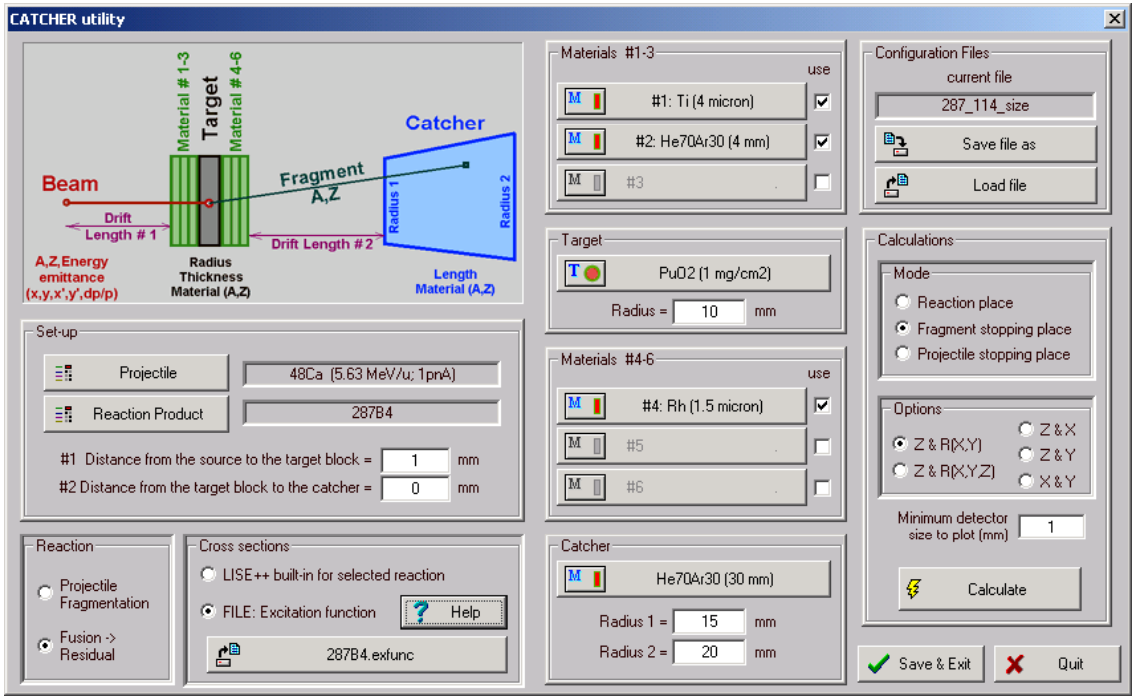
Catcher utility (version 2)

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

version 8.5.8

New features:

- *Fusion- Residual reaction*
- *User excitation function*
- *Materials in front and behind of target*



The CATCHER utility is available through the "Utilities" menu

Contents

CATCHER utility

- *Load & Save Catcher configuration files*
- *Projectile*
- *Reaction fragment, Target*
- *Reaction*
- *Cross sections*
- *Excitation function*
- *Materials*
- *Minimum detector size to plot*

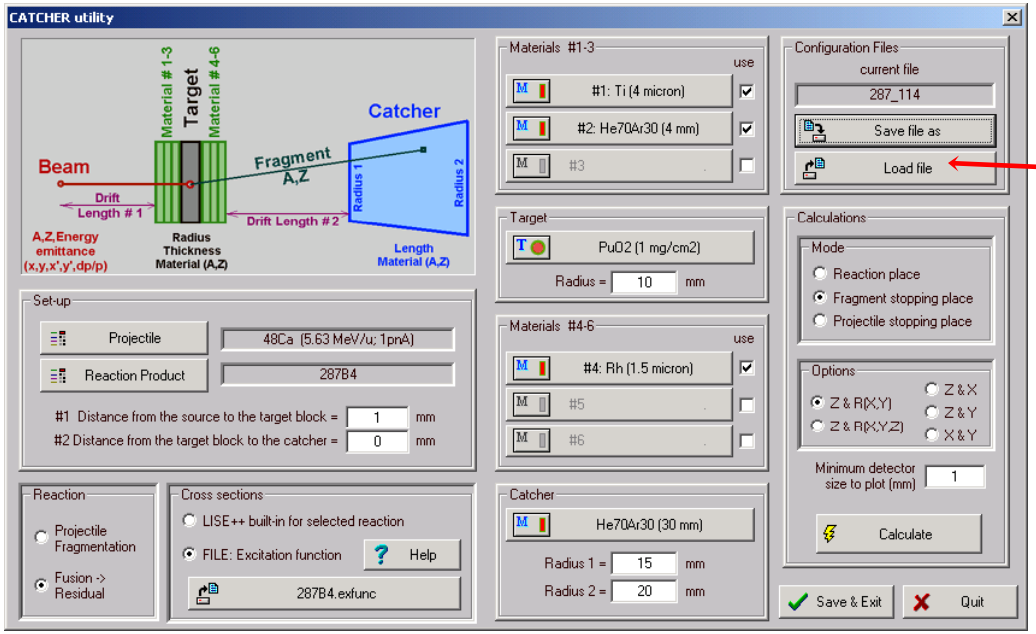
- *Mode: Reaction place*
- *Mode: Fragment stopping place*
- *Mode: Projectile stopping place*
- *Options*

Examples of reaction

- *Fusion – Residual*
  $^{48}Ca + ^{242}Pu \rightarrow ^{287}114$
  - *Cross sections*
  - *Energies 260, 270, 280 MeV for Different channels*

- *Projectile fragmentation*

Load & Save Catcher configuration files



Configuration files are located by default in the “lise \ files” directory

A CATCHER configuration for $^{48}Ca+PuO_2$ presented on this slide can be loaded using the next link:

http://groups.nscl.msu.edu/lise/8_5/catcher/287_114.isol

save this file in the “lise \ files” directory

It is recommended to copy in the same directory the LISE++ file “*48ca_beam_287_114.lpp*” using the following link.

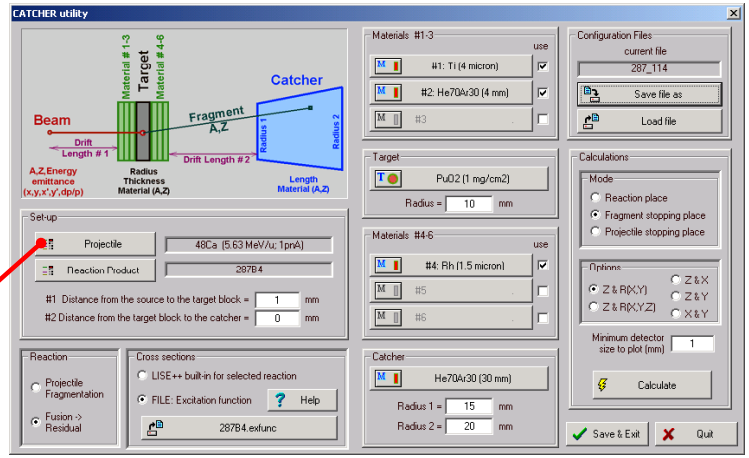
http://groups.nscl.msu.edu/lise/8_5/catcher/48ca_beam_287_114.lpp

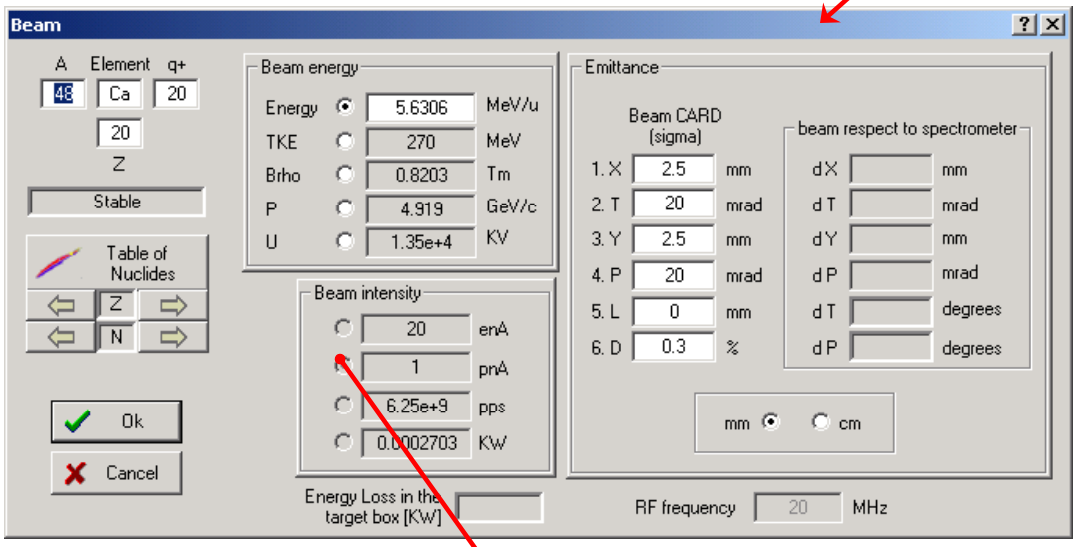
This file should be loaded to provide energy loss and charge state models, evaporation settings and etc corresponding to low energies.

Catcher: Projectile

q – charge state is not used in Catcher simulations; therefore a beam energy it expected to be entered in MeV/u or MeV

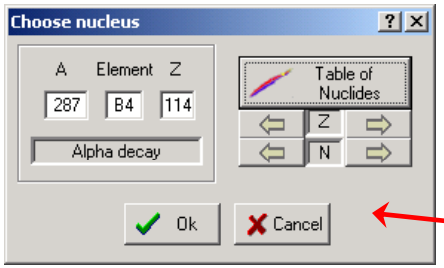
Enter correct values of your beam emittance





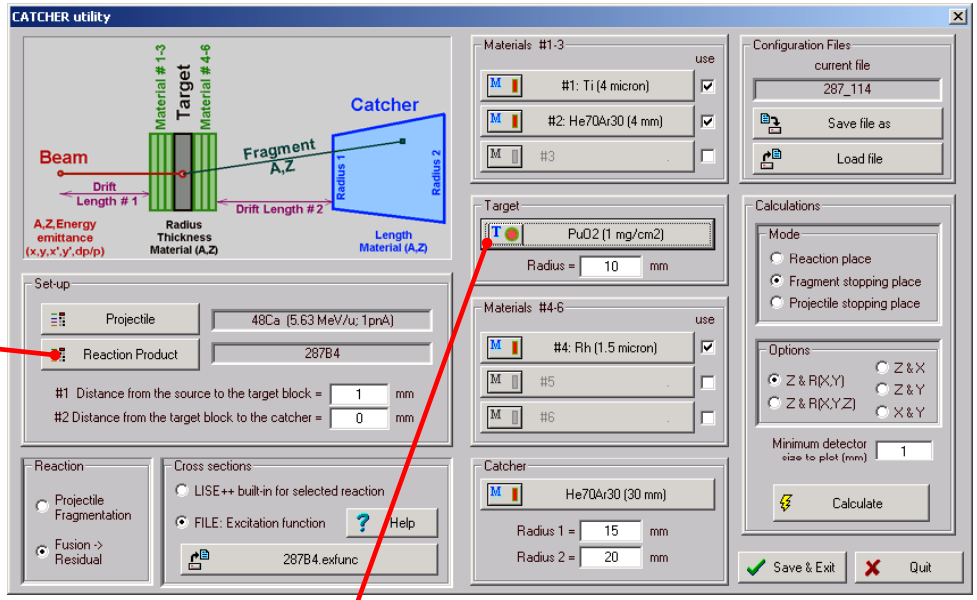
Intensity is always equal to 1pnA. Use scale coefficients to get right answer. For example, if an overall beam dose of ^{48}Ca was 3.1x10^{18}, then the scale coefficient to LISE++ calculations should be equal to 4.5x10^{8}

Catcher: Reaction product, Target



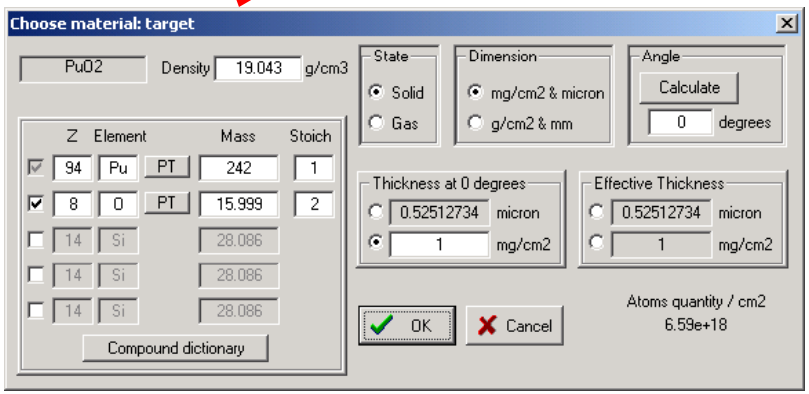
LISE++ uses the hexadecimal system (A=10, B=11, C=12 and so on) to label elements above 100.

So A5 is 105th element , B4 is 114th element, C7 is 127th element, F1 is 161st element



Comparing to version 1, in this version the reaction to produce the fragment of interest takes place **ONLY IN TARGET**

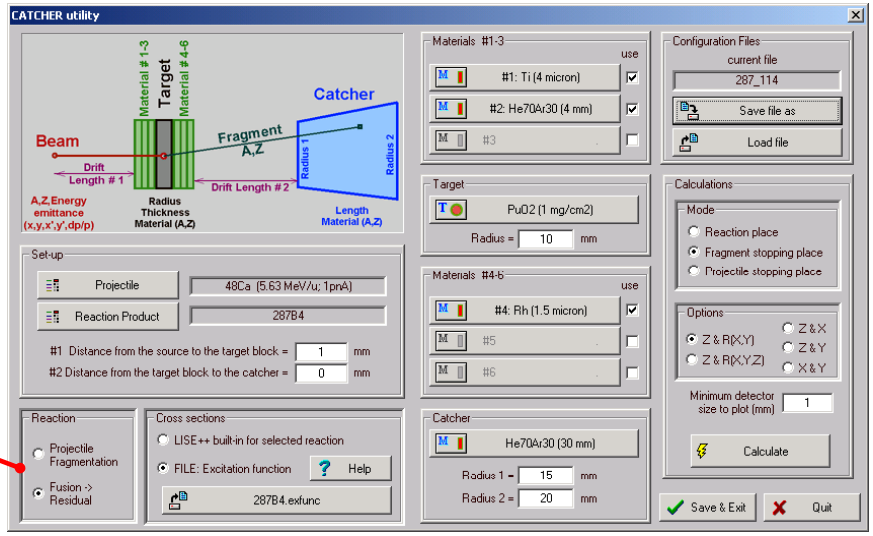
In the case of compound target the **first** material in the list will be taken for the fusion-residual reaction



Catcher : Reaction mechanism

Reactions:

- *Projectile fragmentation*
- *Fusion- Residual*



CATCHER utility takes into account

- *Angular straggling*
- *Energy straggling*
- *Angular distribution after reaction*
- *Velocity distribution after reaction**
- *Energy loss in materials***
- *Intensity loss due to reactions*
- *And calculates production cross sections*** if this mode is selected*

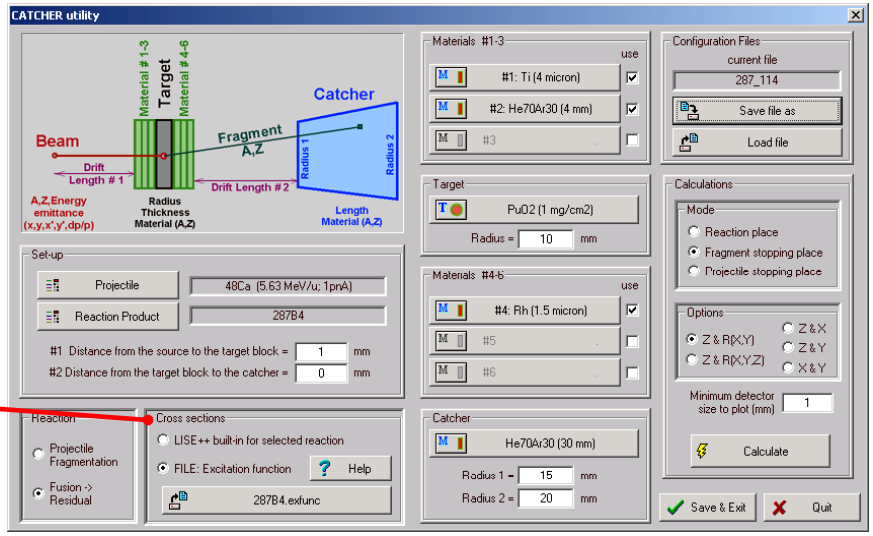
* the Morrissey model is used to simulate a reaction product velocity in the case of projectile fragmentation

** it is recommended to use the Ziegler [1] model for energy loss calculations at low energy

*** Abrasion-Ablation model or user's cross section might be used as well as EPAX in the case of projectile fragmentation

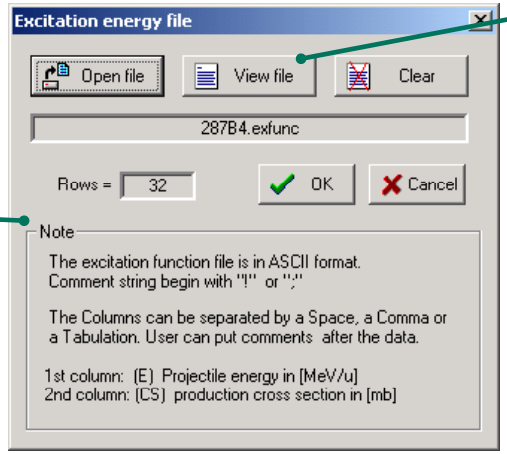
Catcher : Cross sections

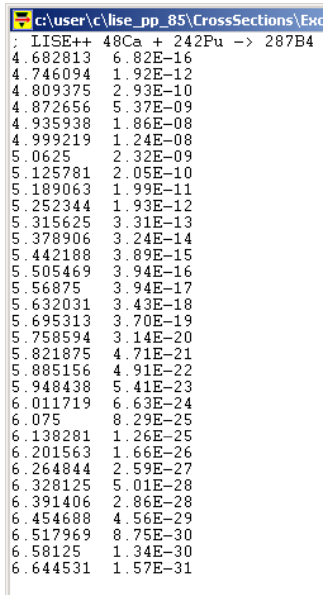
Cross sections are calculated for a projectile energy assuming that the reaction takes place in the middle of target



Cross sections:

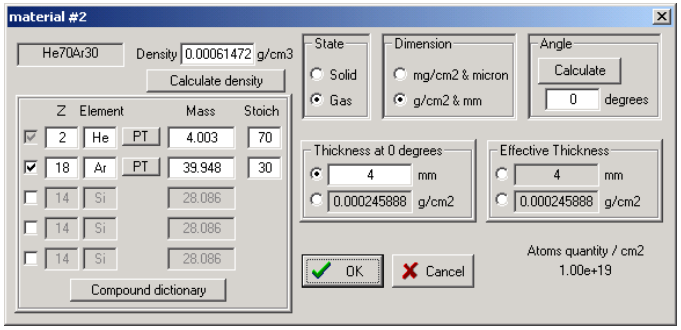
- *LISE++ built-in for the selected reaction*
- *FILE : excitation function*

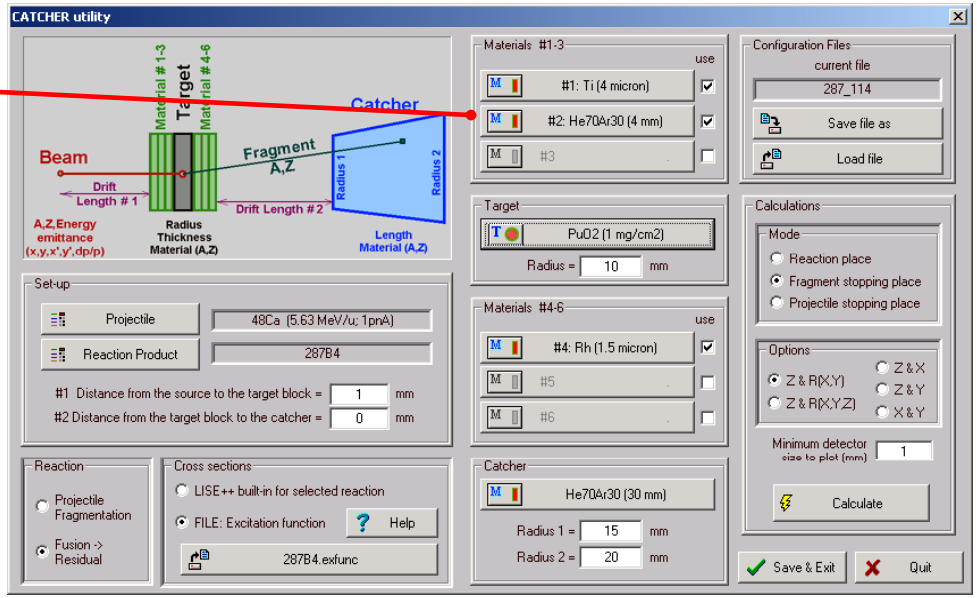




- *"lise \ CrossSections" is directory by default*
- *1st column is Projectile Energy in **MeV/u***
- *2nd column is Cross Section in **mb***
- *Zero cross section will be used for energy out of an energy region defined in the excitation file*

Catcher : Materials





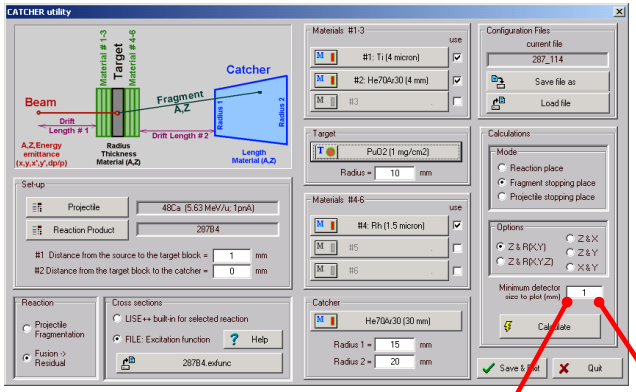
- Three materials in front of the target and three materials behind of the target can be used in the utility.
- If a checkbox corresponding to material is unselected, then the material wont be used in simulations, but its information will be still keeping in a configuration file.
- Pay attention for gas density! Gas density calculator should be used only for molecular formula (not for percentage!)
- Check density of He70Ar30 gas at P=1atm.

	P, Atm	P, Torr	Density , g/cm3
He	1		1.66E-04
Ar	1		1.66E-03
He	0.7	532	1.16E-04
Ar	0.3	228	4.98E-04
He70Ar30	**1**	**760**	**6.15E-04**

	P, Torr
70%	532
30%	228

Thick,g/cm2 = 4 mm	Atoms	
4.66E-02	7.01E+18	1/cm2
1.99E-01	3.00E+18	1/cm2
2.46E-01	1.00E+19	
2.46E-04	1.00E+19	

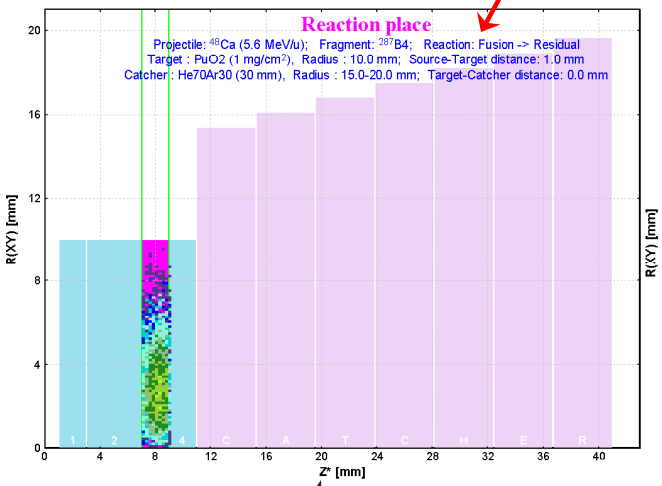
Catcher : Minimum detector size to plot

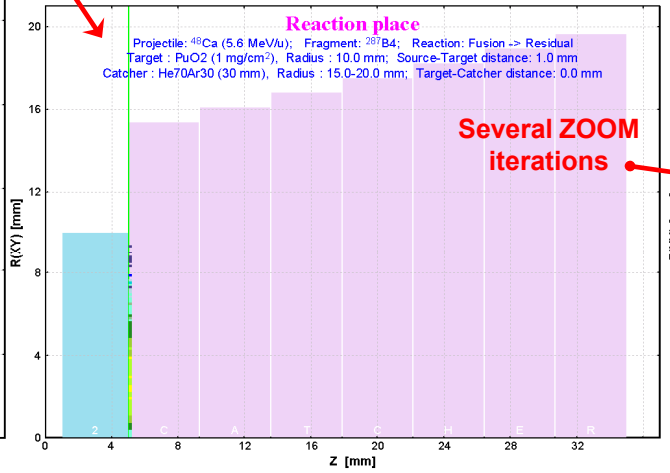


- LISE++ assumes for PLOT minimum size of detector to give a possibility to see the reaction place distribution without zoom. LISE++ automatically stretch a detector size in PLOT.
- The same effect (to see the reaction place distribution) can be reached with several zoom iterations.

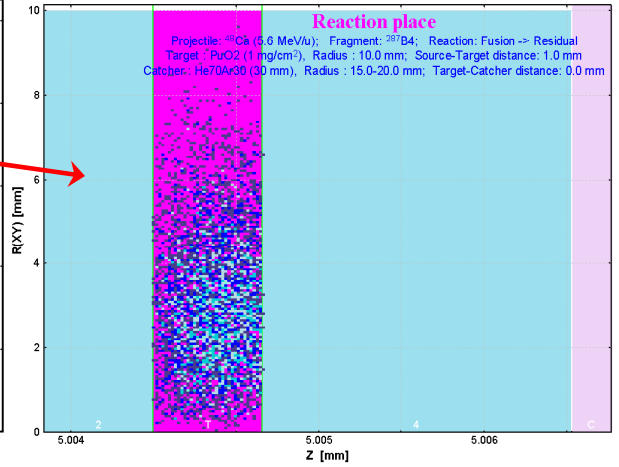
Size=2mm

Size=0mm

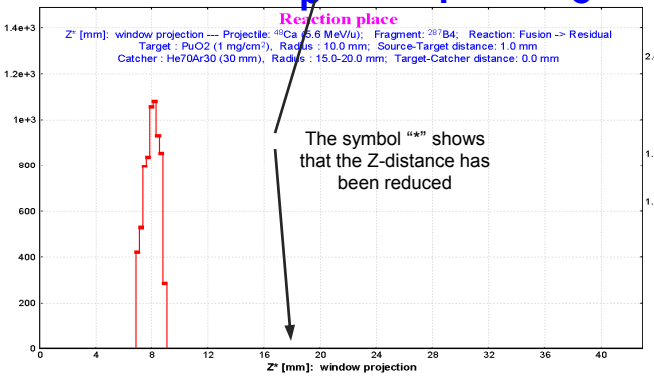




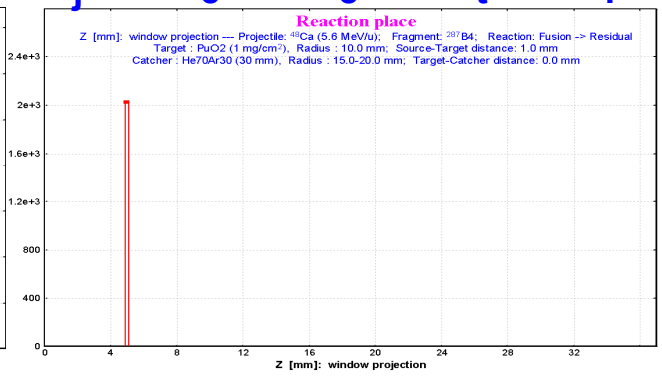
Several ZOOM iterations

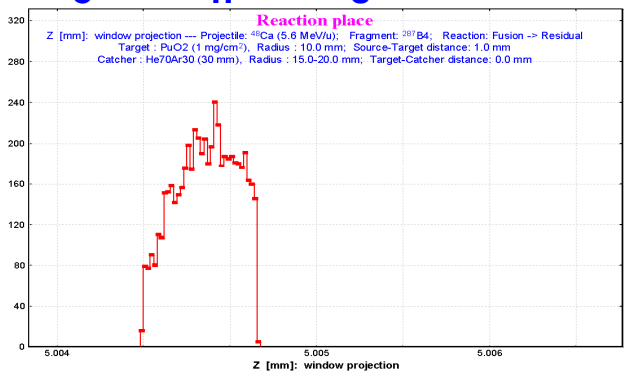


p r o j e c t i o n s

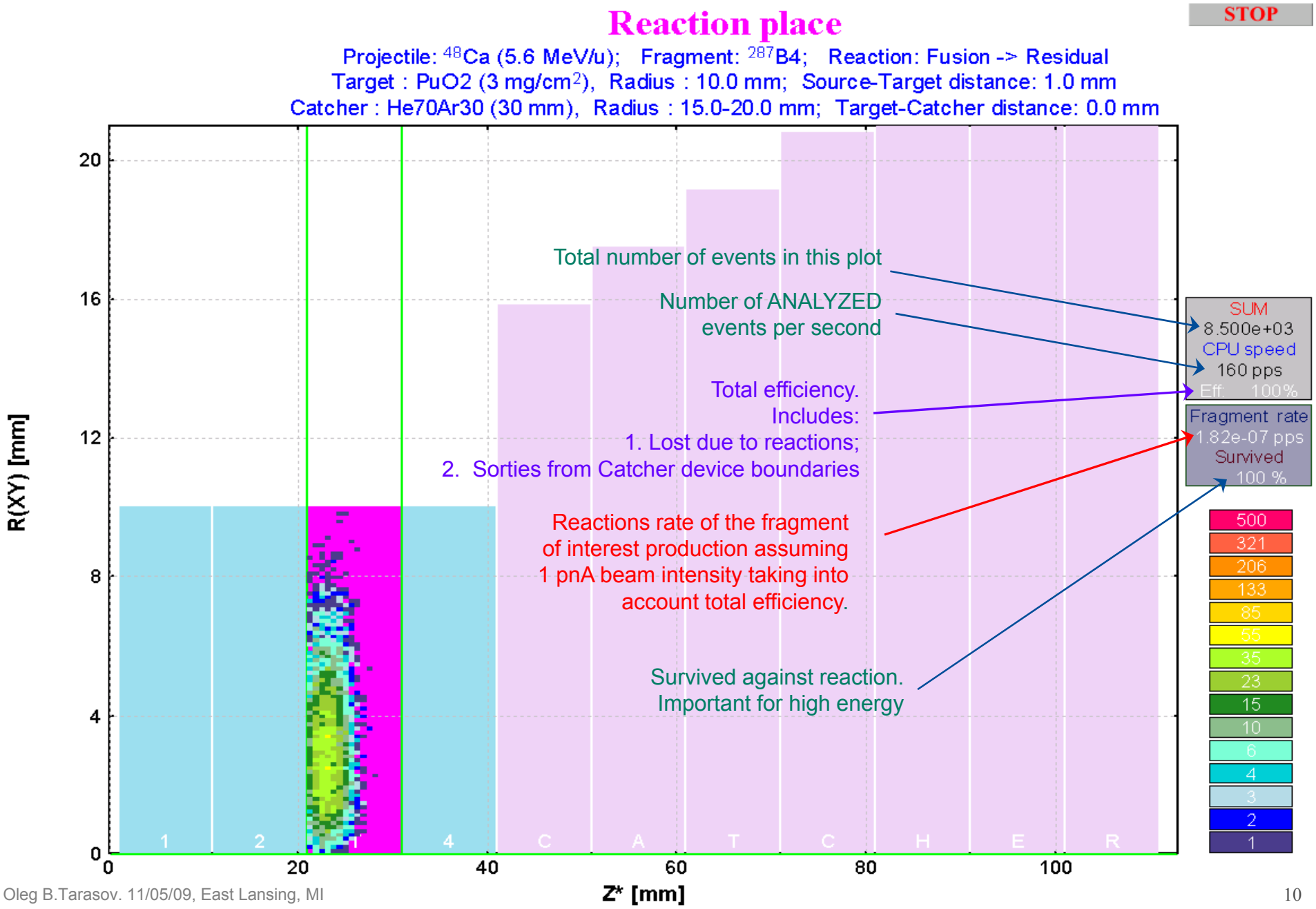


The symbol "*" shows that the Z-distance has been reduced





Mode: Reaction place (1)

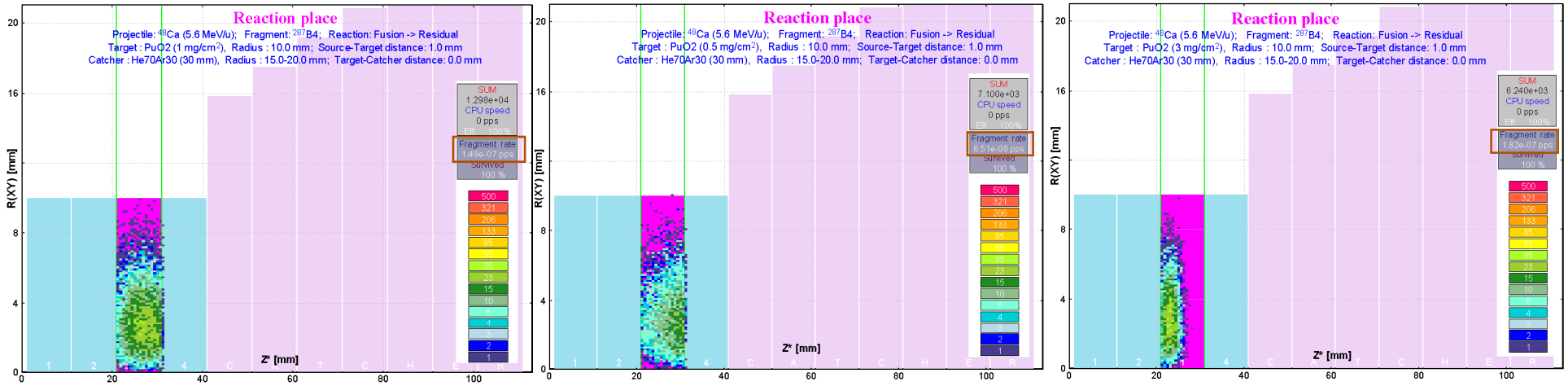


Mode: Reaction place (2)

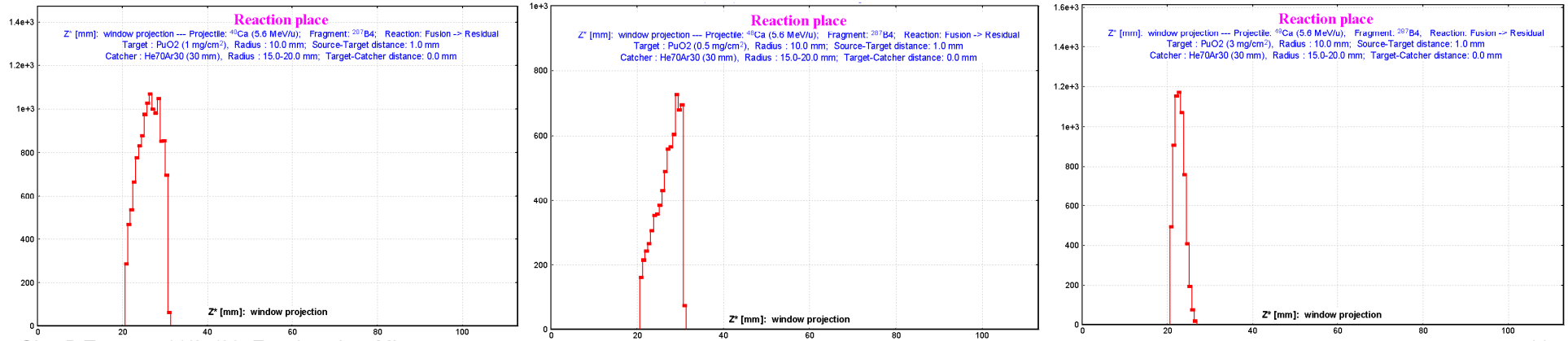
Target thickness = **1.0** mg/cm^2
Reaction rate = **1.5e-07** rps

Target thickness = **0.5** mg/cm^2
Reaction rate = **6.5e-08** rps
The target is THIN for these conditions

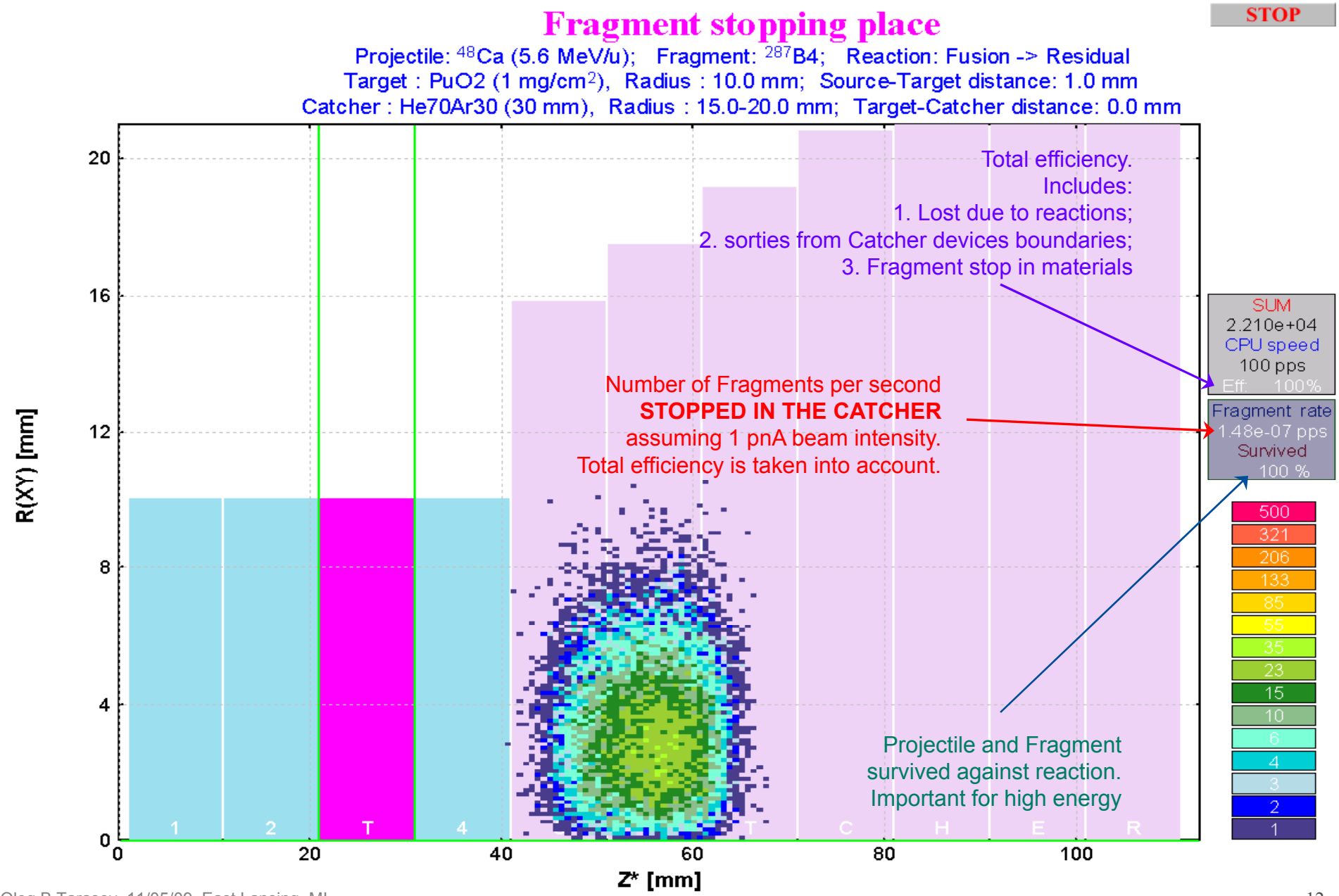
Target thickness = **3.0** mg/cm^2
Reaction rate = **1.8e-07** rps
The target is THICK for these conditions



p r o j e c t i o n s

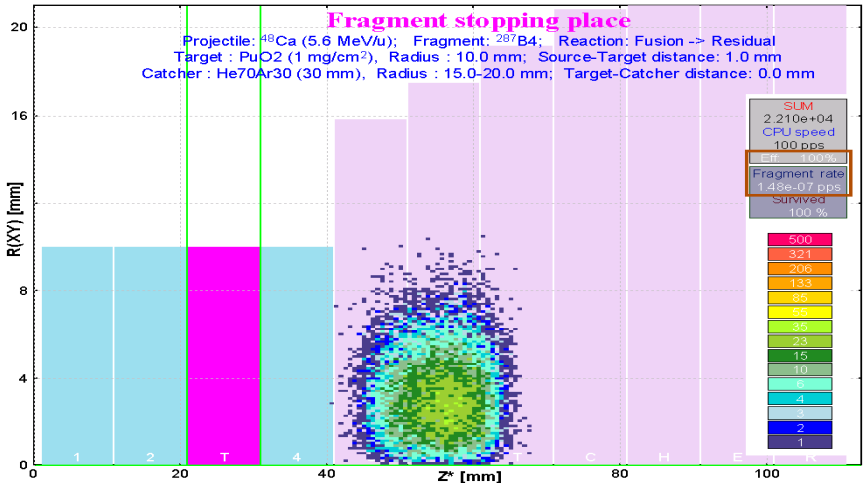


Mode: Fragment stopping place (1)

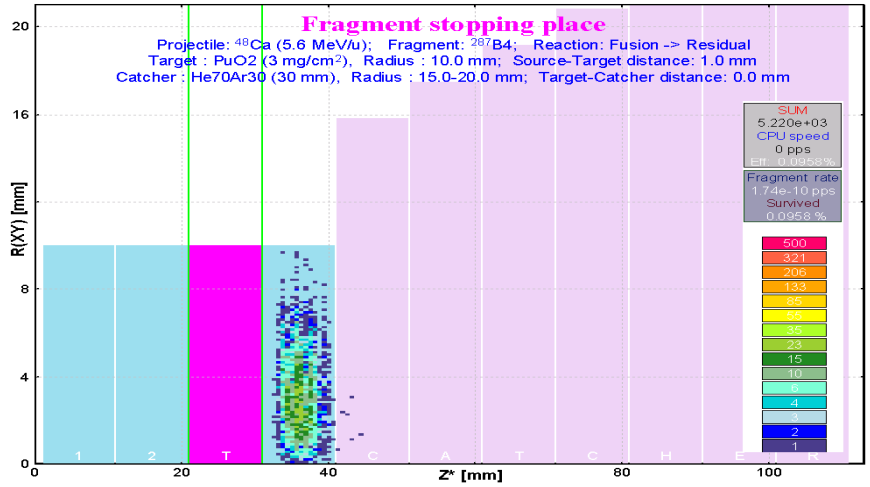


Mode: Fragment stopping place (2)

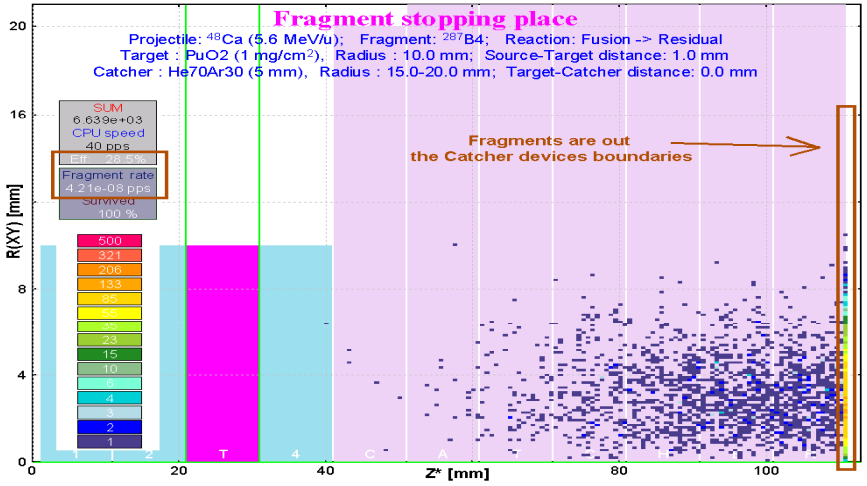
Target thickness = **1.0** mg/cm^2, Efficiency = **100%**
Fragment stopped in the catcher = **1.5e-07** cps



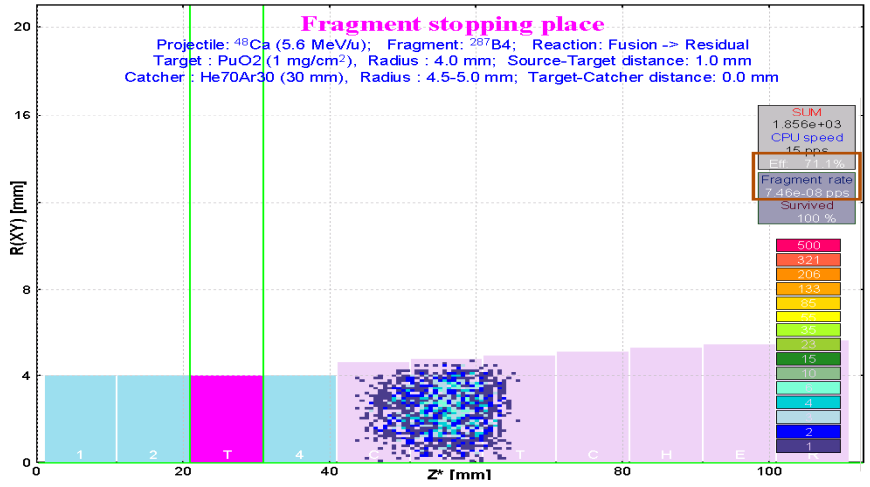
Target thickness = **3.0** mg/cm^2 , Efficiency = **0.1%**
Fragment stopped in the catcher = **1.7e-10** cps
The target is THICK for these conditions.
Fragments stop in 4th material



Catcher length= **5.0** mm , Efficiency = **29%**
Fragment stopped in the catcher = **4.2e-8** cps
The Catcher is too short for these conditions.
Fragments mostly pass through it.



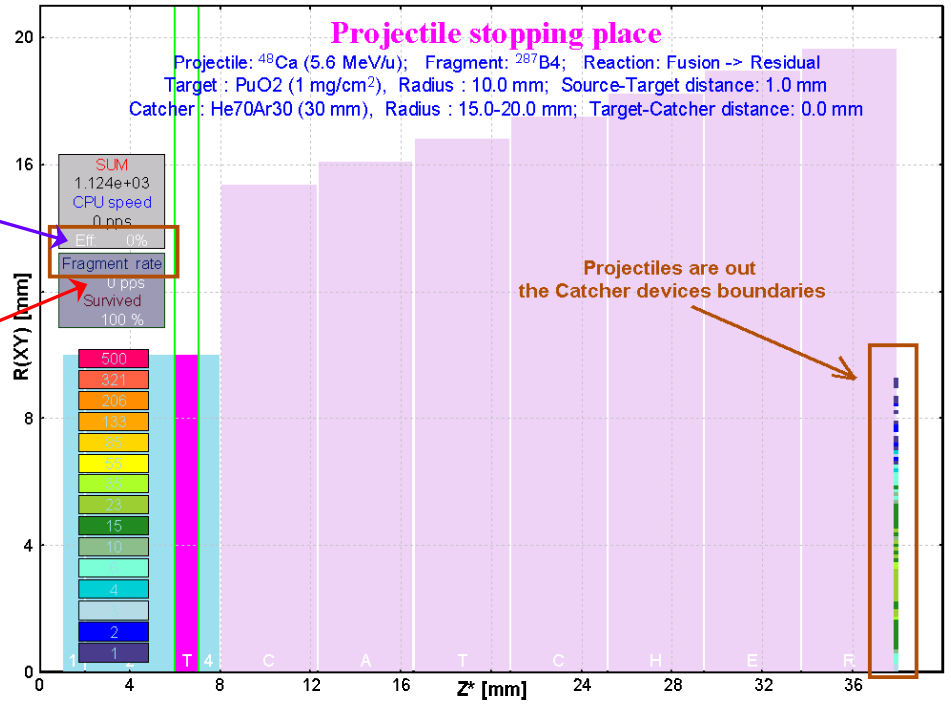
The Catcher radius = **4.5-5.0** mm, Efficiency = **71%**
Fragment stopped in the catcher = **7.6e-8** cps
The Catcher should have larger radius for these conditions.
29% fragments are out the Catcher device



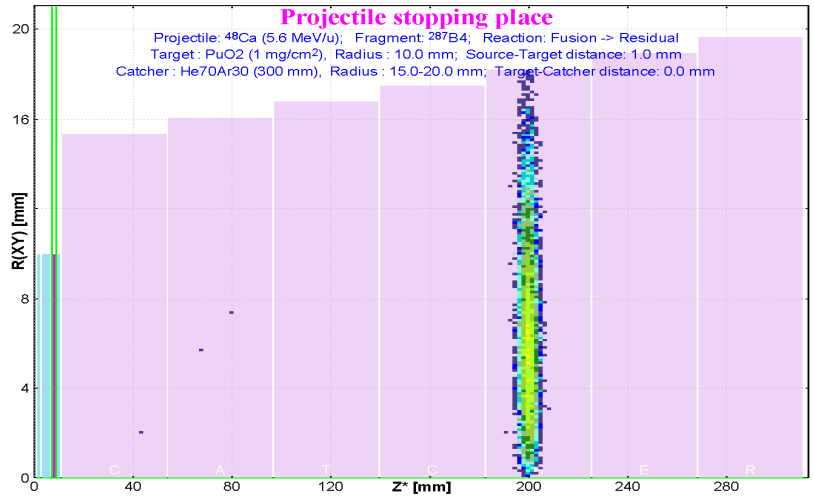
Mode: Projectile stopping place

Total efficiency.
Includes:
1. Lost due to reactions;
2. sorties from Catcher devices boundaries;
3. Projectile stop in materials

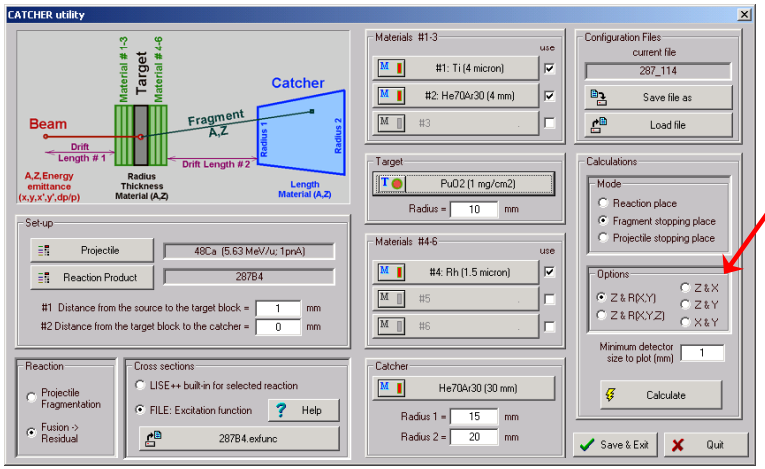
Number of Projectiles per second
STOPPED IN THE CATCHER
assuming 1 pnA beam intensity.
Total efficiency is taken into account.

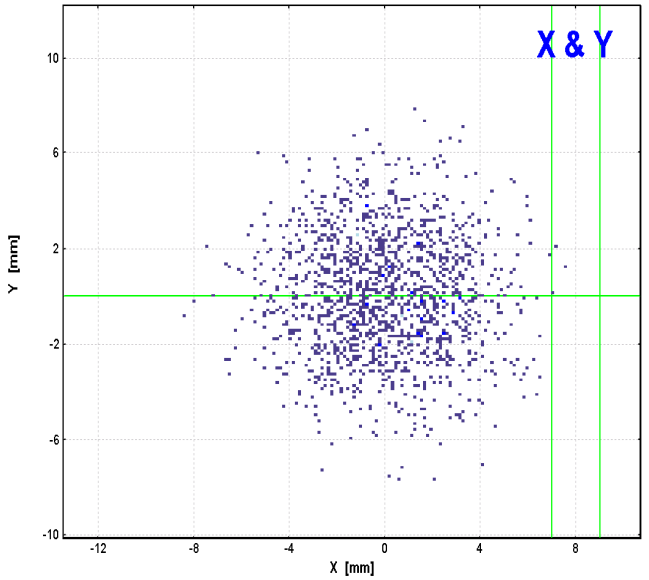


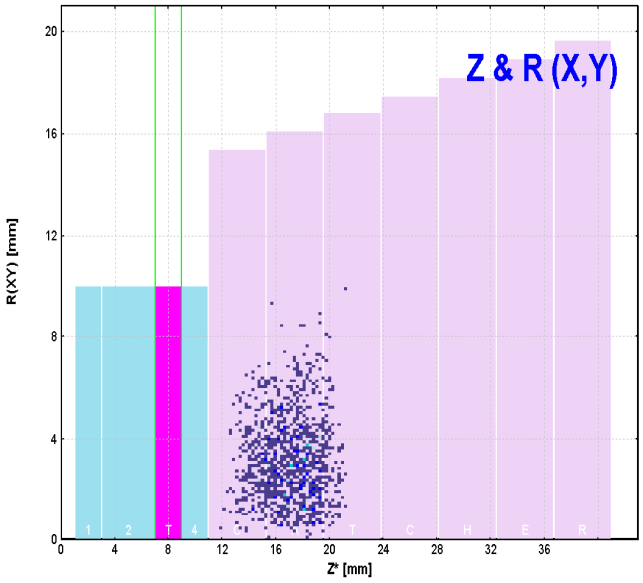
The Catcher length has been increased up to
30 cm to see where projectiles stop

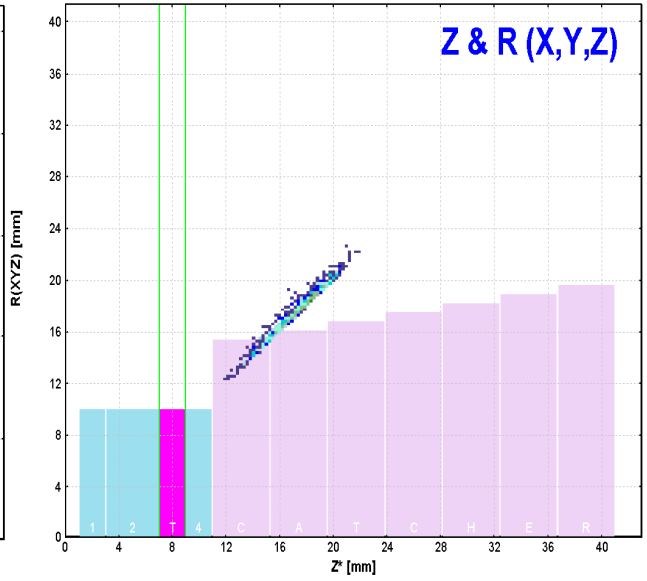


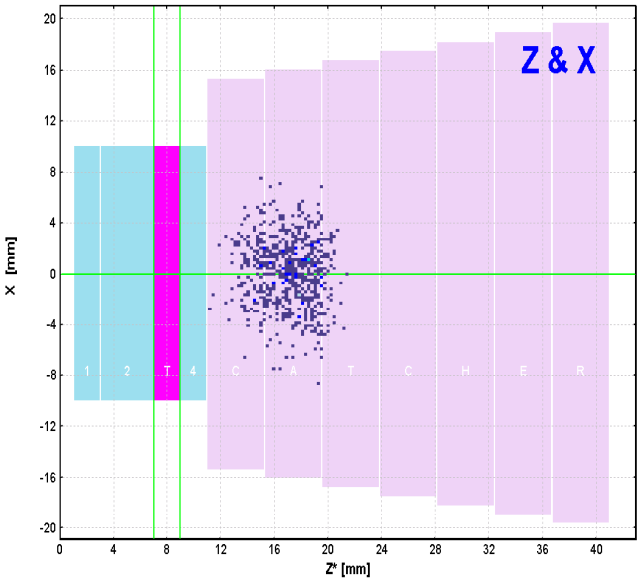
Catcher: Options



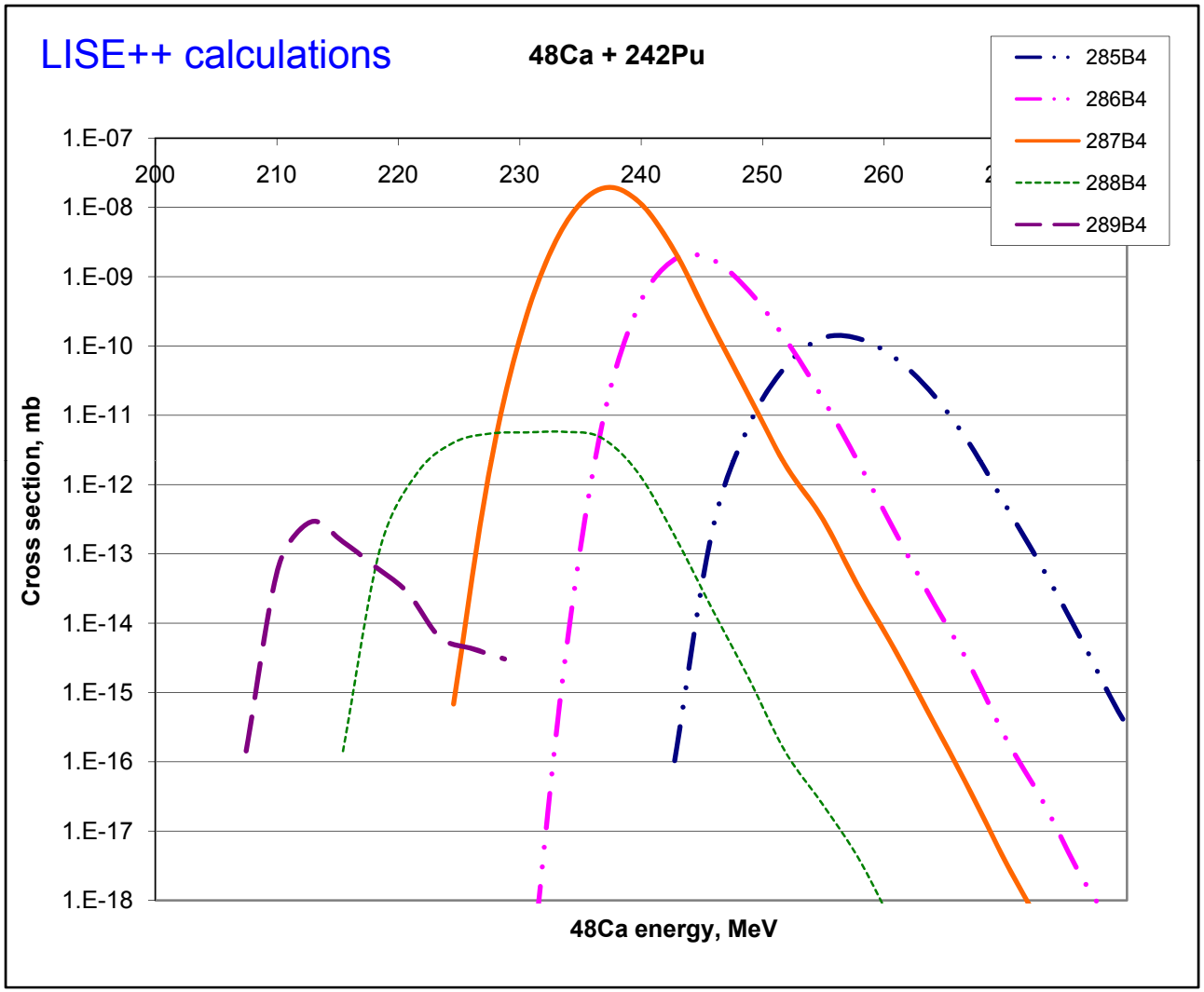








Fusion – Residual : $^{48}Ca + ^{242}Pu \rightarrow ^{287}114$



Index of /lise/8_5/catcher/E

Name	Last modified	Size	Description
Parent Directory		-	
286B4.exfunc	22-Oct-2009 18:34	671	
286B5.exfunc	22-Oct-2009 18:34	707	
287B4.exfunc	22-Oct-2009 18:34	633	
288B4.exfunc	22-Oct-2009 18:35	370	
289B4.exfunc	22-Oct-2009 18:34	201	

Load excitation functions (1n,2n,3n,4n,5n channels) to be used in the Catcher utility from

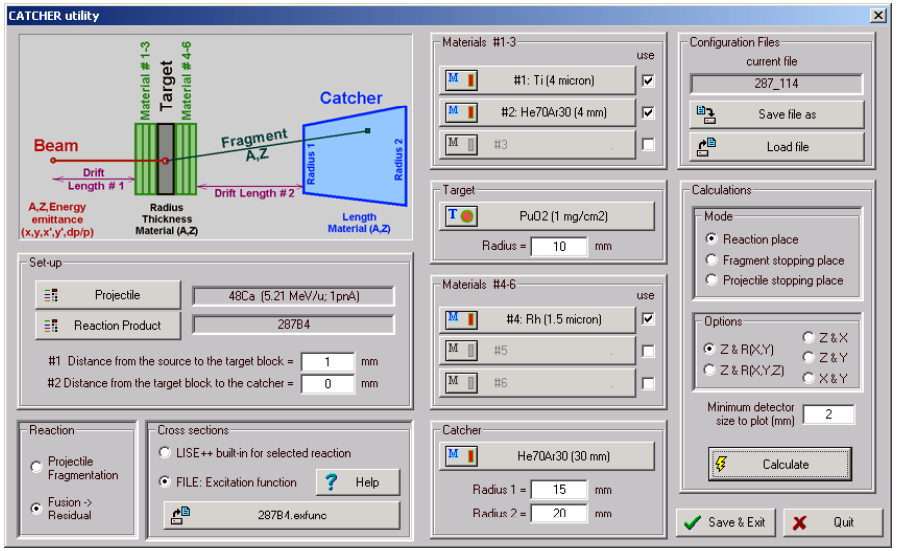
http://groups.nscl.msu.edu/lise/8_5/catcher/ExcitationFunctions/48Ca242Pu/

Energies for 3n - channel

Projectile Energy MeV	MeV/u	$^{287}114$ Reaction rate	Fragment rate in catcher	Normalized to 3.1e18 beam dose
280	5.84		5.3e-9	2.4
275	5.73		5.7e-8	26
270	5.63		1.5e-7	67
265	5.53		7.7e-8	35
260	5.42	2.8e-11		
250	5.21	2.3e-19		

Check the excitation function (2e-8 mb at maximum?). Probably the factor ¼ should be apply

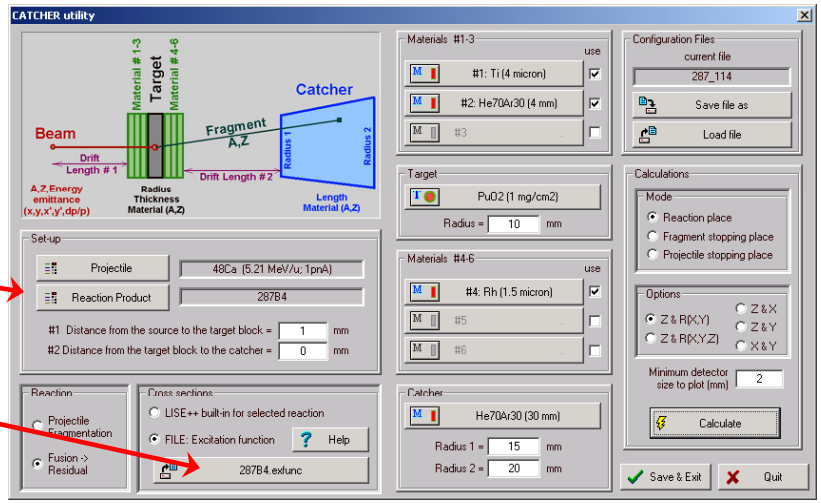
Standard configuration



Energies for 4n - channel

Change the reaction product to ^{286}B4

Load the “286B4.exfunc” excitation function

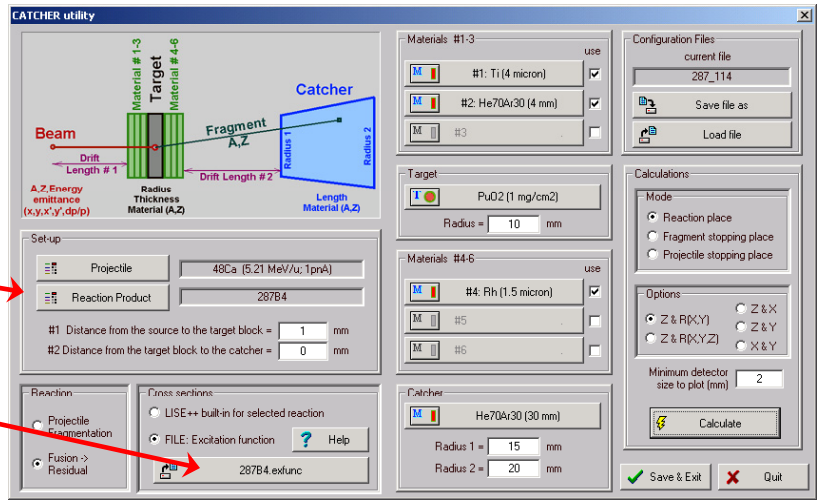


Projectile Energy		^{286}114		
MeV	MeV/u	Reaction rate	Fragment rate in catcher	Normalized to 3.1e18 beam dose
280	5.84		3.6e-10	1.6e-1
275	5.73		5.2e-12	2.3e-3
270	5.63		2.6e-16	1.2e-7
265	5.53	7e-19		
260	5.42			
250	5.21			

Energies for 2n - channel

Change the reaction product to $^{288}B4$

Load the “288B4.exfunc” excitation function

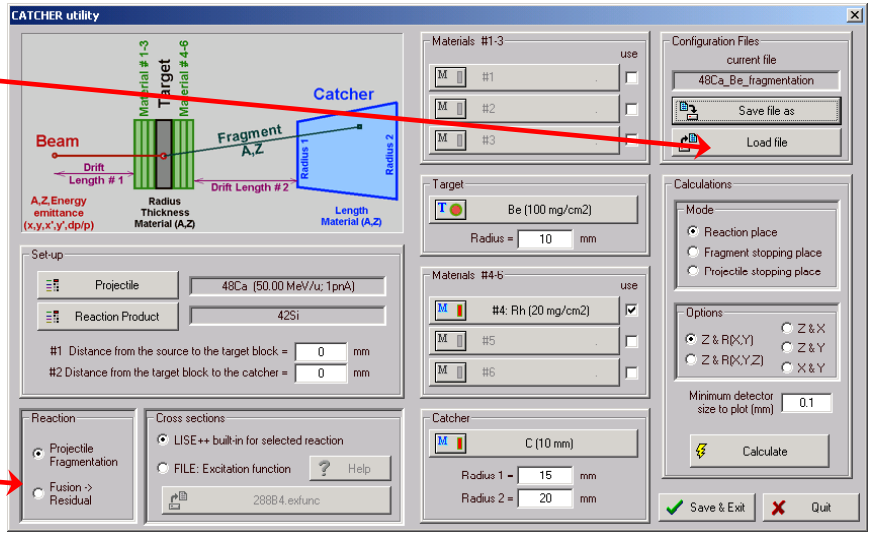


Projectile Energy		$^{288}114$		
MeV	MeV/u	Reaction rate	Fragment rate in catcher	Normalized to 3.1e18 beam dose
280	5.84			
275	5.73			
270	5.63		4.1e-11	1.9e-2
265	5.53		7.1e-11	3.2e-2
260	5.42		6.8e-11	3.1e-2
250	5.21		6.0e-13	2.7e-4

Projectile fragmentation

Load the "48Ca_Be_fragmentation.isol" Configuration file or enter data manually

http://groups.nscl.msu.edu/lise/8_5/catcher/48Ca_Be_fragmentation.isol



Change reaction and cross-section if you enter data manually