

Decay channel analysis

Evaporation calculator

Initial nucleus

Initial nucleus:

Excitation energy window

Lower = MeV gaussian

Upper = MeV rectangle

Initial nucleus production cross-section = mb

make calculations down to Z =

Fragmentation of beam (Abrasion-Ablation)

Excited nucleus evaporation

CALCULATE

2D-plots

Final Evap. Residue CS

Fission channel CS

Break-up channel CS

Decay channel analysis

Temperature after Breakup

Fission Excitation Energy

Evaporation settings

Final nucleus

A	Element	Z	Final fragment production cross-section		1.4e-3	mb	Minimum separation energy (SE)	3.61	MeV	Average values						
24	0	8	Initial production CS of Final fragment (for fragmentation)		0e+0	mb	Minimum sum of (SE + deduced effective Coulomb barrier)	3.61	MeV	< Ex > =	107.28					
stable			Cross section from EPAX 2.15		1.12e-4	mb	Fission barrier at L=0	28.93	MeV	< T > =	5.49					
Table of Nuclides			PARENT		1.06e+0		2.15e-1		1.72e-1	1.09e-1	1.46e-1	1.9e-2			1.72e+0	250
Excitation energy plot			Decay modes		1n		1p		alpha	d	t	3He	Fission		sum	max
N° of all calculated nuclei: 294			DAUGHTER		1.65e+0		1.9e-2		6.1e-3	1.58e-2	2.45e-2	5.37e-4	1.66e-3		1.72e+0	230
			Sum		3.34e+3		2.8e+2		1.01e+2	6.68e+1	5.06e+1	6.86e+0	Initial	Residues	Fission	Break-up
													1.17e+3	1.18e+3	4.3e-1	

Output cross-section file 04820_00904.lcs

Output file of parent - daughter 04820_00904.lpd

Fission CS output file 04820_00904.lfcs

Decay channel analysis

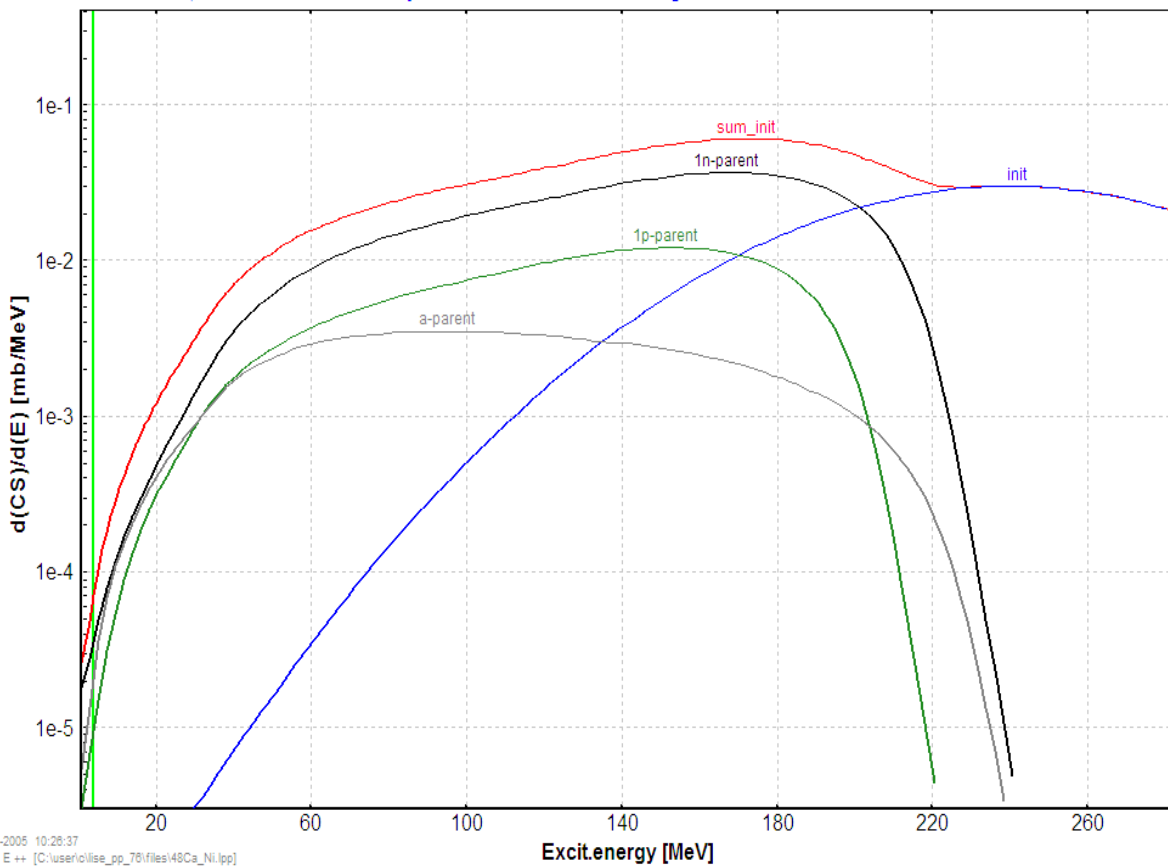
²⁴O excitation distributions: Input parent distr.

Restore Down

ABRASION-ABLATION - ⁴⁸Ca + Ni

Excit. Energy Method: < 2 >; < E* >: 10.0*dA MeV sigma: 10.00

NP=64; SE:"DB0+Cal2" Density:"auto" Geom.Corr:"Off" Tunlg:"auto" FisBar=1 Fac=1.00 Modes=1010 1000 010



Decay channel analysis

Channels

- 1n
- 2n
- 1p
- 2p
- alpha
- d
- t
- 3He
- Fission
- Break-up
- Init (AA)

Current mode: a -> [S res] / [Sevap + Sres]

Mode

Absolute value

Ratio

Value

Sevap + Sres

S res

S evap

(So total) evap

Take ratio to

Sevap + Sres

Si total

Sr total

So total

Description

SE min = minimum separation energy

S res = residue cross-section

S evap = decay channel in the daughter nucleus from this parent channel

Sevap + Sres = exctiation function incoming from the parent nucleus

Si total = sum of all incoming (from parents) channels including Init CS

Sr total = sum of all residue cross-sections

So total = sum of all outgoing (into daughters) channels

(So total) evap = decay channel into the daughter from ALL parent incoming channels

Fission and Break-up are only output channels; Init (AA) is only input channel

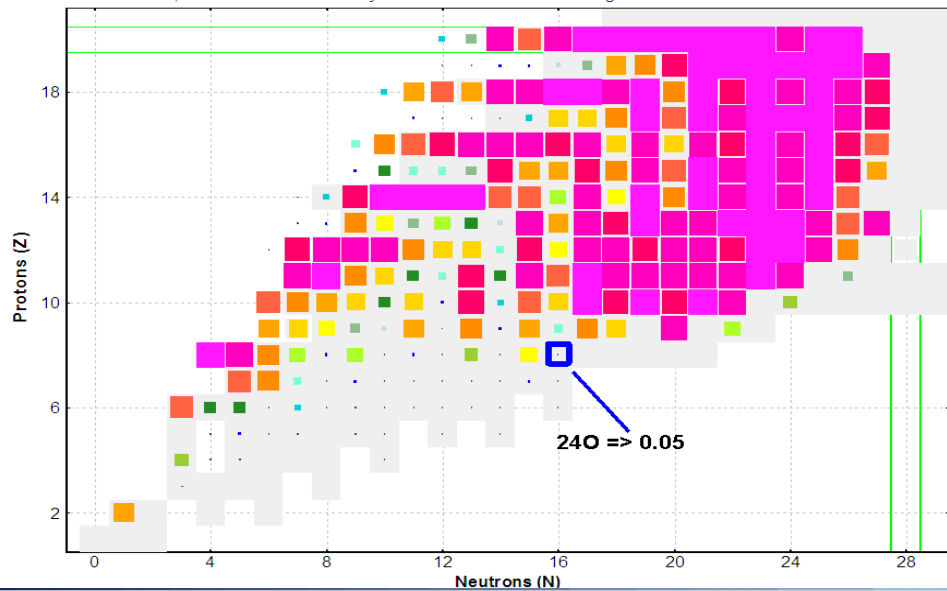
Plot

Cancel

Help

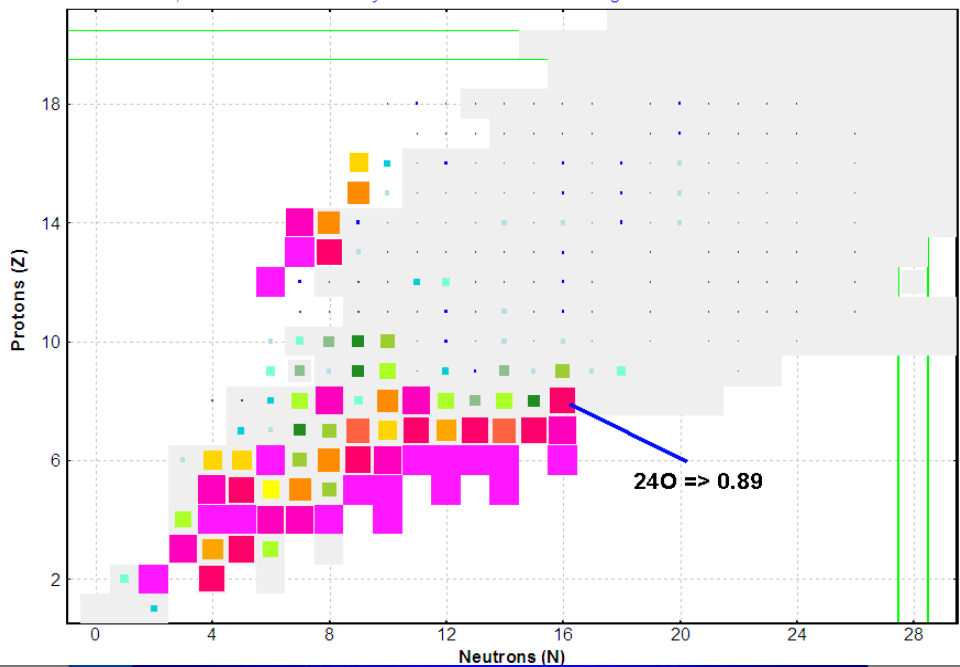
Current mode: 1n -> [S res] / [Sr total]

ABRASION-ABLATION - ⁴⁸Ca + Ni
 Excit.Energy Method:< 2 >; <E*>:13.4*dA MeV sigma:9.40
 NP=64; SE:"DB0+Cal2" Density:"auto" Geom.Corr:"Off" Tunlg:"auto" FisBar=1 Fac=1.00 Modes=1010 1000 010



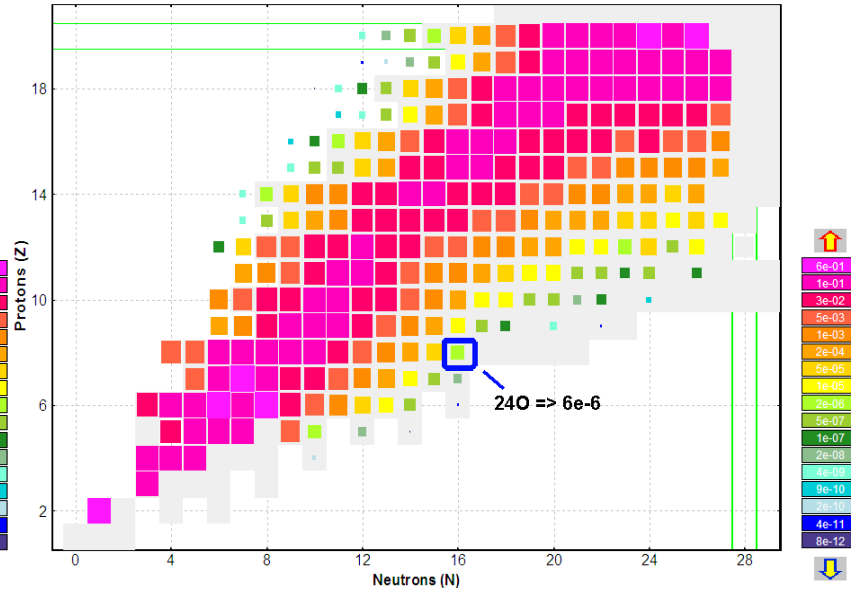
Current mode: a -> [S res] / [Sr total]

ABRASION-ABLATION - ⁴⁸Ca + Ni
 Excit.Energy Method:< 2 >; <E*>:13.4*dA MeV sigma:9.40
 NP=64; SE:"DB0+Cal2" Density:"auto" Geom.Corr:"Off" Tunlg:"auto" FisBar=1 Fac=1.00 Modes=1010 1000 10



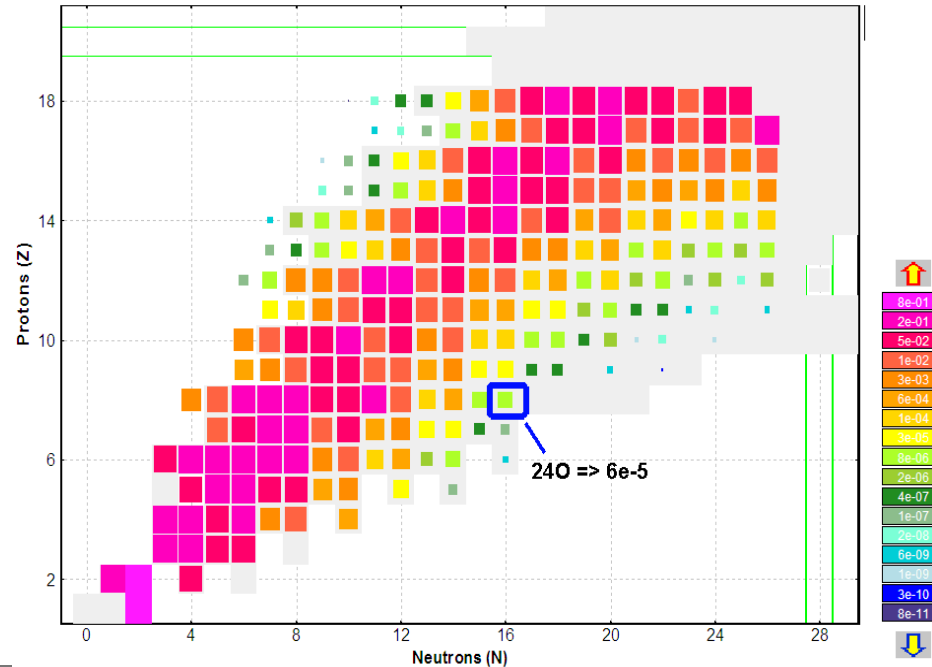
Current mode: 1n -> [S res] / [Sevap + Sres]

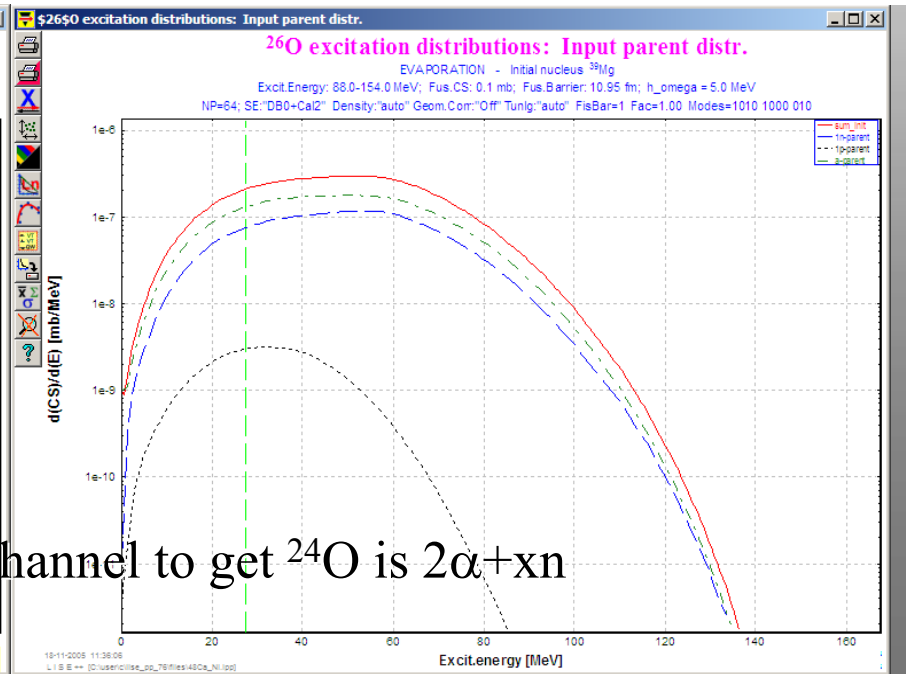
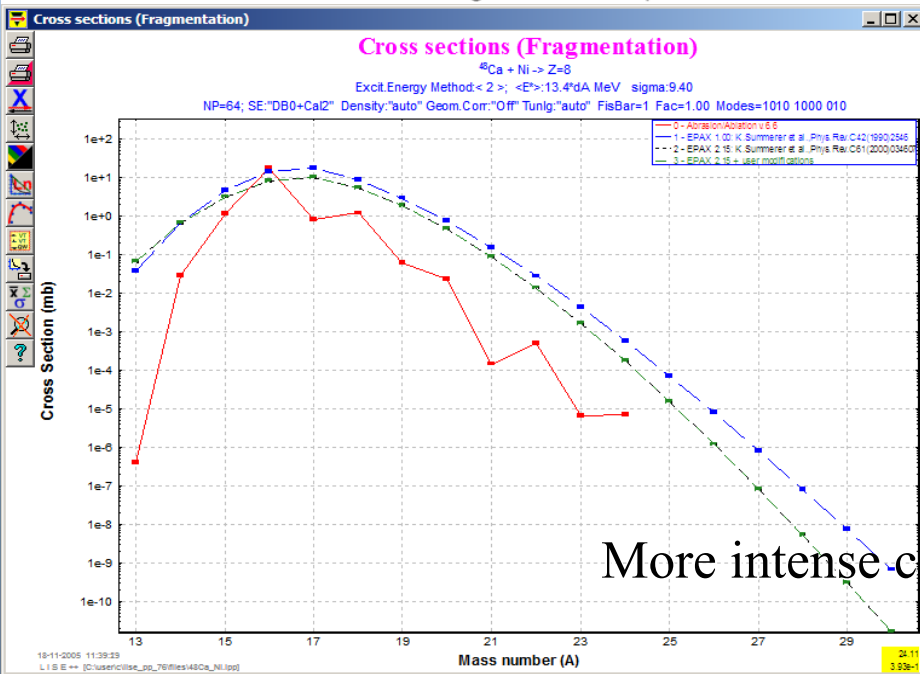
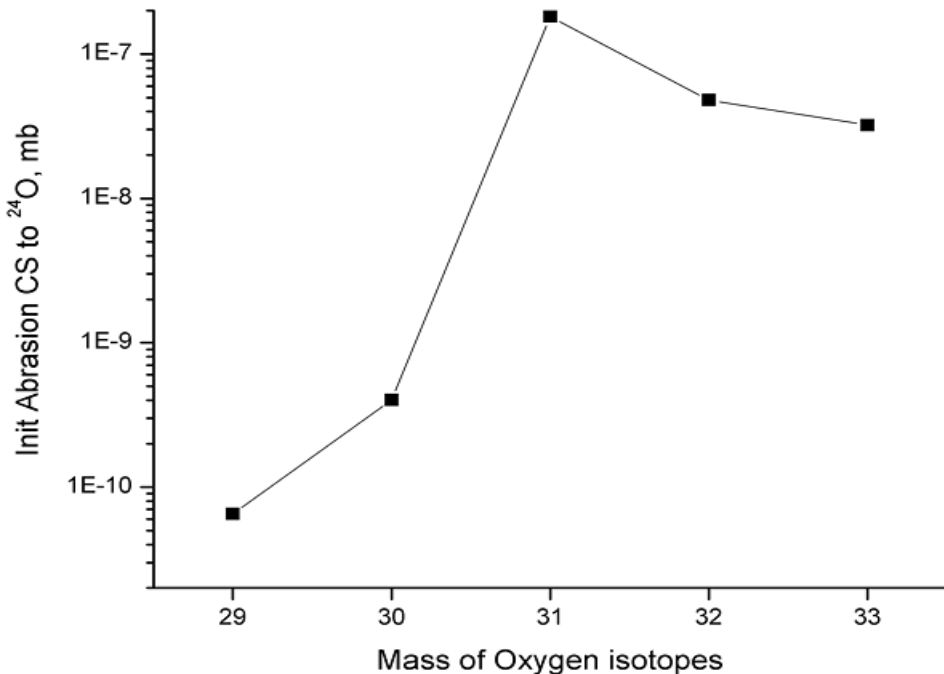
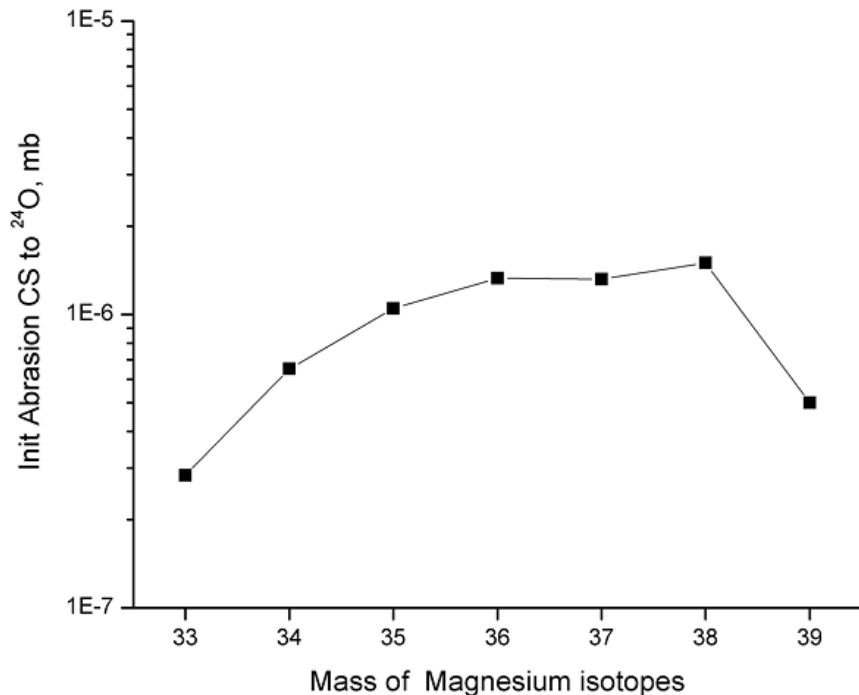
ABRASION-ABLATION - ⁴⁸Ca + Ni
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 NP=64; SE:"DB0+Cal2" Density:"auto" Geom.Corr:"Off" Tunlg:"auto" FisBar=1 Fac=1.00 Modes=1010 1000 010



Current mode: a -> [S res] / [Sevap + Sres]

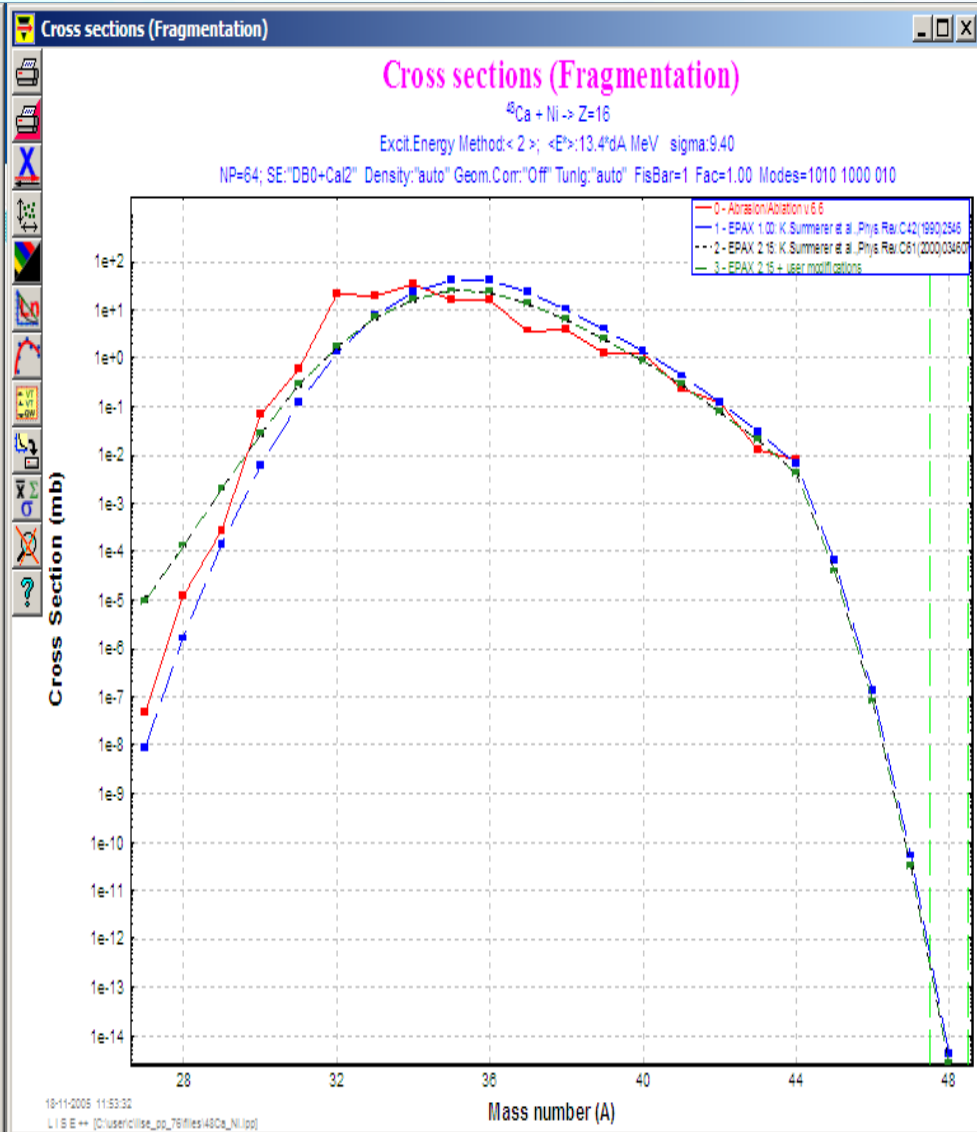
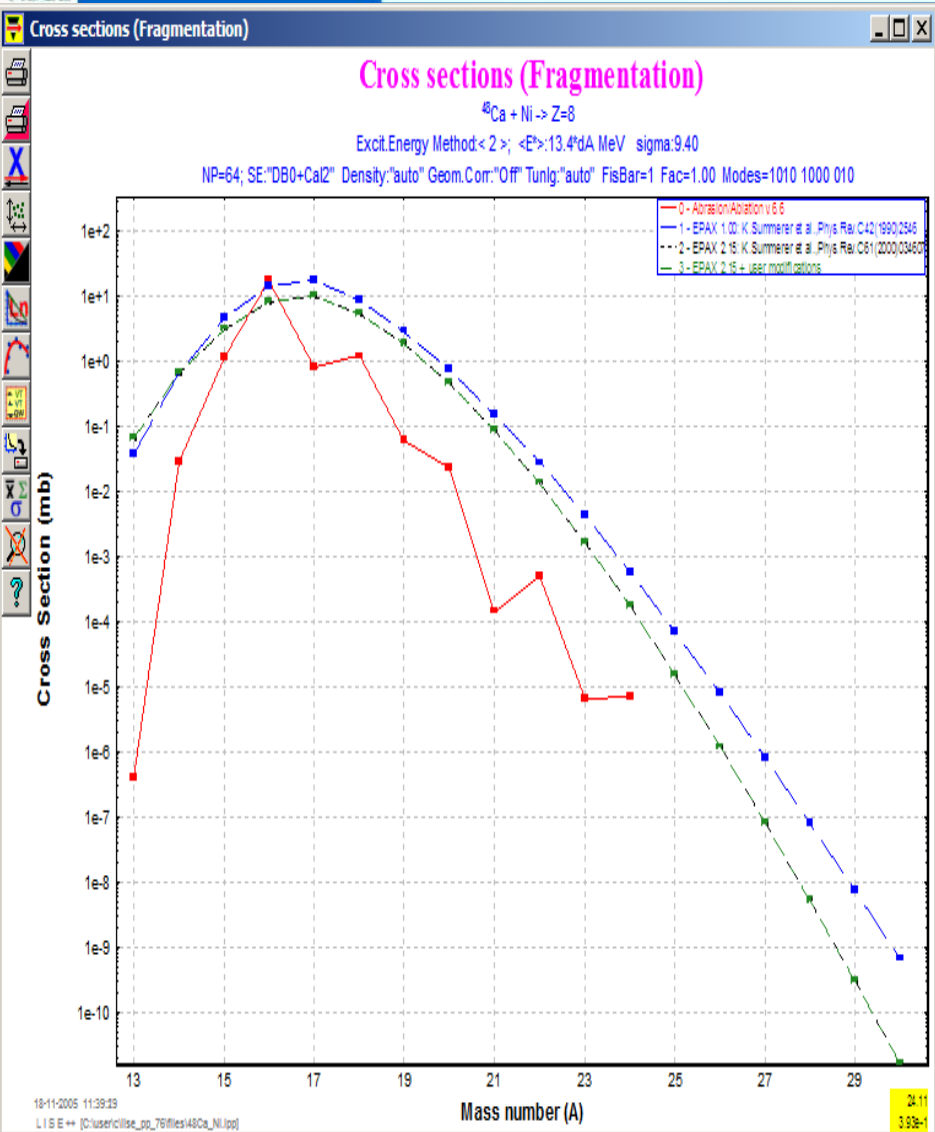
ABRASION-ABLATION - ⁴⁸Ca + Ni
 Excit.Energy Method:< 2 >; <E*>:13.4*dA MeV sigma:9.40
 NP=64; SE:"DB0+Cal2" Density:"auto" Geom.Corr:"Off" Tunlg:"auto" FisBar=1 Fac=1.00 Modes=1010 1000 010





More intense channel to get ^{24}O is $2\alpha + xn$

$^{48}\text{Ca} + \text{Ni} \rightarrow Z=8$ (left) and $Z=16$ (right)



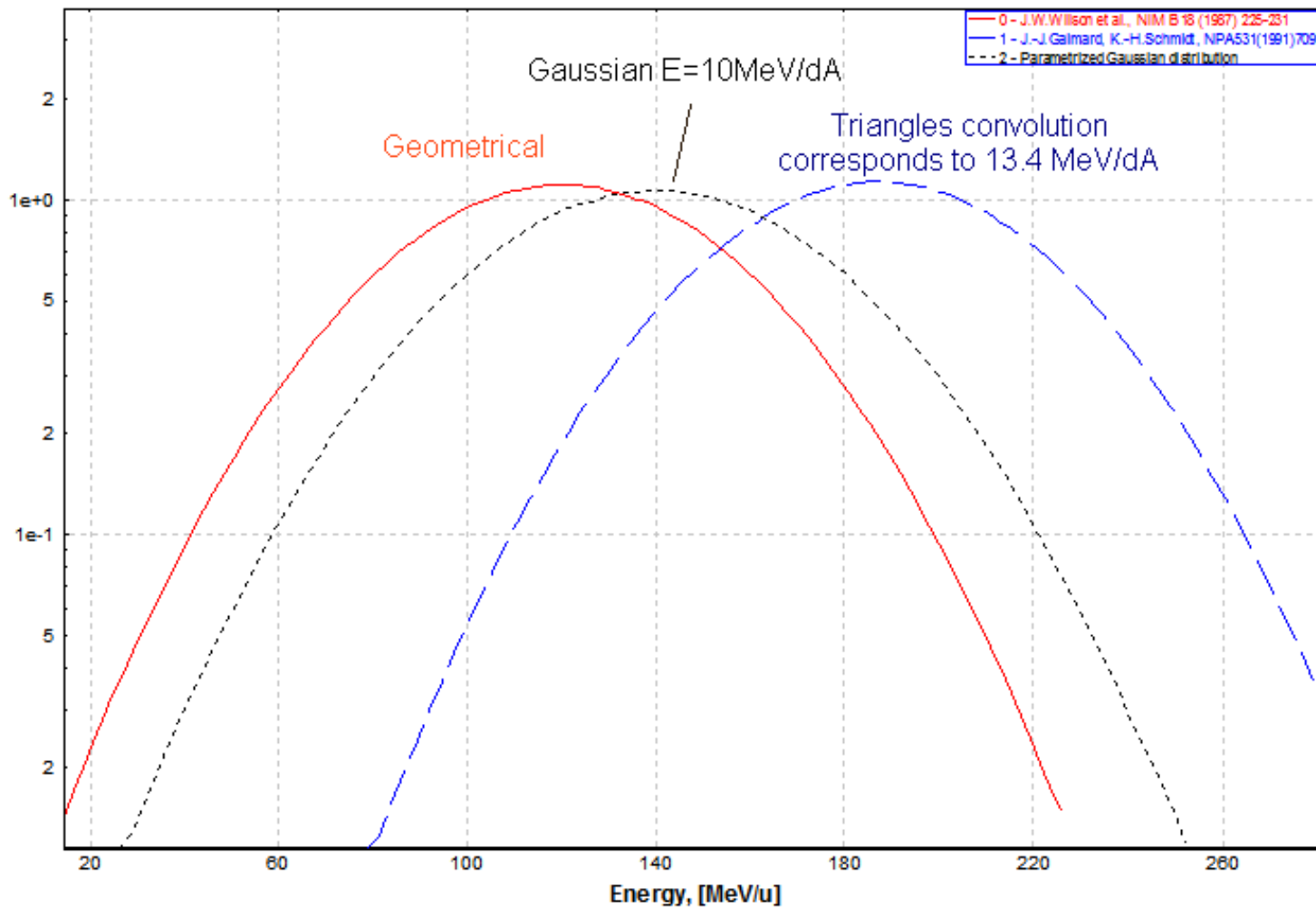
Excitation energy (method 3): $E_x = \text{const}(dA)$ $\text{sig}(E_x) = \text{const}(dA)$

Excitation energy for $^{48}\text{Ca} + \text{Be} \rightarrow ^{34}\text{Mg}$

Excit. Energy Method: < 0 >; g=0.95; Sigma=9.6; c1,2=(1.5,2.5) Friction: "Off"

Excit. Energy Method: < 1 >; Hole Depth: 40.0 MeV

Excit. Energy Method: < 2 >; < E* >: 10.0*dA MeV sigma: 10.00

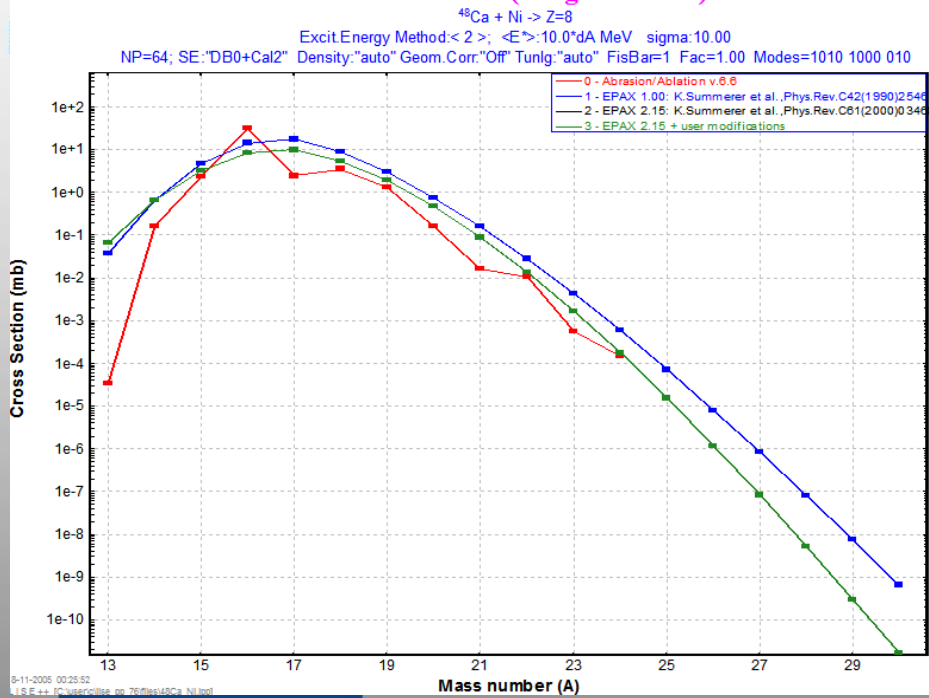




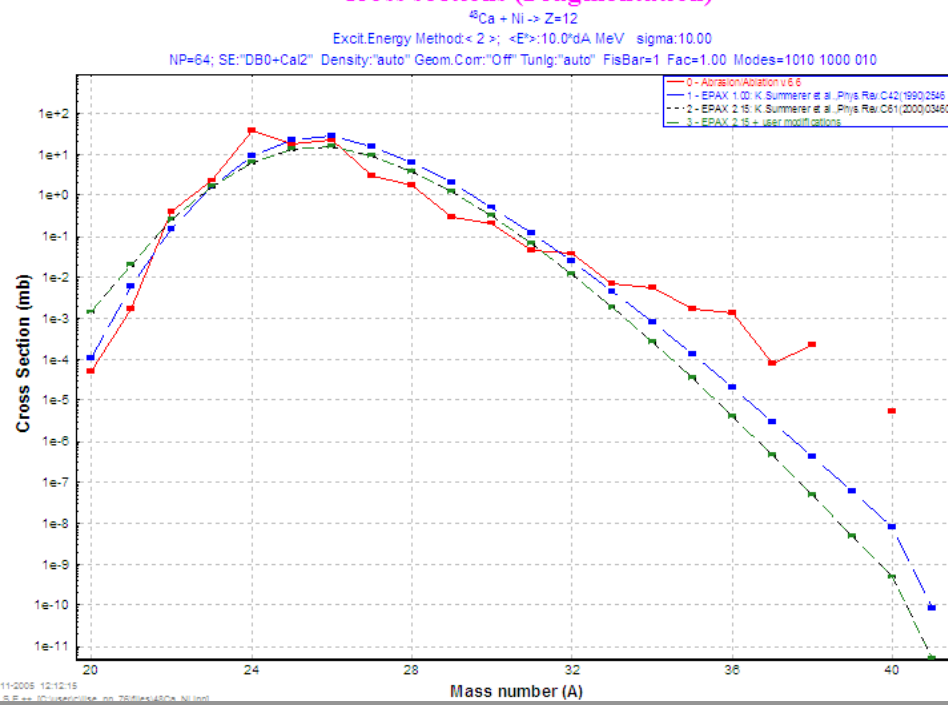
$^{48}\text{Ca} + \text{Ni} \rightarrow Z=8$ (left) and $Z=12$ (right)

$Ex=10\text{MeV/dA}$, $\text{sig}(Ex)=10\text{MeV/dA}$

Cross sections (Fragmentation)



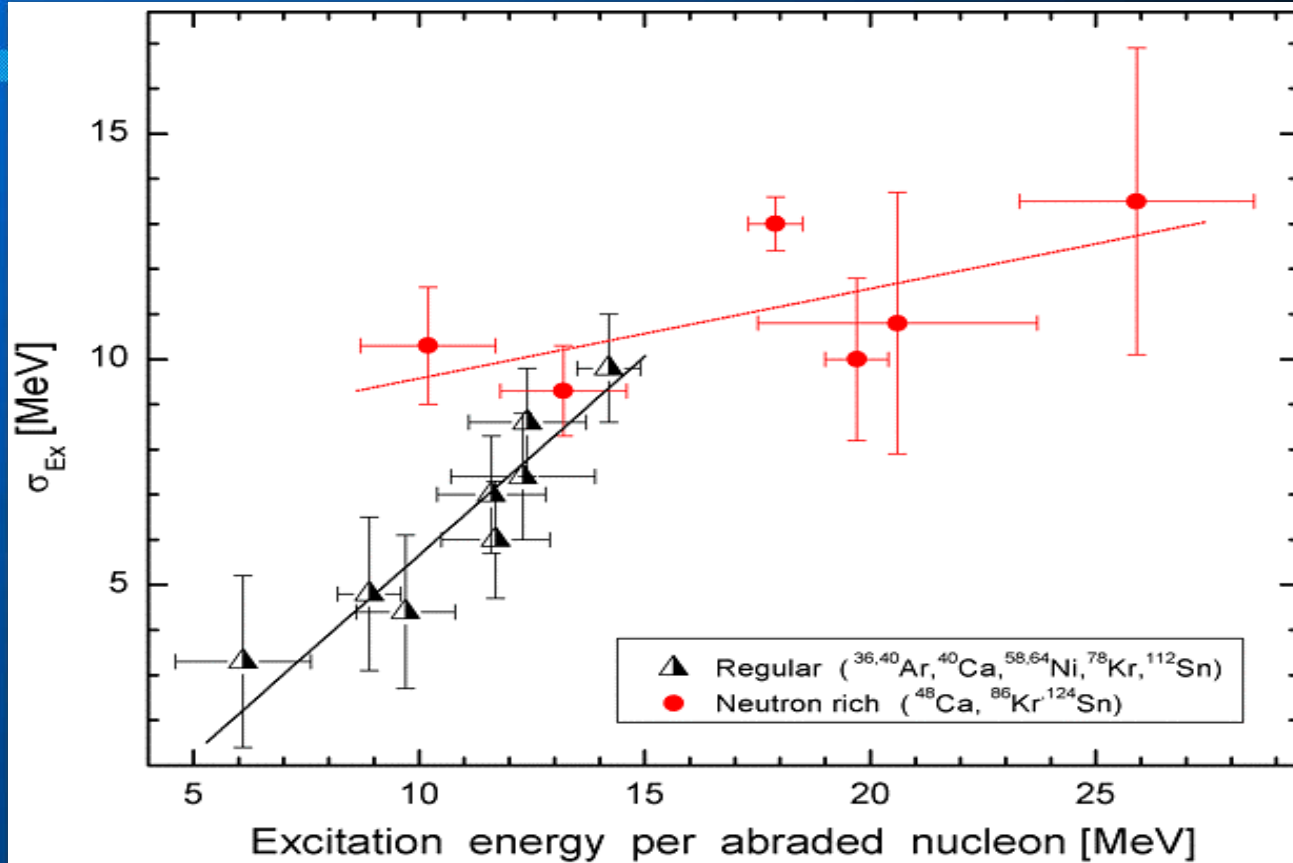
Cross sections (Fragmentation)



To produce ^{24}O

Ex & sig(Ex)	Alpha	n
13.4 & 9.6	0.89	0.05
10 & 10	0.26	0.59

Excitation energy



Widths versus mean values of excitation energy distributions obtained by matching EPAX values with the AA model.

Ex and sig(Ex) should be the function of dA in AA

What do we know from experiments?

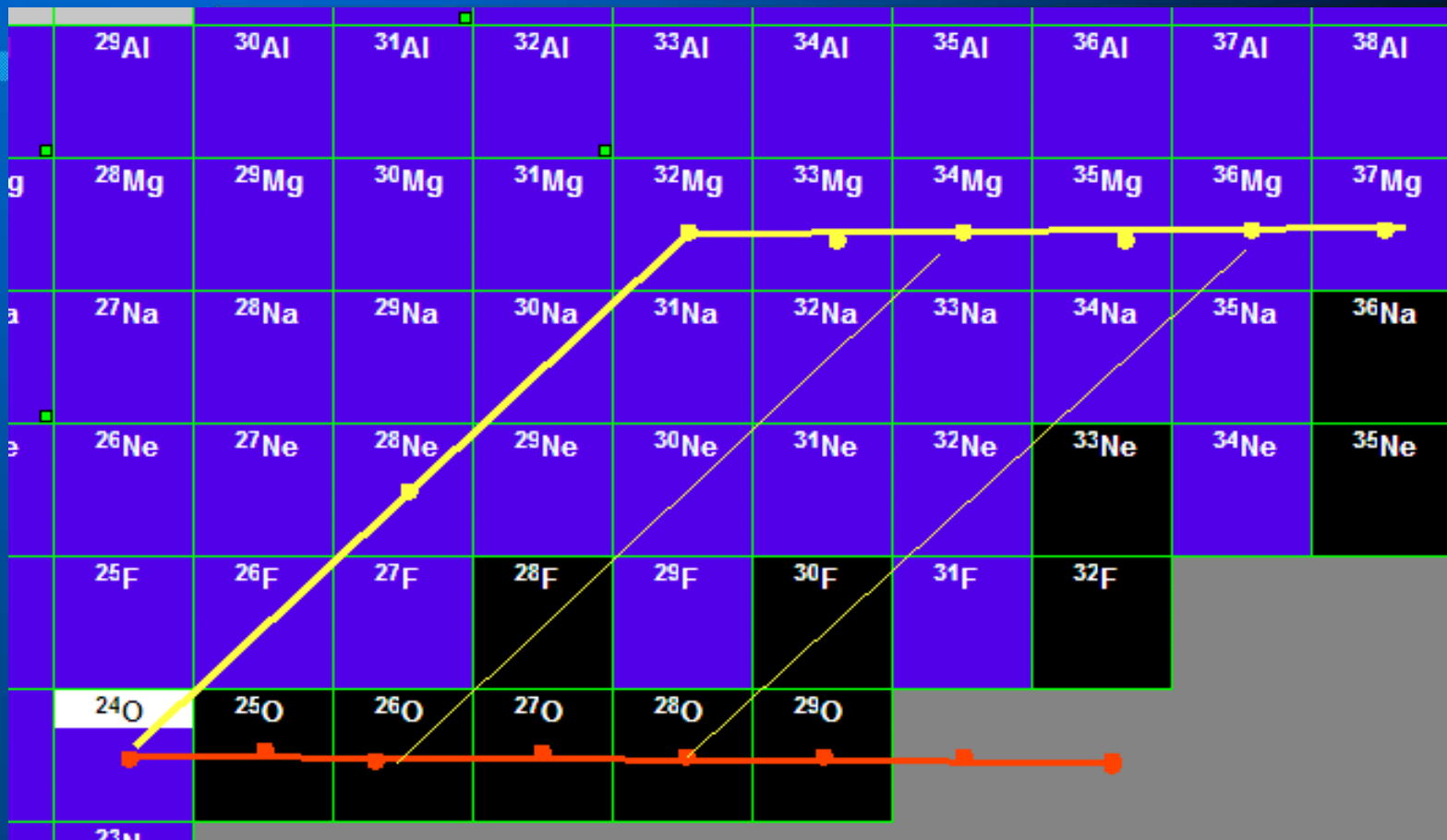
- Decreasing the projectile velocity – increase of production cross-section of neutron-rich isotopes
- Target with large Z – increase of production cross-section of neutron-rich isotopes
- Low Exponential tail is due to dissipative processes

Why?

- Time of dissipation is increasing
- Touching Area + Time of dissipation is increasing due to target size

Touching area is ~ to square (Chord_min)
Time of dissipation ~ to Chord_max & beam velocity
But Chords are functions of dA !

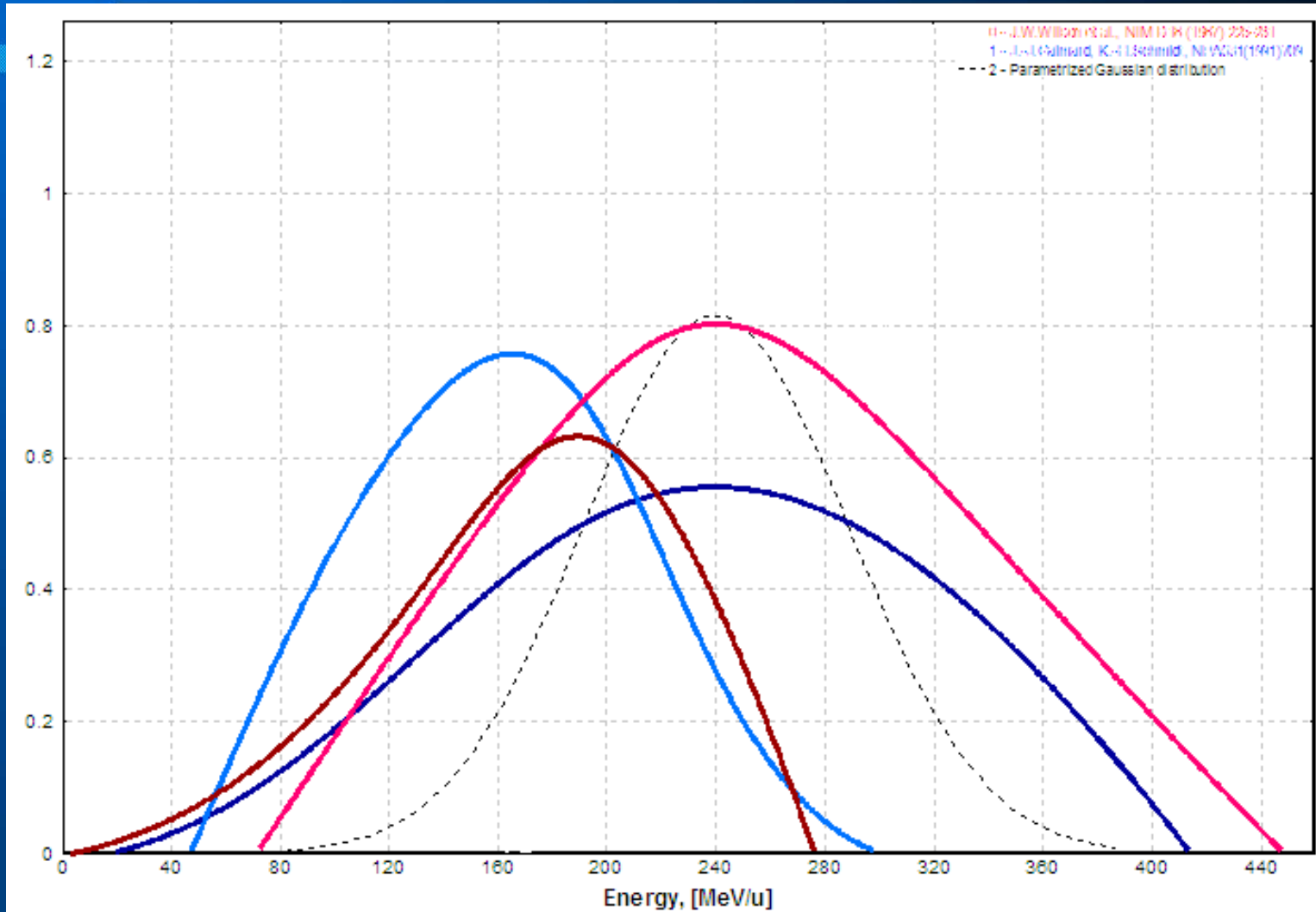
Dissipation process contribution defines a way to produce nucleus



To produce ^{24}O

Ex & sig(Ex)	Alpha	n
13.4 & 9.6	0.89	0.05
10 & 10	0.26	0.59

Excitation energy distribution changes due to dissipation. What is shape??

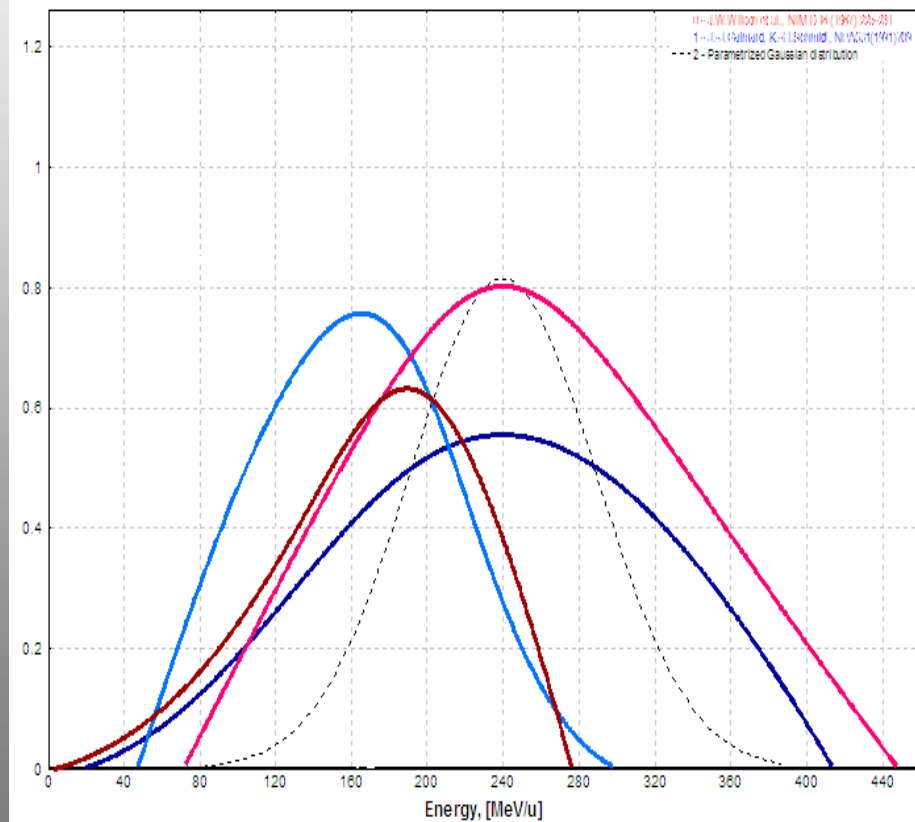
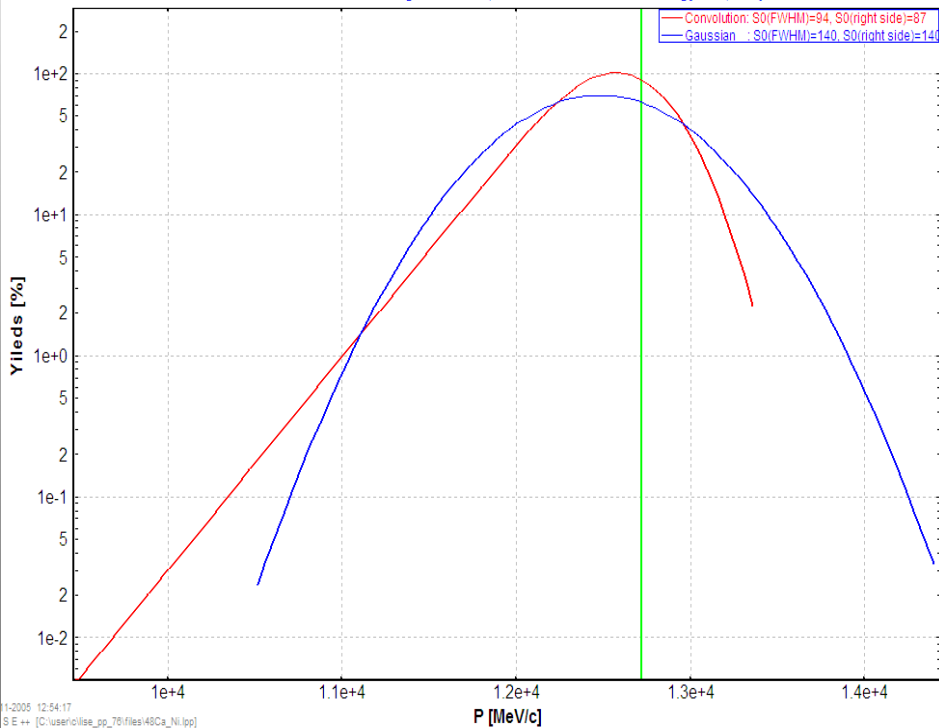


Is there a correlation between the final fragment momentum distribution and prefragment excitation energy?

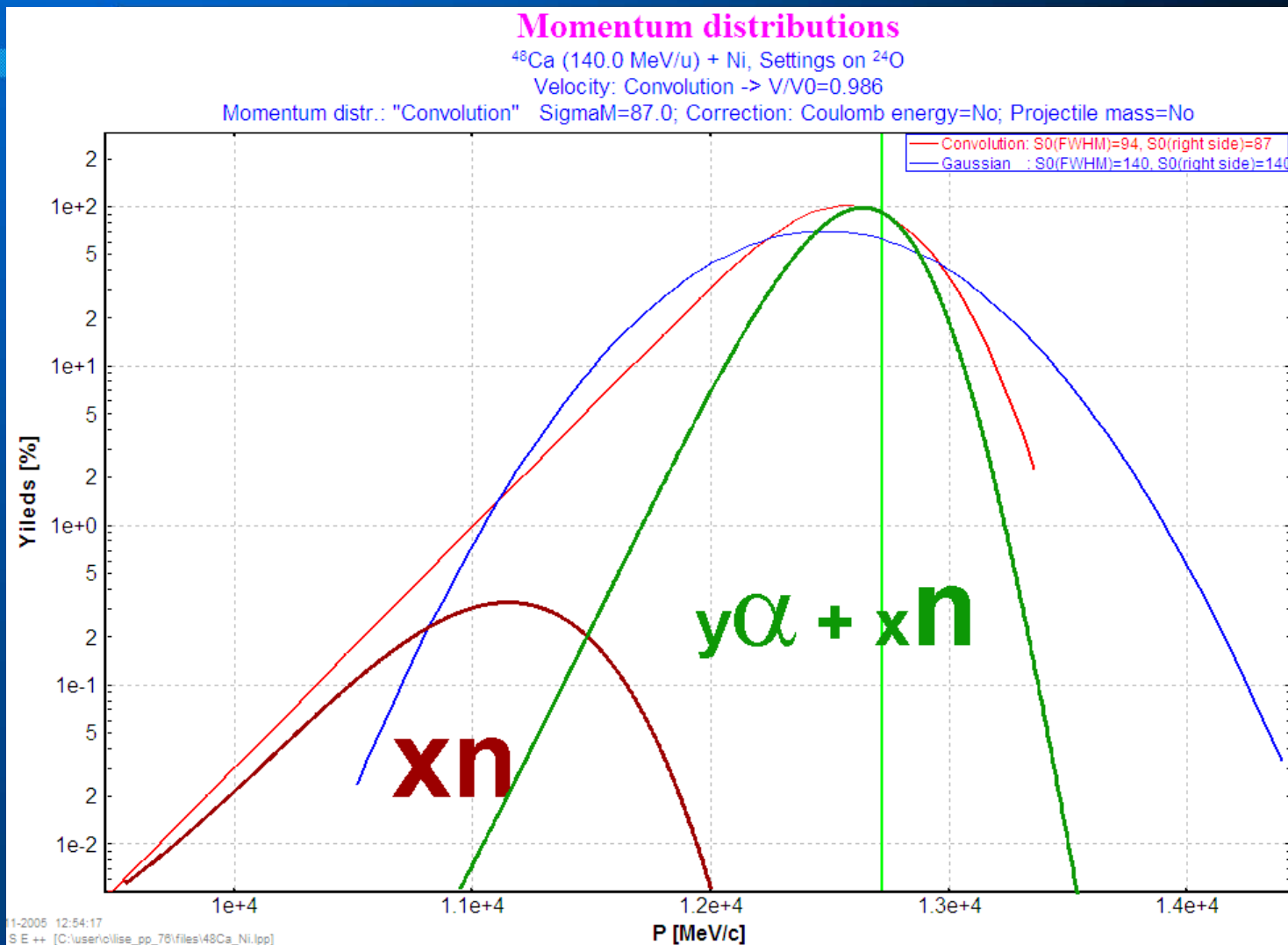
Momentum distributions

^{48}Ca (140.0 MeV/u) + Ni, Settings on ^{24}O
 Velocity: Convolution -> $V/V_0=0.986$

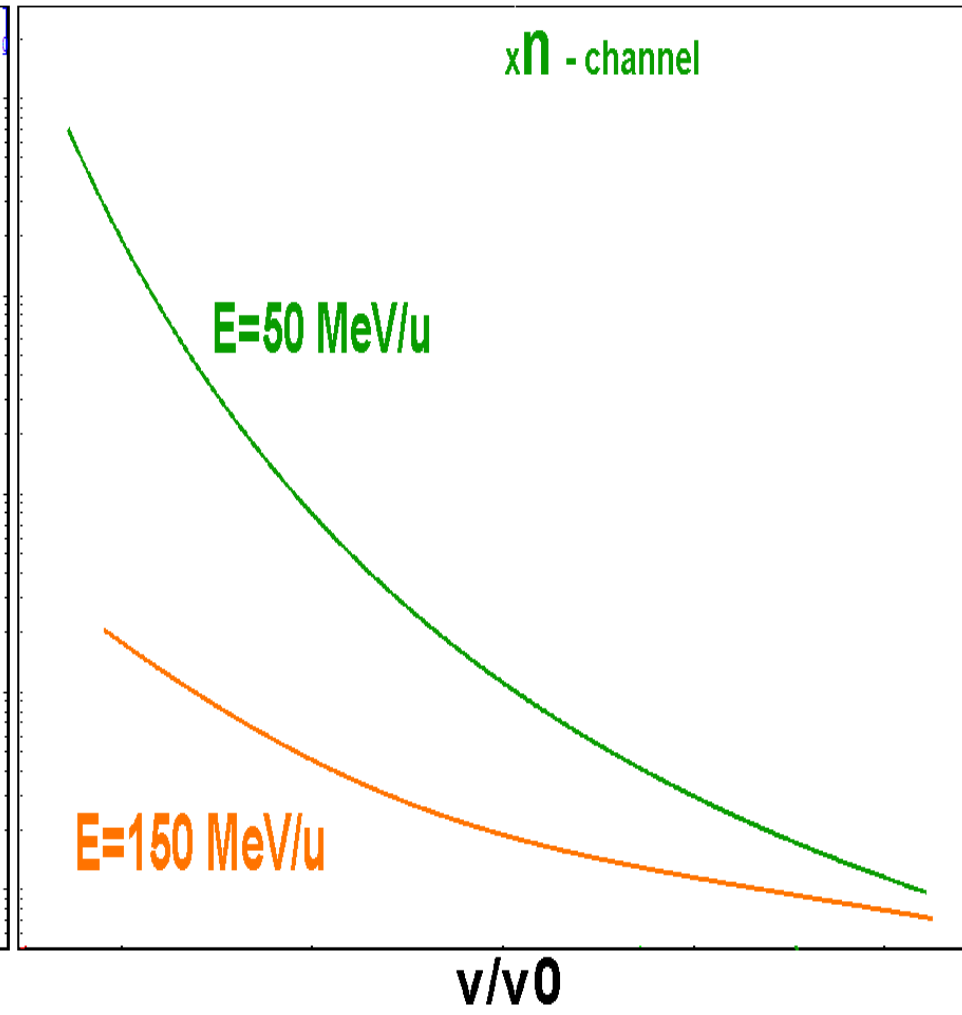
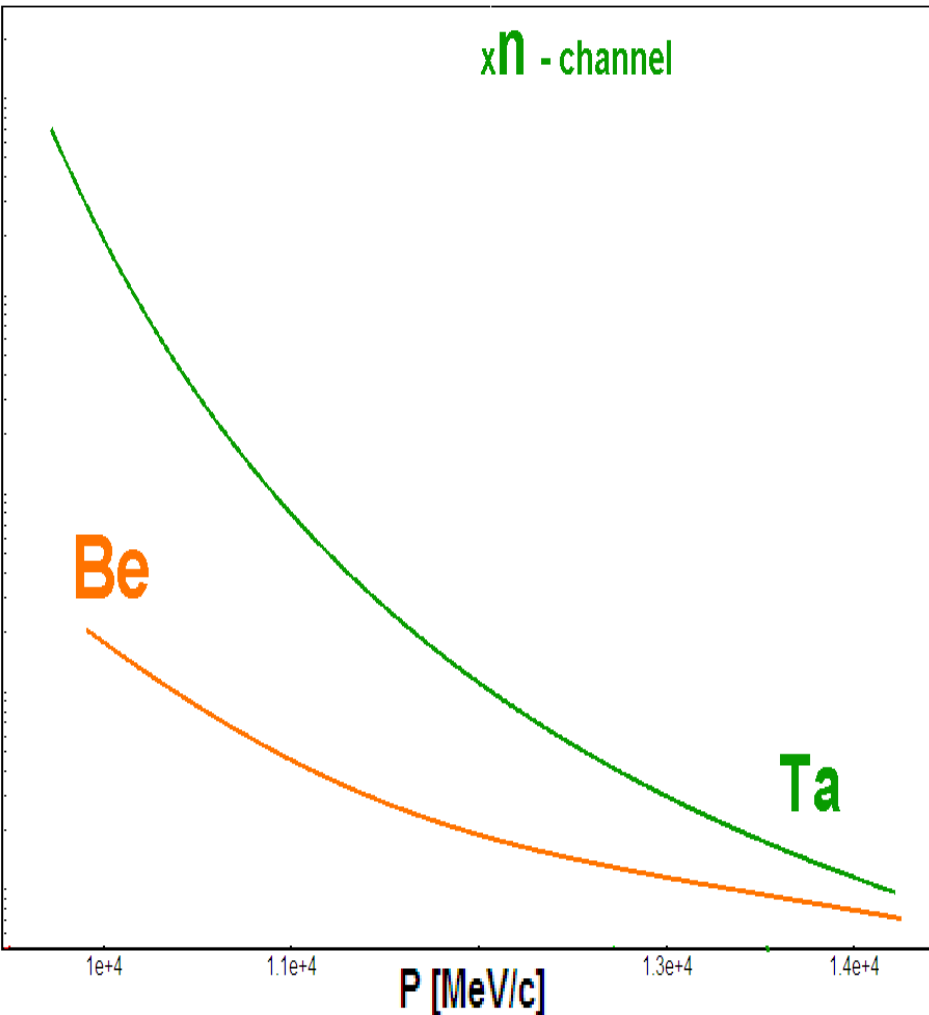
Momentum distr.: "Convolution" SigmaM=87.0; Correction: Coulomb energy=No; Projectile mass=No



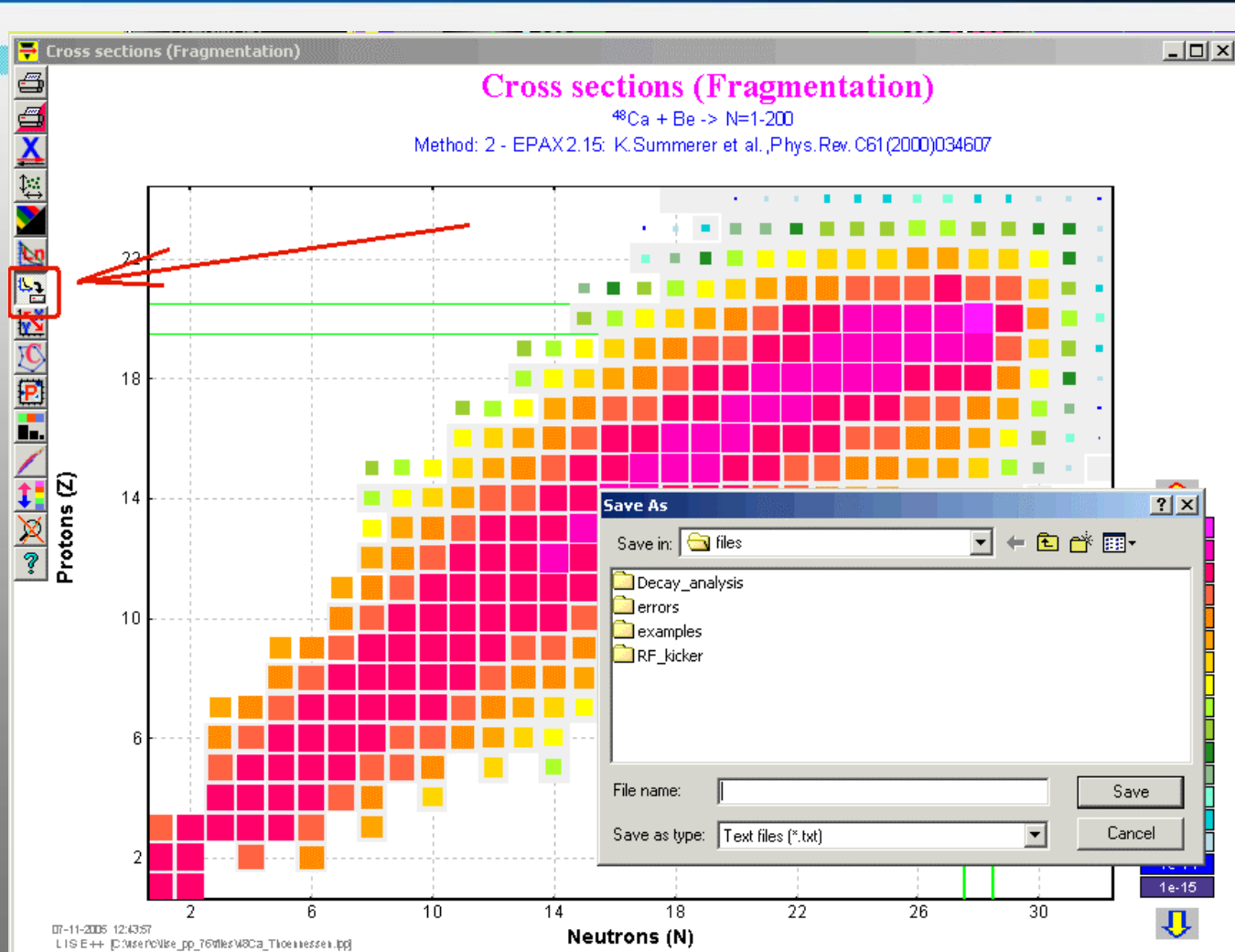
Or Is there a correlation between the final fragment momentum distribution and the chain of decays?



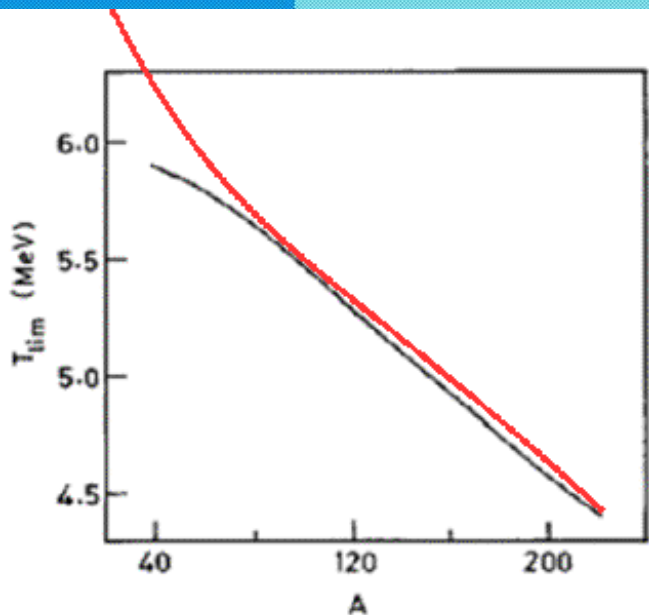
It will be nice to measure Fragment Energy vs N(n) [and N(alpha)??]
 On different targets with the beam of different energies



2D "Cross section" plot -> file



Break-up channel



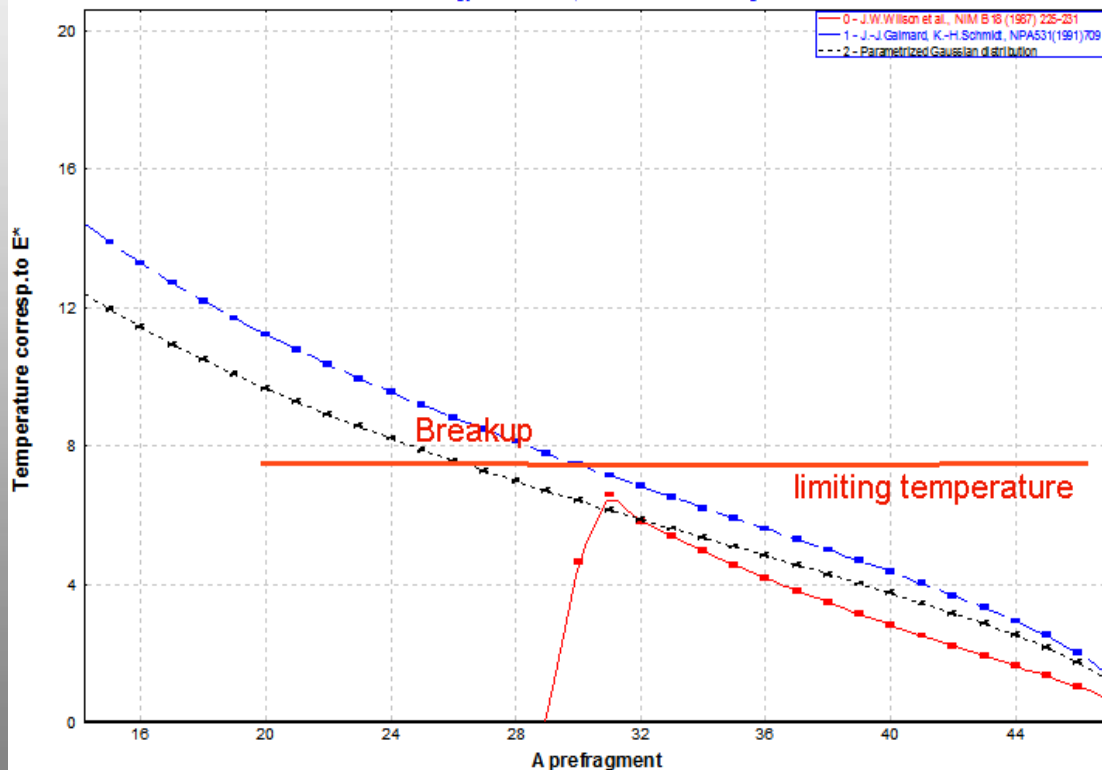
The limiting temperature T_{lim} as a function of mass number on the β -stability line [De96].

Excitation energy for $^{48}\text{Ca} + \text{Be} \rightarrow ^{30}\text{Ne}$: Temperature

Excit.Energy Method:<0 >; g=0.95; Sigma=9.6; c1,2=(1.5,2.5) Friction:"Off"

Excit.Energy Method:<1 >; Hole Depth : 40.5 MeV

Excit.Energy Method:<2 >; <E*>:10.0* μ A MeV sigma:10.00



^{36}S for ^{24}O ?