Karakterizacija jednodimenzionalnog pozicijski osjetljivog detektora ionskom mikroprobom

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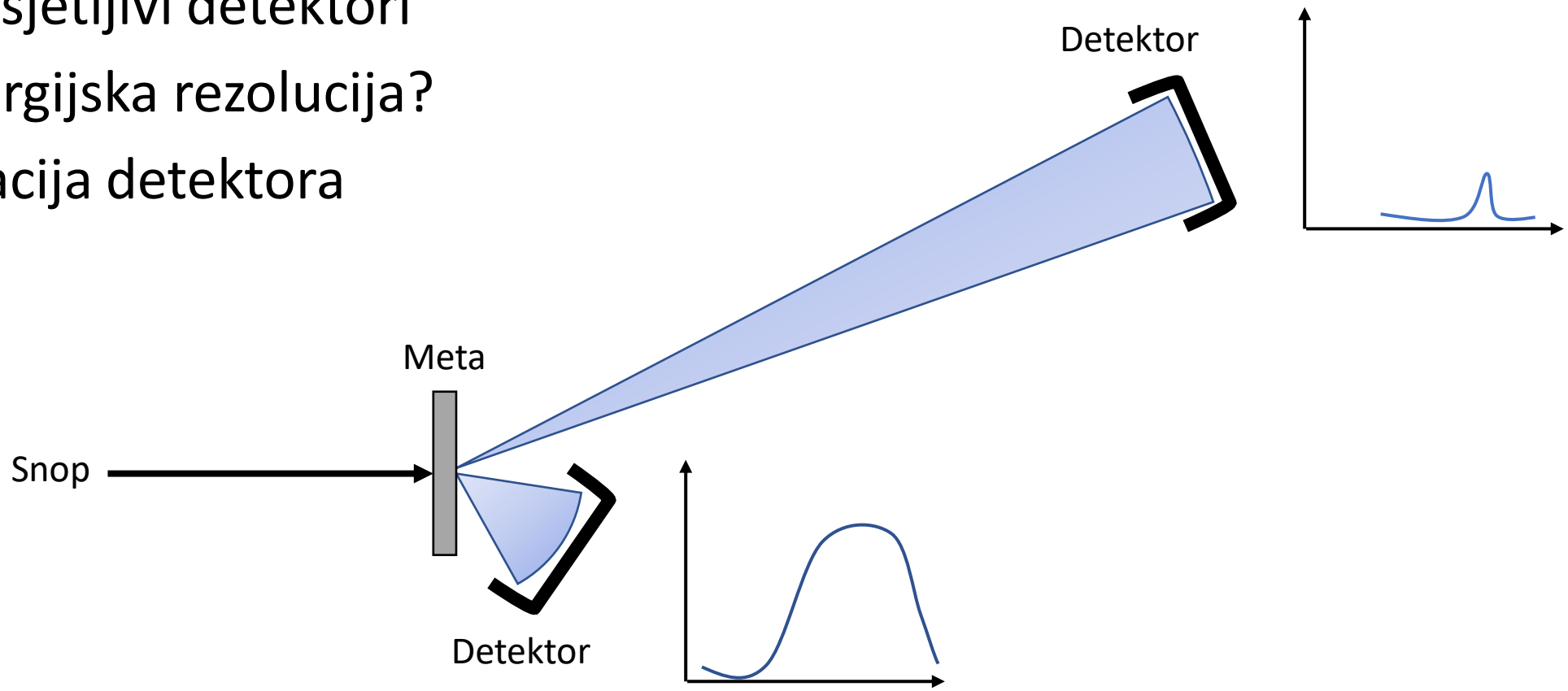
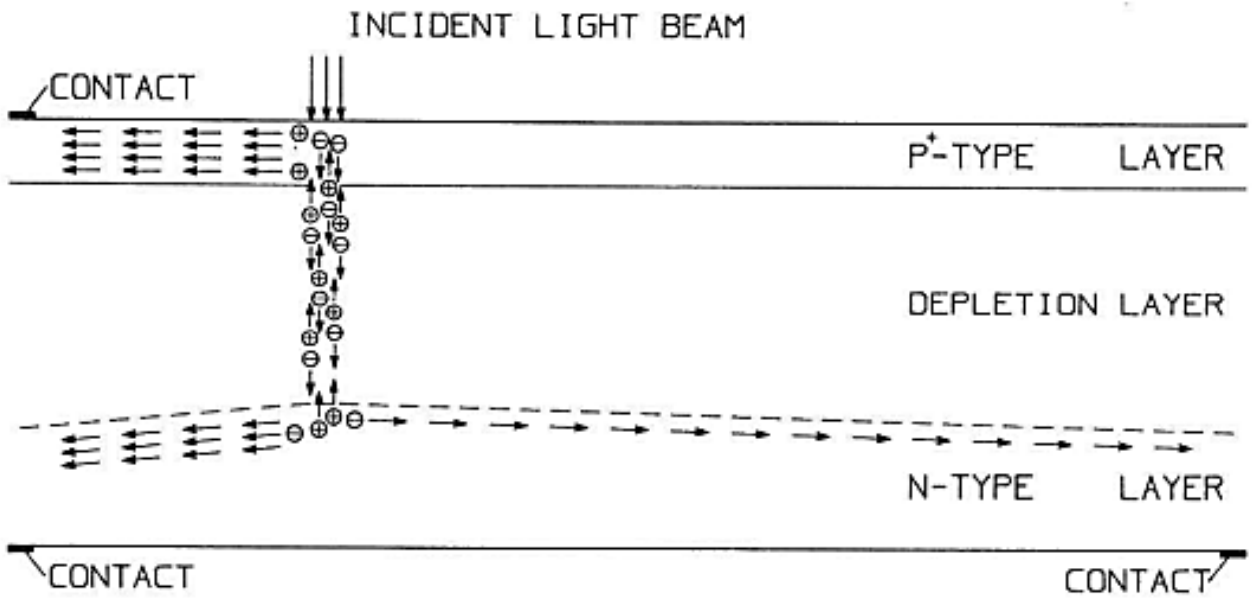
Uvod

- Želimo prostorno i energijsko razlučivanje
- Pozicijski osjetljivi detektori
- Slabija energijska rezolucija?
- Karakterizacija detektora



Pozicijski osjetljivi detektori

- Kontinuirani i diskretni
- Jednodimenzionalni i dvodimenzionalni



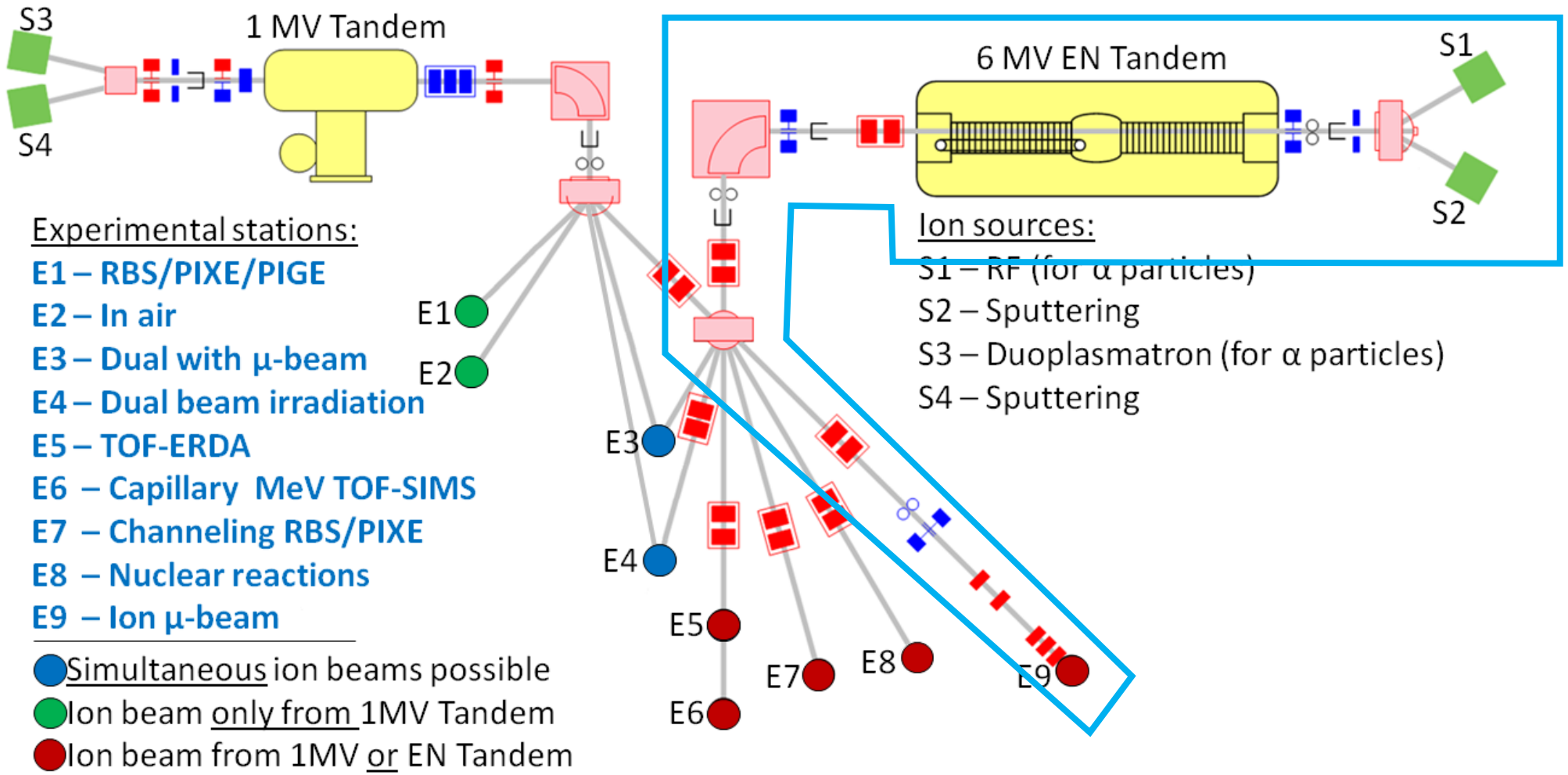
[D.J.W. Noorlag, *Lateral-photoeffect position-sensitive detectors*, doktorska disertacija, TU Delft (1982)]

SiTek S-0341 (1L2.5UV_CP2_NW)

- Aktivno područje 2.5×0.6 mm^2
- Povećana osjetljivost na UV
- DIL14 keramičko kućište
- Zaporni napon 5…20V na katodu

[http://www.sitek.se/1d.htm]

Akceleratorski sustav



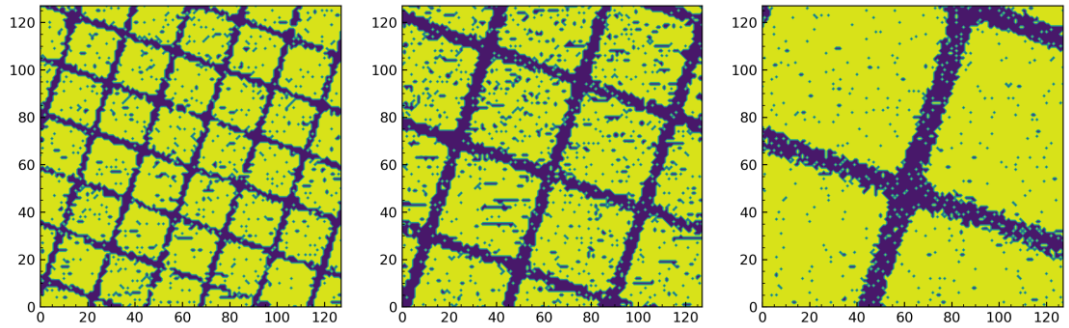
[https://www.irb.hr/Zavodi/Zavod-za-eksperimentalnu-fiziku/Laboratorij-za-interakcije-ionskih-snopova/Clanci/Eksperimentalne-linije]

Ionska mikroproba

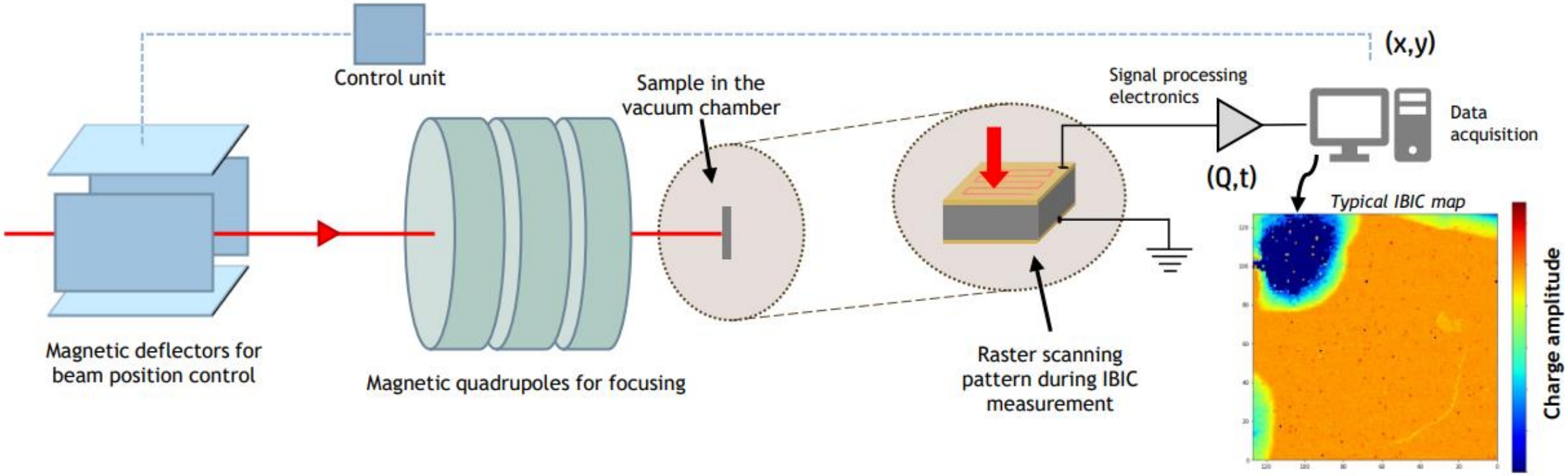
- Snop p^+ energije 2 MeV
- Širina snopa

x FWHM = 0.94 ± 0.30 µm

y FWHM = 0.73 ± 0.30 µm

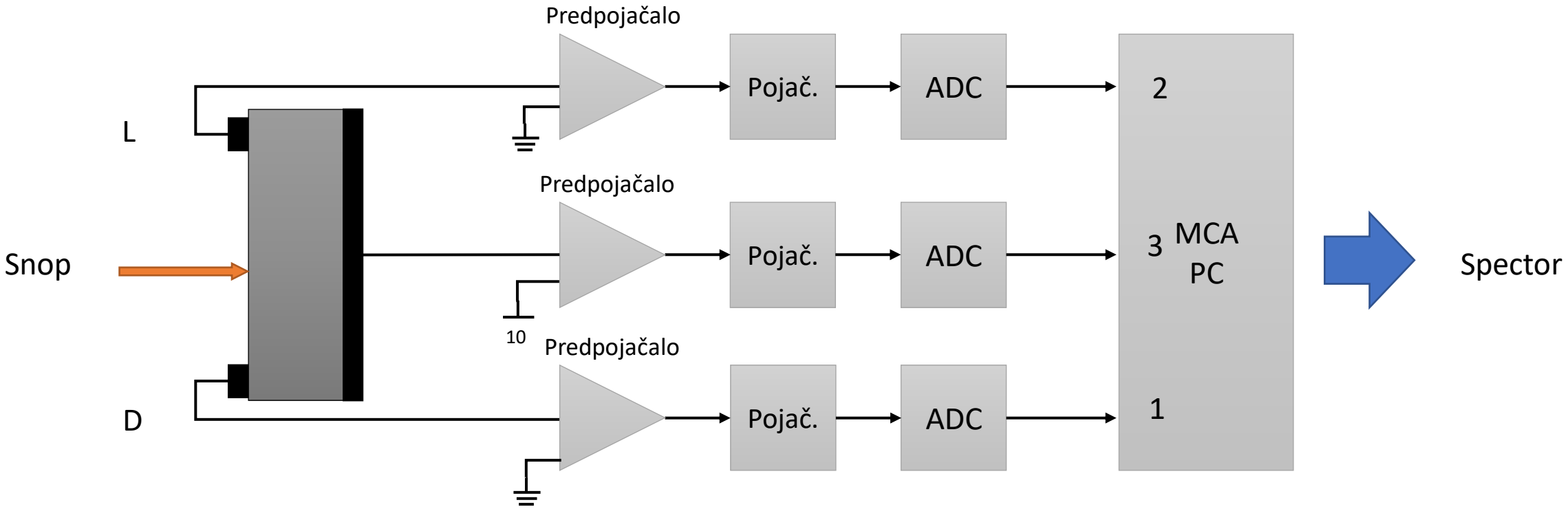


243 µm 128 µm 65 µm



[A. Crnjac, *Influence of radiation and high temperatures on electronic properties of diamond detectors*, doktorska disertacija, PMF (2022)]

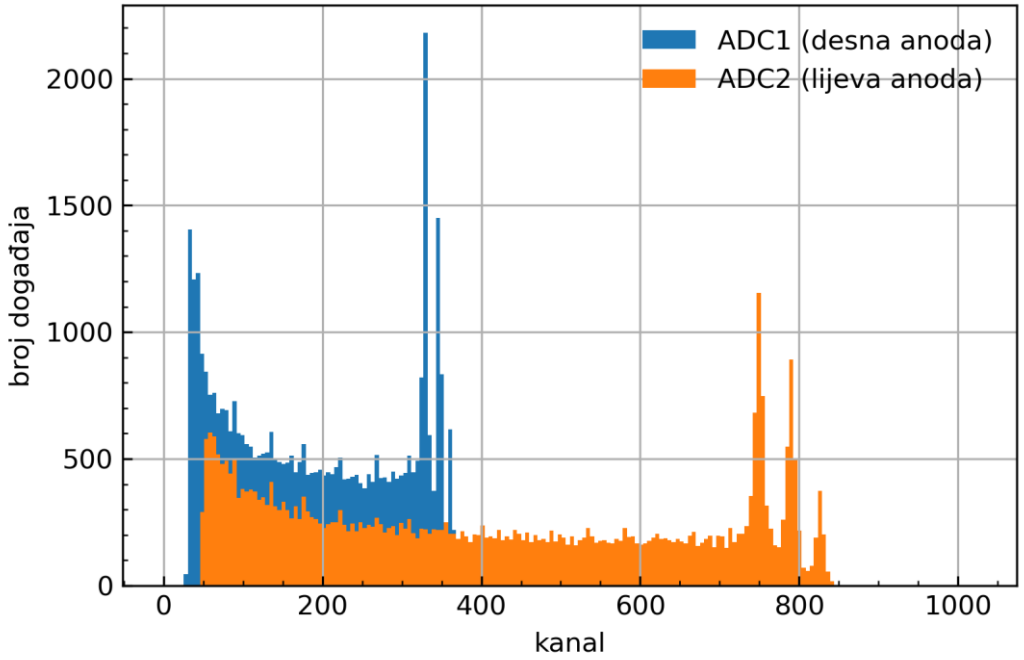
Mjerni postav

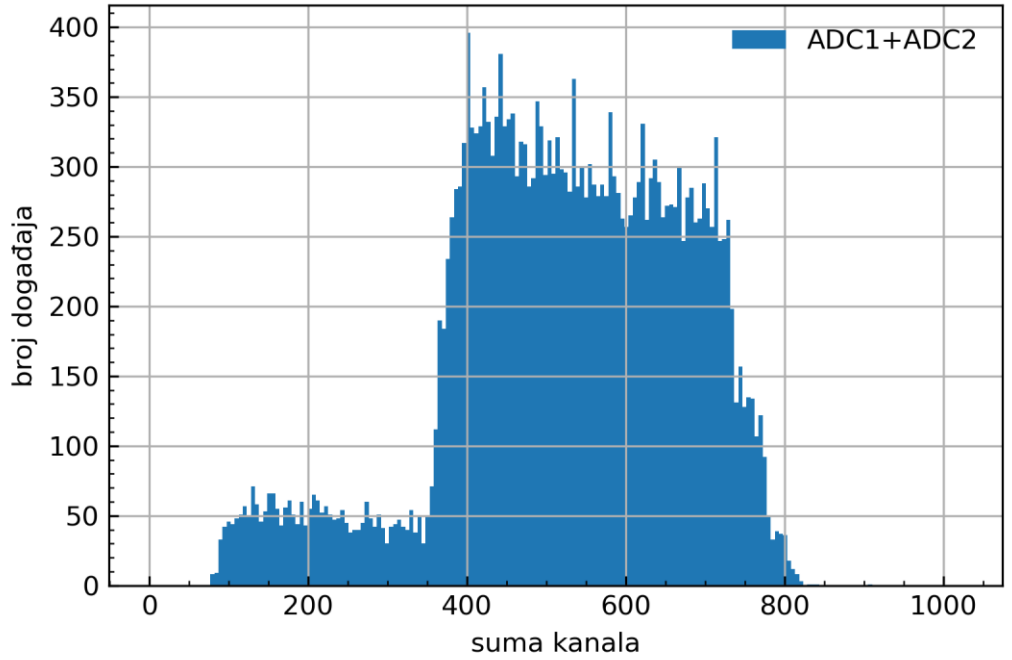


$$E \propto I_1 + I_2 \propto I_3$$

$$\frac{2x}{L} = \frac{I_1 - I_2}{I_1 + I_2}$$

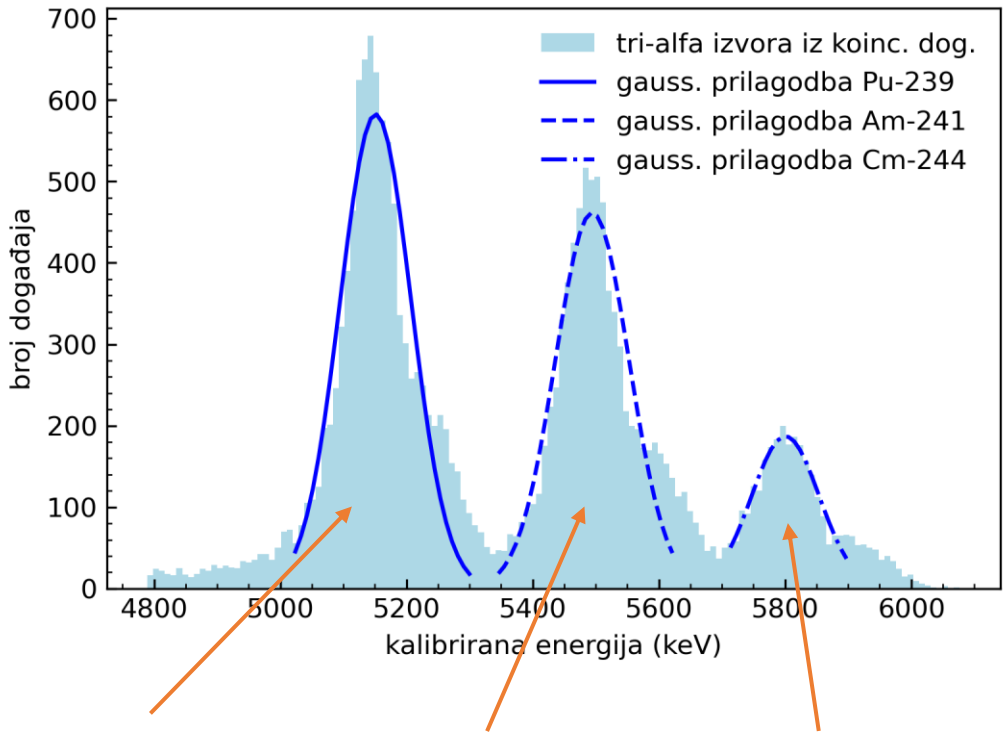
Asimetrija





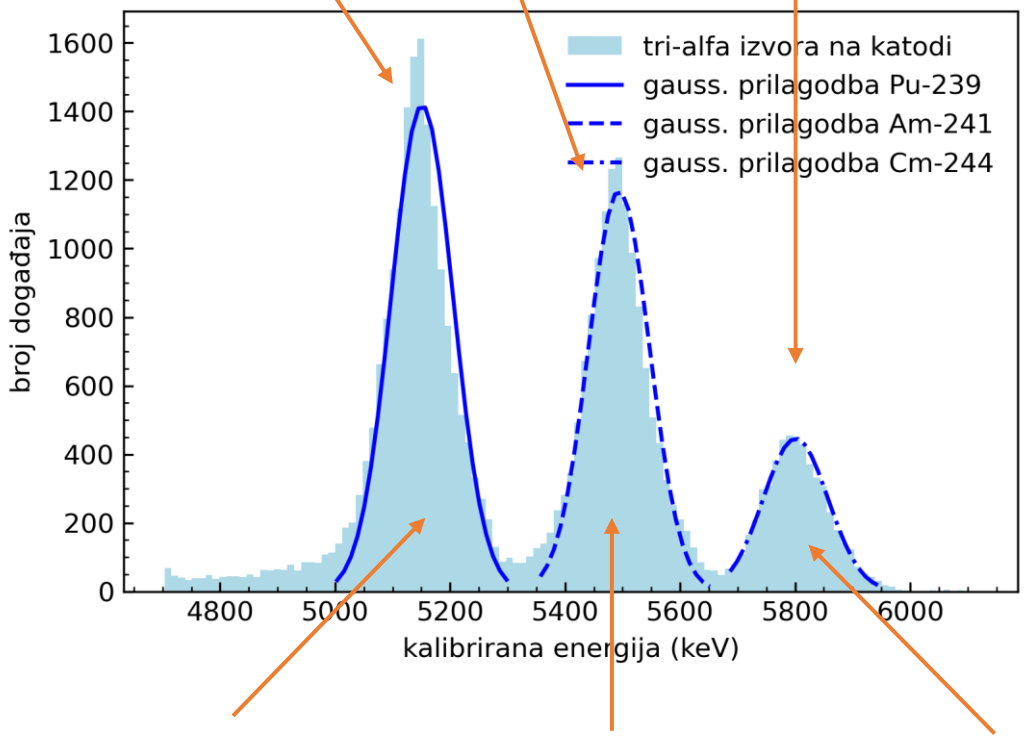
Faktor asimetrije = 2.2762 ± 0.0036

Energijska rezolucija



132.7 ± 7.1 keV 137.8 ± 6.3 keV 126.4 ± 4.7 keV

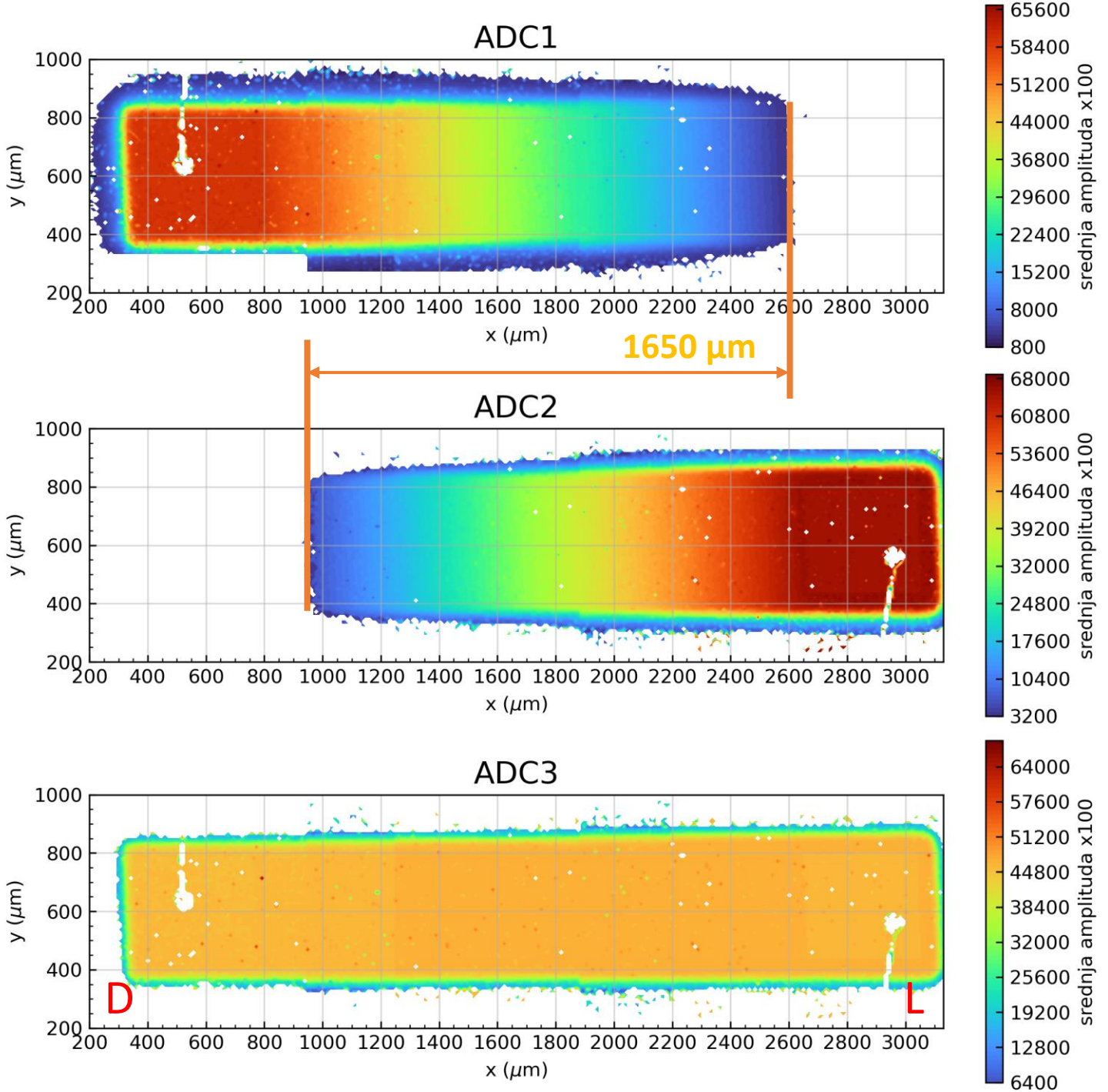
5155 keV 5486 keV 5805 keV

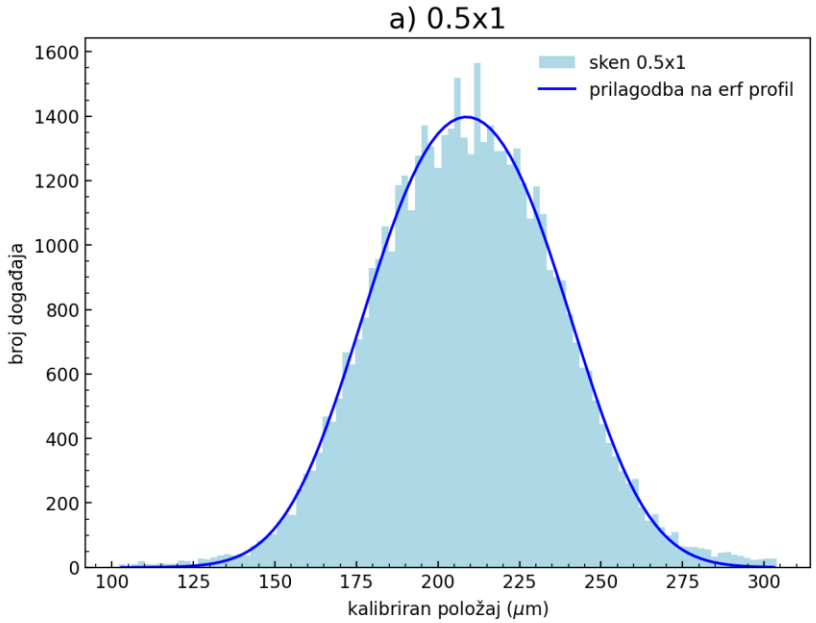


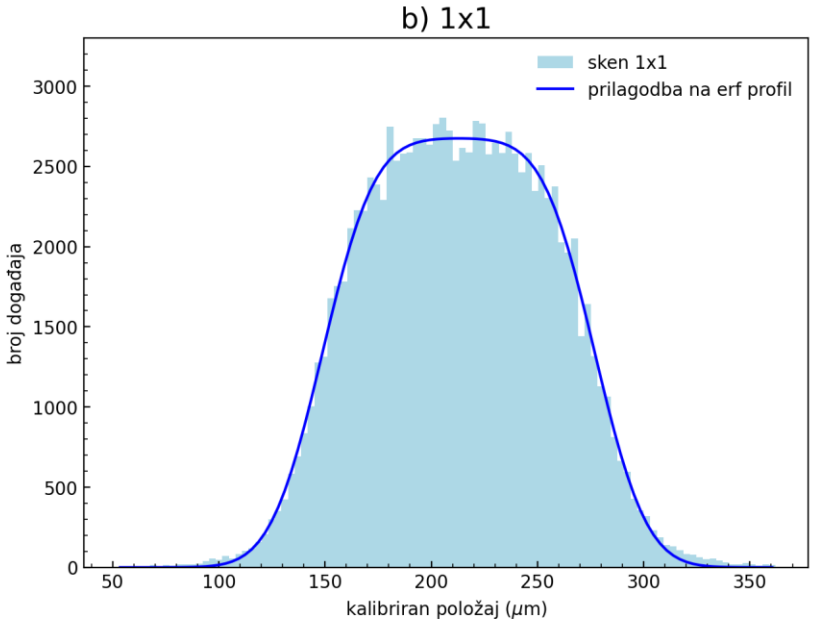
126.8 ± 4.2 keV 125.7 ± 3.2 keV 132.0 ± 2.3 keV

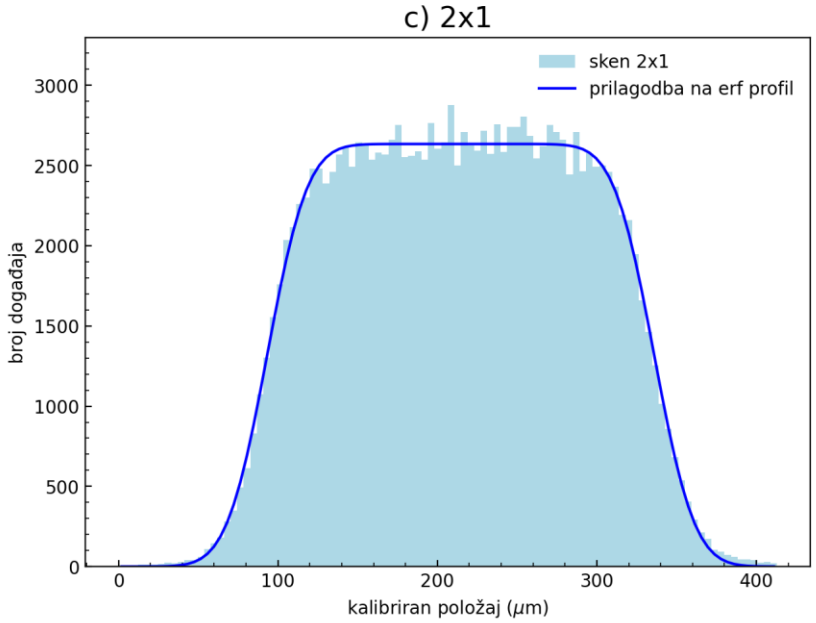
IBIC mape

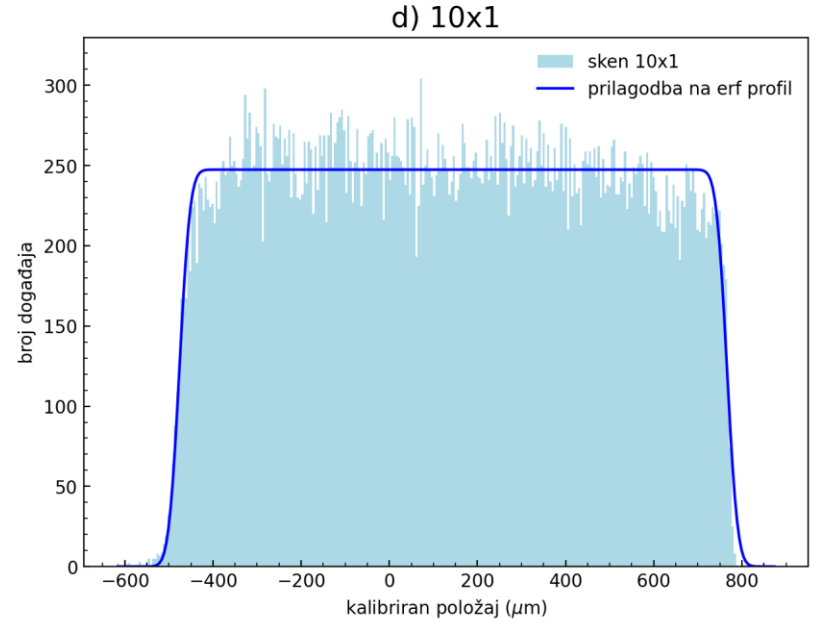
- Aktivna duljina 2.5 mm
- Stvarna pozicijski osjetljiva duljina L = 2057 ± 14 µm
- Pozicijski osjetljiva duljina u našem postavu 1650 µm











Prostorna rezolucija

(FWHM)

a) 44.4 ± 1.9 μm

b) 45.4 ± 1.1 μm

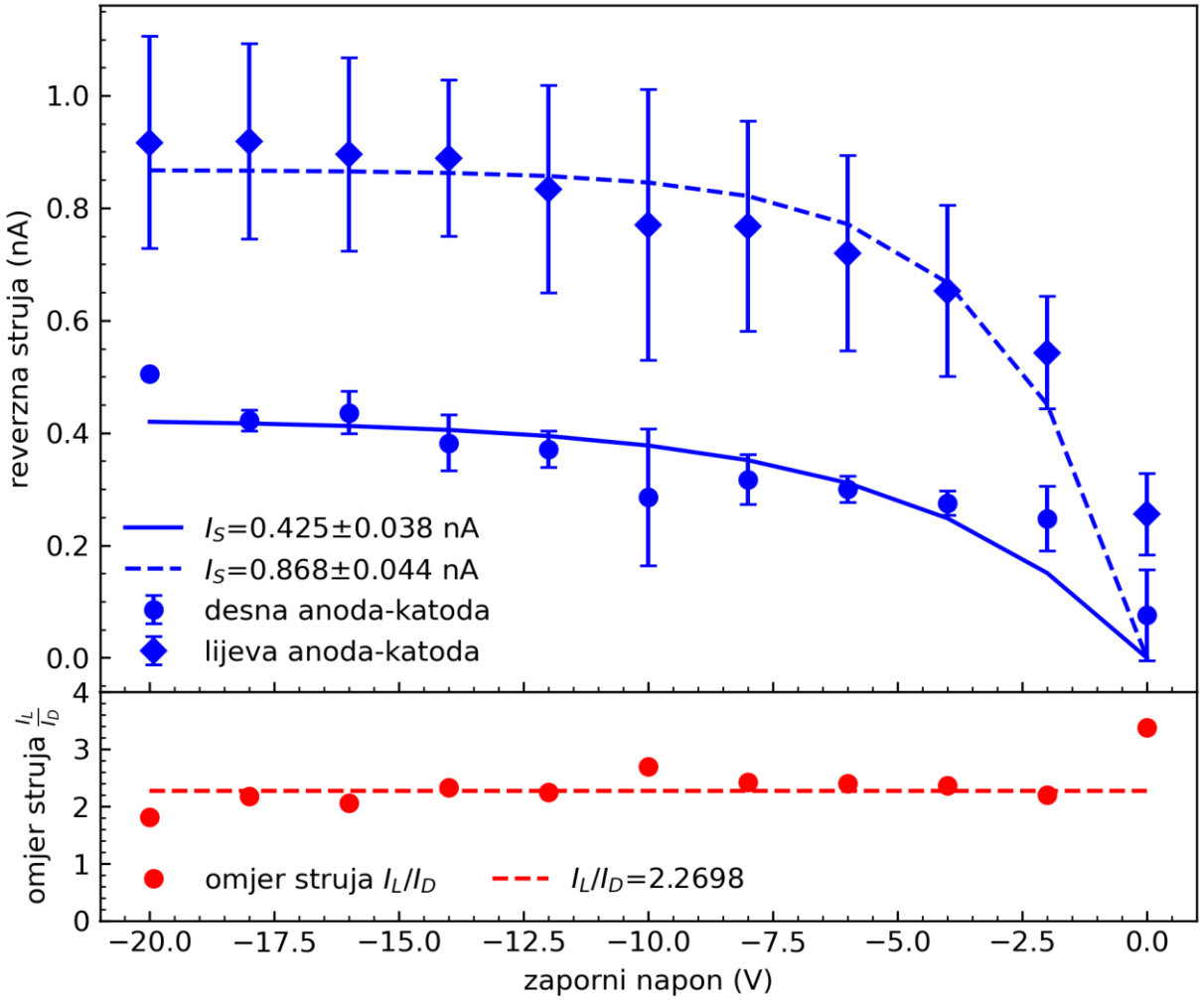
c) 47.0 ± 1.1 μm

d) 44.7 ± 3.3 μm

45.89 ± 0.70 μm

Strujno-naponska karakteristika

- U parovima anoda-katoda; druga anoda = *floating*
- Metoda dva kontakta
- Shockley-eva jednadžba
- Prosječni omjer struja reproducira faktor korekcije 2.2698…



Zaključak

- Energijska rezolucija **120-130 keV** na energijama 5000-6000 keV
  - Konvencionalni SSB[1]: *60-90 keV* (2-10 MeV ioni kisika)
  - Plinski ionizacijski[2]: *40-60 keV* (2-10 MeV ioni kisika)
  - 2D kontinuirani PSD (Sitek)[3]: *16 keV* (6 MeV alfa čestice)
- Prostorna rezolucija **45.89 ± 0.70 µm**
  - 2D kontinuirani PSD[4]: *120 µm*
  - 2D kontinuirani PSD (Sitek)[3]: *70 µm*

[1]Z. Siketić, I.Bogdanović Radović, *Energy resolution measurement and application of the F series ORTEC SSB detector in TOF-ERDA spectrometry*, Nuclear Instruments and Methods in Physics Research B, 296 (2013)
[1]P. F . Hincrichsen et al., *Heavy-ion energy resolution of SSB detectors,* Nuclear Instruments and Methods in Physics Research B, 45 (1990)
[2]M. Mallepell et al., *Annular gas ionization detector for low energy heavy ion backscattering spectrometry*, Nuclear Instruments and Methods in Physics Research B, 267 (2009)
[3]M. Lindroos, Ö. Skeppstedt, *A position sensitive photon detector used as a charged particle detector*, Nuclear Instruments and Methods in Physics Research A306 (1991)
[4]M. Brajković, *Primjena pozicijsko osjetljivih pin dioda u EBS spektrometriji*, diplomski rad, PMF (2018)

Zaključak

- Faktor asimetrije 2.27… ?
- Osjetljiva duljina 2057 ± 14 µm
- Na 10 mm udaljenosti od mete hvatamo raspon kutova raspršenja u iznosu od 11.7° s kutnim razlučivanjem

Hvala na pažnji!