News from Dubna.

M. Gostkin

on behalf of the JINR FCAL group.

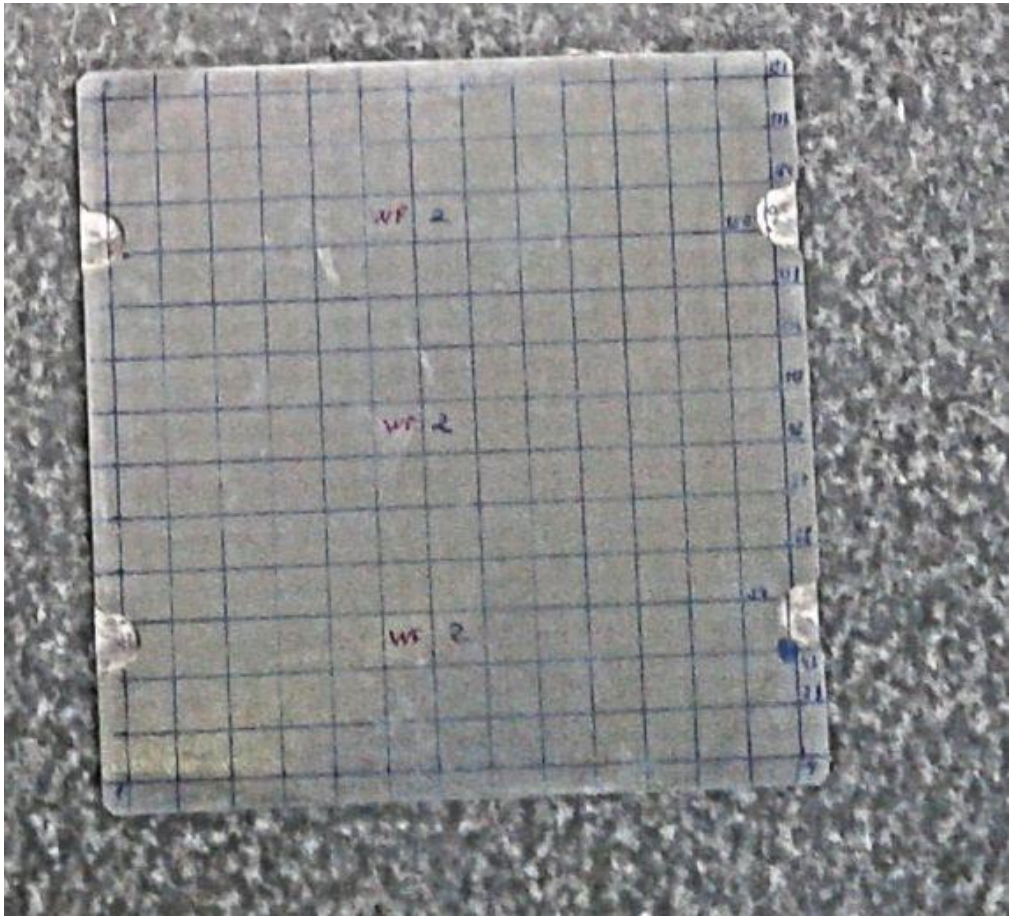
FCAL Workshop

21 October 2015

OUTLINE

- Measurement of tungsten plates.
- GaAs irradiation by fast neutrons.

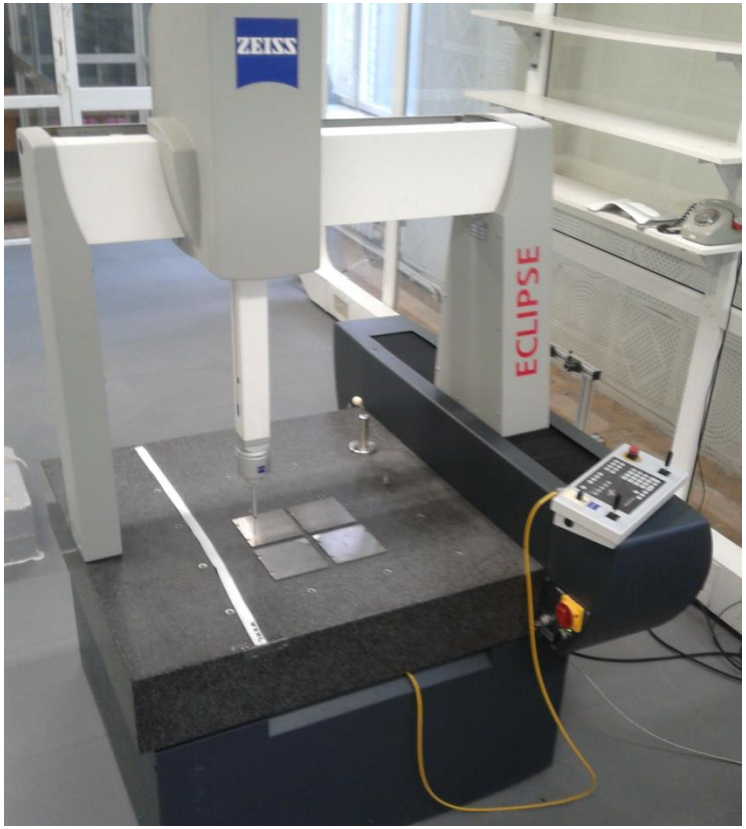
Tungsten plates

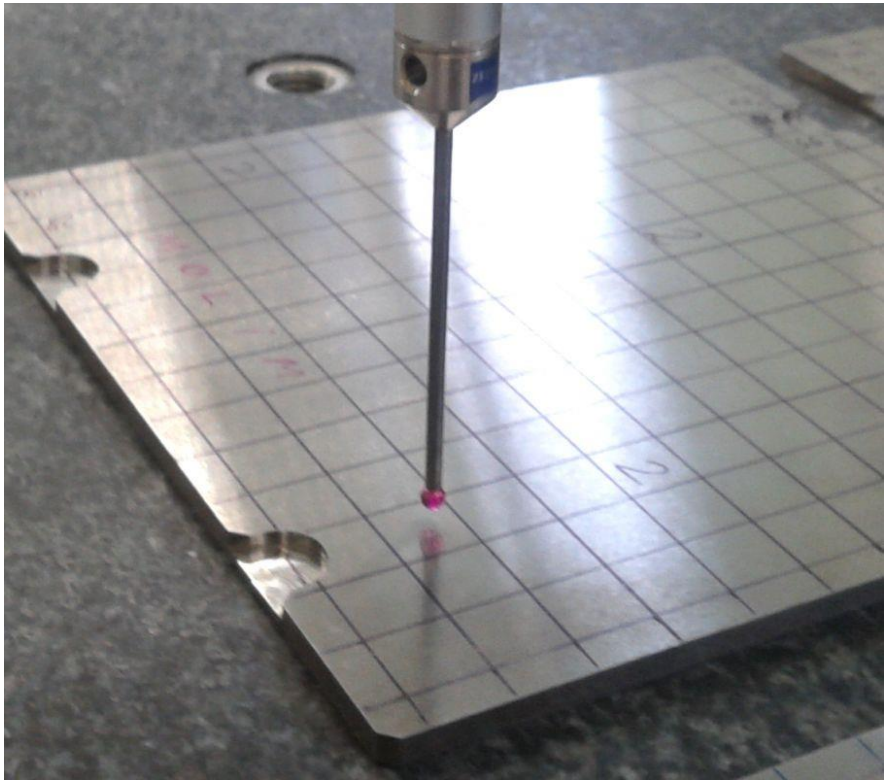


- 2 plates “Molimet“
- 2 plates "WOLFRAMOFF“
- Dimensions 140x140x3.5 mm
- all plates are 99.95% tungsten,

impurities contribution is measured by X-ray radiometric method, see backup slides.

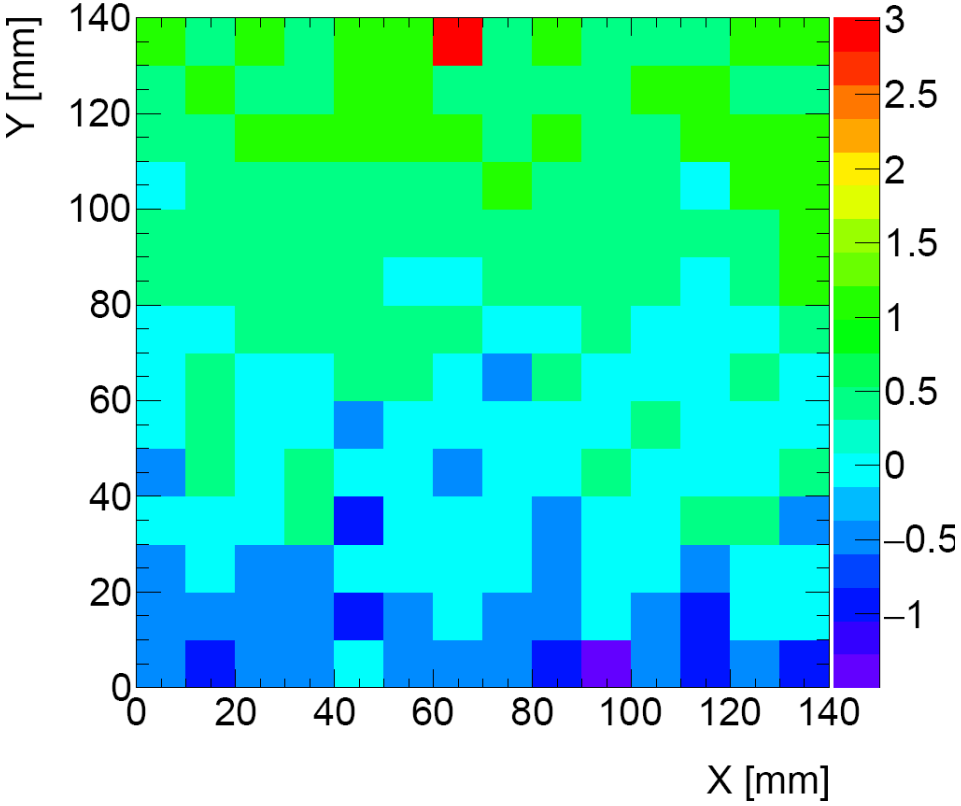
Zeiss 3D coordinate measurement system

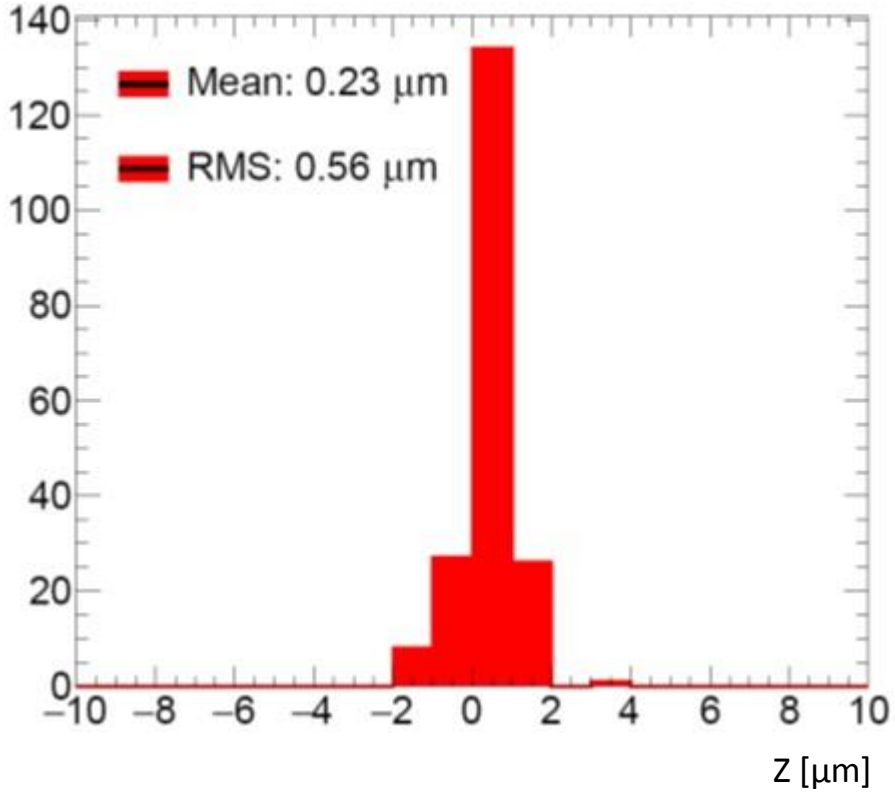




Precision 2.5 µm

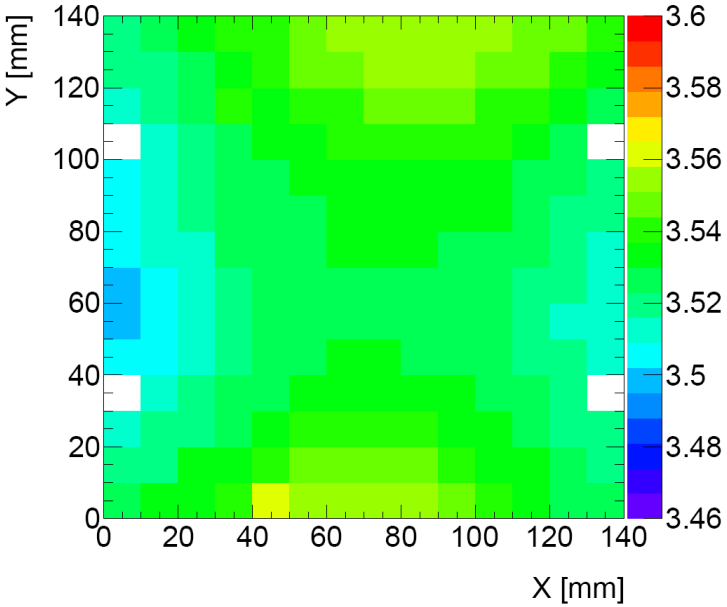
Granite table flatness measurement

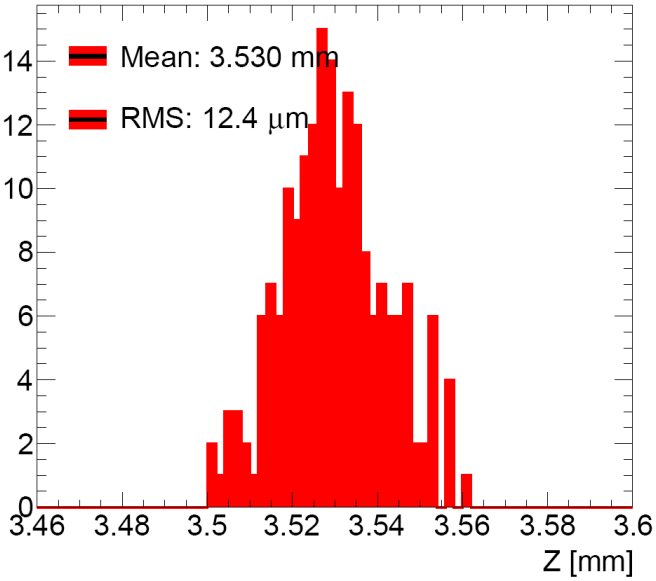




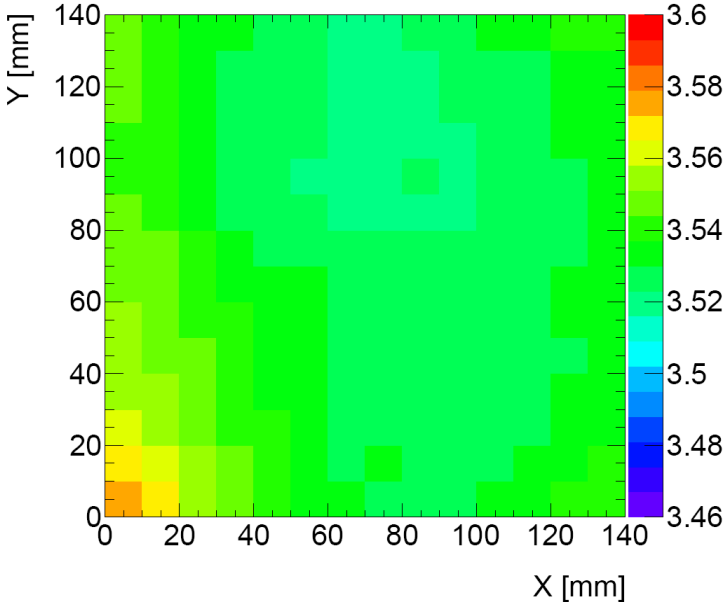
Molimet N1

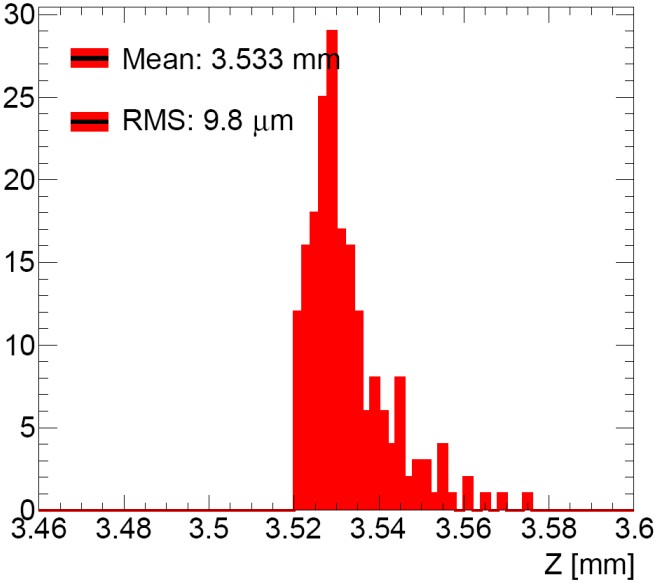
FRONT SIDE





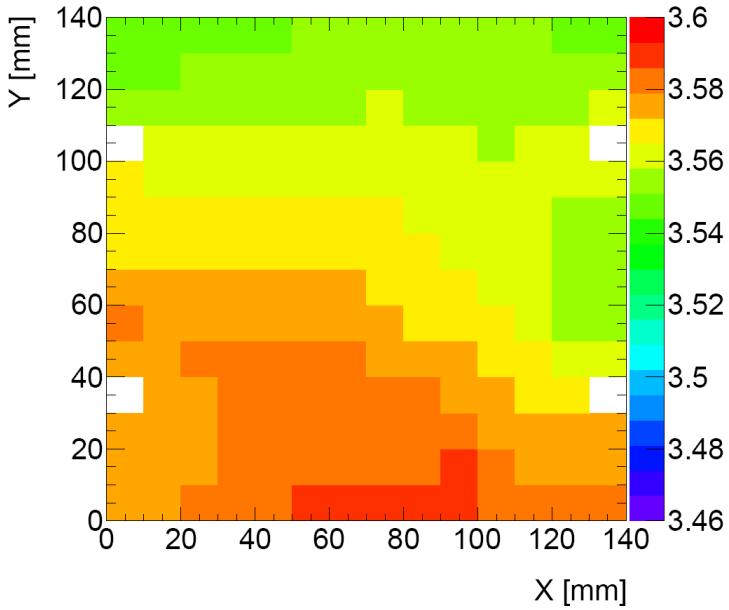
BACK SIDE

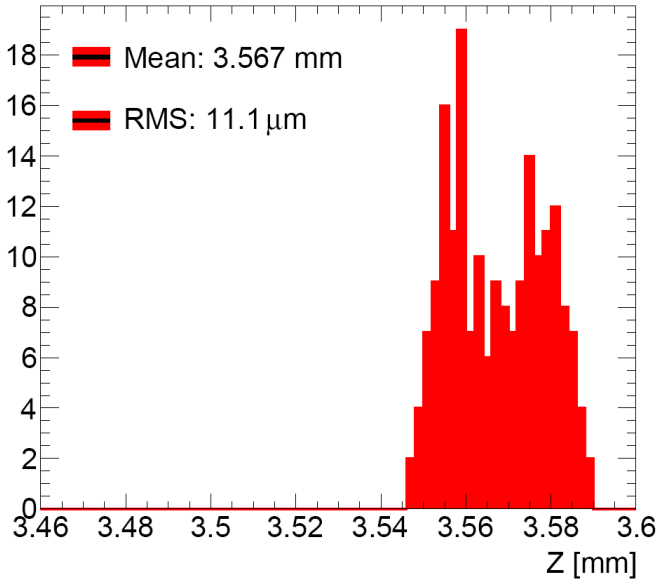




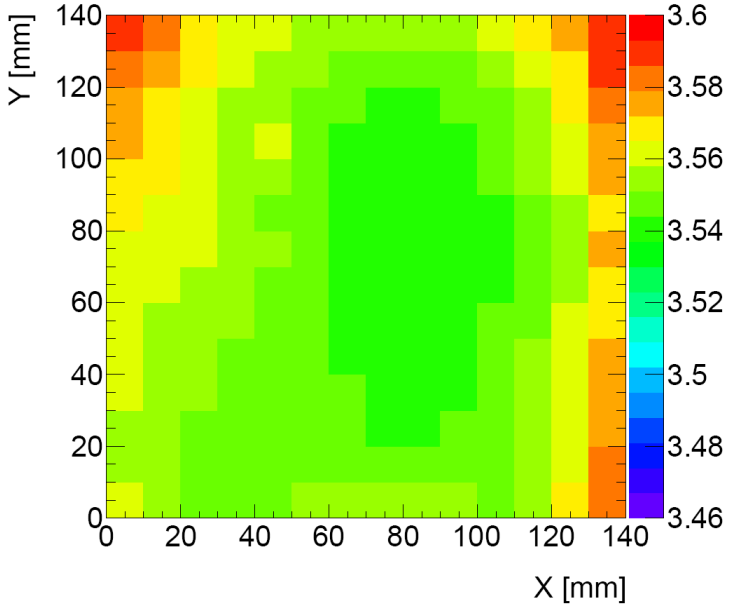
Molimet N2

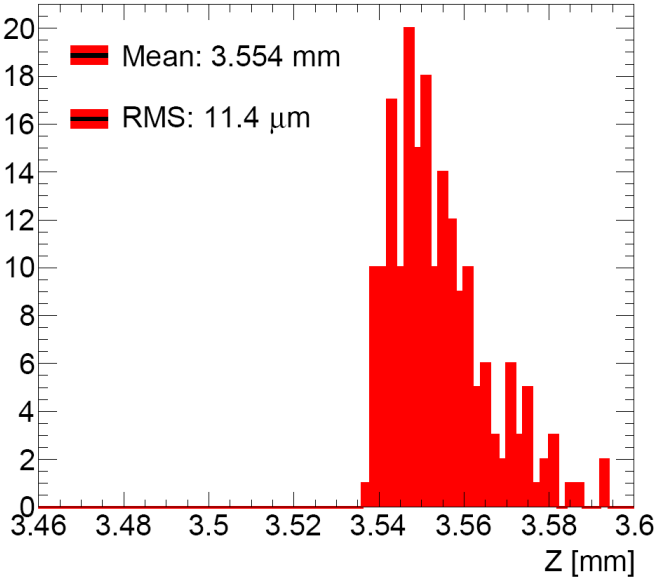
FRONT SIDE





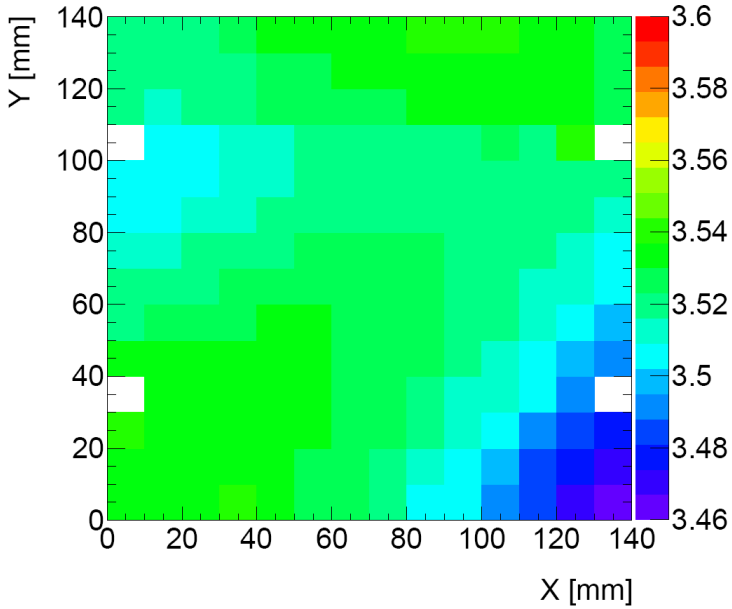
BACK SIDE

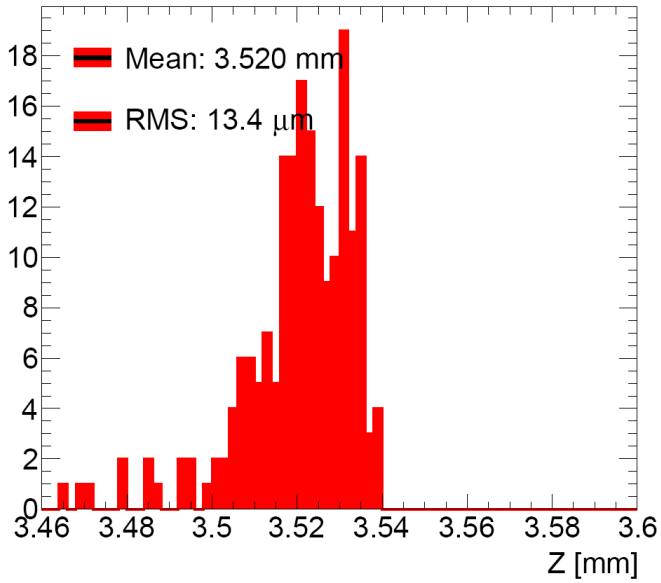




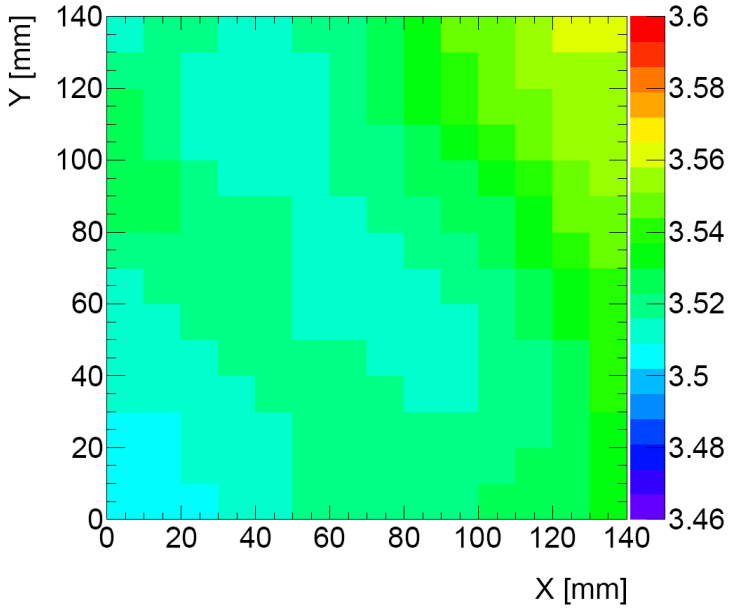
Wolframoff N1

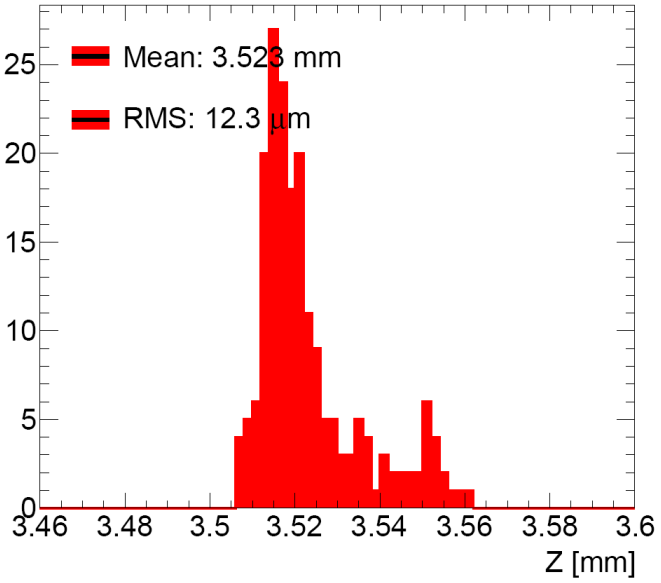
FRONT SIDE





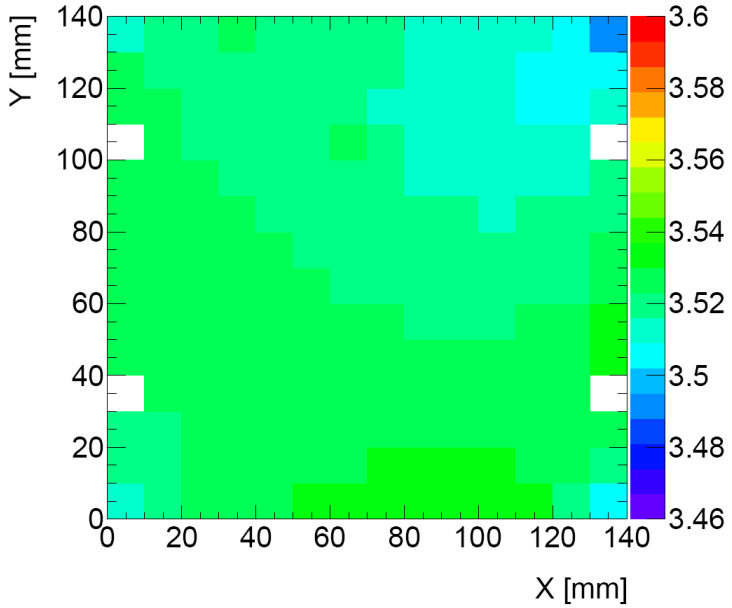
BACK SIDE

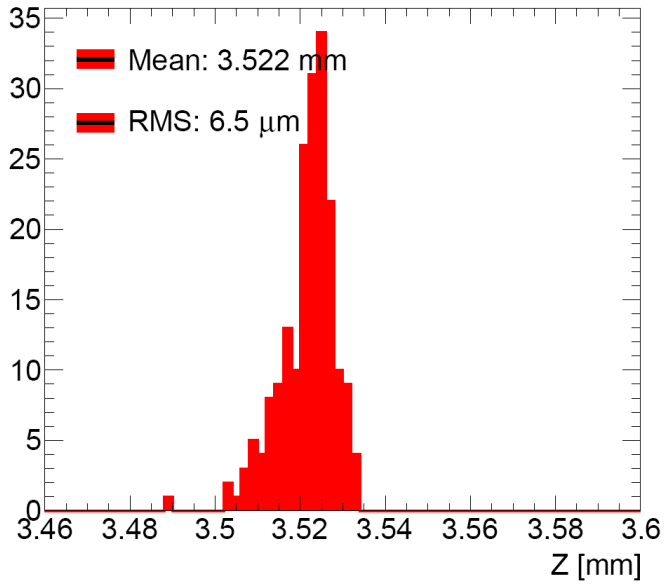




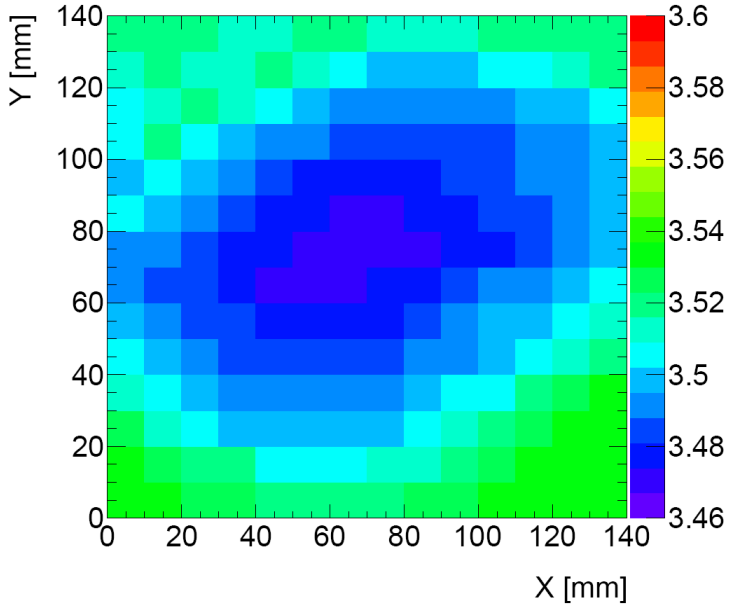
Wolframoff N2

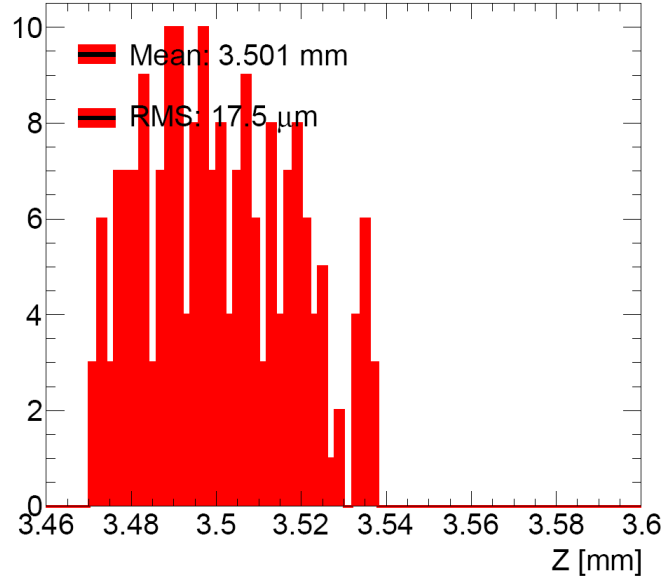
FRONT SIDE



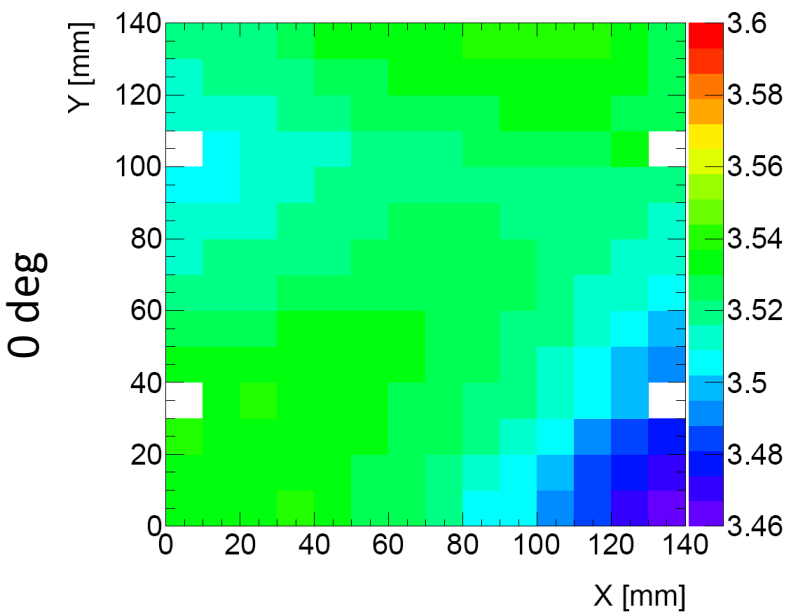


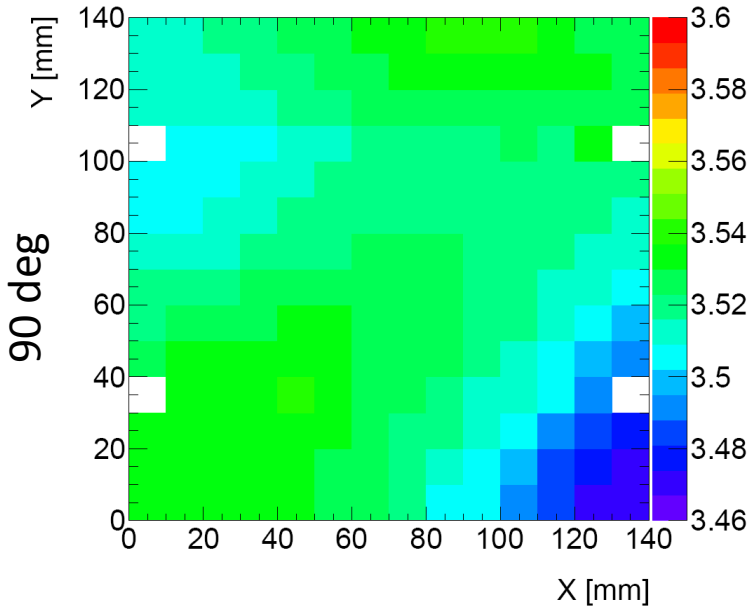
BACK SIDE

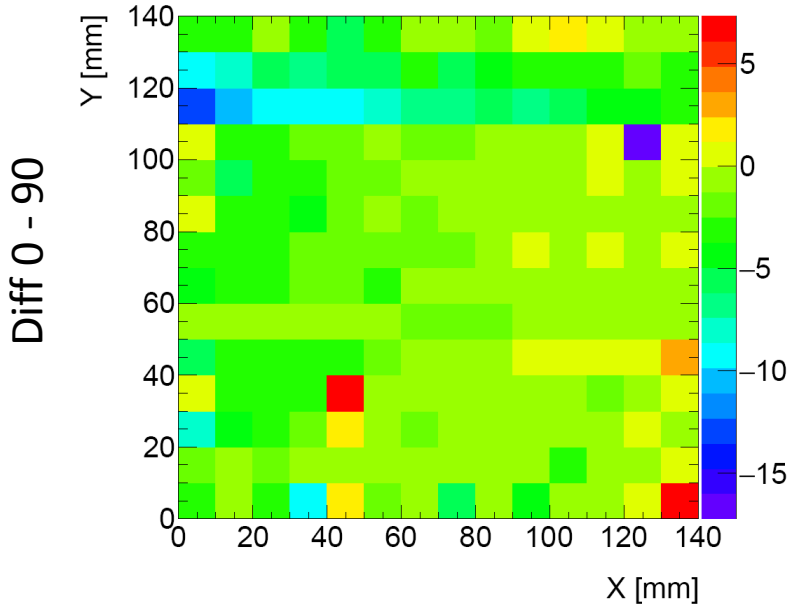


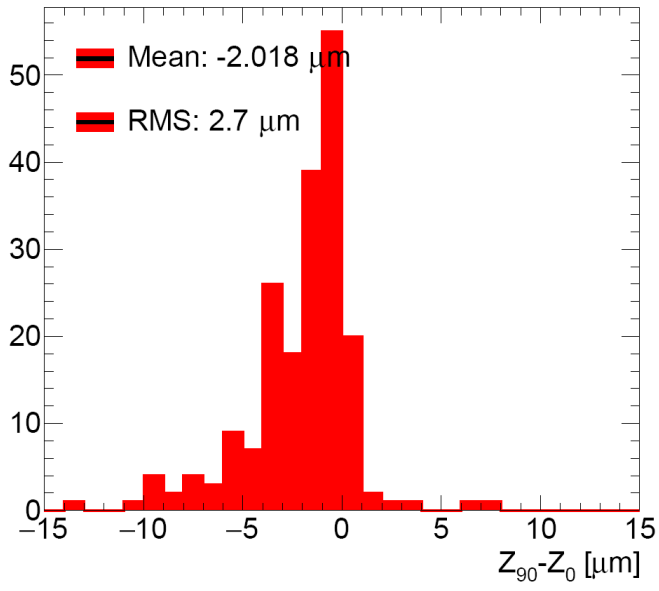


Remeasurements Wolframoff N1 front side



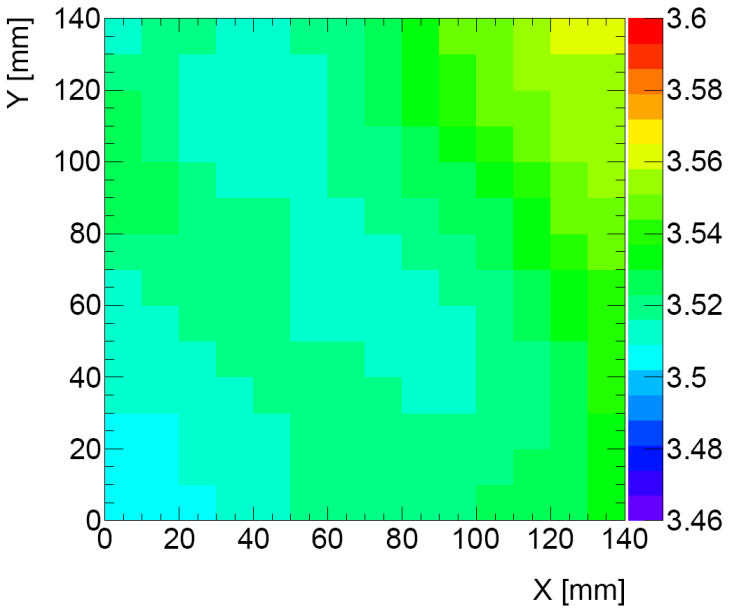




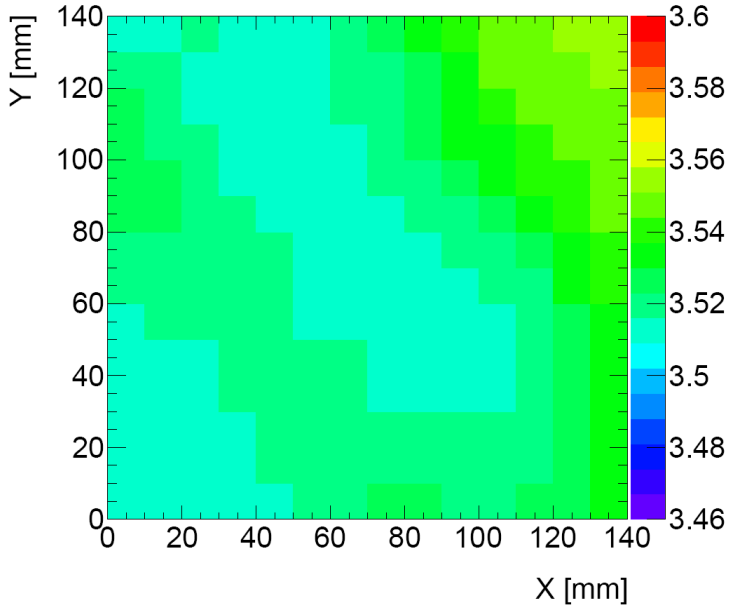


Remeasurements Wolframoff N1 back side

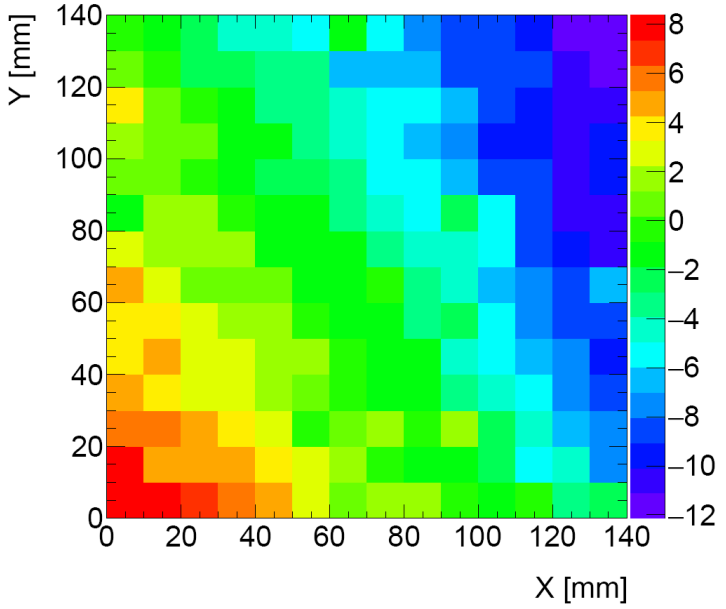
0 deg

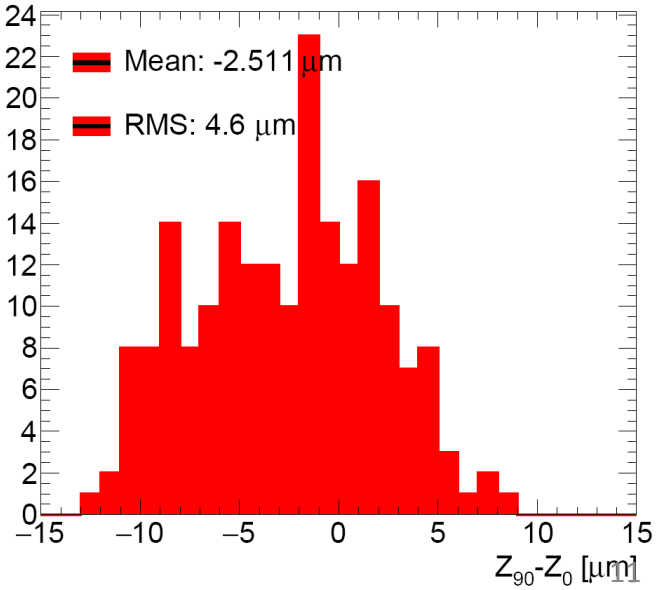


90 deg



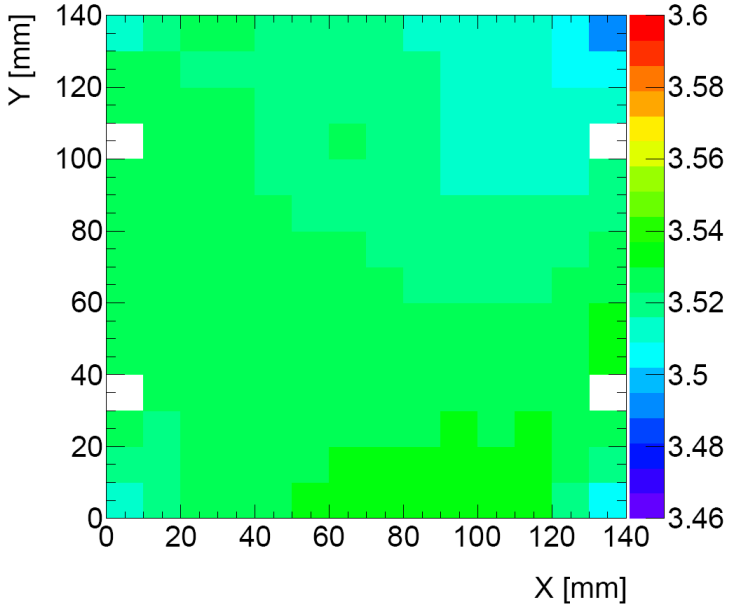
Diff 0 - 90



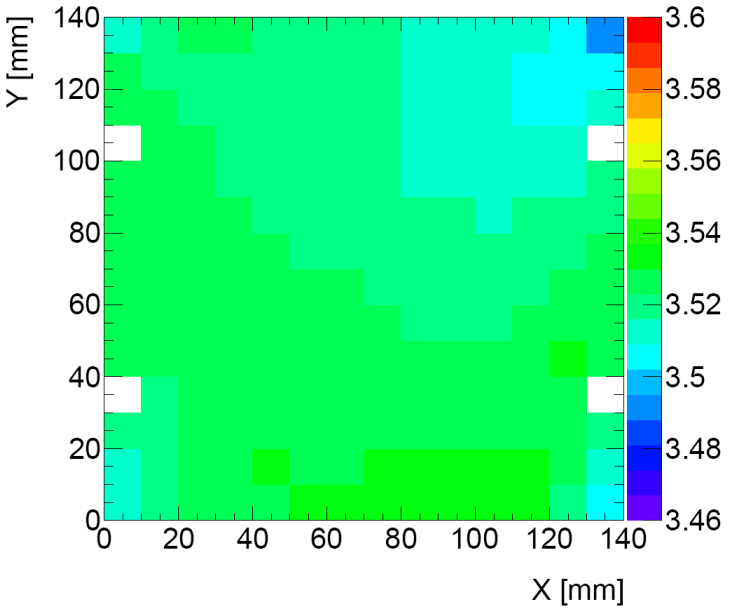


Remeasurements Wolframoff N2 front side

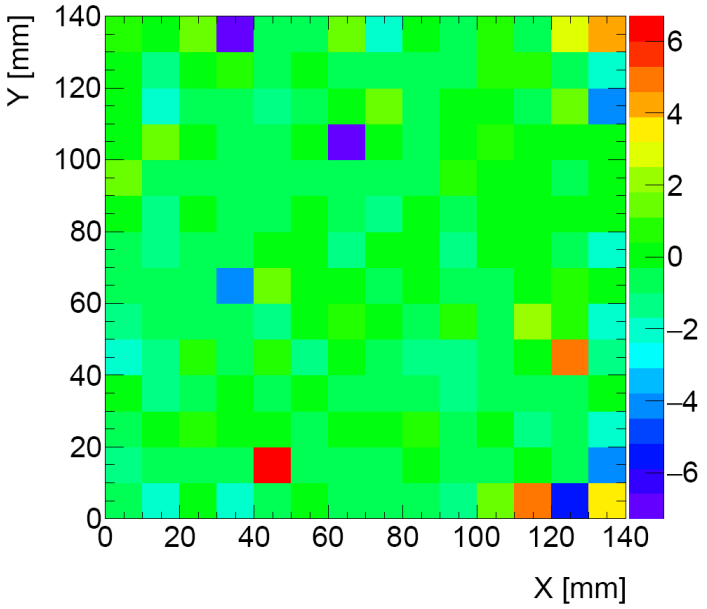
0 deg

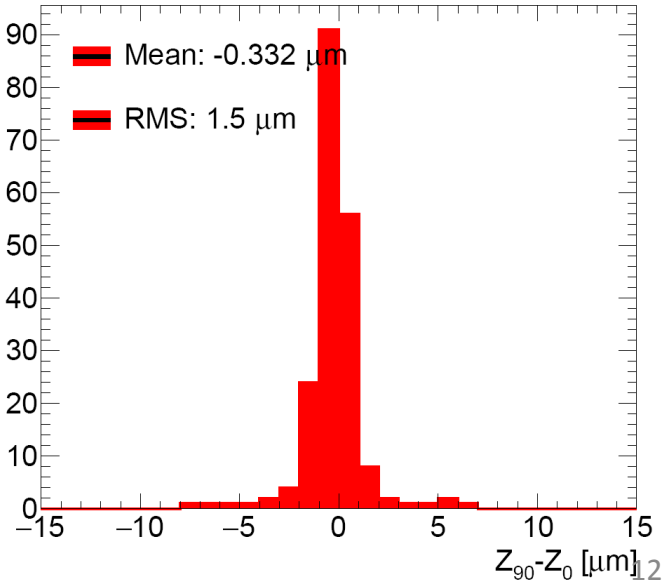


90 deg



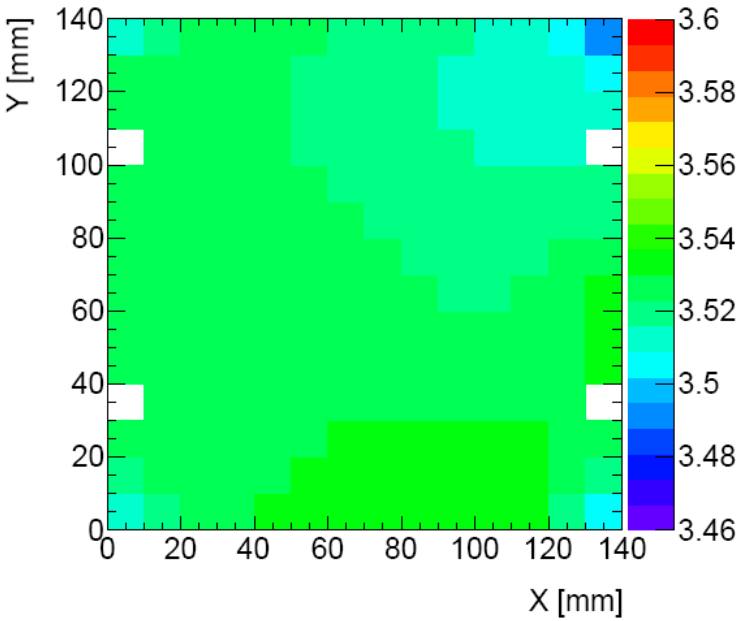
Diff 0 - 90



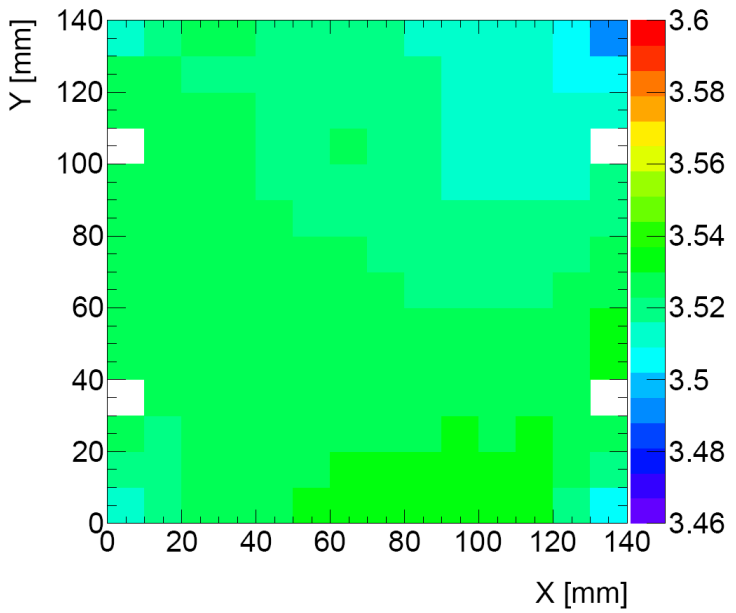


Remeasurements Wolframoff N2 front side

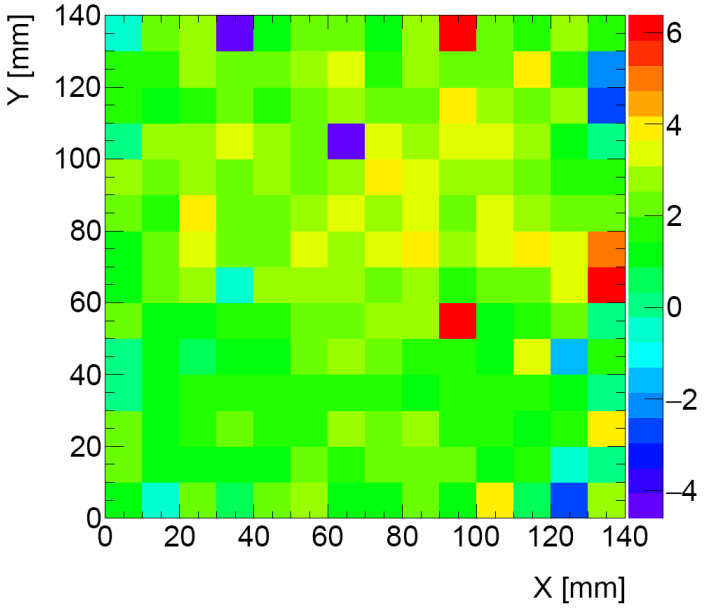
03/2015

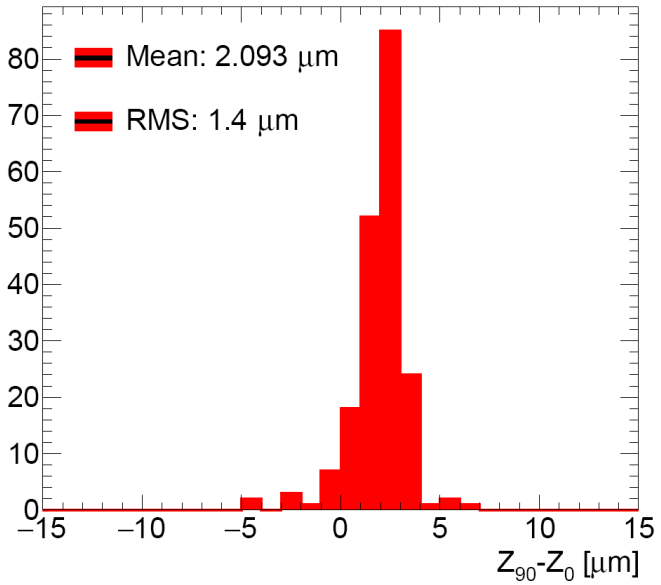


10/2015



Diff





Results & density measurement

Plate	Thickness Front, mm	RMS Front, µm	Max. deviation, front, µm	Thickness Back, mm	RMS Back, µm	Max. deviation, back, µm	Density g/cm^3
W1	3.520	13.4	40	3.523	12.3	60	19.18±0.03
W2	3.522	6.5	35	3.501	17.5	40	19.17±0.03
M1	3.530	12.4	60	3.533	9.8	75	19.11±0.03
M2	3.567	11.1	90	3.554	11.4	95	19.13±0.03

Summary I

- Measurements done with mechanical Zeiss 3-D coordinate measurement system, precision 2.5 µm
- Front and back side measurements were done.
- Repeatability with different plate orientation is quite good ~1.5µm.
- March and October measurement repeatability is also good ~2µm
- Density of tungsten plate is near by 19.18 g/cm^3 for Wolframoff and 19.12 g/cm^3 for Molimet.
- Delivery of new plates from Wolframoff is expected next week
- Manufacturer

  MOLIMET: 300€/piece if <3 pieces

  WOLFRAMOFF: 600 € /piece if <3 pieces

GaAs fast neutron irradiation by JINR IBR-2 pulse reactor

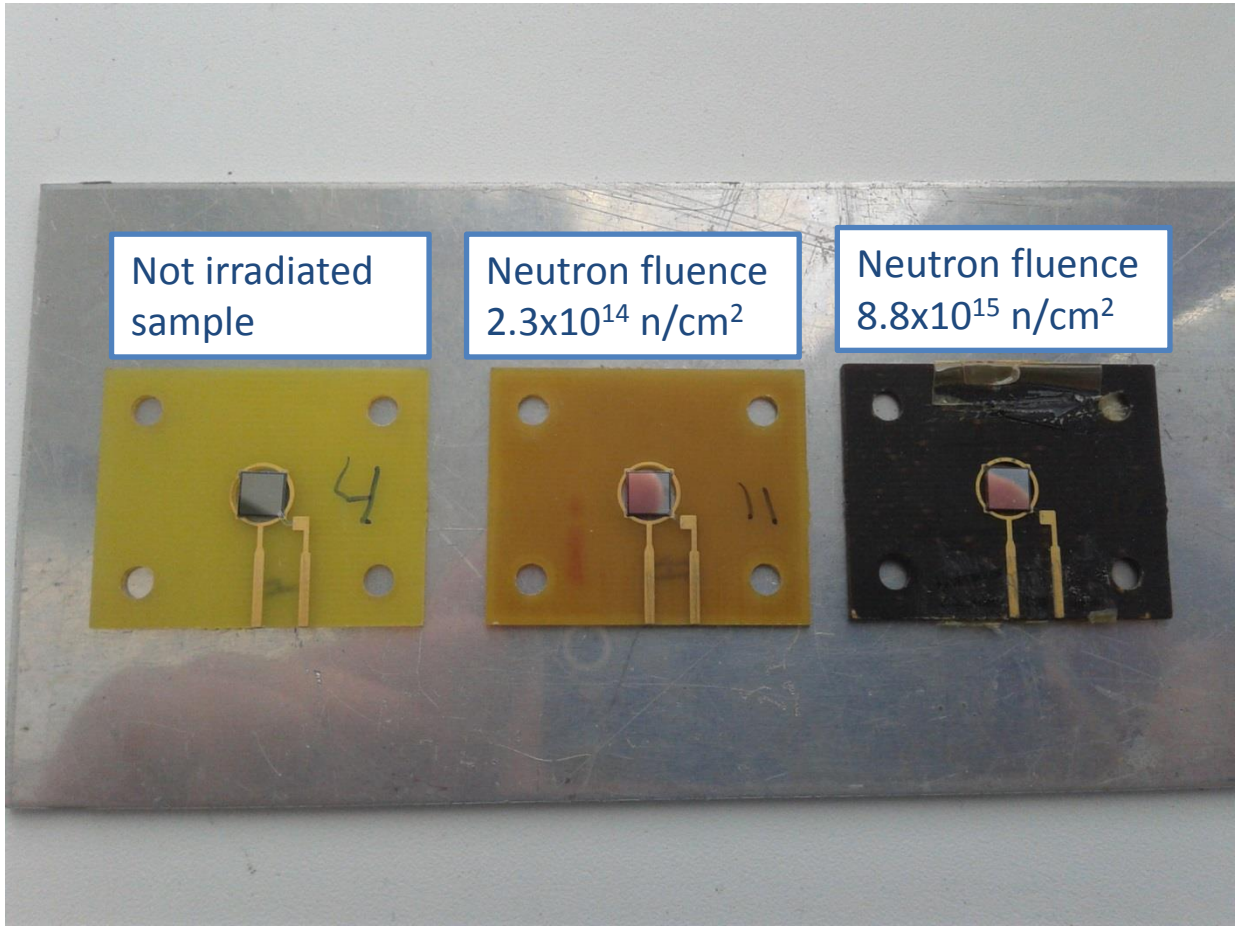
GaAs 300 µm

Neutron fluence

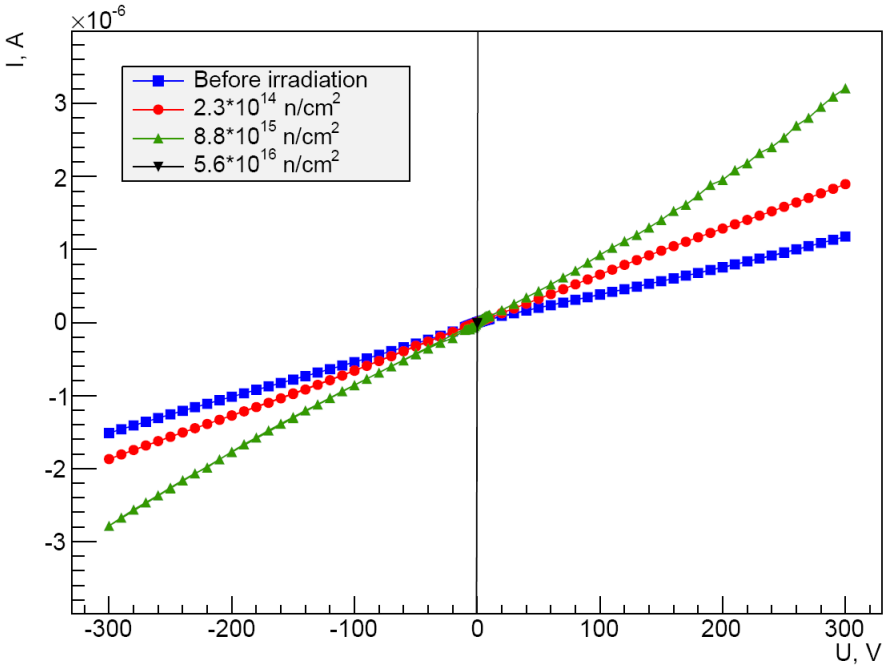
- 2.3×10^{14} n/cm^2
- 8.8×10^{15} n/cm^2
- 5.6×10^{16} n/cm^2

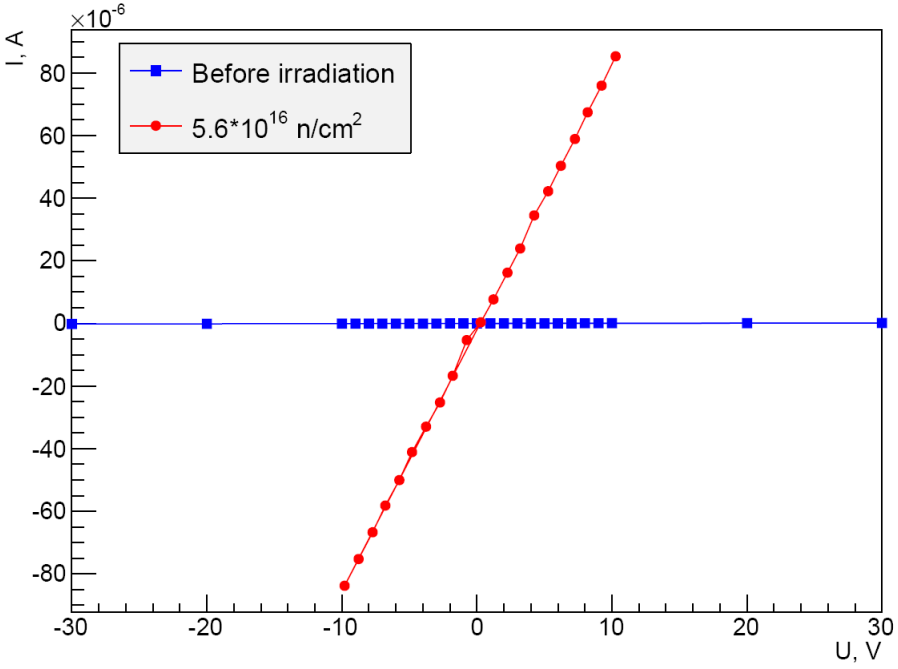
Fast neutrons are in a broad spectrum from 1.5 MeV to 4.4 MeV.

GaAs samples

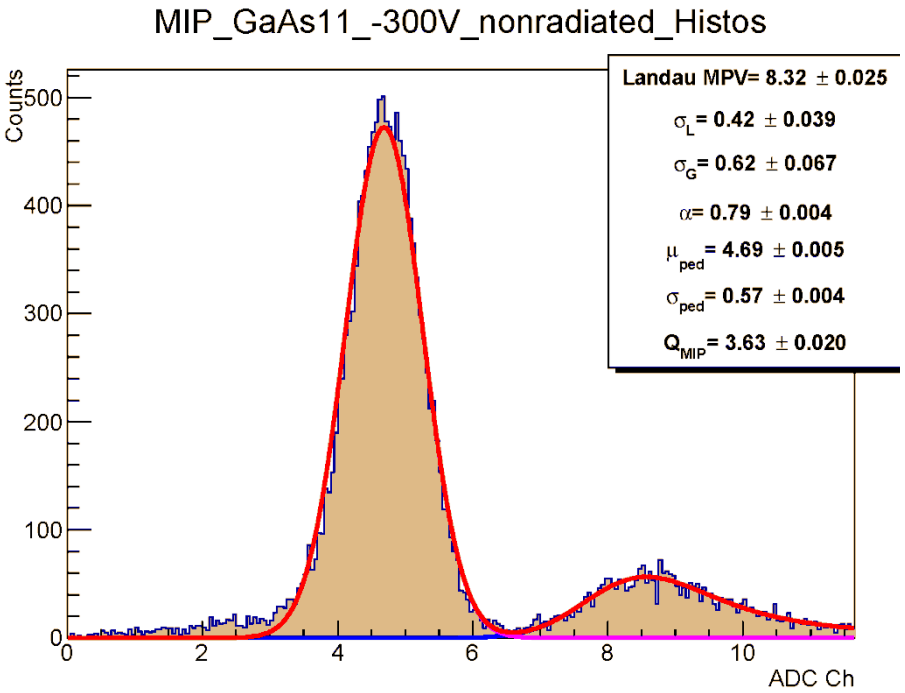


IV-characteristics

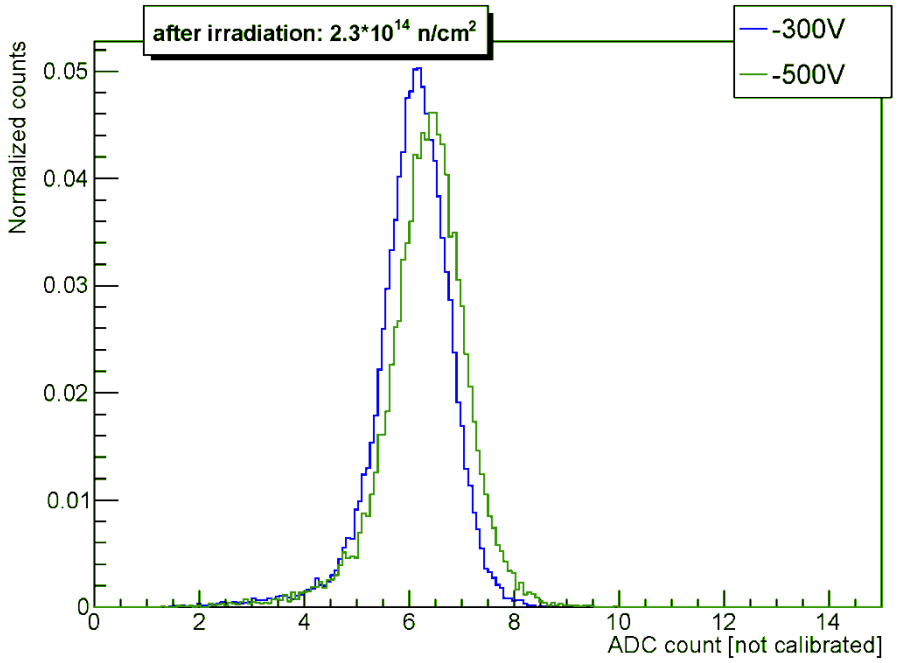




MIP from Sr-90



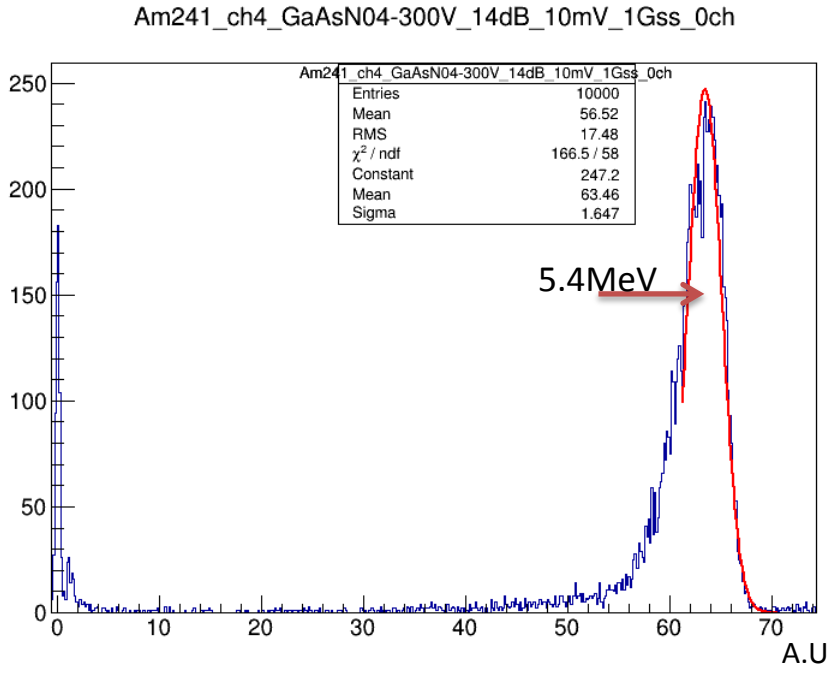
1ADC Ch = 4,26 ke

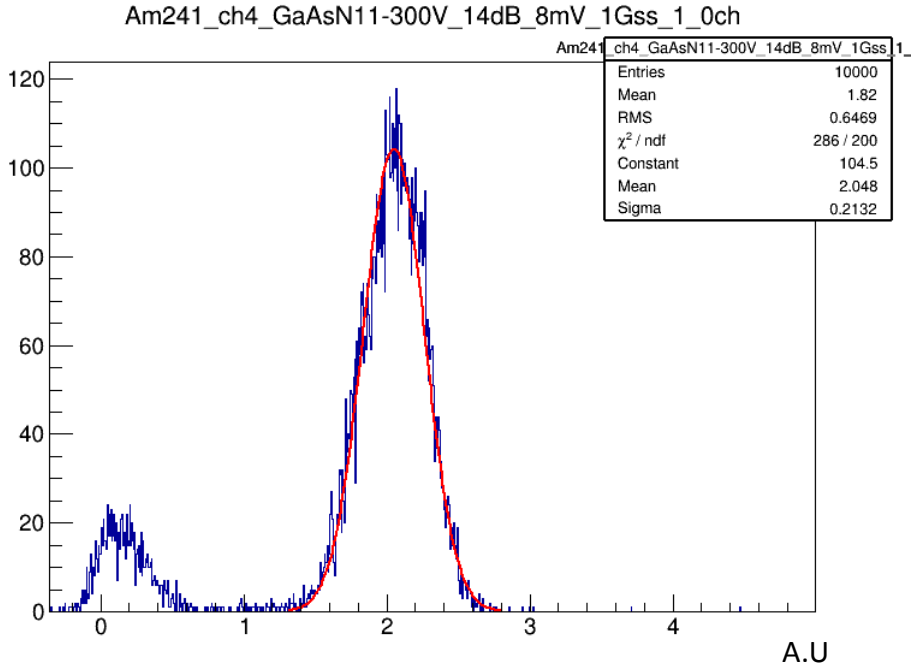


Am-241 spectra

Not irradiated sample

neutron fluence 2.3×10^{14} n/cm^2



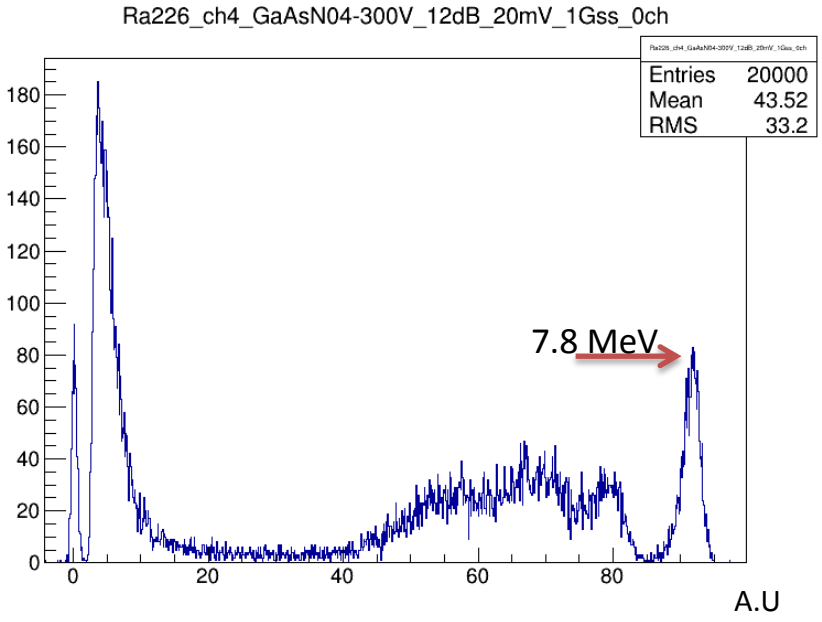


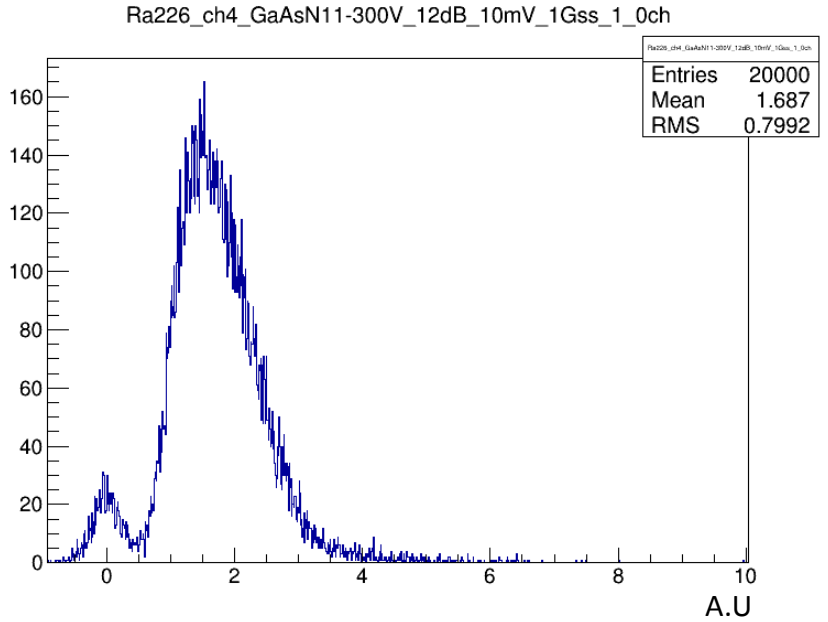
The signal (and CCE) decreased from 63.4 to 1.9 or ~ 33 times

Ra-226 spectra

Not irradiated sample

neutron fluence 2.3×10^{14} n/cm^2





With Ra-226 the signal decreased ~ 33 times
But peaks can not be separated

Summary II

- GaAs sensors are still working after neutron fluence 2.3×10^{14} n/cm^2
- The signal peak remains narrow and clearly visible
- And almost died after neutron fluence 8.8×10^{15} n/cm^2
- More detailed series of measurements with a neutron fluence < 10^{14} n/cm^2 is necessary

Backup

Impurities	MOLIMET [%]	WOLFRAMOFF [%]
Fe	≤ 0.007	0.001
Ca	≤ 0.004	0.003
Mg	– – –	0.0005
Mo	≤ 0.03	0.0016
C	– – –	0.0023
Al	≤ 0.001	0.0005
Si	≤ 0.003	0.0005
Ni	≤ 0.004	0.0005
N	– – –	0.0004
O	– – –	0.0015
K	≤ 0.009	– – –
Na	≤ 0.01	– – –
As	≤ 0.003	– – –