_2$, $A_3 Z_3$

Projectile fragmentation: $A_1 > A_2 \geq A_3$

Settings:

- Projectile Fragmentation
- Fusion -> Residual
- Fusion -> Fission
- Coulomb fission
- Abrasion-FissionHigh
- Two Body Reactions
- ISOL mode

Make default OK Cancel Help

//-----
 // 14.4.6 05/10/20
 // * d_Setup (spectrometer design) : DONE!
 // * d_Setup_array : redesign 100%, connection 50%
 // * d_Gamma_detection : DONE!



Spectrometer design

Block	Given Name	Z-q	Length, m	Enable
T	Target			<input checked="" type="checkbox"/>
Str	Stripper			<input checked="" type="checkbox"/>
Z	Delay		0	<input checked="" type="checkbox"/>
H	Shift		0	<input type="checkbox"/>
R	Rotate		0	<input type="checkbox"/>
D	Dipole	0	8.719	<input checked="" type="checkbox"/>
F	Fit		0	<input checked="" type="checkbox"/>
S	Drift		0	<input checked="" type="checkbox"/>
W	Wedge			<input type="checkbox"/>
D	Dipole	0	8.767	<input checked="" type="checkbox"/>
M	Material			<input type="checkbox"/>
A	FaradayCup			<input type="checkbox"/>
S	Drift		0	<input checked="" type="checkbox"/>
W	Wedge			<input checked="" type="checkbox"/>
M	Material			<input type="checkbox"/>
M	Material			<input type="checkbox"/>
D	Dipole	0	8.767	<input checked="" type="checkbox"/>
S	Drift		0	<input type="checkbox"/>
W	Wedge			<input type="checkbox"/>
D	Dipole	0	9.39	<input checked="" type="checkbox"/>

Insert Mode

before
 after

Move element

Up
Down

Edit
Delete

Array operations

Help
Ok

Insert block

Materials

Wedge Target
 Material (Detector) Stripper after Target
 Faraday cup

Optical

dispersive

Dispersive (M-dipole)
 Wien velocity filter
 Electrostatic dipole
 Gas-filled separator
 Compensation Dipole

non-dispersive

Drift (multipole, slits)
 Beam Rotation
 Shift of Optical Axis
 Solenoid

dispersive RF-based **special** (no beam dynamics charges)

RF-separator Delay (efficiency) block
 RF buncher Fitting constraints

Total

Number of Blocks: 39
 Length [m]: 52.793

Selected block

Enable Delay (efficiency) block

Let call automatically Block Length [m]: 0

Block name = Delay 1 Length after this block [m]: 0

Sequence number: 3

Gamma detection

[A] - Geometrical efficiency

Use [A] to calculate the total efficiency

One gamma-detector

Detector surface area: 38.81 cm²
 Distance to detector: 1 cm
 Geometrical efficiency: 36.317 %

Acquisition for Gamma

Delay = 0 microsec
 Gate = 10 microsec

Delay is assumed after arrival of fragment stopped in detectors at the end of spectrometer

Reference line is based on 0.01 gamma per implanted fragment

Total Efficiency = 4.472 %
 at Energy = 200 keV

Make default

Efficiency Plot

[B] - Energy efficiency

Use [B] to calculate the total efficiency

eff(x) = a*exp(-b*log(x-c+d*exp(-e*x)))

a = 5 [x] = keV b = 0.69523 d = 1
 c = -5.92199 e = 0.269

Threshold = 100 keV

//-----
 // 14.4.7 05/11/20
 // * d_Setup_array : DONE!
 // * d_Setup_charge : redesign 100%, connection 80%

1. select by mouse a range of blocks

2. click "Array operations" ×

The screenshot shows the 'Spectrometer design' software interface. A table of blocks is visible, with a range of blocks from 'Dipole D1' to 'Dipole D4' selected. The 'Array operations' button is highlighted in the control panel. The 'Operations with block arrays' dialog box is open, showing the 'Delete' operation selected and the 'Array definition' section with 'First (or Last) Block of Array' set to 'D1' and 'Last (or First) Block of Array' set to 'D4'. The 'Number of blocks in the Array' is set to 15. The 'Total Number of Blocks' is 39, and the 'Total Length [m]' is 52.793.

Block	Given Name	Z-q	Length, m	Enable
Stripper	Stripper			<input checked="" type="checkbox"/>
Delay	Delay 1		0	<input type="checkbox"/>
Shift	Shift 1		0	<input type="checkbox"/>
Rotate	Rotate 1		0	<input type="checkbox"/>
Dipole	D1	0	8.719	<input checked="" type="checkbox"/>
Fit	Fit XX		0	<input checked="" type="checkbox"/>
Drift	I1_slits		0	<input checked="" type="checkbox"/>
Wedge	I1_wedge			<input type="checkbox"/>
Dipole	D2	0	8.767	<input checked="" type="checkbox"/>
Material	I2_PPAC0			<input type="checkbox"/>
FaradayCup	FaradayCup 1			<input type="checkbox"/>
Drift	I2_slits		0	<input checked="" type="checkbox"/>
Wedge	I2_wedge			<input checked="" type="checkbox"/>
Material	I2_PPAC1			<input type="checkbox"/>
Material	I2_SCI			<input type="checkbox"/>
Dipole	D3	0	8.767	<input checked="" type="checkbox"/>
Drift	I3_slits		0	<input checked="" type="checkbox"/>
Wedge	I3_wedge			<input checked="" type="checkbox"/>
Dipole	D4	0	9.39	<input checked="" type="checkbox"/>
Material	FP_PPAC0			<input checked="" type="checkbox"/>

3. The selected range appears in "Operation with block arrays" dialog

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//-----
// 14.4.8 05/12/20
// * d_Setup_charge      : DONE!
// * d_Setup_optics     : redesign 100%, connection 50%
//
// LISE2000.docx(pdf) was completed
// All LISE2000 rtf, html, word, pdf (including original) are located at
https://1drv.ms/u/s!Aj8\_a9I2zt5kiv98fU4QaA5jKkeMgw?e=2JMbsw
```

All (March-May) weekly reports are found in the next folder
https://1drv.ms/u/s!Aj8_a9I2zt5ki4MZHA1hFrISep1R2A?e=zNhZwy

Charge states of the selected nucleus

	Block	Given Name	Z-q	q
1	Target	Target		
2	Stripper	Stripper		
3	Delay	Delay 1		
4	Shift	Shift 1		
5	Rotate	Rotate 1		
6	Dipole	D1	0	16
7	Drift	quad		
8	Fit	Fit XX		
9	Drift	I1_slits		
10	Wedge	I1_wedge		
11	Dipole	D2	1	15
12	Material	I2_PPAC0		
13	FaradayCup	FaradayCup 1		
14	Drift	I2_slits		
15	Wedge	I2_wedge		
16	Material	I2_PPAC1		
17	Material	I2_SCI		
18	Dipole	D3	1	15

Selected ion : $^{42}\text{S}^{16+}$ $^{15+}$ $^{15+}$ $^{15+}$ $^{15+}$ $^{15+}$ $^{15+}$ $^{15+}$ $^{15+}$

Selected block

Charge (q) = Block name =

- //-----
- // 14.4.9 05/13/20
- // * d_Mechanism : redesign 100%, connection 40%
- // * d_Mechanism_fragmentation : redesign 60%, connection 10%
- // files and file names revision in directories /d_Database and /d_Mechanism

Production Mechanism dialog box showing reaction settings for $^{48}\text{Ca} (140.0 \text{ MeV/u}) + \text{Be} \rightarrow ^{42}\text{S}$. The Reactions tab is active, showing a diagram of projectile fragmentation ($A1 \rightarrow A2 \rightarrow A3$) and a list of reaction types with checkboxes for 'Projectile Fragmentation', 'Fusion -> Residual', 'Fusion -> Fission', 'Coulomb fission', 'Abrasion-Fission', 'Two Body Reactions', and 'ISOL mode'. The 'Projectile Fragmentation' option is selected. Buttons for 'Settings', 'OK', 'Cancel', and 'Help' are visible.

Production Mechanism dialog box showing energy loss and straggling options. The Energy Loss model is set to '2 - ATIMA 1.2 LS-theory (recommended for high energy)'. The Energy Straggling model is set to '1 - ATIMA 1.2 (LS-theory)'. The Shape is set to 'Gaussian' and the Calculation method is 'interpolation from table'. The Angular Straggling method is '1 - Moliere et al. (ATIMA 1.2)'. The Slope is 0.217 and the Free member is 1.112. Buttons for 'Make default', 'OK', 'Cancel', and 'Help' are visible.

Production Mechanism dialog box showing charge state and GLOBAL options. The Reaction is '3 - GLOBAL (>UB AMeV) + J.Winger (<30 AMeV) (30-UB AMeV mixed); NIM B142(1998)441'. The 'Optimization of "charge state" transmission calculations' is checked. The 'Calculate charge states for ALL energy distribution points' is set to 'Auto' with a threshold of 30 MeV/u. The 'GLOBAL' options include 'Non Equilibrium mode for thin materials'. The Upper boundary of "mixed" region is 70 MeV/u. The Zfrag >= is 2. The Charge state after reaction is Z - q = 0. Buttons for 'Make default', 'OK', 'Cancel', and 'Help' are visible.

Production Mechanism dialog box showing masses and isomer database settings. The Masses section has 'Database + Calculations' selected with 'DataBase' set to '0 - AME2016 (database)' and 'Formula' set to '2 - LDM#1 + shell corrections (O.T.)'. The User's MassExcess File is 'AME2016.lme'. The 'Take into account electron binding energies for ion mass calculations' is checked. The Isomer database is 'isomer.dbf' and the USER database is 'no file'. Buttons for 'Make default', 'OK', 'Cancel', and 'Help' are visible.

//-----
 // 14.5.1 05/14/20
 // * d_Setup_optics : DONE!
 // it was the last "setup dialog". The Middle version number has been increased

// Global revision of "formula" images in
 // dialogs d_Dipole_transport, d_Magnet_deal, d_Apf_auto, d_Apf_excitation, d_Foil_lifeTime
 // d_Fragmentation_convolution, d_Fragmentation_friedman, d_Mechanism_fragmentation
 // All these images have been made transparent

example of transparent formula images

Convolution of Gaussian (Fragmentation) and Exponent (Friction) distributions - [Preview] - Qt Creator

Reaction

$$f(p) \approx \exp\left(\frac{p}{\tau}\right) \cdot \left[1 - \text{ferr} \left(\frac{p - p_0 + \frac{\sigma_{11}^2}{\tau} - \text{shift} \cdot \tau}{\sqrt{2} \sigma_{11}} \right) \right]$$

$$\sigma_{11}^2 = \left(\sigma_0^{\text{conv}} \sqrt{\beta_p} \right)^2 \frac{A_F^* (A_p - A_F^*)}{A_p - 1} \quad \tau = \frac{\text{coef}}{\beta} \sqrt{A_F^* E_S}$$

Settings for Gaussian distribution

PO (MeV/C) = 12500.1
 Vf/Vb from settings = 12500.1
 Mom. distribution = Goldhaber
 σ_0 = 12500.1 MeV/c
 σ_{11} = 12500.1 MeV/c (*)

Settings for convolution

Separation Energy	Es	coef	shift	FWHM / 2.355(*)	tau	P(Ymax)	peak	mean
Energy from Qg	125	200	0.222	mom	mom	mom	mom	mom
Excitation from dSurface	125	200	0.222	mom	mom	mom	mom	mom
+ dSurface	125	200	0.222	mom	mom	mom	mom	mom

MeV
 MeV/c
 MeV/fm²
 MeV/c MeV/c MeV/c
 (*) - with Gamma-factor

Plot 1D Plot Conv. Analysis Make default OK Cancel Help

Optic settings (fast editing)

Block	Given Name	Start(m)	Length(m)	B0(kG) / *U	Br(Tm)cor/*real	DriftM / *Angle	Rapp(m)/*R(m)	Leff(m)/*Ldip(m)	2nd order	CalcMatr / *Z-q	AngAcc,Apps,Slits	COSY Fit	S E
** Dipole	D1	0	8.719	+14.4823	* 4.4895	* +45.0	* 3.1000	* 2.4347	--	* 0	HV -- --		S
<Quad>	quad	8.719	0.2	+5.0000	4.4895	QUAD	5.0000	0.2000	no	1 R	-- HV --	fit - Q	e
Fit	Fit XX	8.919	0									R11 < 12	e
slits	I1_slits	8.919	0			SLITS					-- -- H-		e
** Dipole	D2	8.919	8.767	-14.4823	* 4.4895	* -45.0	* 3.1000	* 2.4347	--	* 0	HV -- --		S
slits	I2_slits	17.686	0			SLITS					-- -- H-		s
** Dipole	D3	17.686	8.767	-13.9196	* 4.3151	* -45.0	* 3.1000	* 2.4347	--	* 0	HV -- --		S
** Dipole	D4	26.453	9.39	+13.9196	* 4.3151	* +45.0	* 3.1000	* 2.4347	--	* 0	HV -- --		S
slits	FP_slits	35.843	0			SLITS					-- -- HV		s
<Quad>	Drift 6	35.843	0.5	+10.0000	4.3128	QUAD	5.0000	0.5000	yes	1	-- HV --	cosy	e
RFbuncher	RFbuncher 1	36.343	0.2								-- -- --		s
RFseparator	RFseparator 1	36.543	0.7							* 0	-- HV -V		s
ElecDip	ElecDip 1	37.243	2.3562	*47693.0 kV	1.6251	* +45.0	* 2.0000	* 1.5708	yes	* 0 R	-- HV HV		E
GasFS	GasFS 1	38.814	12							* 0	-- HV HV		s
* CompDip	CompDip 1	50.814	0.7995	+2.1830	* 2.0000	* +5.0	* 9.1615	* 0.7995	--	* 0	-- HV HV		e
Solenoid	Solenoid 1	51.613	0.5944	0.2000 T	2.0000		Eff 0.210	Coil 0.594	--	* 0	-- HV --		e

Selected block

Drift (multipole,slits)

Block name: Auto call

Block Length [m]:

Length after this block [m]:

Use in FIT process: Q S

Selected Block Edit Multipole Edit Cuts (Acceptances) Optical Matrix

Angular acceptance (mrad)

Horizontal ± Use

Vertical ± Use

Shape: Rectangle Ellipse

Inside Aperture (mm)

min max Use

X =

Y =

Shape: Rectangle Ellipse

Slits (mm) after this BLOCK

min max Use

X =

Y =

Shape: Rectangle Ellipse

1-st order Matrix Elements

Matrix Plot Beam-Sigma Plot View

Quit Help

