A MULTI-CAMERA SYSTEM FOR TOMOGRAPHIC BEAM DIAGNOSTICS

A. Ateş, G. Blank, H. Hähnel and U. Ratzinger

LINAC2022
**LIVERPOOL**

Introduction

- A prototype of a beam-induced residual gas fluorescence monitor (BIF) has been developed and successfully tested at the Institute of Applied Physics (IAP) at the Goethe University Frankfurt.
- The overall goal is to study the beam with tomography algorithms at a low energy beam transport section.

Experiment

- FRANZ project at IAP
- Hydrogen beam (p, H_2^+, H_3^+)
- 60 keV, 33 mA, 20 Hz@1 ms
- $1 \cdot 10^{-4}\ mbar$ Argon residual gas
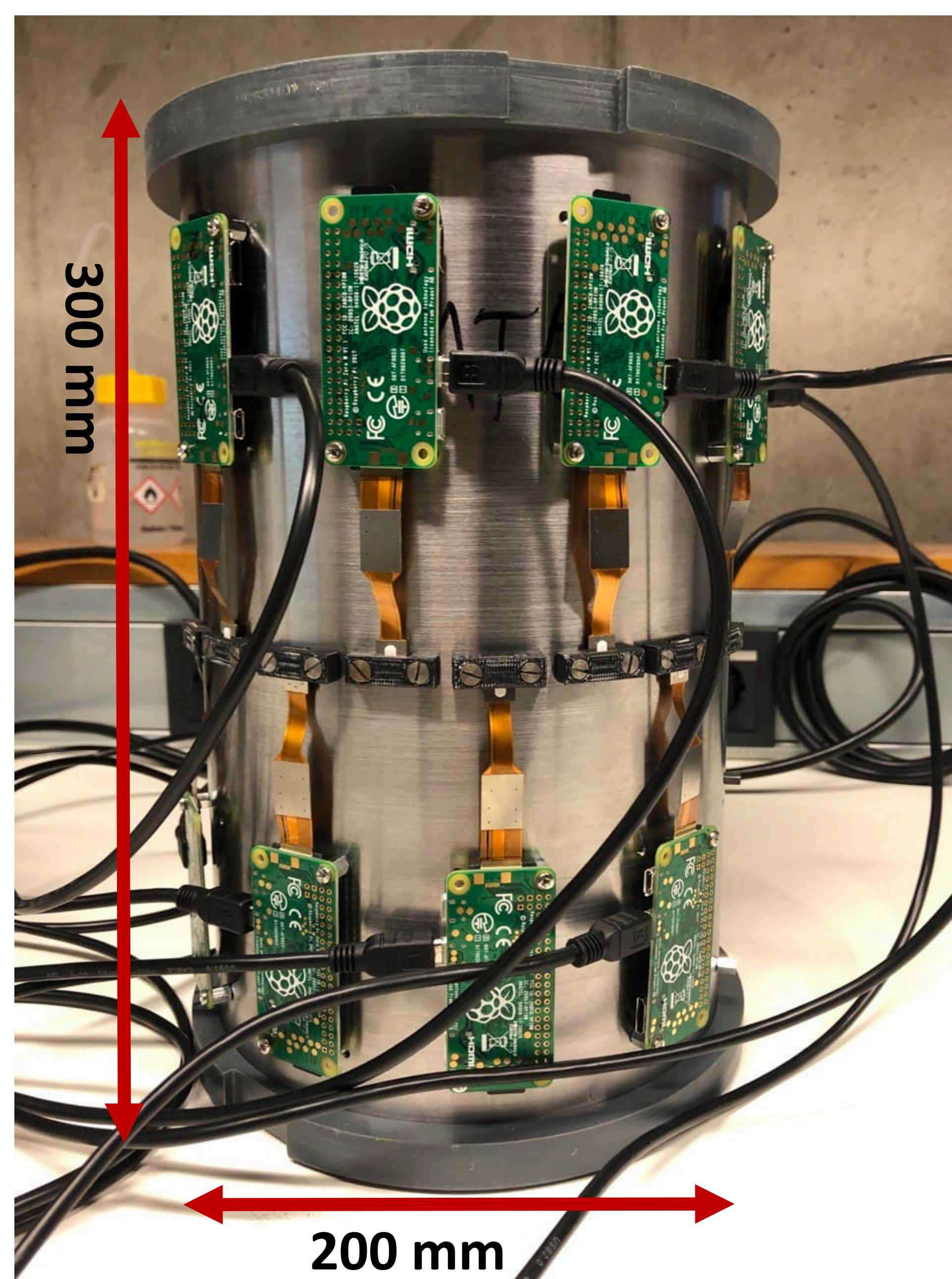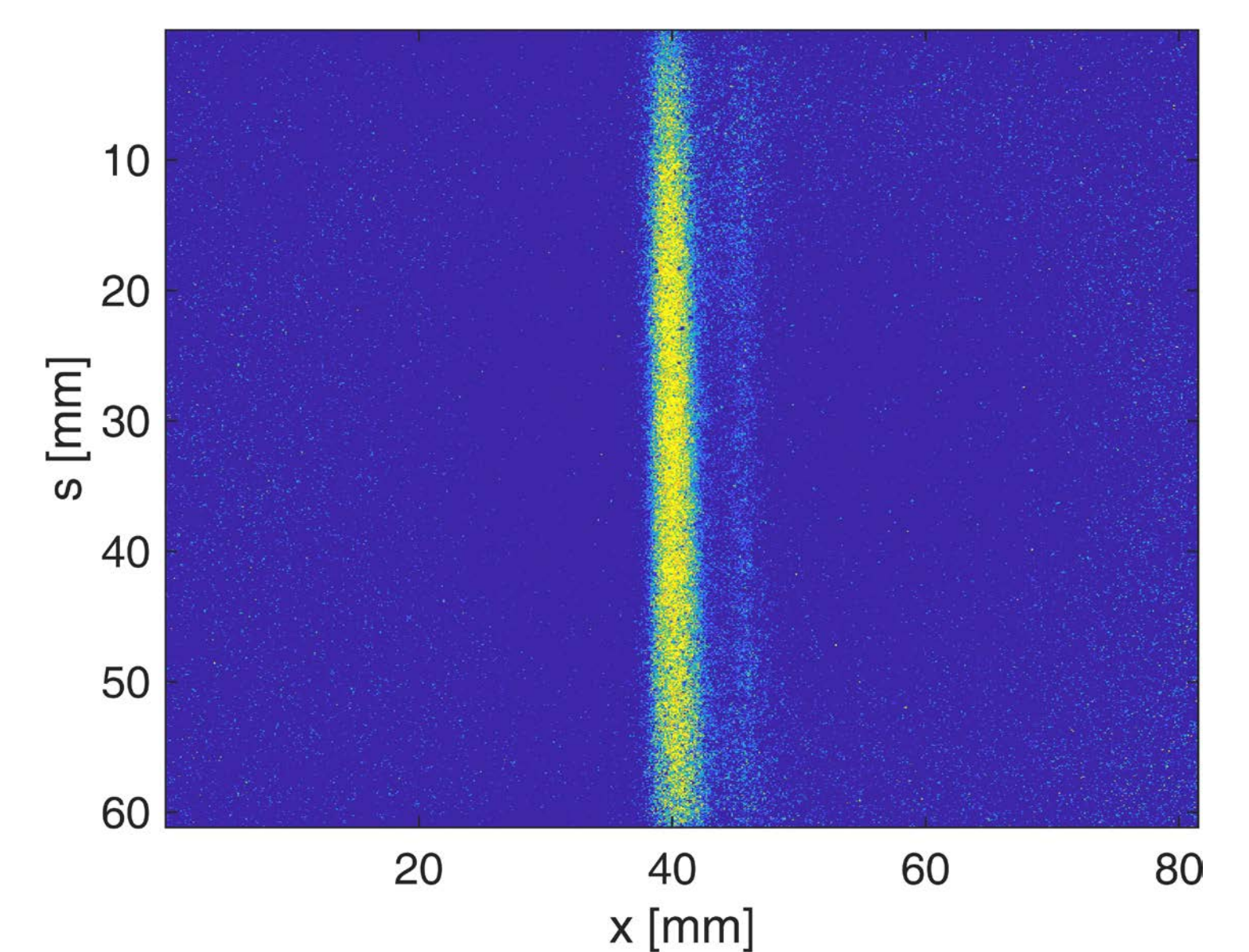- Detector position is at RFQ injection area
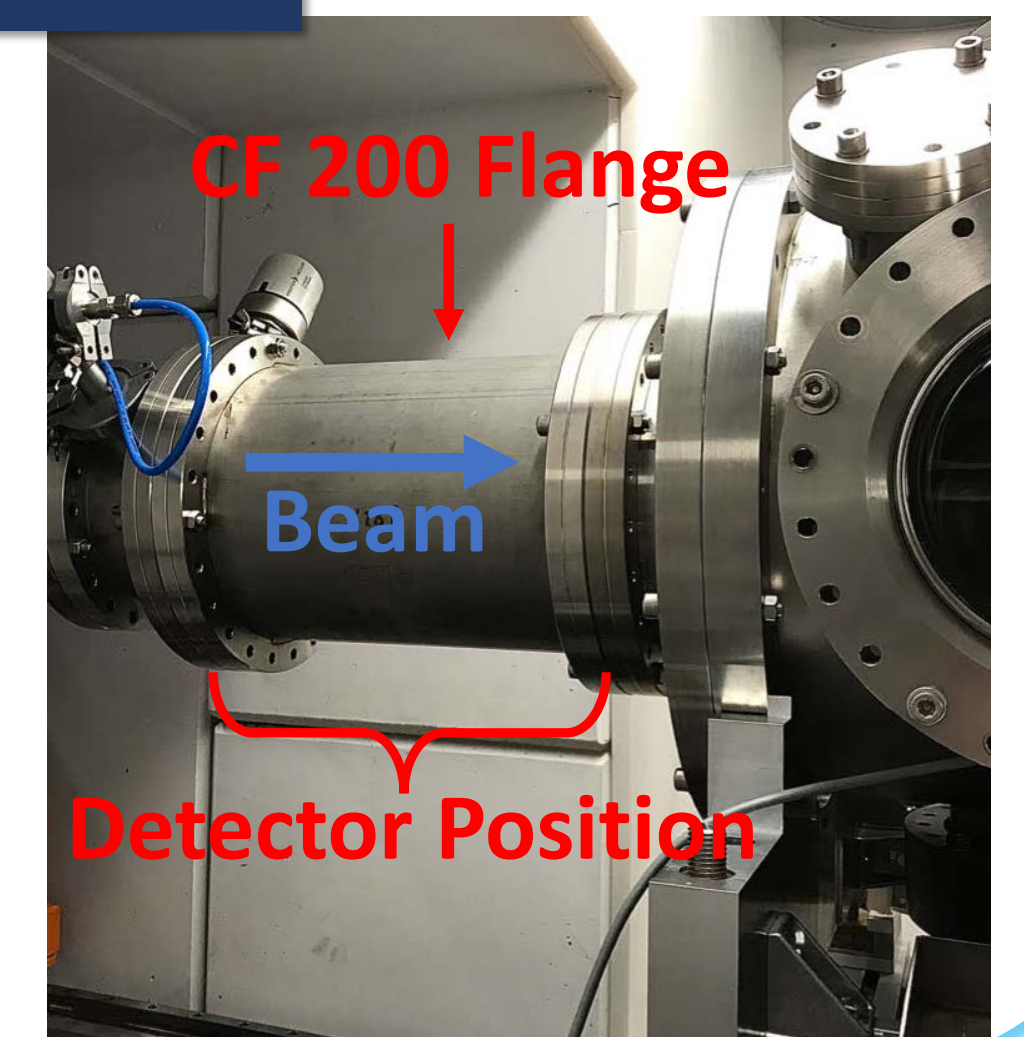
Hardware
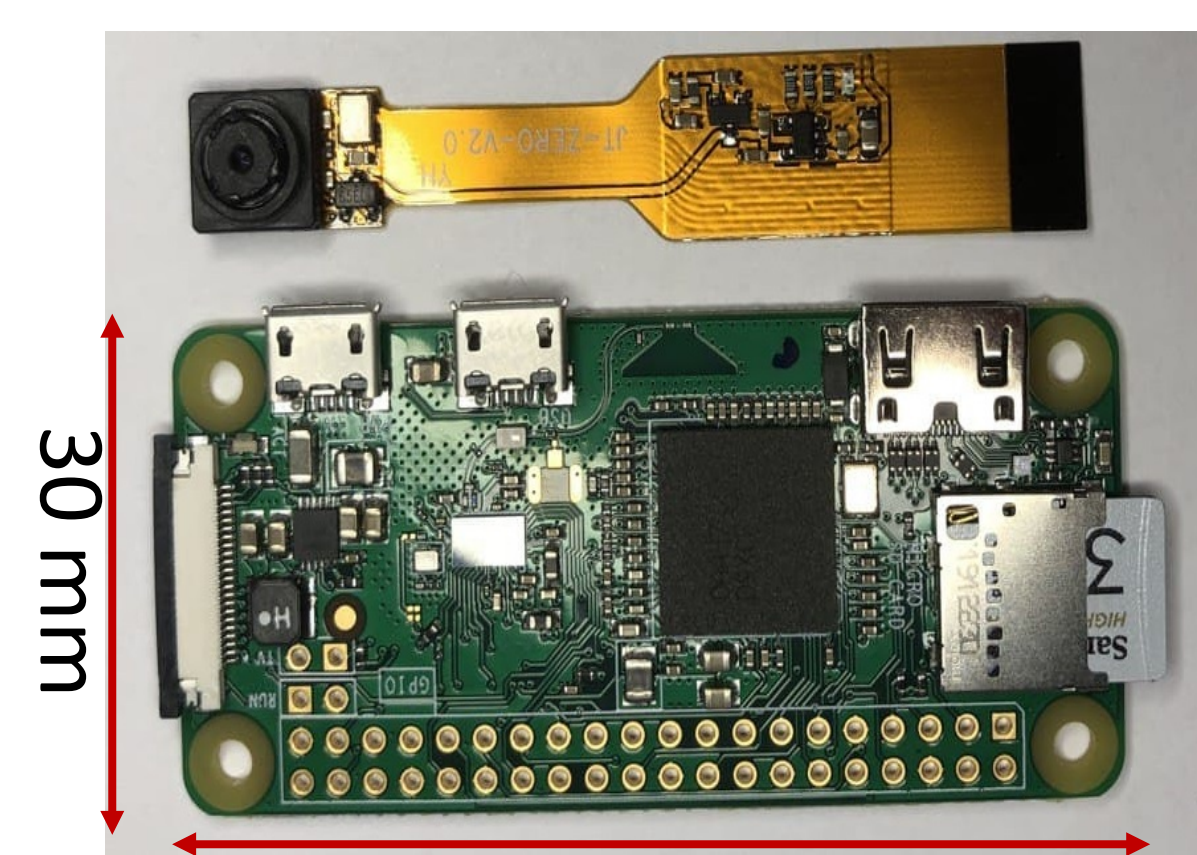

30 mm
65 mm
Raspberry Pi Zero with camera

Communication

- Power supply 5V, 300mA
- Power Management Unit within Vacuum
- WIFI antenna inserted into the vacuum to communicate with cameras and get data out

Algorithm

- Tomopy – Tomographic Reconstruction in Python [1]
- https://tomopy.readthedocs.io
- ART : Algebraic Reconstruction Techniqe [2]

Multi-Camera System

300 mm
200 mm
Ten cameras inserted into the vacuum and directed onto the beam axis.

Image of two Beams

False Color profile of two species of hydrogen beam
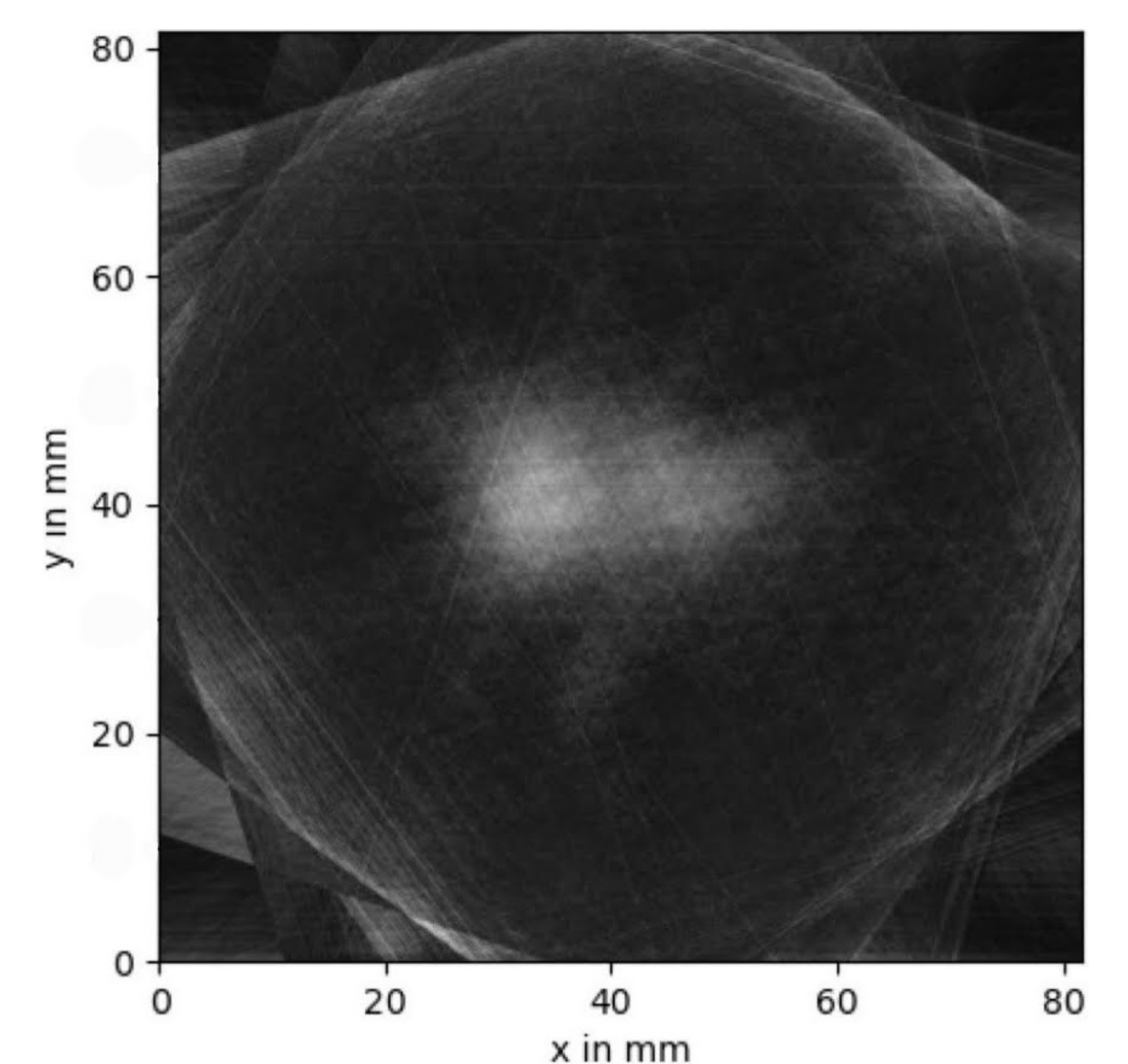
Reconstruction

After performing Tomographic reconstruction. One slice of beam profile [3] .

Conclusion

- Studies are currently underway to improve image preprocessing and the choice of the right tomography algorithm.
- Different solutions to filter the images to improve the reconstruction process are current topics of this project.
- For beam operation, an electromagnetically compatible circuit (EMC) is required to transmit the data through the vacuum and to protect the devices from flashovers.

Fitting

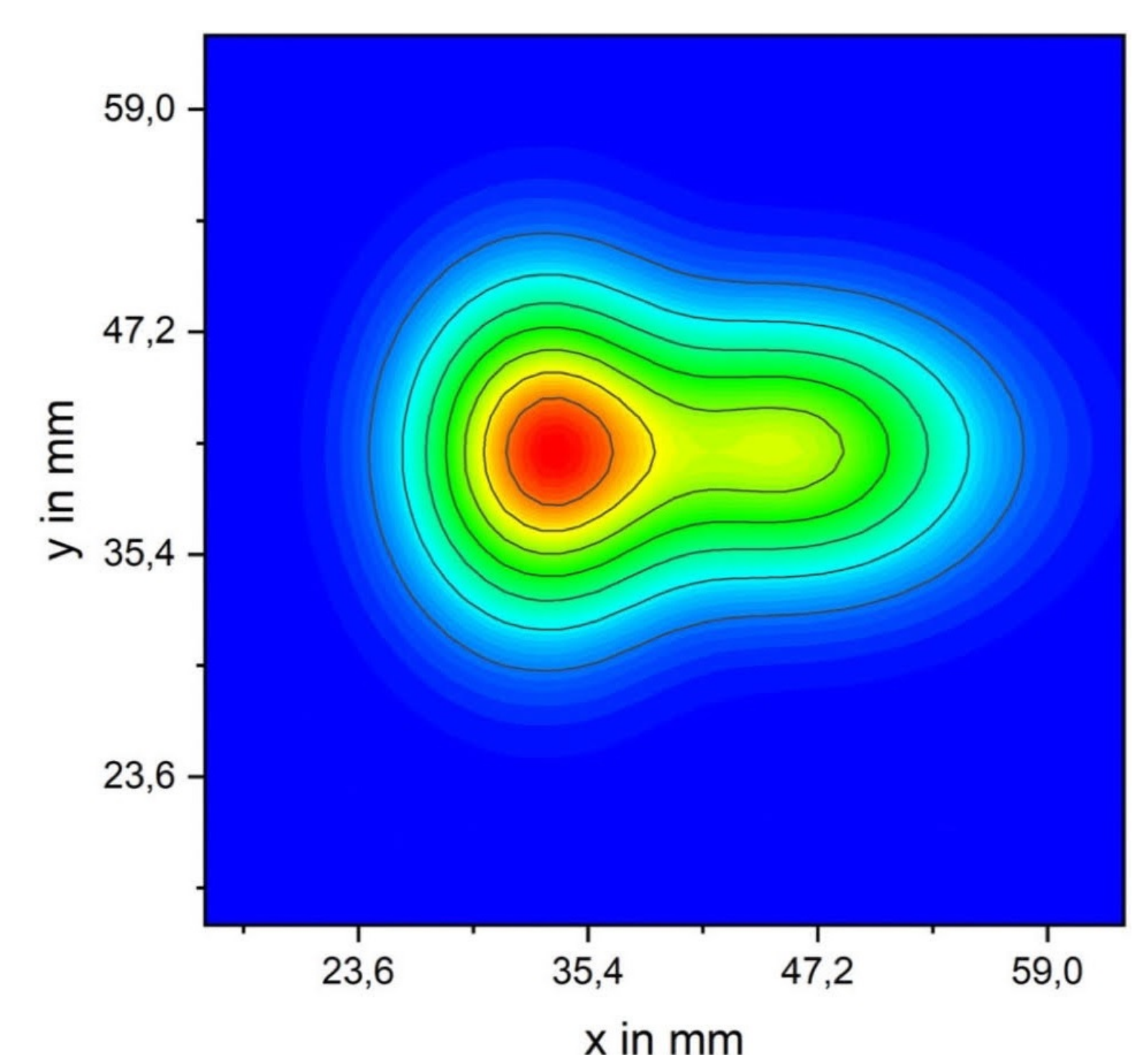
Gauss fit of reconstructed intensity distribution [3].

References

[1] D. Gürsoy et al.,"TomoPy: a framework for the analysis of synchrotron tomographic data", Synchrotron Radiation, (2014), 1188-1193, doi:10.1107/S1600577514013939.
[2] J.S. Fraser, "Beam Tomography or Art in Accelerator Physics", Los Alamos Scientific Laboratory Report LA-7498-MS, 1978.
[3] G. Blank, "Optische Tomographie mit einem Multikamerasystem für intensive Ionenstrahlen", Bachelor thesis, 02.2022

GOETHE UNIVERSITÄT FRANKFURT AM MAIN

IAP Institut für Angewandte Physik

SCAN ME