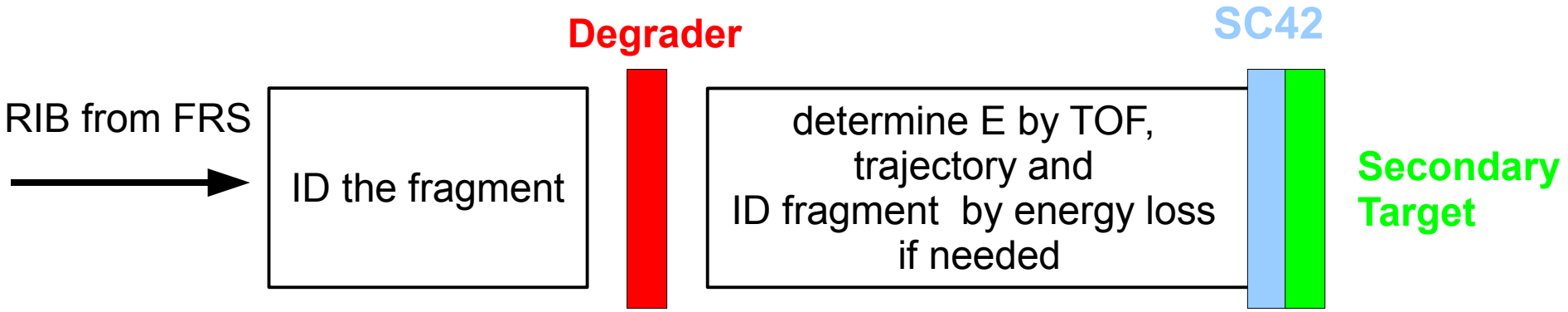
Simulations and first tests of slowed down beams at GSI

P.Boutachkov, M.Górska, W.Prokopowicz, I.Kojouharov, H.Schaffner, S.Tashenov, J.Gerl
GSI-Darmstadt

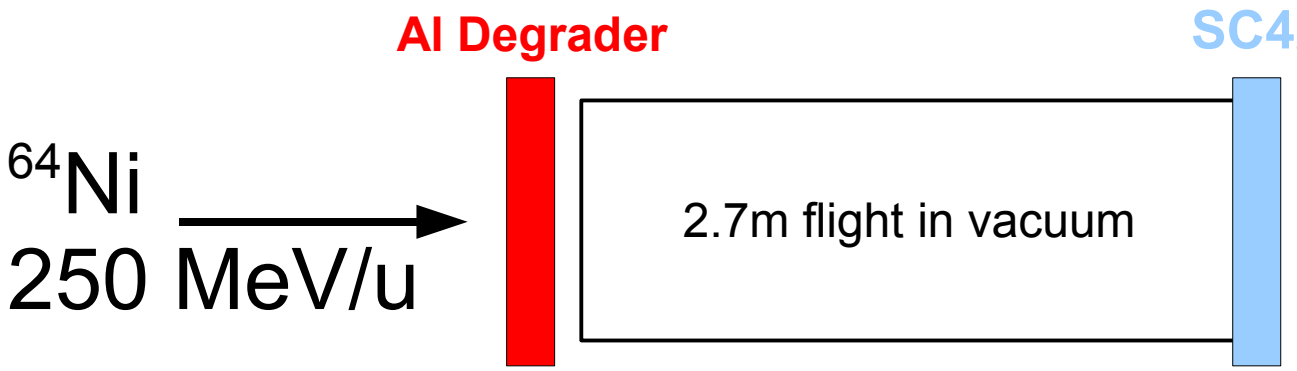
- Monte-Carlo simulations
- Test with ^{64}Ni at FRS

Objective

Obtain 5 MeV/u to 10 MeV/u RIB to be used for secondary reaction studies at FRS.

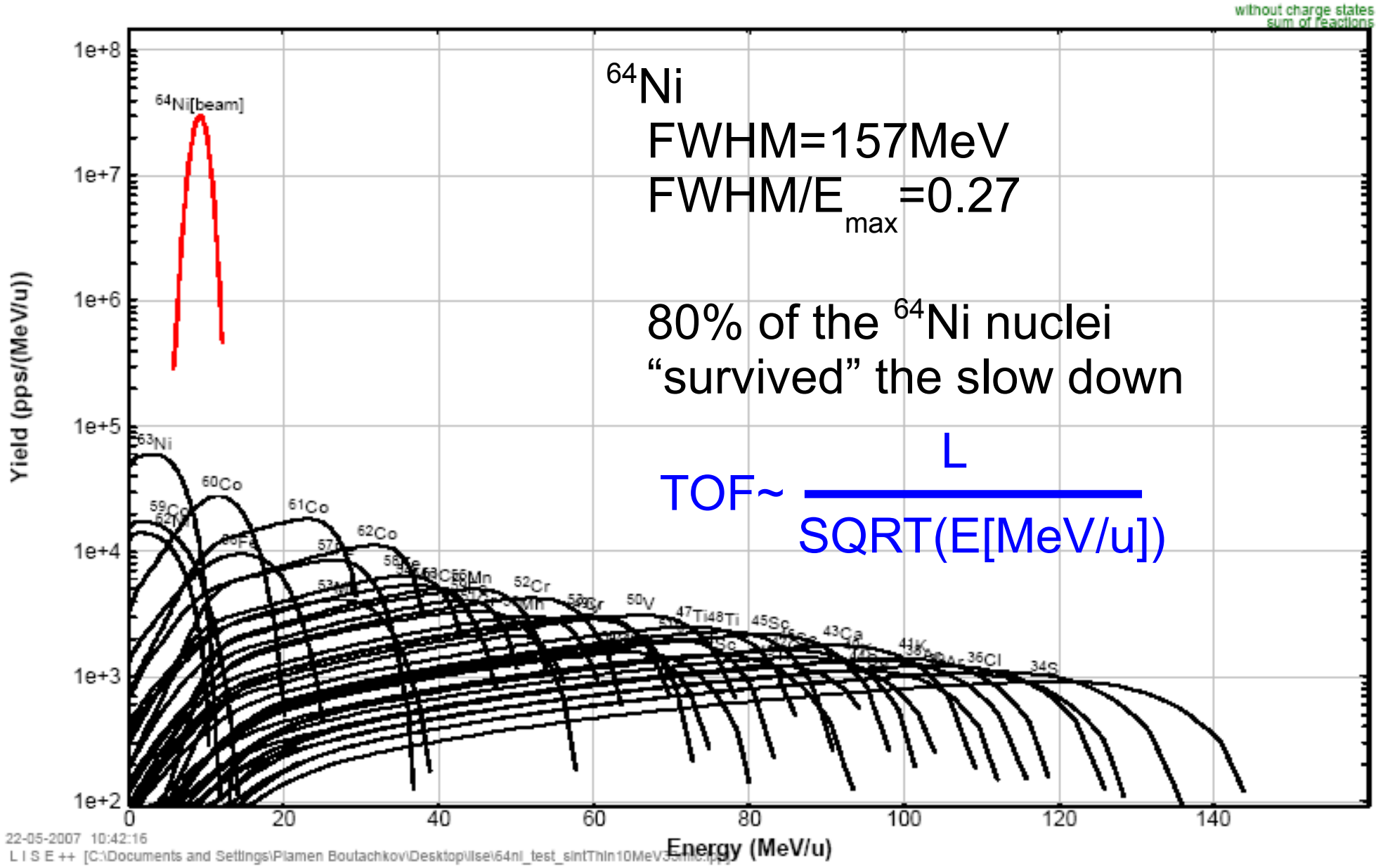


Lise++ simulations



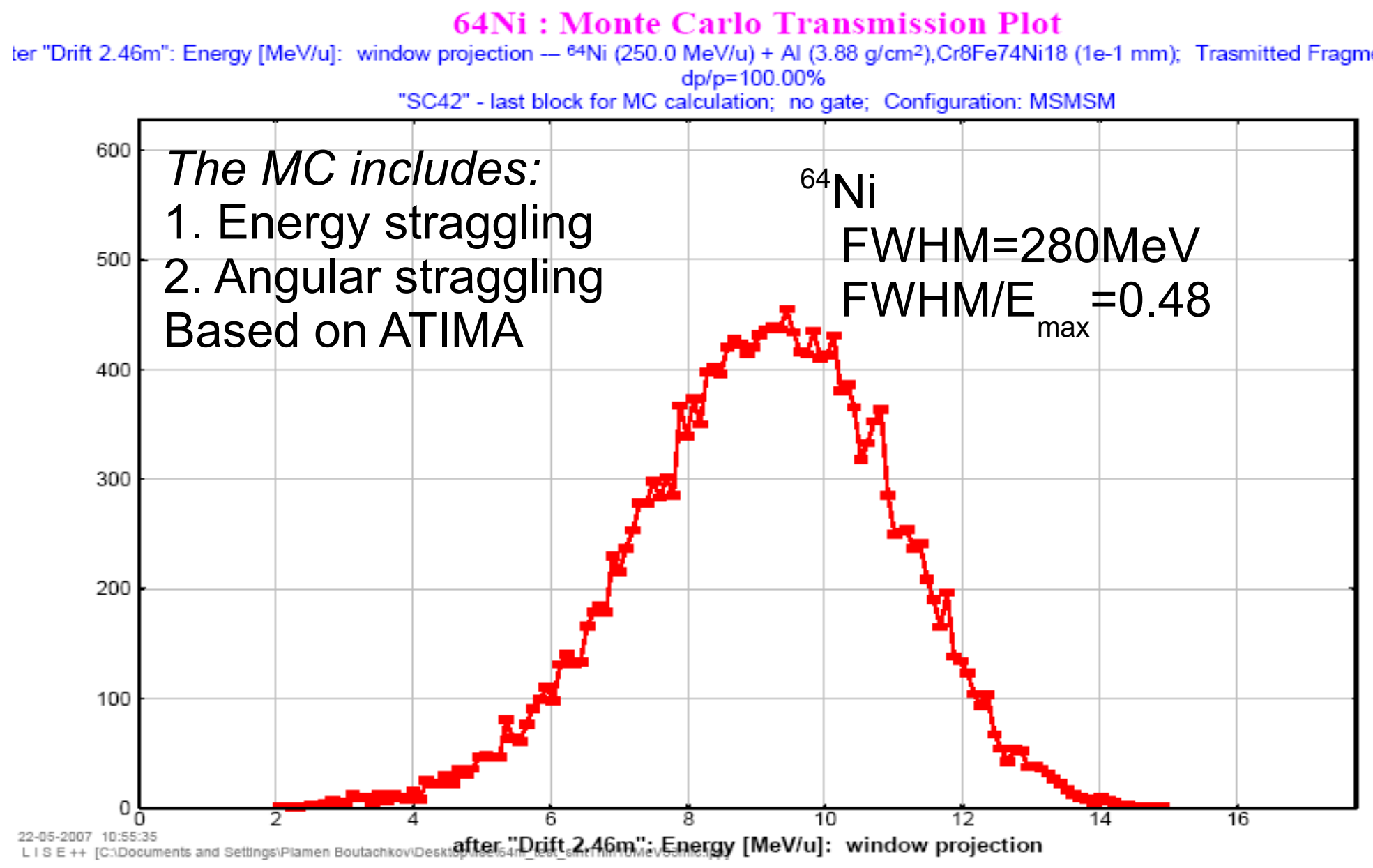
SC42-Energy: input

^{64}Ni (250.0 MeV/u) + Al (3.88 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Settings on ^{64}Ni; Config: MSMSM
dp/p=100.00%



TOF -> contaminants from secondary reactions are of the order of 10^{-3} compare to the fragment of interest

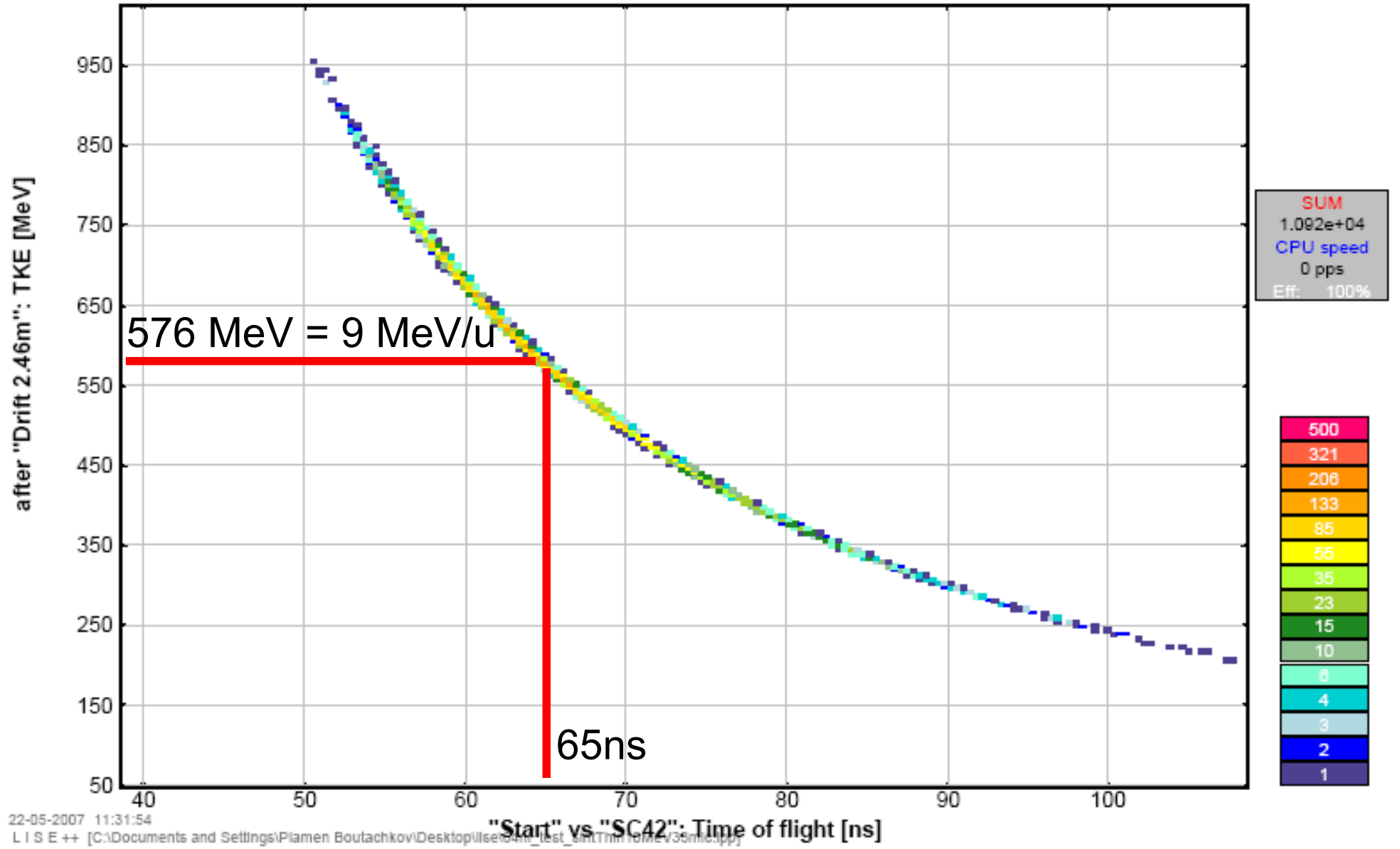
Lise++ and MC



Less than 10% difference in the stopping powers calculated with ATIMA and SRIM2006

^{64}Ni : Monte Carlo Transmission Plot

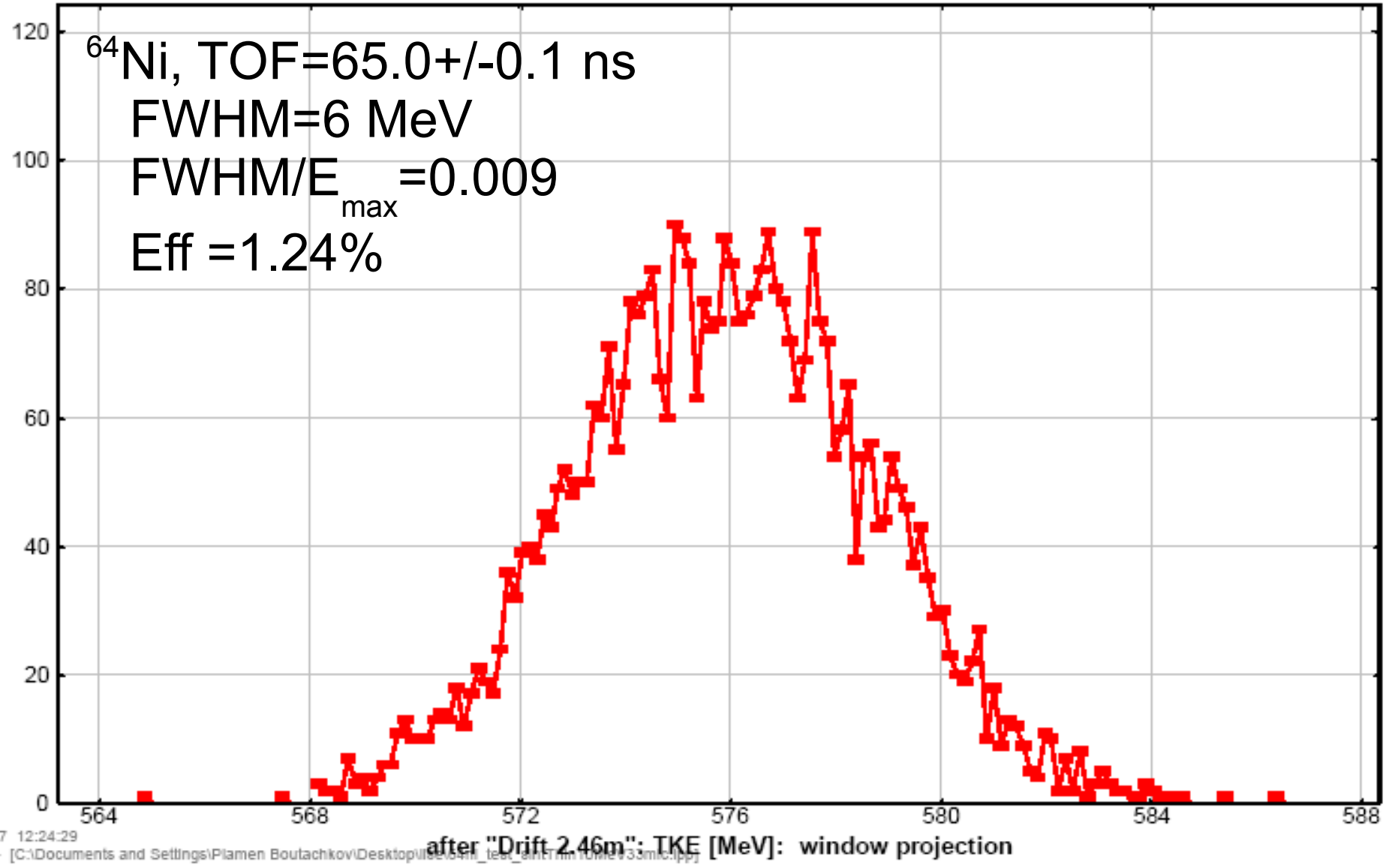
^{64}Ni (250.0 MeV/u) + Al (3.88 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Trasmitted Fragment ^{64}Ni (beam)
dp/p=100.00%
"SC42" - last block for MC calculation; no gate; Configuration: MSMSM



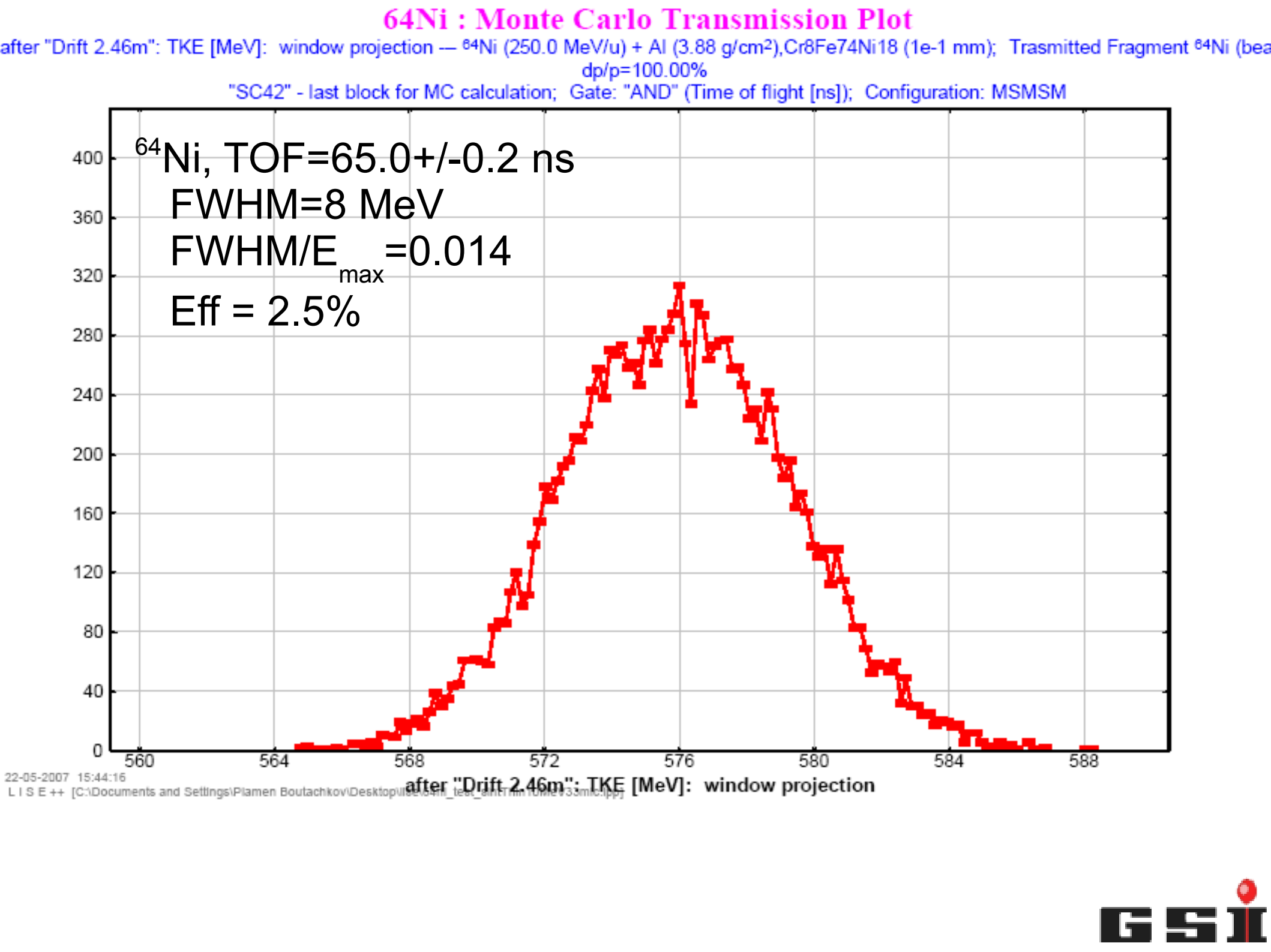
22-05-2007 11:31:54
L I S E ++ [C:\Documents and Settings\Plamen Boutachkov\Desktop\lise64ni_test_shiftmm rome v38mle.lpp]

64Ni : Monte Carlo Transmission Plot

after "Drift 2.46m": TKE [MeV]: window projection — ^{64}Ni (250.0 MeV/u) + Al (3.88 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Trasmitted Fragment ^{64}Ni (bea
dp/p=100.00%
"SC42" - last block for MC calculation; Gate: "AND" (Time of flight [ns]); Configuration: MSMSM

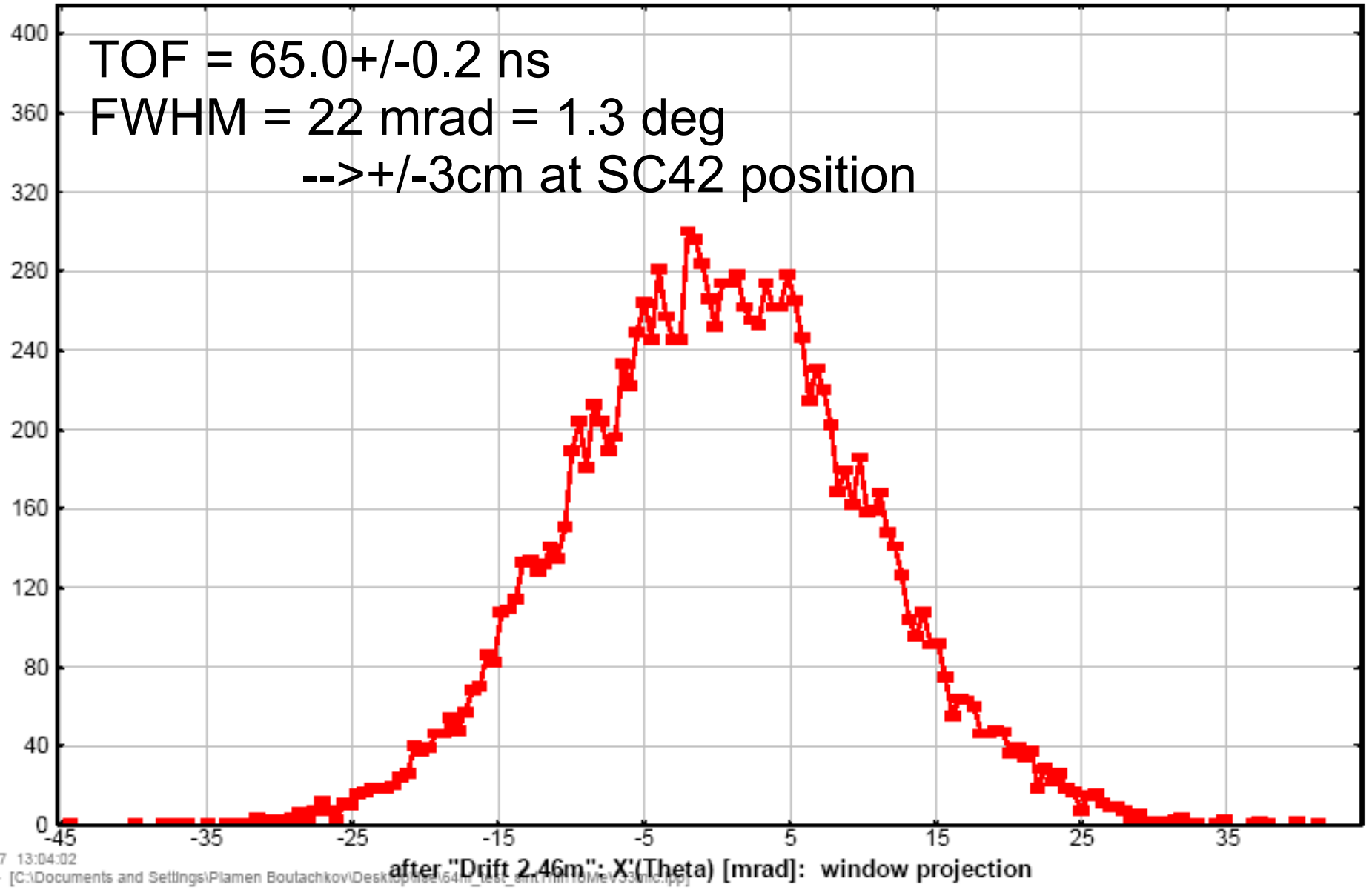


64Ni : Monte Carlo Transmission Plot



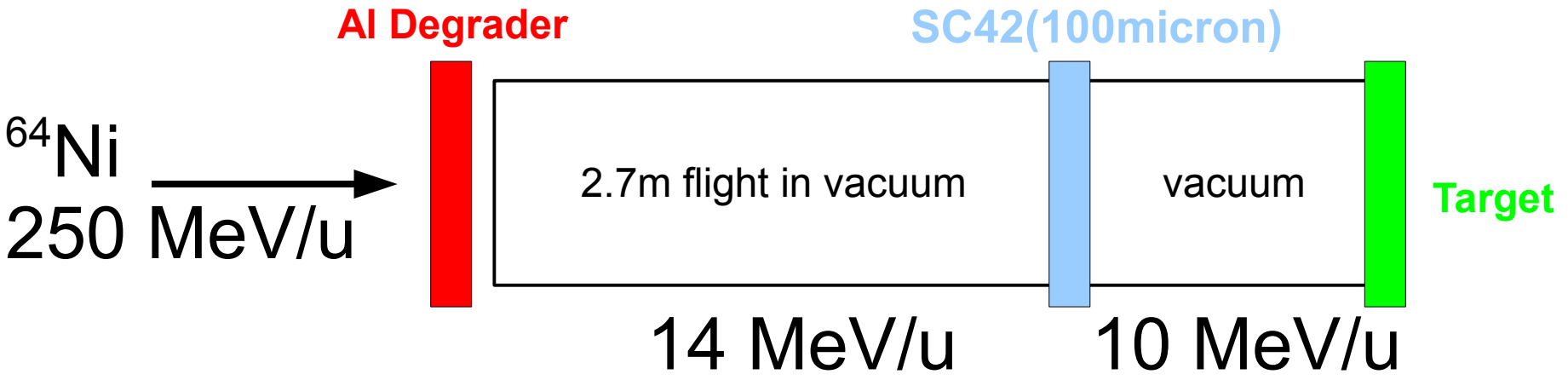
64Ni : Monte Carlo Transmission Plot

er "Drift 2.46m": X'(Theta) [mrad]: window projection --- ^{64}Ni (250.0 MeV/u) + Al (3.88 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Trasmitted Fragment ^{64}Ni (b
dp/p=100.00%
"SC42" - last block for MC calculation; Gate: "AND" (Time of flight [ns]); Configuration: MSMSM

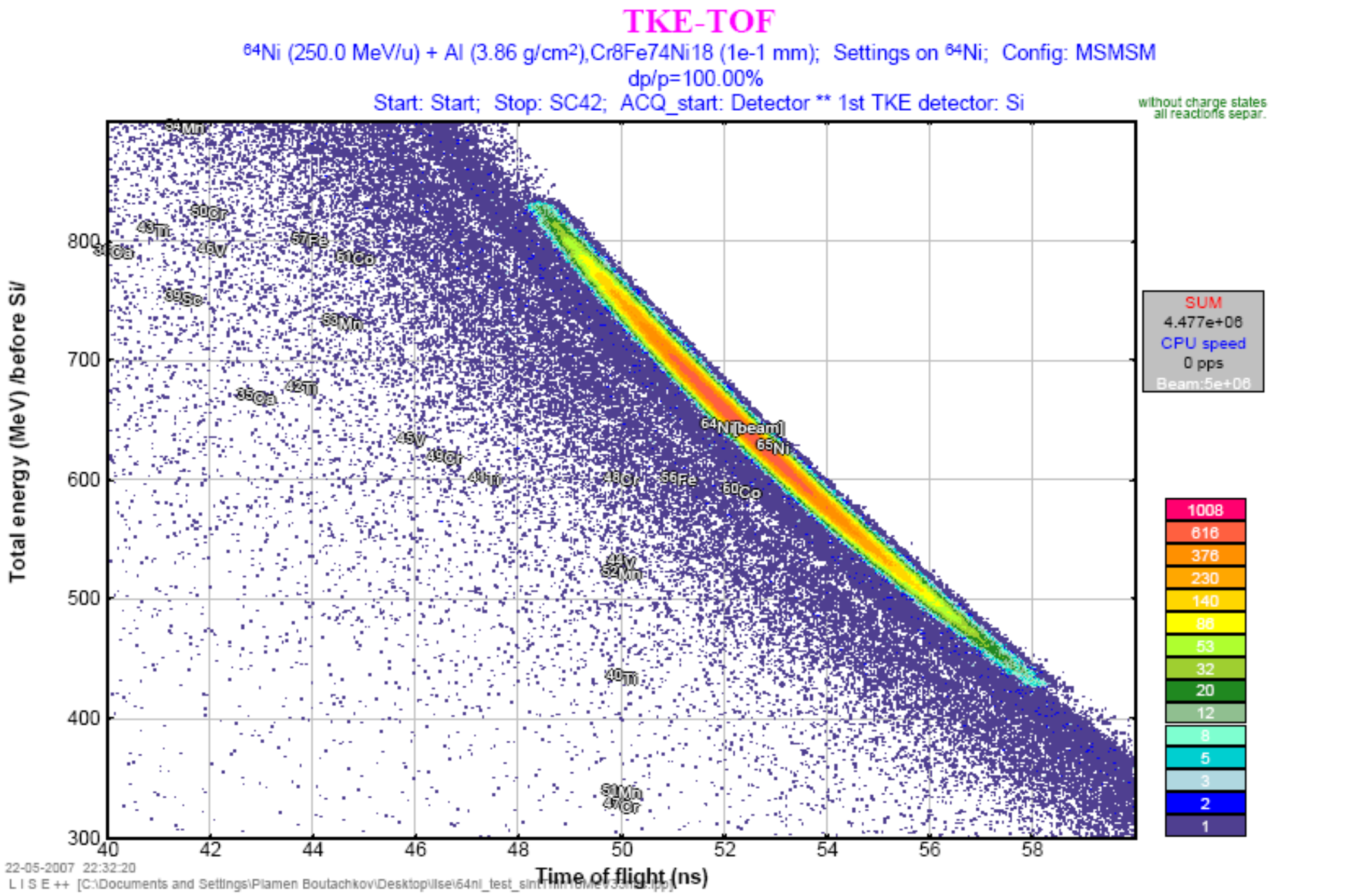


Reducing the unwanted fragments

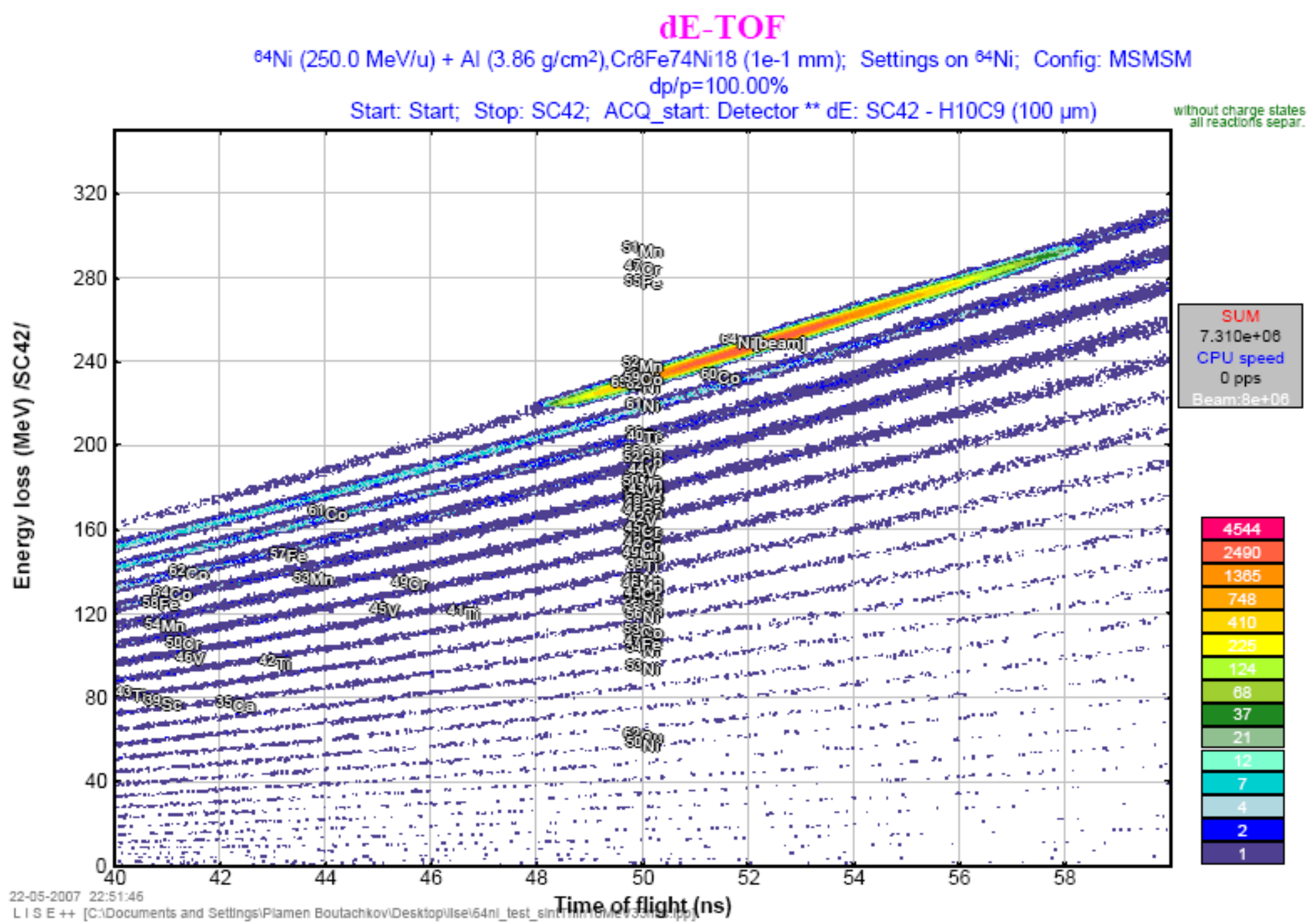
Use dE signal from SC42



100 microns SC material ~ 57 microns Si



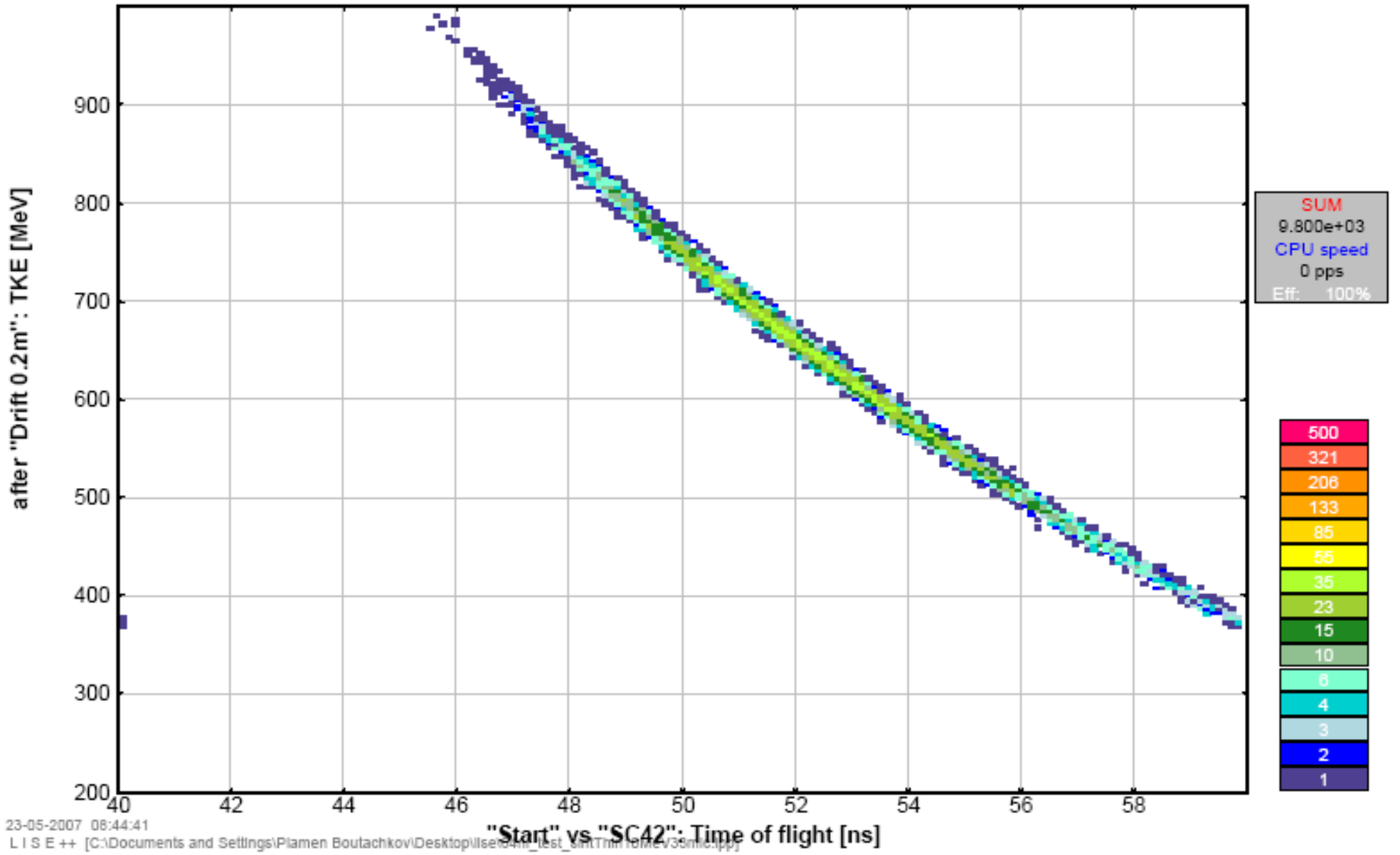
E=10MeV/u --> TOF = 52.5 ns



Need a detector with resolution 5/240=0.02 or better

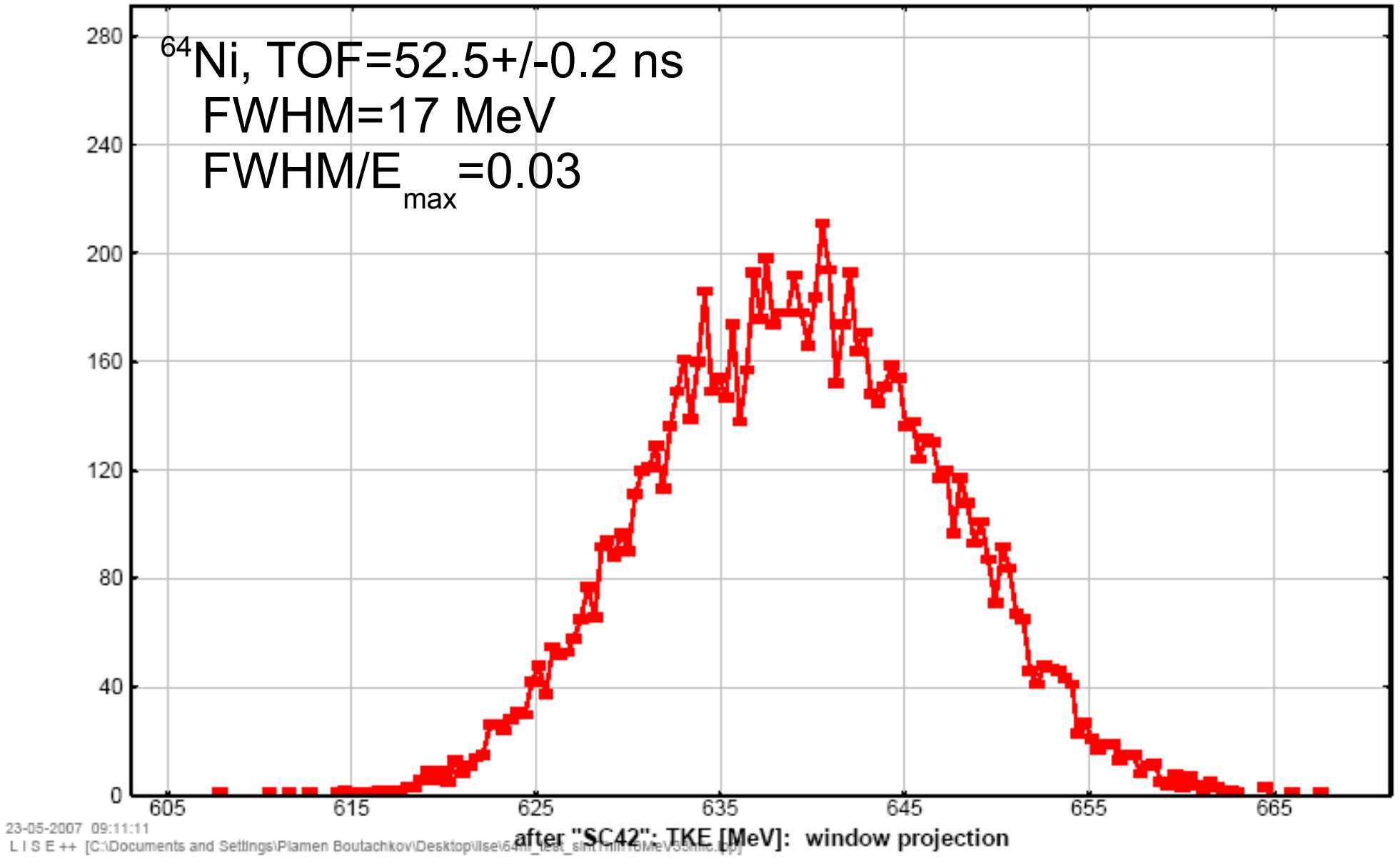
^{64}Ni : Monte Carlo Transmission Plot

^{64}Ni (250.0 MeV/u) + Al (3.86 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Trasmitted Fragment ^{64}Ni (beam)
dp/p=100.00%
"Drift 0.2m" - last block for MC calculation; no gate; Configuration: MSMSM



64Ni : Monte Carlo Transmission Plot

after "SC42": TKE [MeV]: window projection — ^{64}Ni (250.0 MeV/u) + Al (3.86 g/cm^2),Cr8Fe74Ni18 (1e-1 mm); Trasmitted Fragment ^{64}Ni (beam)
dp/p=100.00%
"SC42" - last block for MC calculation; Gate: "AND" (Time of flight [ns]); Configuration: MSMSM



Add back:
E=E(TOF)+dE(SC42)

Optimum initial ^{64}Ni energy

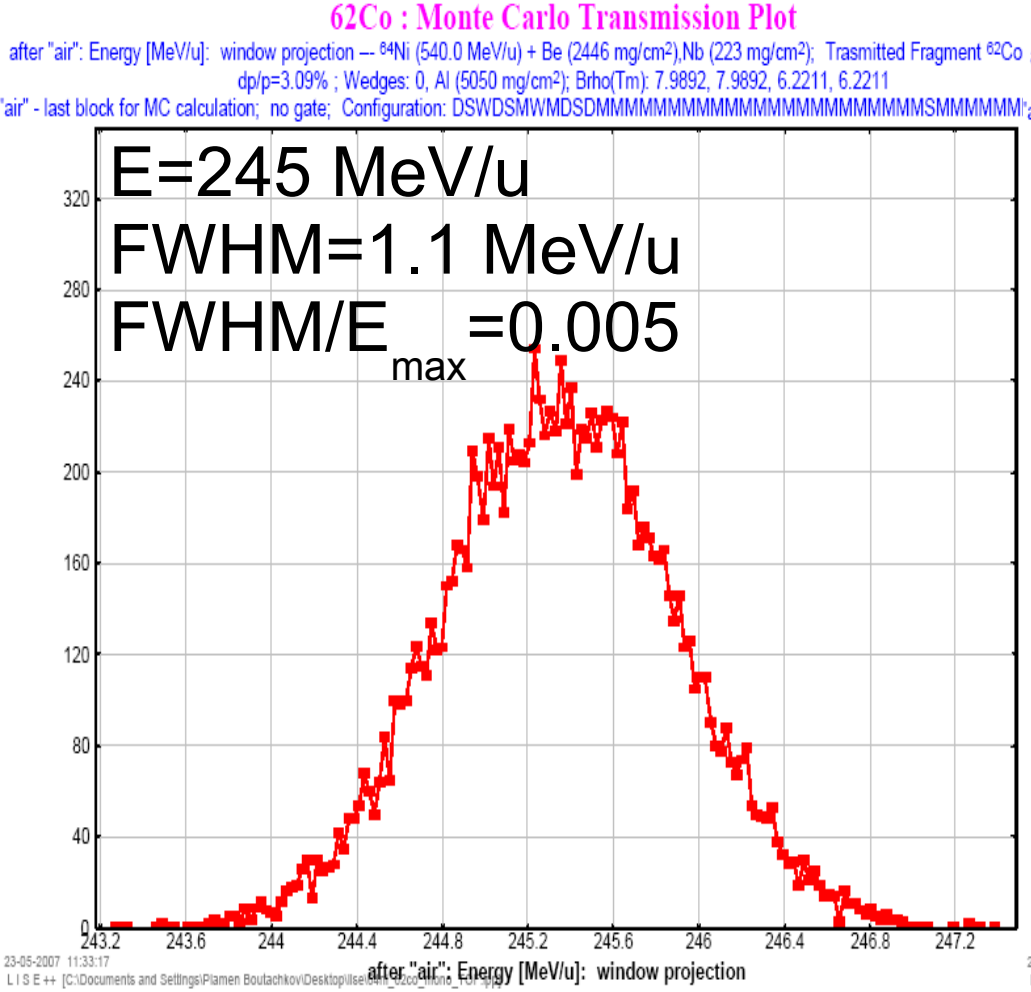
E=9 MeV/u -->TOF=65.0+/-0.2 ns

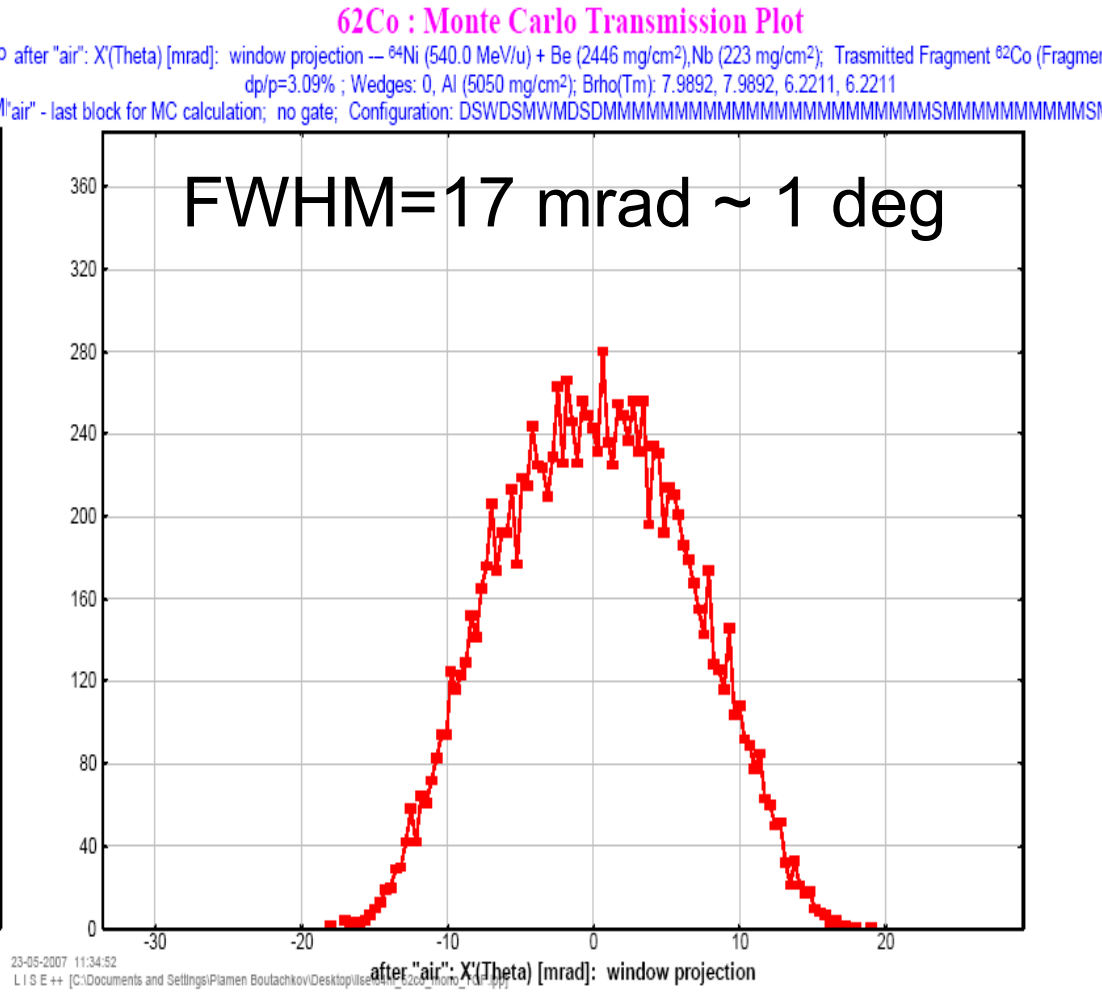
E[MeV/u]	Degrader[mg/cm^2]	FWHM(E)[MeV]	FWHM/Emax	Eff[%]	FWHM(A)[mrad]
200	2.654	8	0.013	3.8	19
250	3.880	8	0.014	2.5	22
300	5.255	8	0.014	1.8	23

No reduction in Eff due to secondary reactions in the degrader are taken into account.

E[MeV]	Survive prob	Tot Eff[%]
200	0.85	3.2
250	0.80	2.0
300	0.73	1.3

Mono-energetic ^{62}Co



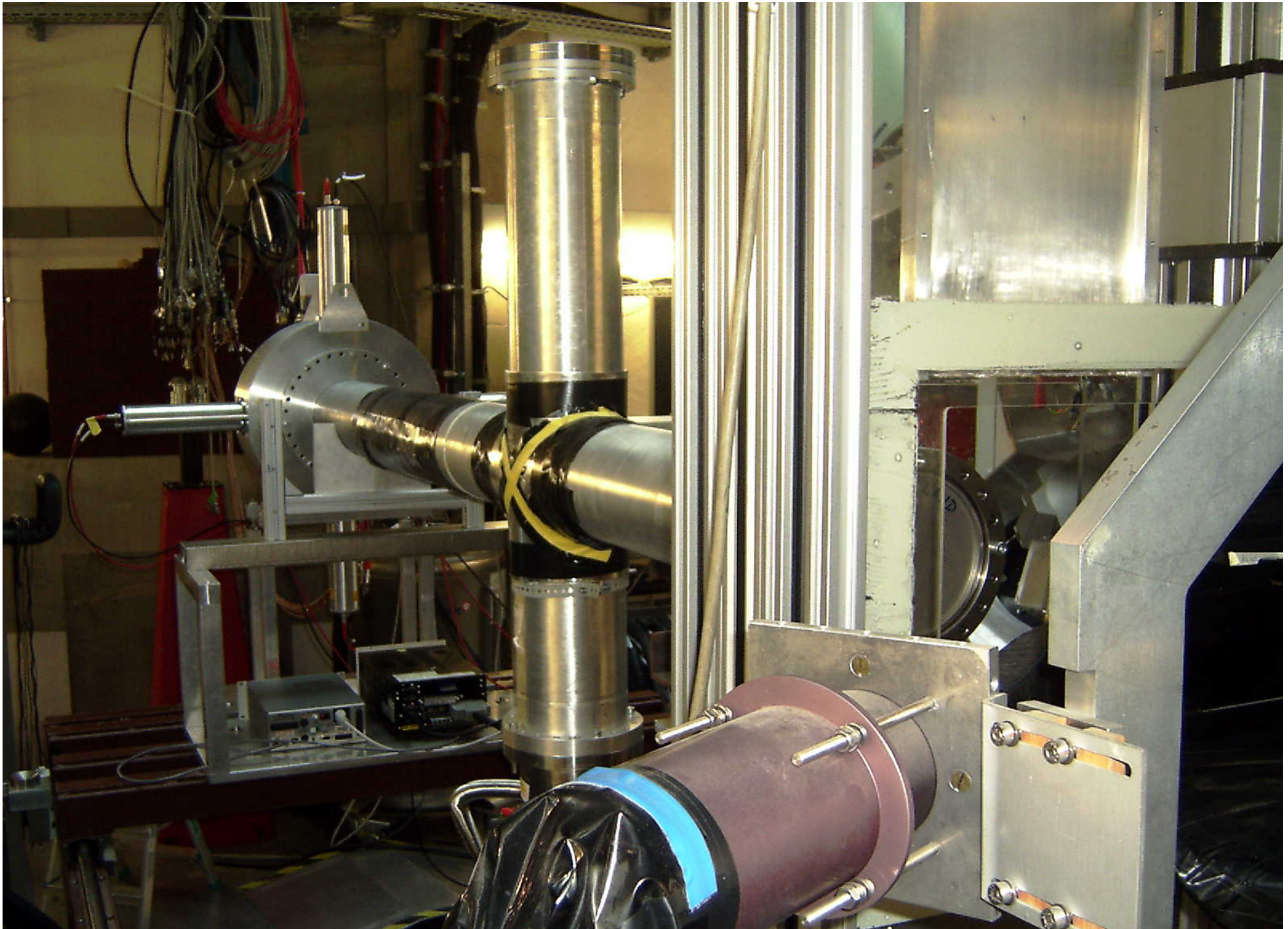


E=10MeV/u before SC42-->61.6 ns

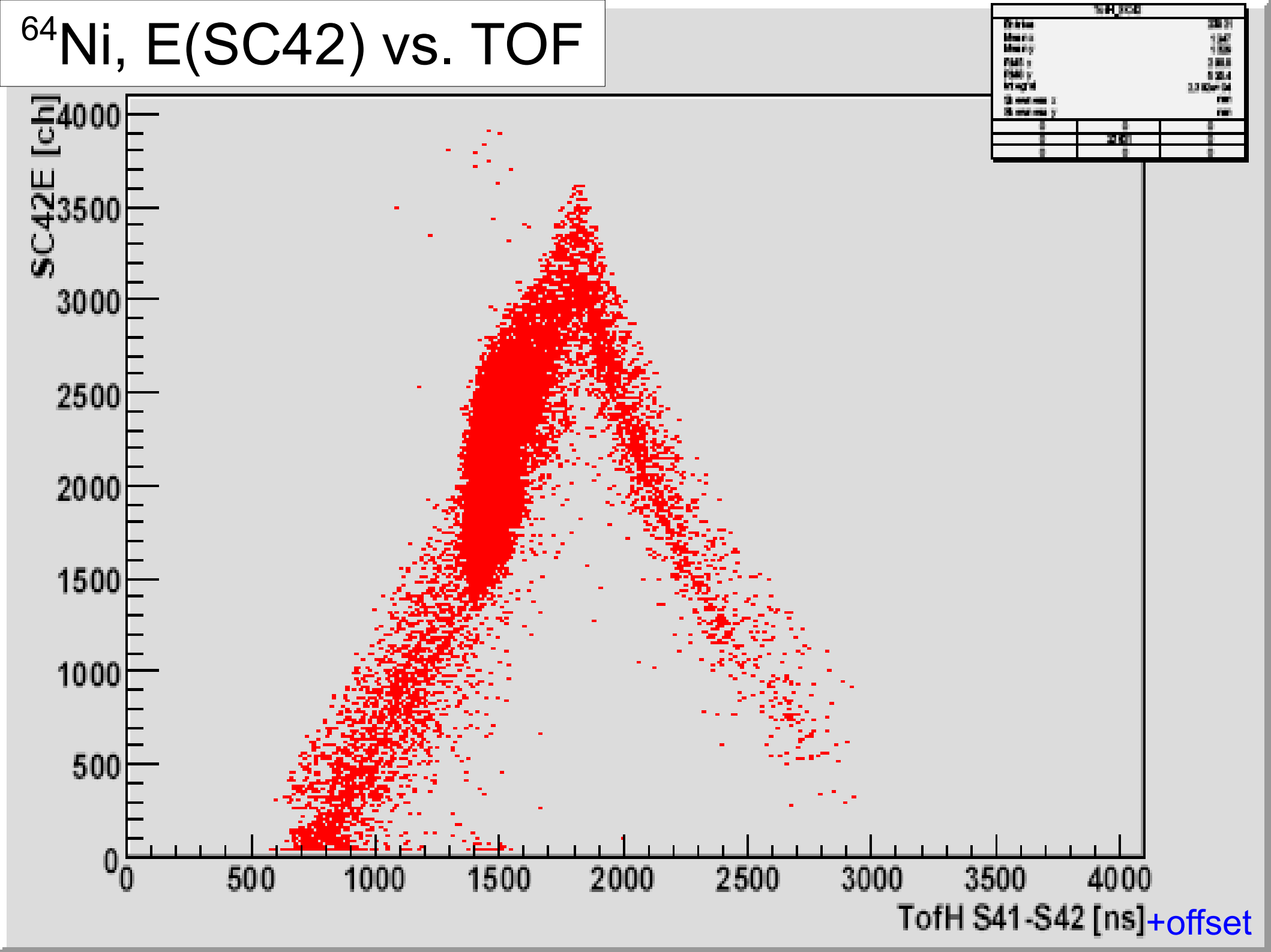
TOF=61.6+/-0.2ns

Eff~1.3% FWHM(A)~29 mrad

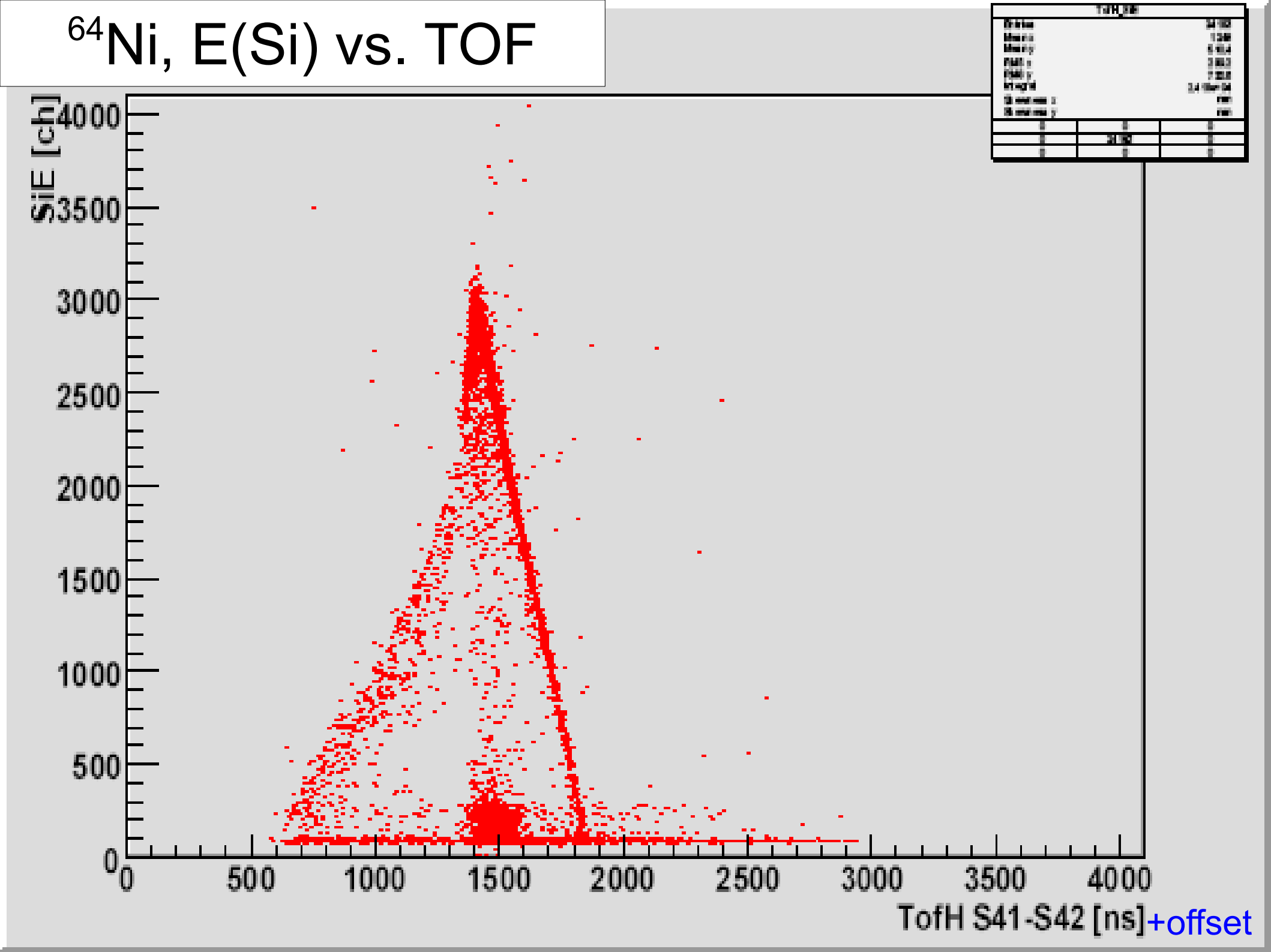
Test Experiment



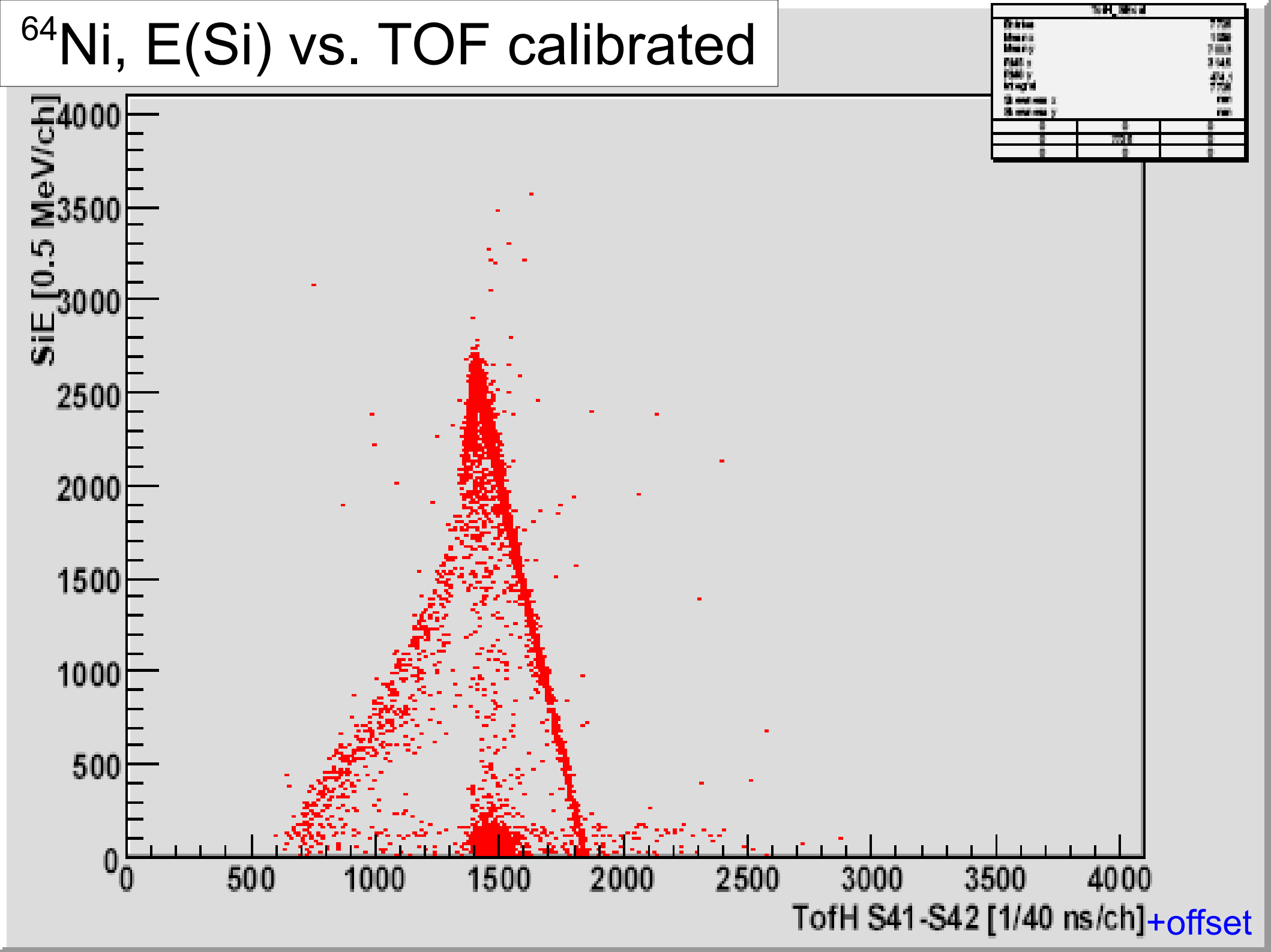
^{64}Ni, E(SC42) vs. TOF



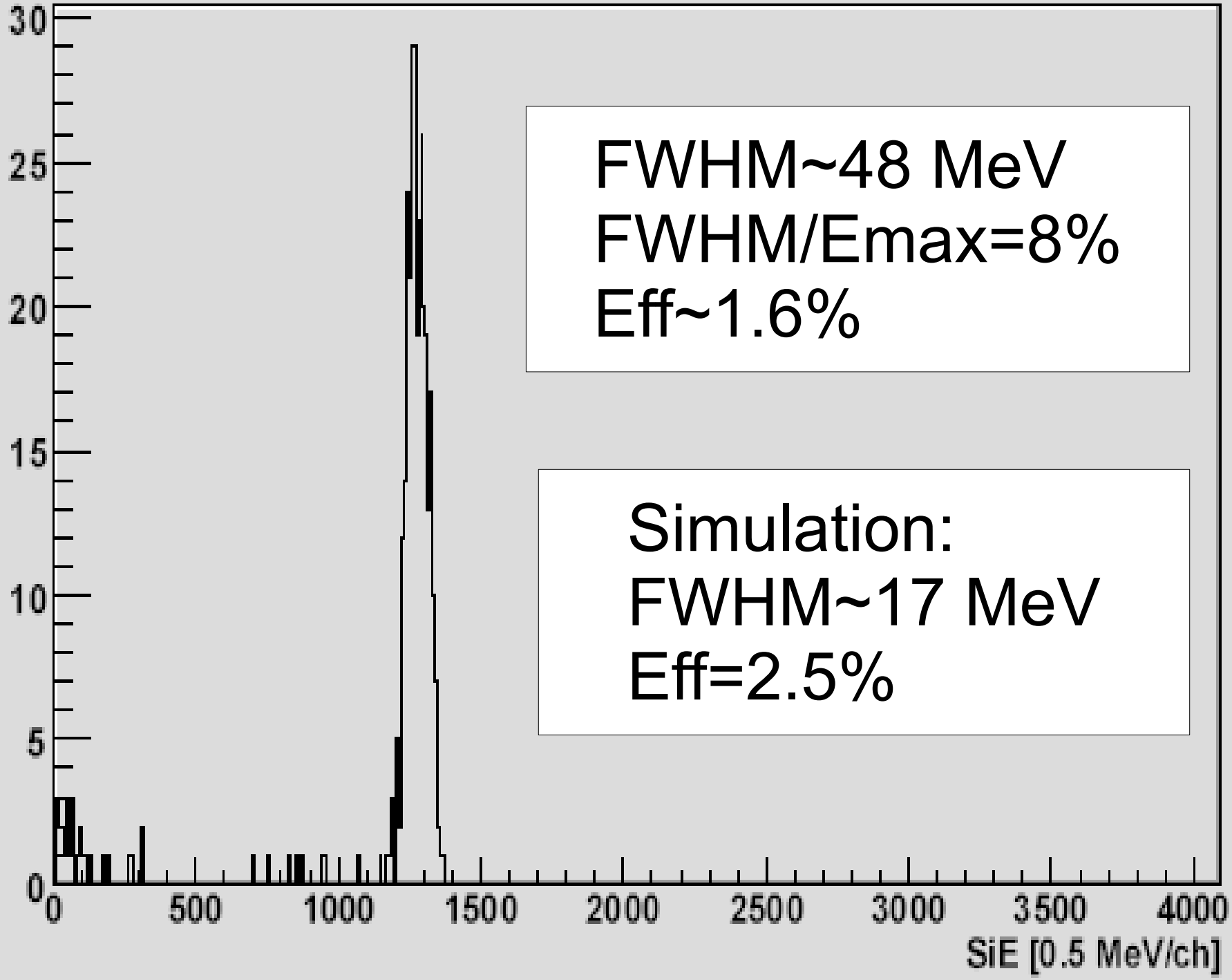
^{64}Ni, E(Si) vs. TOF



^{64}Ni, E(Si) vs. TOF calibrated



^{64}Ni, E(Si) gated on TOF for 10 MeV/u



FWHM~48 MeV
FWHM/Emax=8%
Eff~1.6%

Simulation:
FWHM~17 MeV
Eff=2.5%

Summary

- *Results of the Monte-Carlo simulations*:
  1. Eff and energy resolution from TOF.
  2. Effects from rejecting BG by dE, energy resolution

  Each experiment type needs a dedicated setup.

- Test experiment performed for ^{64}Ni primary beam and fragments:
  1. Angular and energy spread after slowing down was measured.
  2. The first test results on energy straggling support the MC simulations.
  3. Further analysis will give the angular straggling and characteristics of the slow down fragments.

Future

- Experiments with Si DSSD detectors and fast pre-amplifiers are planed for August 2007.
- Experiment at FRS with optimized setup and secondary target in October 2007.