Status of the Electron Detection System

EDS Publication

Antonios Athanassiadis, on behalf of the EDS team

02.12.2025

HELMHOLTZ LUXE CLUSTER OF EXCELLENCE QUANTUM UNIVERSE Universität Hamburg DER FORSCHUNG | DER LEHRE | DER BILDUNG DESY.

Publication

- about the developments of the EDS prototypes
- to be published as an instrumentation paper in JINST
- covers tests at ARES in ‘23 and at FACET in ‘24
- will not cover E320 data

Prepared for submission to JINST

A high-flux electron detection system to measure non-linear Compton scattering at LUXE

Antonios Athanassiadis[a,b,1] John Hallford[a] Louis Helary[a] Luke Hendriks[a,d,1] Ruth Jacobs[a] Jenny List[a] Gudrid Moortgat-Pick[b] Evan Ranken[a] Stefan Schmitt[a] Ivo Schulthess[a,e,1] Matthew Wing[a,d]

[a] *Deutsches Elektronen-Synchrotron DESY, 22603 Hamburg, Germany*
[b] *Universität Hamburg, 20148 Hamburg, Germany*
[c] *Weizmann Institute of Science, 7610001 Rehovot, Israel*
[d] *University College London, London WC1E 6BT, United Kingdom*
[e] *Institute for Particle Physics and Astrophysics, ETH Zurich, 8093 Zurich, Switzerland*

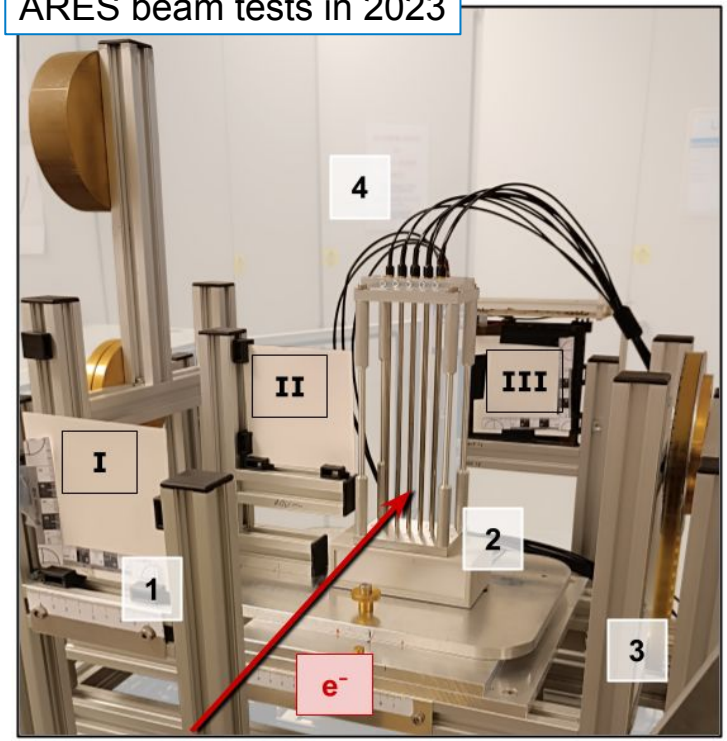
E-mail: antonios.athanassiadis@desy.de

Abstract: This manuscript presents the development and testing of a high-flux electron detection system designed to measure the energy spectrum of up to 10^9 electrons from laser–electron collisions at the LUXE experiment planned at DESY. The system is intended to enable precision measurements of non-linear Compton scattering in the regime of strong-field quantum electrodynamics. It combines a scintillating screen observed by a camera system with a spatially segmented detector based on the Cherenkov effect. Prototype tests were conducted at two accelerator facilities, where the performance of the system was evaluated under realistic beam conditions. The results demonstrate that the detector concept is suitable for the expected particle fluxes and energy resolution requirements, and provide input for the final design of the detection system to be used in the experiment.

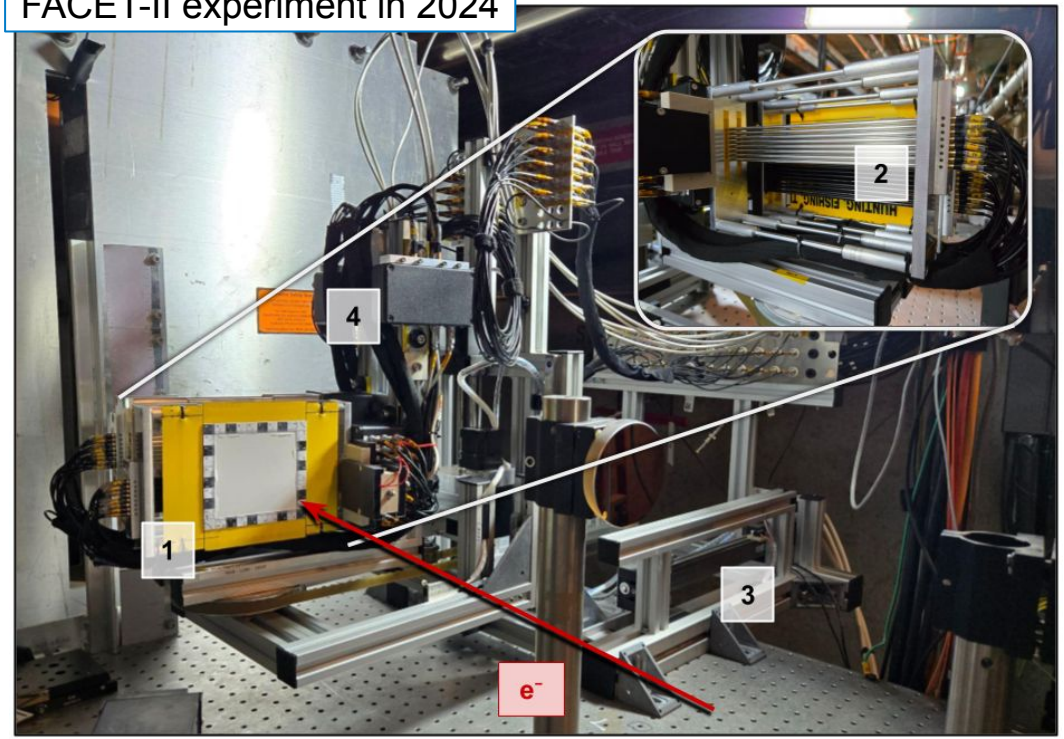
[1] Corresponding author.

Images of the EDS prototypes

ARES beam tests in 2023



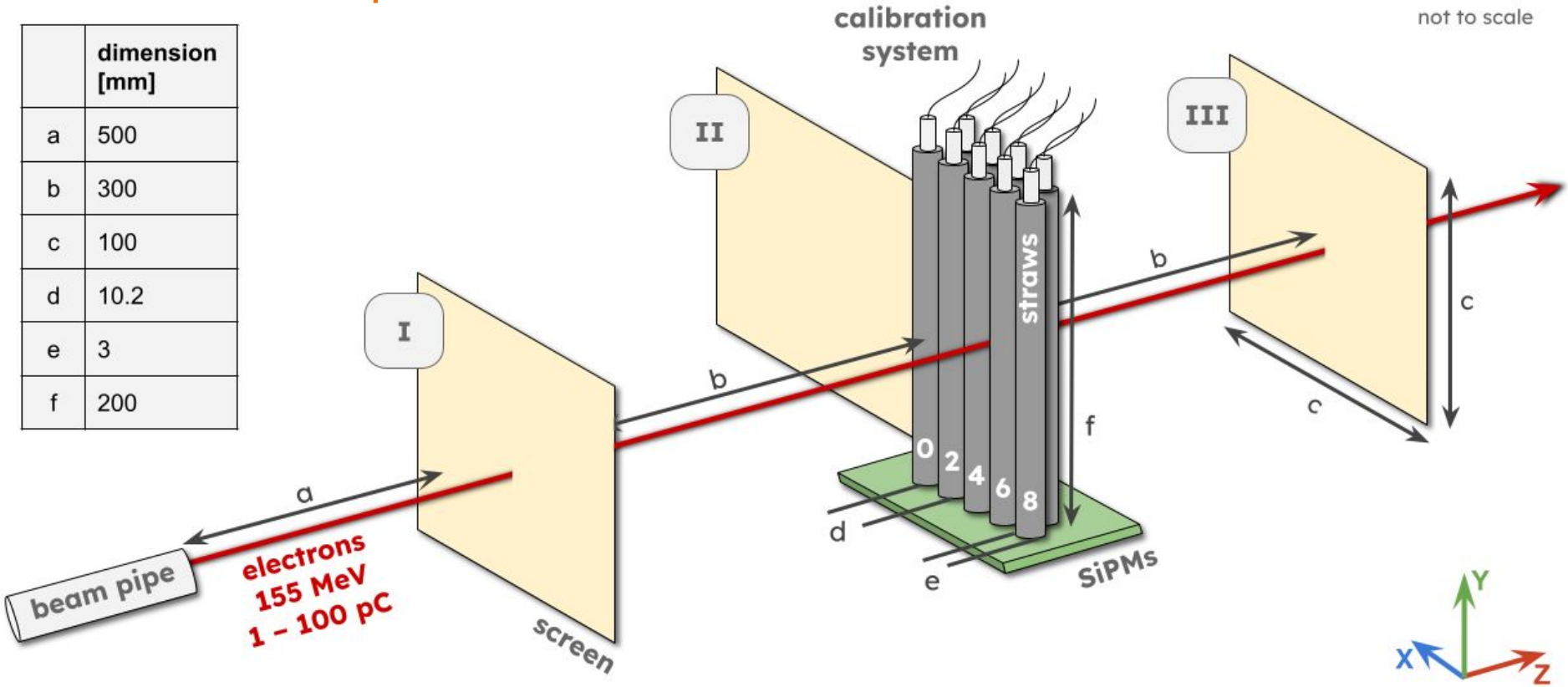
FACET-II experiment in 2024



EDS at ARES

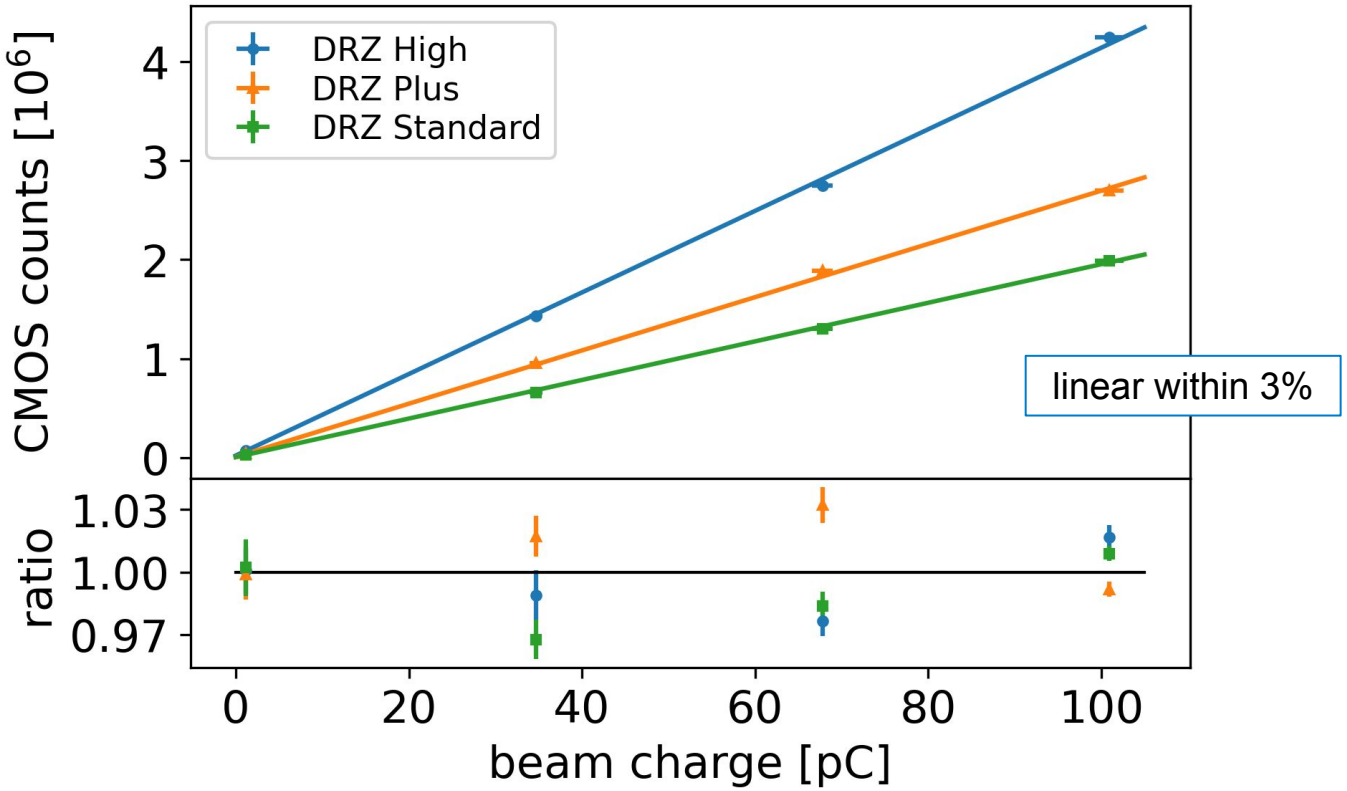
Schematics of the Setup

	dimension [mm]
a	500
b	300
c	100
d	10.2
e	3
f	200



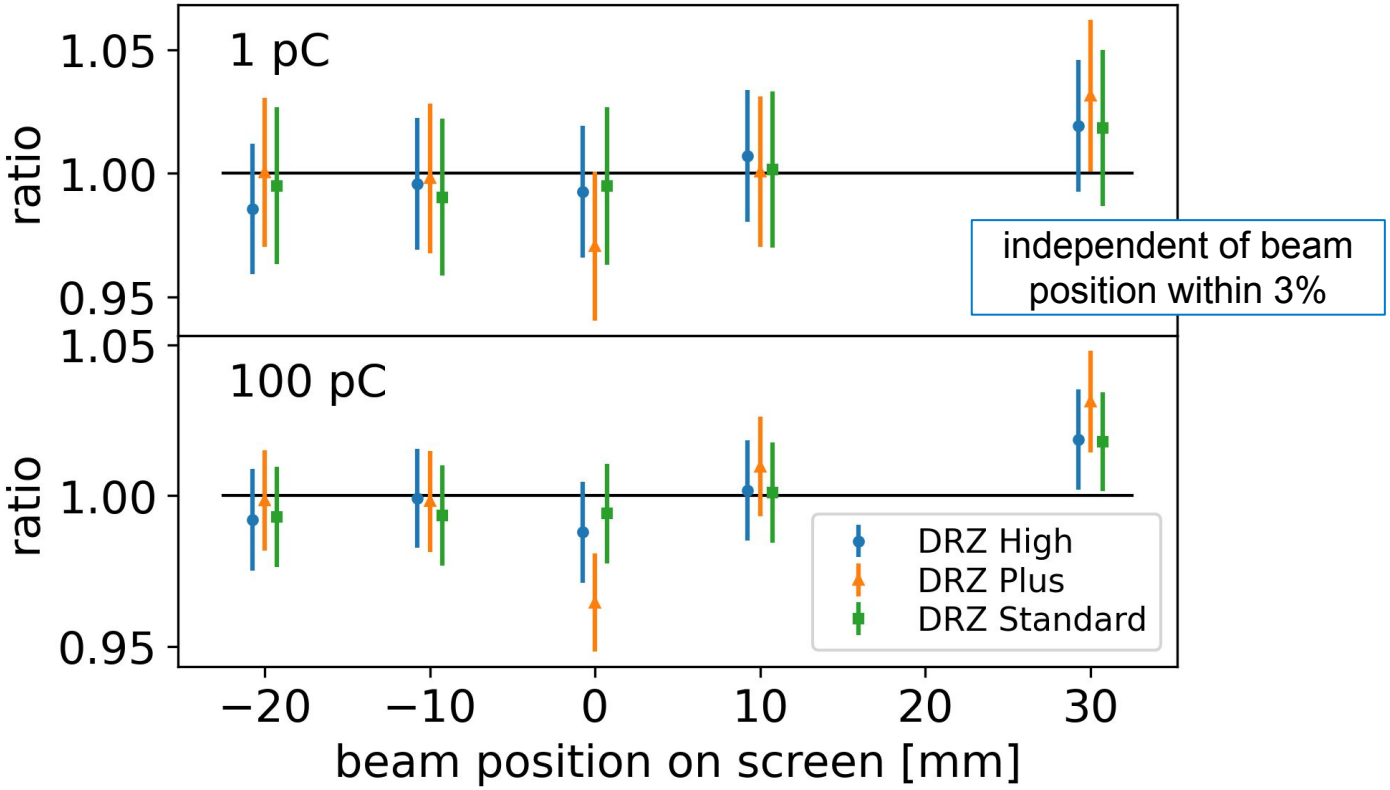
EDS at ARES

Screen Detector: Beam Charge Scan



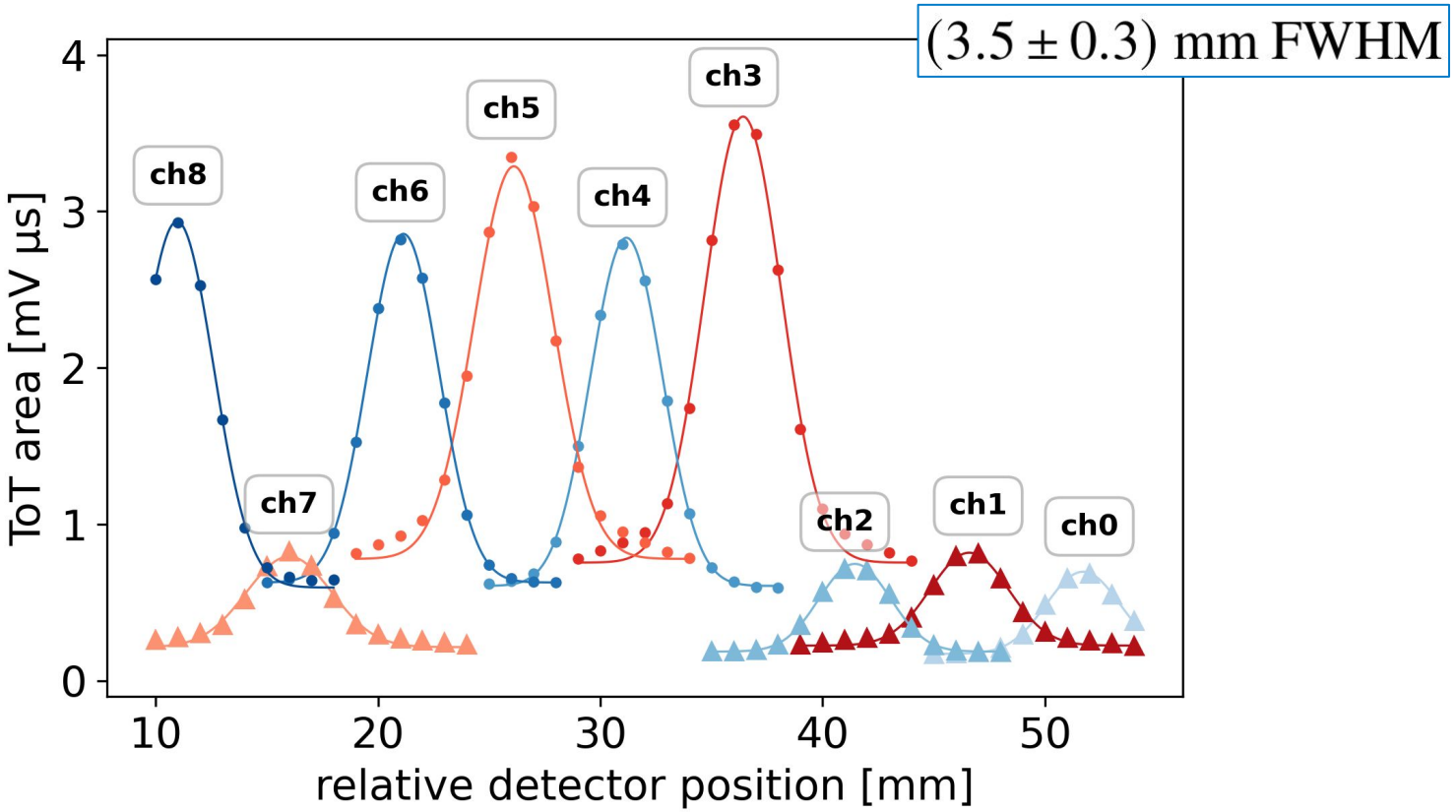
EDS at ARES

Screen Detector: Transverse Position Scan



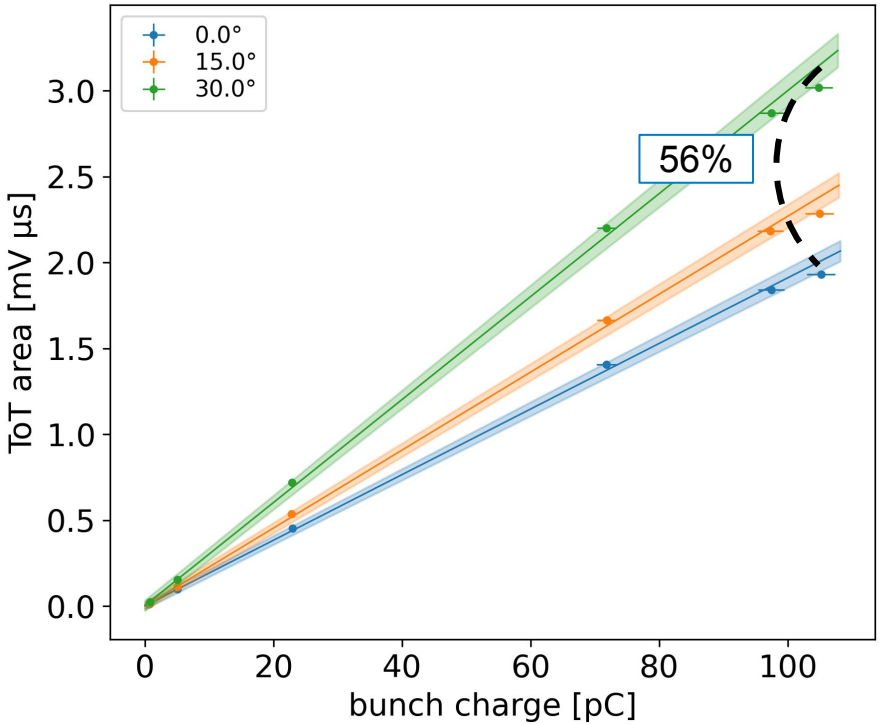
EDS at ARES

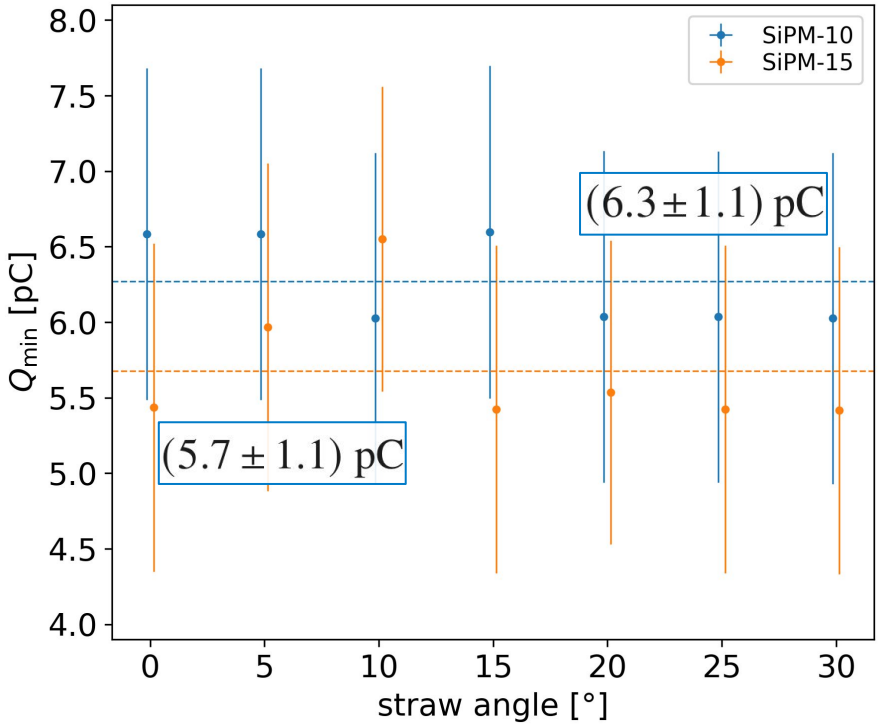
Straw Detector: Transverse Position Scan



EDS at ARES

Straw Detector: Charge Scan and Minimal Detectable Charge

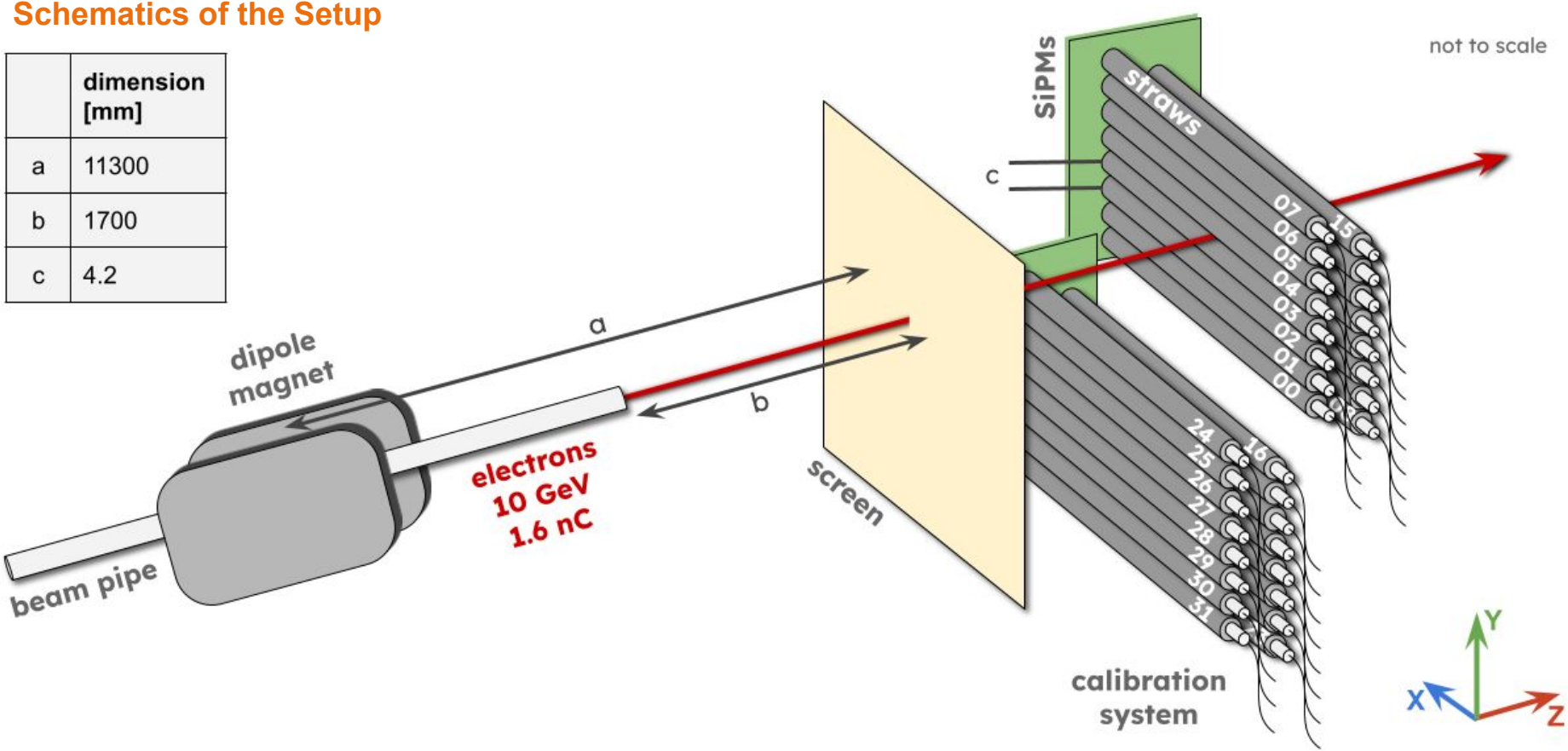




EDS at FACET-II

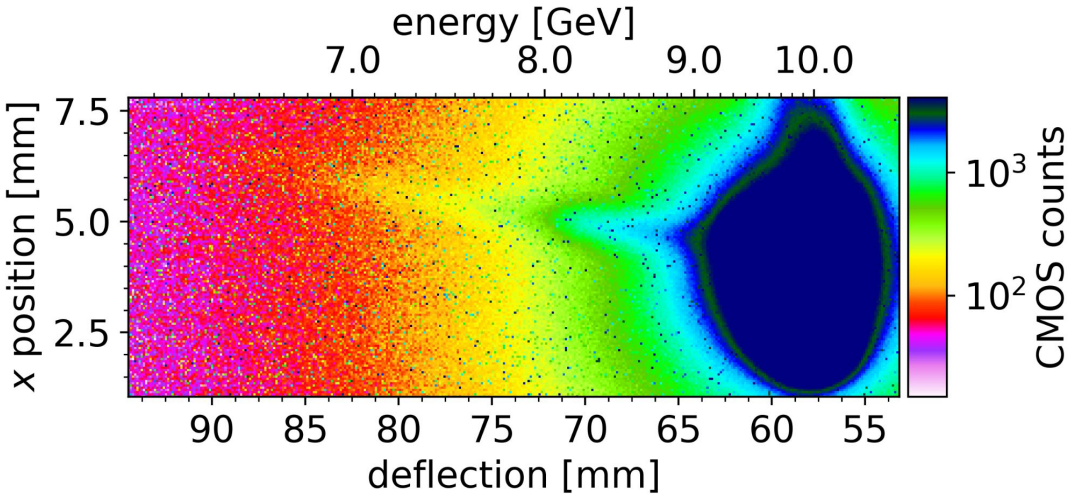
Schematics of the Setup

	dimension [mm]
a	11300
b	1700
c	4.2



EDS at FACET-II

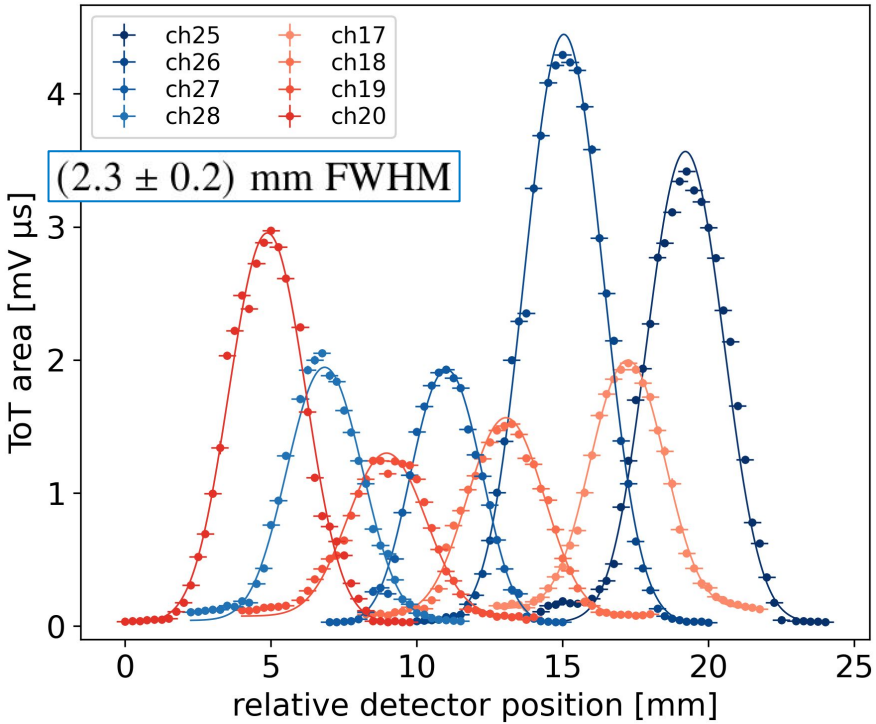
Screen Detector: Main Beam Image with Compton Spectrum

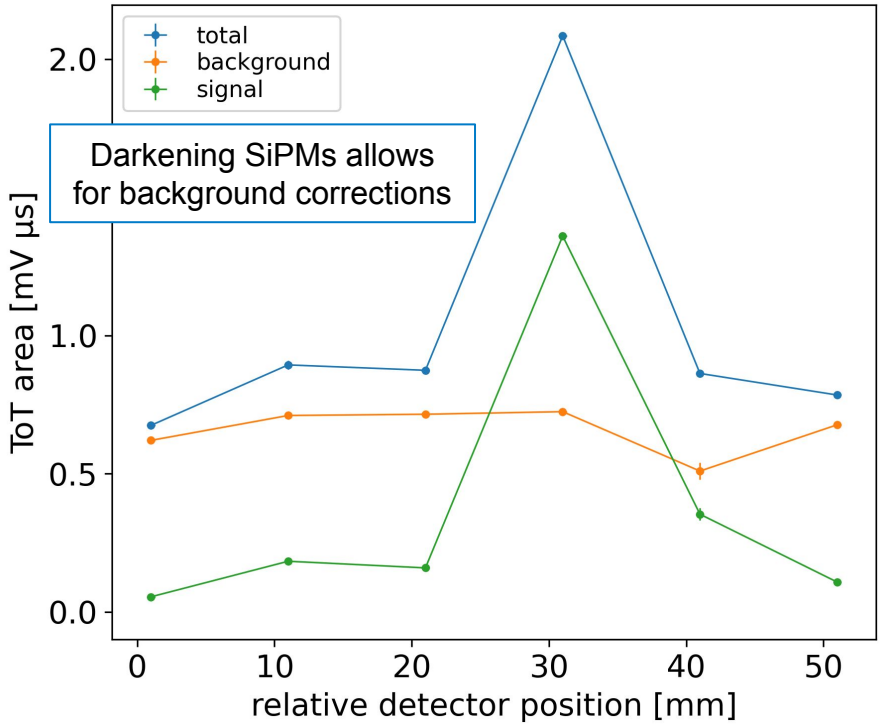


- calibration of beam deflection vs. energy
- measurement of beam size: FWHM 2.5 mm
- likely need brighter screen for LUXE
  - similar position resolution as expected for LUXE, but
  - Compton spectrum only resolvable down to 7 GeV at FACET-II with DRZ Standard

EDS at FACET-II

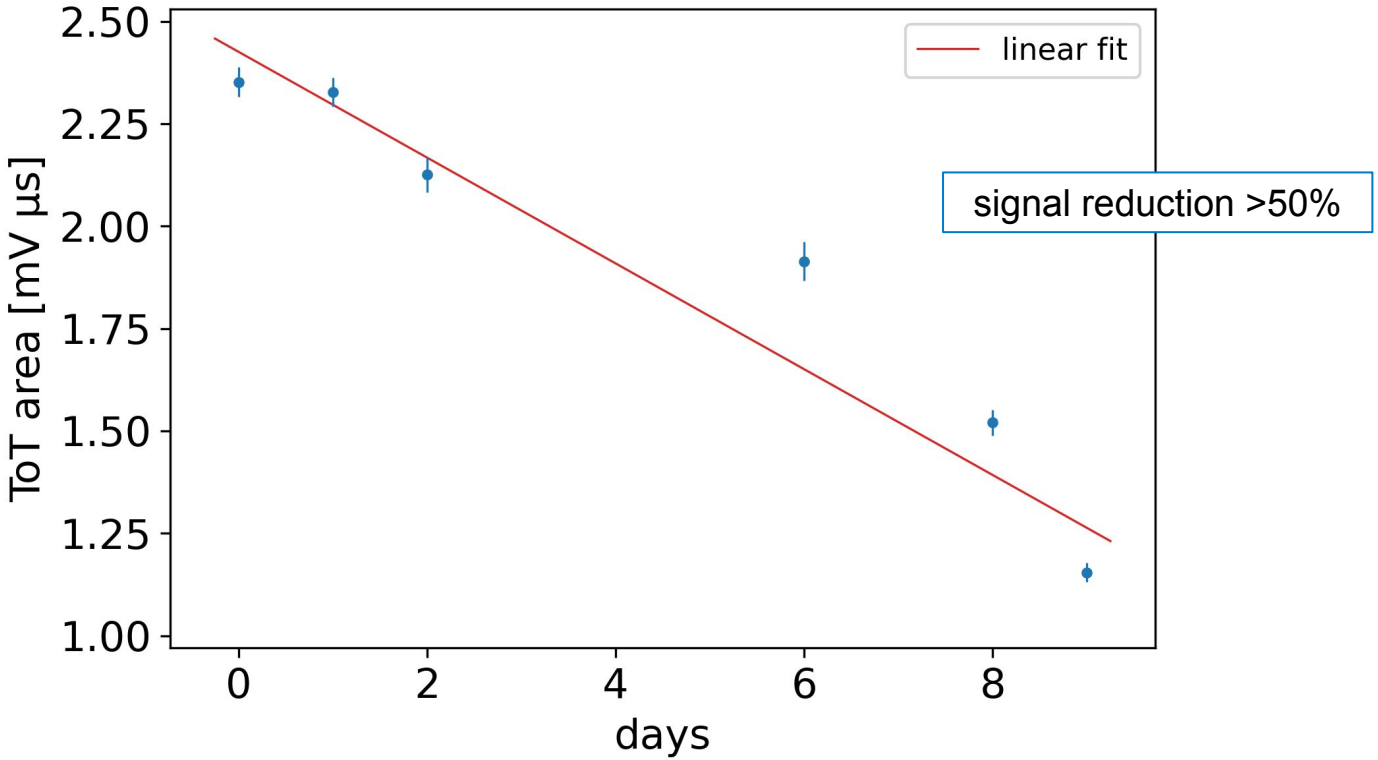
Straw Detector: Transverse Position Scan and Background Measurement



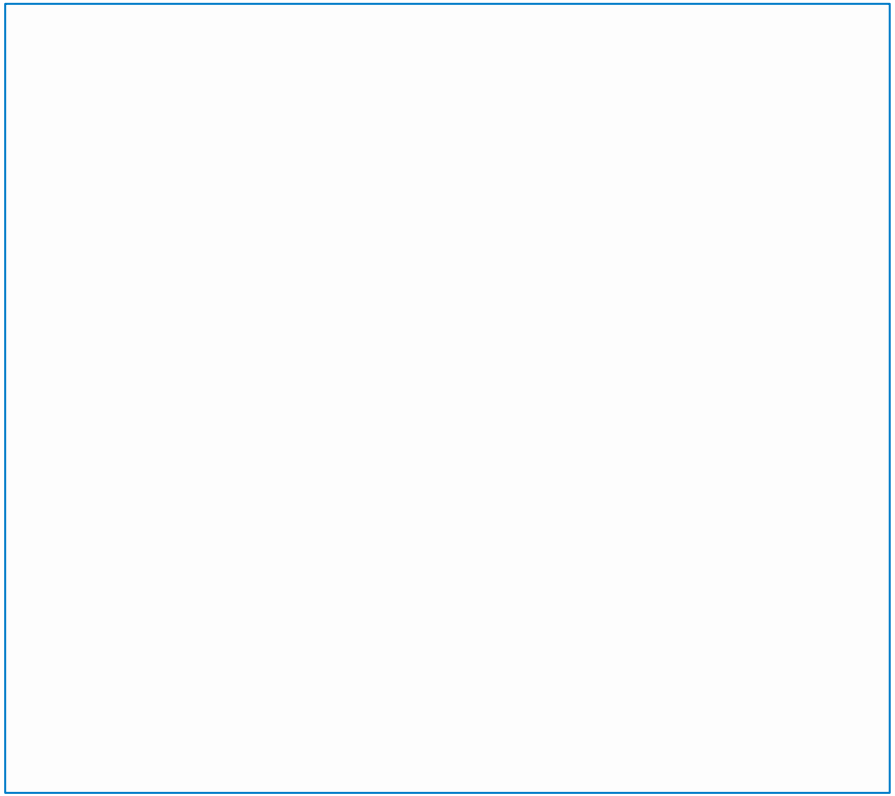


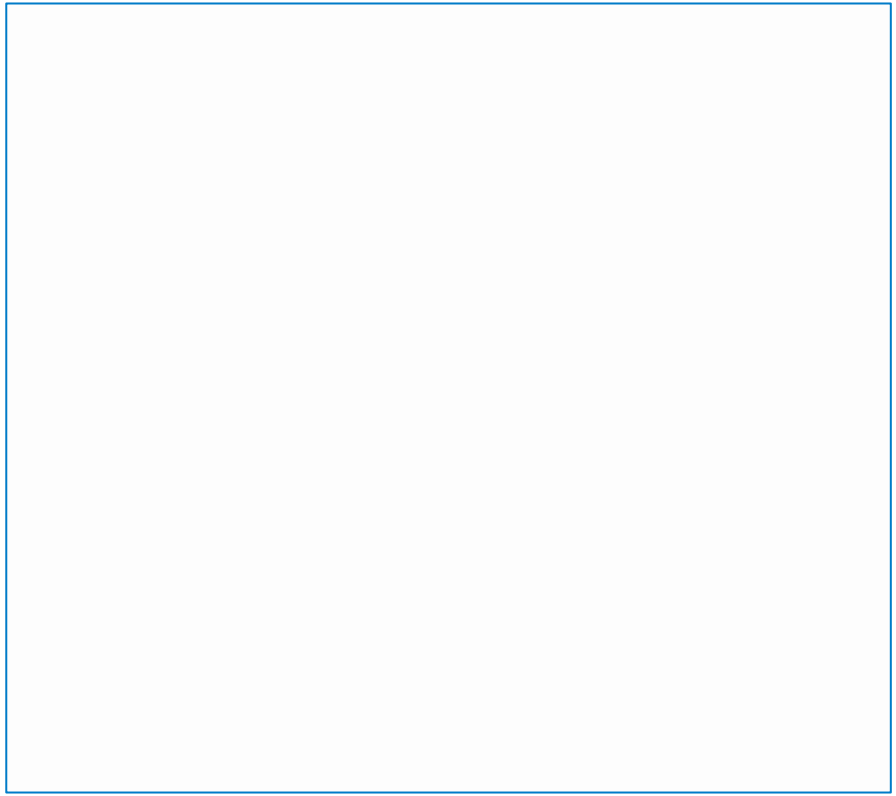
EDS at FACET-II

Straw Detector: SiPM Radiation Damage

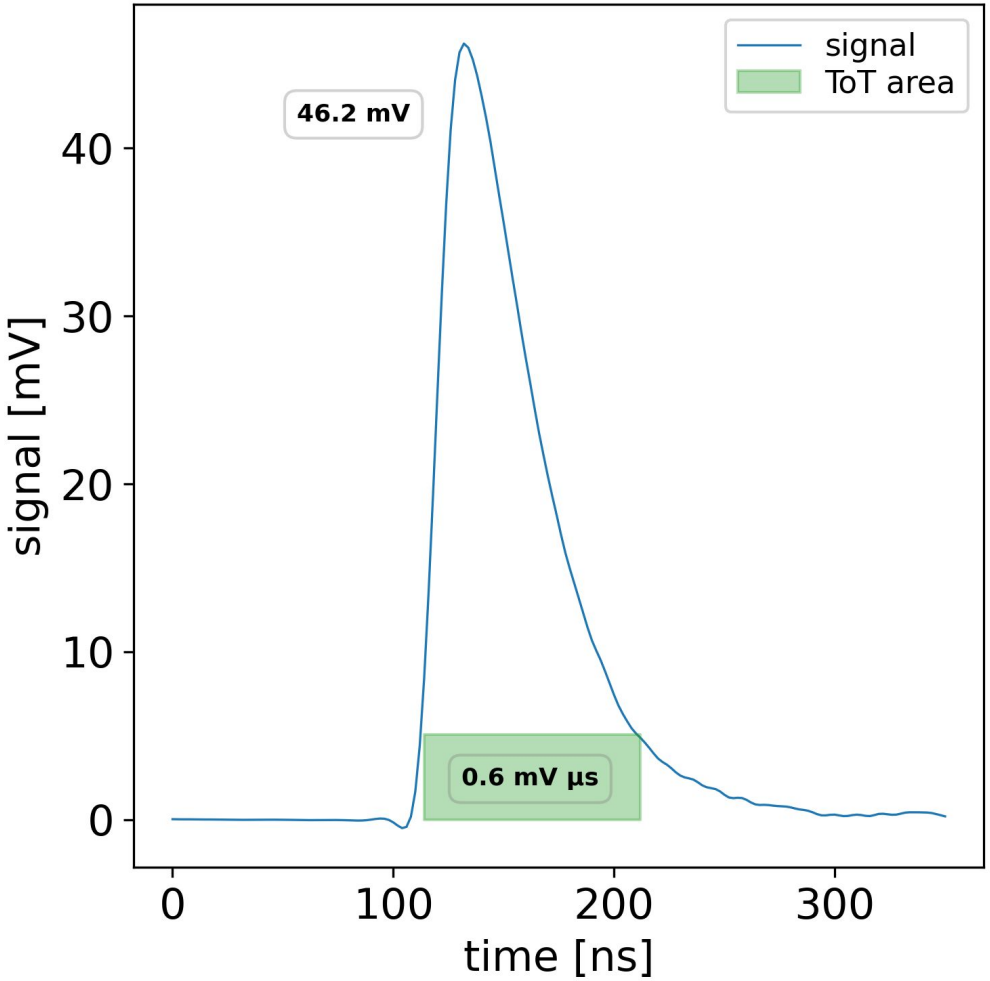


Conclusion





Backup


signal
ToT area
46.2 mV
0.6 mV µs
signal [mV]
time [ns]
0
10
20
30
40
0
100
200
300