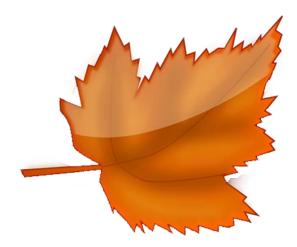
SEPTEMBER 11, 2015



SIROP TUTORIALS SENSITIVITY MODULE – QUICK START EXAMPLE

NICO QUARK NOVA PROJECT University of Calgary **IMPORTANT UPDATE (July 2017):** This quick start is from an older version of SiRop (2015). A few things have changed which are necessary for the proper execution of this tutorial. These changes are in bold face in the text.

This tutorial is a quick start guide to using the sensitivity module in SiRop. It will go through the steps to set up an example r-process sensitivity run.



From the main desktop, select the "Data" module.

lement																	P(β-delayed)	
	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
									Add ros									
									Remove									
									Insert n									
									Copy ro									
									Clear									
									Creat Creat									
									Select a									
									Save as									
									Reset	text								
									Column	• •								
										_								

From the Data module, right click (control-click for Mac) and select "Reset". This will populate the isotope table with default values.

Element	Z	A	N	M (amu)	Mf	Mfg	Mfo	λα(s ⁻¹)		β-Q Value (MeV)			P(Bdn2)	P(Bdn3)	λf (s ⁻¹)	Bf (MeV)	P(β-delayed)	T = 0.001 ×10
	26	71	45	70.9648	0.0	0.0	0.0	0.0	4.67805	13.13	0.7922	0.2053	0.0025	0.0	0.0	0.0	0.0	0.0
	26	72	46	71.9675	0.0	0.0	0.0	0.0	6.79889	10.81	0.7998	0.2002	0.0	0.0	0.0	0.0	0.0	0.0
	26	73	47	72.9743	0.0	0.0	0.0	0.0	12.3622	15.12	0.6229	0.3397	0.0374	0.0	0.0	0.0	0.0	0.0
	26	74	48	73.9776	0.0	0.0	0.0	0.0	14.7384	13.28	0.5517	0.4404	0.0079	0.0	0.0	0.0	0.0	0.0
	26	75	49	74.9847	0.0	0.0	0.0	0.0	20.9284	17.07	0.3293	0.5191	0.1515	1.0E-4	0.0	0.0	0.0	0.0
	26	76	50	75.9893	0.0	0.0	0.0	0.0	25.5209	15.01	0.215721572	0.683568357	0.099509951	0.00120012	0.0	0.0	0.0	0.0
	26	77	51	76.9968	0.0	0.0	0.0	0.0	65.3912	19.2	0.0879	0.3889	0.5021	0.0211	0.0	0.0	0.0	0.0
	26	78	52	78.0027	0.0	0.0	0.0	0.0	51.117	18.17	0.063	0.2854	0.3785	0.2731	0.0	0.0	0.0	0.0
	26	79	53	79.011	0.0	0.0	0.0	0.0	82.2239	20.57	0.0383	0.0128	0.4799	0.469	0.0	0.0	0.0	0.0
	26	80	54	80.0173	0.0	0.0	0.0	0.0	130.782	18.93	0.0185	0.0554	0.0443	0.8818	0.0	0.0	0.0	0.0
	26	81	55	81.026	0.0	0.0	0.0	0.0	264.56	21.54	0.013	0.0013	0.3076	0.6781	0.0	0.0	0.0	0.0
	26	82	56	82.033	0.0	0.0	0.0	0.0	236.569	20.24	0.0	0.0326	0.006	0.9614	0.0	0.0	0.0	0.0
	26	83	57	83.0421	0.0	0.0	0.0	0.0	391.609	22.54	0.0098	0.9902	0.0	0.0	0.0	0.0	0.0	0.0
	26	84	58	84.0495	0.0	0.0	0.0	0.0	410.146	21.3	0.0	0.0199	0.9801	0.0	0.0	0.0	0.0	0.0
	26	85	59	85.059	0.0	0.0	0.0	0.0	364.814	23.38	0.0174	0.9826	0.0	0.0	0.0	0.0	0.0	0.0
	26	86	60	86.0666	0.0	0.0	0.0	0.0	430.526	22.26	0.0	0.0117	0.9883	0.0	0.0	0.0	0.0	0.0
	26	87	61	87.0767	0.0	0.0	0.0	0.0	577.623	24.5	0.0074	0.9926	0.0	0.0	0.0	0.0	0.0	0.0
	26	88	62	88.0846	0.0	0.0	0.0	0.0	630.134	22.98	0.0	0.0113	0.9887	0.0	0.0	0.0	0.0	0.0
	26	89	63	89.0943	0.0	0.0	0.0	0.0	653.912	24.65	0.007	0.993	0.0	0.0	0.0	0.0	0.0	0.0
	26	90	64	90.1033	0.0	0.0	0.0	0.0	693.147	23.94	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
	27	44	17	44.0553	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	45	18	45.0393	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	46	19	46.027	0.0	0.0	0.0	0.0	0.0	-20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	47	20	47.012	0.0	0.0	0.0	0.0	0.0	-22.19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	48	21	48.0027	0.0	0.0	0.0	0.0	0.0	-15.62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	49	22	48.9896	0.0	0.0	0.0	0.0	0.0	-18.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	50	23	49.9822	0.0	0.0	0.0	0.0	0.0	-12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	51	24	50.9703	0.0	0.0	0.0	0.0	0.0	-16.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	52	25	51.9643	0.0	0.0	0.0	0.0	0.0	-10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	53	26	52.9548	0.0	0.0	0.0	0.0	0.0	-13.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	54	27	53.95	0.0	0.0	0.0	0.0	0.0	-7.38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	55	28	54.9431	0.0	0.0	0.0	0.0	0.0	-8.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	56	29	55.9414	0.0	0.0	0.0	0.0	0.0	-1.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	57	30	56.9366	0.0	0.0	0.0	0.0	0.0	-3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	58	31	57.9373	0.0	0.0	0.0	0.0	1.34E-9	1.62	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
			····)															

Once the table is populated, search for the isotope Z=26, A=70 in the search fields at the bottom of the table. Press enter to complete the search. The table will automatically scroll and select the desired isotope.

							\											
Element	Z	A	N	M (amu)	м	f Mfa	Mfo	λα(s ⁻¹)	λβ(s ⁻¹)		feV) P(Bdn0)	P(Bdn1)			λf (s ⁻¹)	Bf (MeV)	P(β-delayed)	T = 0.001 ×10
					0.0	25	0.0											
	26	71	45	70.9648	0.0	0.0	0.0	0.0	4.67805	13.13	0.7922	0.2053	0.0025	0.0	0.0	0.0	0.0	0.0
	26	72	46	71.9675	0.0	0.0	0.0	0.0	6.79889	10.81	0.7998	0.2002	0.0	0.0	0.0	0.0	0.0	0.0
	26	73	47	72.9743	0.0	0.0	0.0	0.0	12.3622	15.12	0.6229	0.3397	0.0374	0.0	0.0	0.0	0.0	0.0
	26	74	48	73.9776	0.0	0.0	00	0.0	14.7384	13.28	0.5517	0.4404	0.0079	0.0	0.0	0.0	0.0	0.0
	26	75	49	74.9847	0.0	0.0	0.0	0.0	20.9284	17.07	0.3293	0.5191	0.1515	1.0E-4	0.0	0.0	0.0	0.0
	26	76	50	75.9893	0.0	0.0	0.0	0.0	25.5209	15.01	0.215721572	0.683568357	0.099509951	0.00120012	0.0	0.0	0.0	0.0
	26	77	51	76.9968	0.0	0.0	0.0	0.0	65.3912	19.2	0.0879	0.3889	0.5021	0.0211	0.0	0.0	0.0	0.0
	26	78	52	78.0027 79.011	0.0	0.0	0.0	0.0	51.117 82.2239	18.17 20.57	0.063	0.2854	0.3785	0.2731	0.0	0.0	0.0	0.0
	26	80	54	80.0173	0.0	0.0	0.0	0.0	130.782	18.93	0.0383	0.0128	0.0443	0.8818	0.0	0.0	0.0	0.0
	26	81	55	81.026	0.0	0.0	0.0	0.0	264.56	21.54	0.013	0.0013	0.3076	0.6781	0.0	0.0	0.0	0.0
	26	82	56	82.033	0.0	0.0	0.0	0.0	236.569	20.24	0.0	0.0326	0.006	0.9614	0.0	0.0	0.0	0.0
	26	83	57	83.0421	0.0	0.0	0.0	0.0	391.609	22.54	0.0098	0.9902	0.0	0.0	0.0	0.0	0.0	0.0
	26	84	58	84.0495	0.0	0.0	0.0	0.0	410.146	21.3	0.0	0.0199	0.9801	0.0	0.0	0.0	0.0	0.0
	26	85	59	85.059	0.0	0.0	0.0	0.0	364.814	23.38	0.0174	0.9826	0.0	0.0	0.0	0.0	0.0	0.0
	26	86	60	86.0666	0.0	0.0	0.0	0.0	430.526	22.26	0.0	0.0117	0.9883	0.0	0.0	0.0	0.0	0.0
	26	87	61	87.0767	0.0	0.0	0.0	0.0	577.623	24.5	0.0074	0.9926	0.0	0.0	0.0	0.0	0.0	0.0
	26	88	62	88.0846	0.0	0.0	0.0	0.0	630.134	22.98	0.0	0.0113	0.9887	0.0	0.0	0.0	0.0	0.0
	26	89	63	89.0943	0.0	0.0	0.0	0.0	653.912	24.65	0.007	0.993	0.0	0.0	0.0	0.0	0.0	0.0
	26	90	64	90.1033	0.0	0.0	0.0	0.0	693.147	23.94	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
	27	44	17	44.0553	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	45	18	45.0393	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	46	19	46.027	0.0	0.0	0.0	0.0	0.0	-20.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	47	20	47.012	0.0	0.0	0.0	0.0	0.0	-22.19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	48	21	48.0027	0.0	0.0	0.0	0.0	0.0	-15.62	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	49	22	48.9896	0.0	0.0	0.0	0.0	0.0	-18.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	50	23	49.9822	0.0	0.0	0.0	0.0	0.0	-12.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	51	24	50.9703	0.0	0.0	0.0	0.0	0.0	-16.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	52	25	51.9643	0.0	0.0	0.0	0.0	0.0	-10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	53	26	52.9548	0.0	0.0	0.0	0.0	0.0	-13.43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	54	27	53.95	0.0	0.0	0.0	0.0	0.0	-7.38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	55	28	54.9431	0.0	0.0	0.0	0.0	0.0	-8.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	56	29 30	55.9414 56.9366	0.0	0.0	0.0	0.0	0.0	-1.81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	27	57	30		0.0	0.0	0.0	0.0	0.0 1.34E-9	-3.5		0.0		0.0	0.0	0.0	0.0	0.0
	27	58	31	57.9373	0.0	0.0	0.0	0.0	1.34E-9	1.62	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Double click on the Mf0 (initial mass fraction) field of the selected isotope (Z=26, A=70). Enter 0.5 as an example. UPDATE: In the newest version of SiRop the column header "Mf0" has been replaced with "X0".

Display the "Code" module by clicking on the calculator icon in the quick launch bar. Alternatively you can return to the desktop and select the "Code" module from there.



From the Code module, add a new "r-process" operation to the operations list by clicking on the "add" icon.

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Operations	Properties						Ouput		
r-Process	General		Processes				dStep:	100	
	Network:	Full -	α decay:	\checkmark	α capture:	v	Save: Directory:		
	Δt (s):		β decay:	V	β delayed Ns: Neutron capture:		Prefix:		
	t decay (s):	4-3-240E17	Neutron decay: Photo diss. :	 ✓ 	Neutron capture:	V	Image width:	1500	
							Image height:	800	
+ - + +									
	Environment		Fission						
	Туре:	Custom -	Fission:	Full		-			
	T ₀ (K):	3.0000E9	Z cutoff:	92.0000					
	ρ ₀ (g cm ⁻²):	1.0000E11	A cutoff:	272.0000					
	τ (s):	0.1000	v heating:	0.5000					
	p (t):	ntx0/(1+V(2*144))*2							
Sirop v1.0						Importing Photo-dissociation cross sections (Comple	ed)		×

Selecting "Waiting point" from the network drop down box.

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Operations	Properties						Ouput	
r-Process	General		Processes				dStep:	100
	Network:	-	α decay:	✓	α capture:	✓	Save:	
	Δt (s):	1.0000	β decay:	\checkmark	β delayed Ns:	✓	Directory:	
	t decay (s)	p.0000	Neutron decay:	\checkmark	Neutron capture:		Prefix:	
	Z ₀ :	-1	Photo diss. :	✓			Image width:	1500
	yes:	0.3000					Image height:	800
		\smile						
+ - + +								
	Environment		Fission					
	Туре:	Custom -	Fission:	Full		*		
	T ₀ (K):	3.0000E9	Z cutoff:	92.0000				
	p ₀ (g cm ⁻²):	1.0000E11	A cutoff:	272.0000				
	τ (s):	0.1000	v heating:	0.5000				
	p (t):	rho0 / (1+t/(2*tau))^2						
Sirop v1.0						Importing Photo-dissociation cross sections (Complete		

Set the "t decay" field to 0 (to speed up the calculations for the demonstration).

Vertex Results			6 - •
Operations	Properties	Output	
Baseline (Baseline)		Directory:	
		Prefix:	
		Enable:	
+ - + + 0 •			
Add new operation Sensitivity actions	Properties	Options	
Desault	Name Default	A min:	100
	Function: 100 * abs(Y - ¥8ass)/¥8ass	A max:	200
+ - + + 0	2		
Sirop v1.0	Importing Photo-dissociation cross sections (Compl	eted)	

Select the "Sensitivity" module by clicking on the pen and paper icon in the quick launch bar.

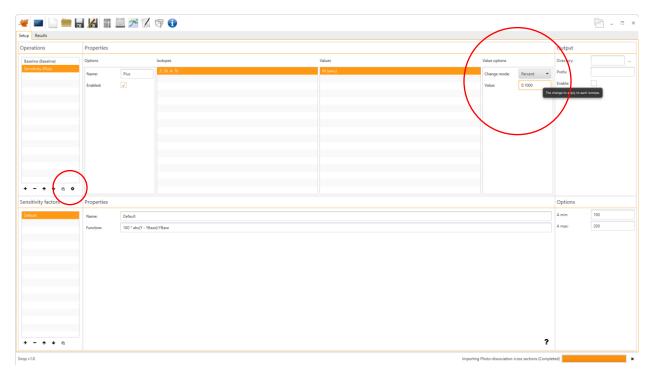
From the Sensitivity module, select a new operation by clicking the "add" icon.

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Setup Results						
Operations	Properties				Output	
Baseline (Baseline)	Options	Isotopes	Values	Value options	Directory:	
Sensitivity (Plus)	Name:	Plus Z: 26, A: 70		Change mode:	+ Prefix:	
	Enabled:			Value:	Enable:	
			Available Selected			
			2, 26, A: 70			
			Z: 26, A: 71			
			Z: 26, A: 72 Z: 26, A: 73			
			Z: 26, A: 74 Z: 26, A: 75			
+ - + + @			Z: 26, A: 76			
			Z: 26, A: 77 Z: 26, A: 78		-	
Sensitivity factors	Properties		Z: 26, A: 79 Z: 26, A: 80		Options	
Default	Name:	Default	Z: 26, A: 81		A min:	200
	Function	100 * abs(Y - YBase)/YBase	Z: 26, A: 82 Z: 26, A: 83		A max:	200
			2: 26: A: 84 4: 26, A: 85			
			Z: 20, #: 05 Z: 26, #: 06			
			Z: 26 A: 70 R			
+ - + + @					?	
rop v1.0				Importing Photo-dissociation cross sections (C	molated	

Right click on the isotopes list to display a list of isotopes you can change. Scroll down to isotope Z=26, A=70 (or use the search fields at the bottom of the list). Click on the right arrow to move the isotope to the selected list.

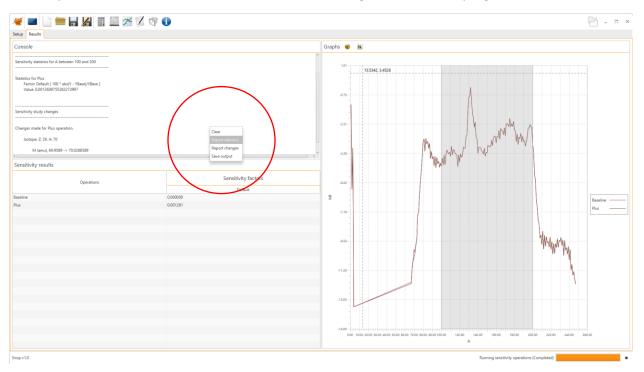
Dptions Name: Plus Enabled:	kotopes 2. 24, A.70	Values M. (umu)	Value options Charge mode Value Available	Dectory:
	2.3X, A.70	M (pmg)	Value Available	Enable:
Inabled: 🗸			Available	
				Selected
				Salactad
				Selecteu
			M (amu) Mfs	(imu)
			Μf ο λ α (s ⁻¹)	
			λ β (s ⁻¹) β-Q Value (MeV)	\frown
			P(Bdn0)	
Properties			P(Bdn2)	
Name: Default			λf (s ⁻¹)	
Function: 100 * abs	s(Y - YBase)/YBase		P(β-delayed)	
			fission rate [T = 0.001 ×10 ⁸ K]	
			fission rate [T = 0.005 \times 10 ⁹ K] fission rate [T = 0.01 \times 10 ⁹ K]	
			<u> </u>	
Na	me: Default	mes Default	ne: Defeuit	perties P(8h-0) me: Default M(4^-) st (M44) Bf (M44) st (M44) Bf (M44) st (M44) Bf (M44) st (M44) Bf (M44) fill st (M44) Bf (M44) <t< td=""></t<>

UPDATE: In the newest version, one must first create a "Group" but clicking on the "plus" icon at the bottom of the group panel (not shown here). Once a group is created, select it and you can proceed as usual. Right click on the "Values" list to display a list of isotope properties that can be changed for the sensitivity study. Select "M (amu)" from the list and press the right arrow button to move it to the selected list.

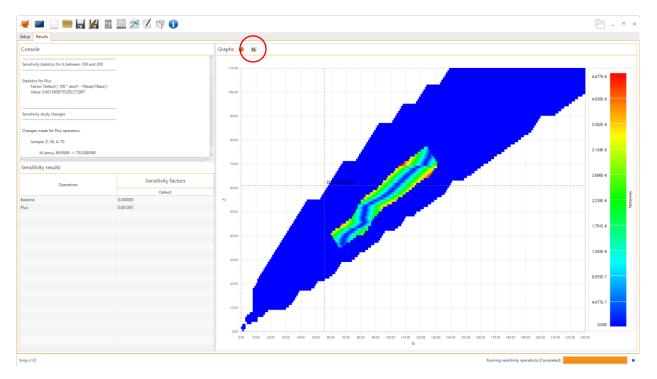


Click on the "M (amu)" value to show the options in the "Value options" pane. Set the change mode to "Percent" and the "Value" to 0.1. (This will change the mass of isotope Z=26, A=70 by +0.1%)

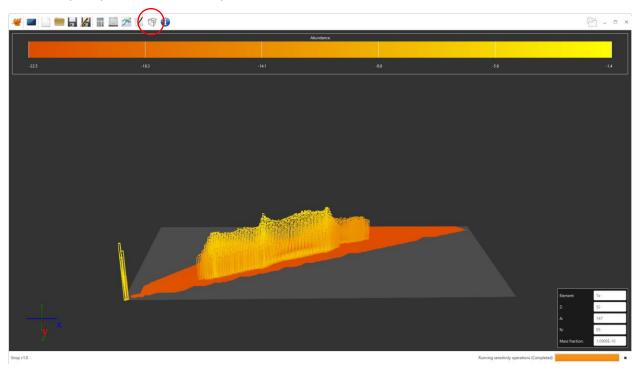
Once the setup is complete, press the cog icon to start the sensitivity study. Wait until all processes are complete. The status can be observed in the bottom right corner of the program.



Click on the "Results" tab in the Sensitivity module to display the output from the current sensitivity run. Right click on the "Console" pane to display statistics and a summary of what was changed. The results table will also show the resulting sensitivity factors that can be defined in the setup tab.

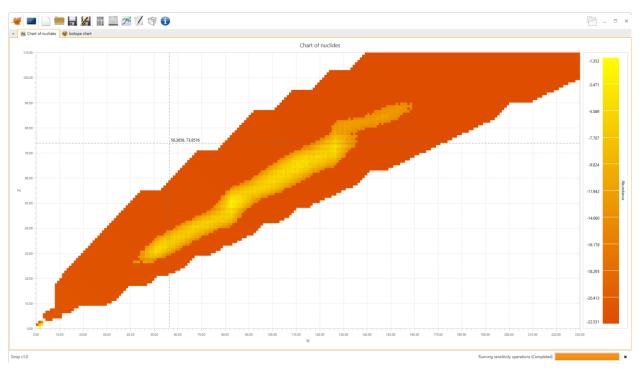


Selecting the N icon from the Graphs title bar will show a color coded chart of nuclides. The colors of each isotope represent its sensitivity.



Select the cube icon from the quick launch bar to show the 3D module. This is an interactive 3D chart of nuclides.





Select the graph icon from the quick launch bar to display the graphs. You can select from three different kinds by pressing the "plus" icon in the top left. Below is an example isotope graph.

Another type of graph is the chart of nuclides which is color coded according to abundance or mass fraction. Simply right click on the axes, or the legend to change properties.