

Results of the Shadowgraphy Measurements and Commissioning of the new MCP System

Hanna Eick, Simon Obszerninks, Philipp Brand, Christian Mannweiler,
Sophia Vestrick, and Alfons Khoukaz

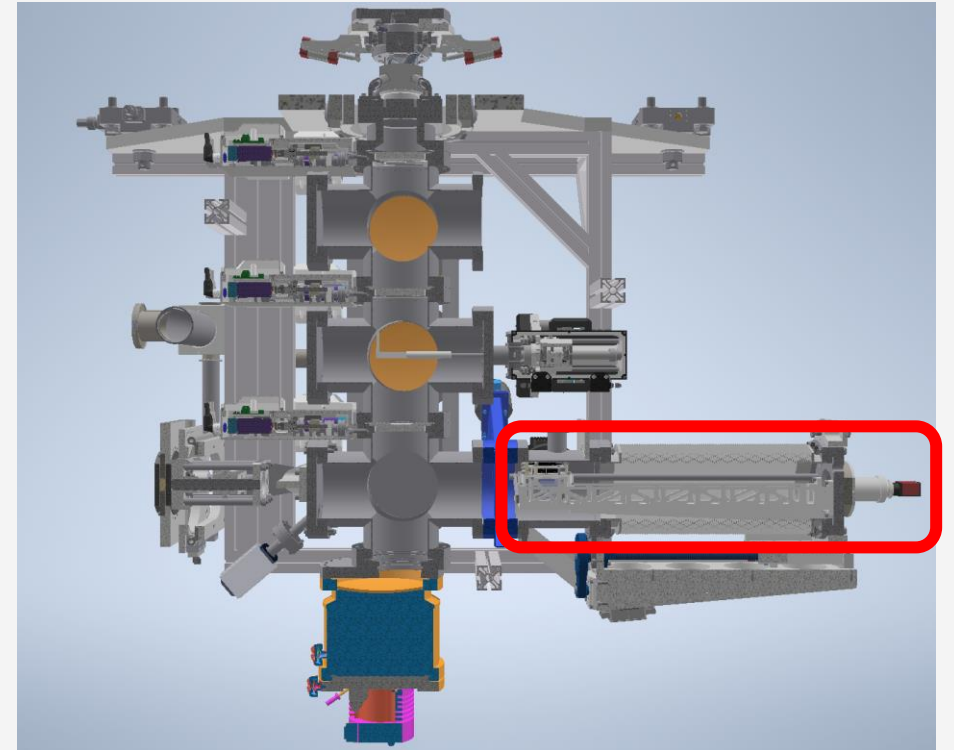
Institute for nuclear physics, Universität Münster, June 13, 2023

PANDA Meeting
June 12 – June 16, 2023

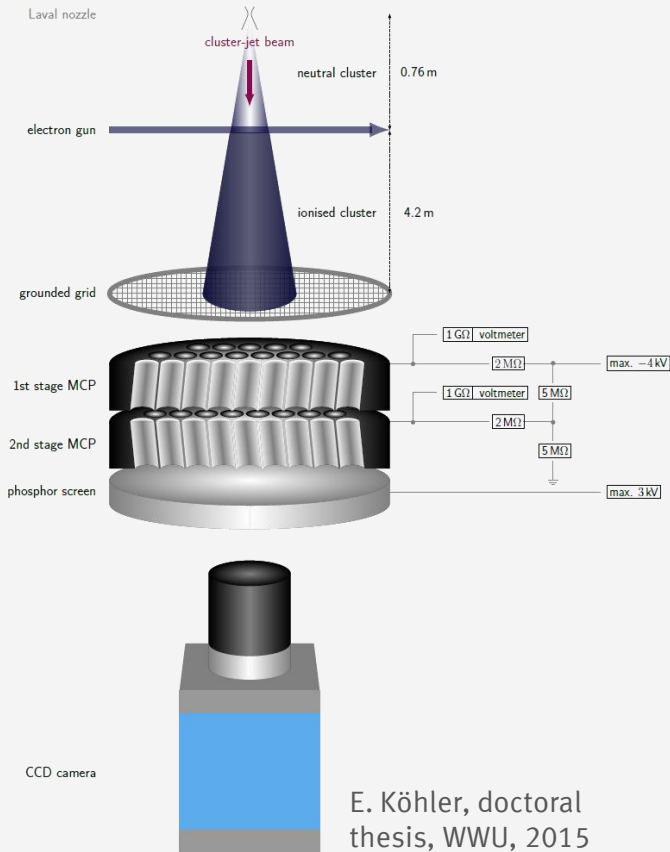


Commissioning of New MCP System for PANDA

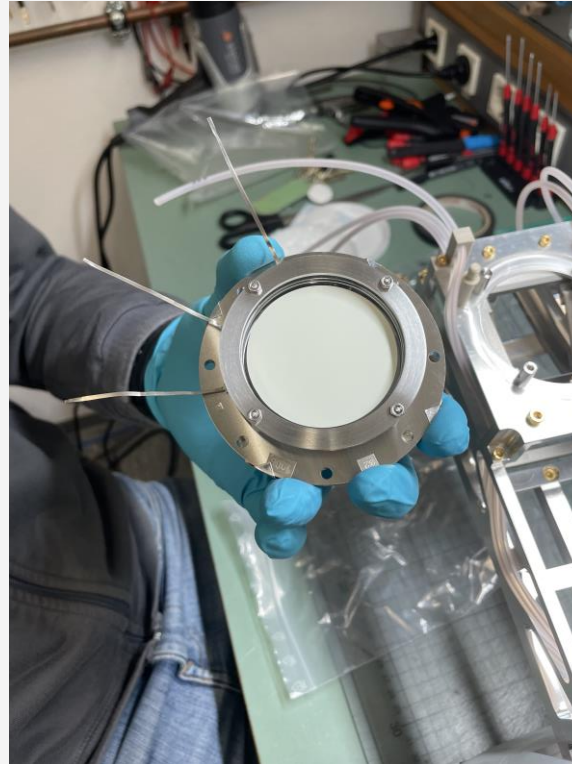
- An MCP system is installed in the new beam dump of the PANDA experiment to...
 - ... align the cluster beam
 - ... measure Tof of clusters
 - ... visualize overlap of accelerator beam and cluster jet
- It is mounted on a movable arm



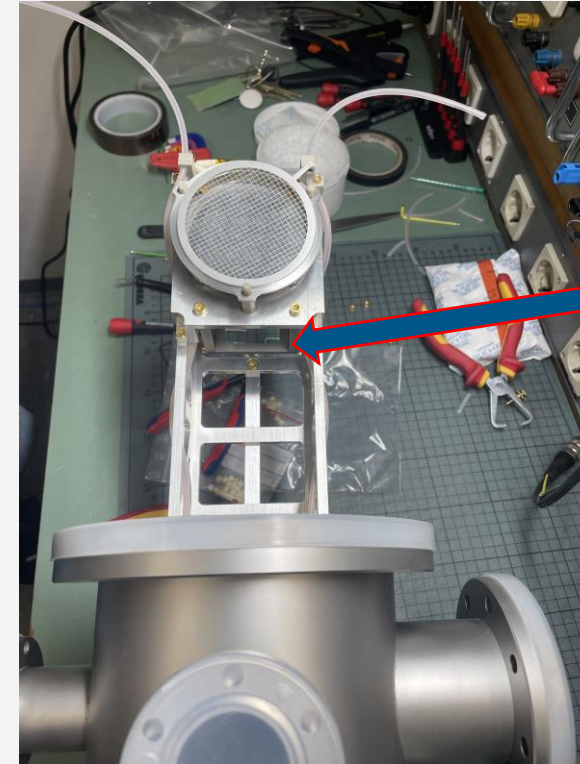
Mounting of the MCP



Back of the MCP with phosphor screen

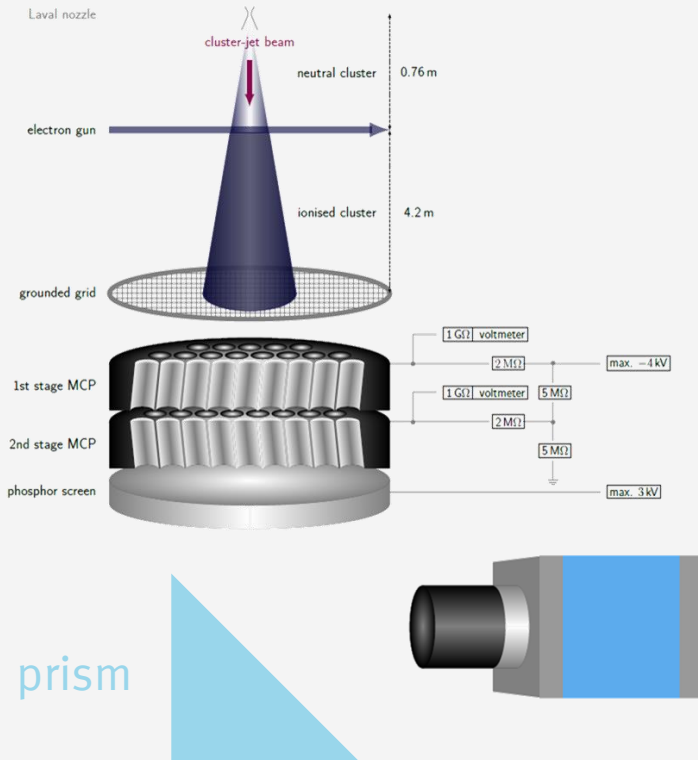


Grounded grid in front of MCP



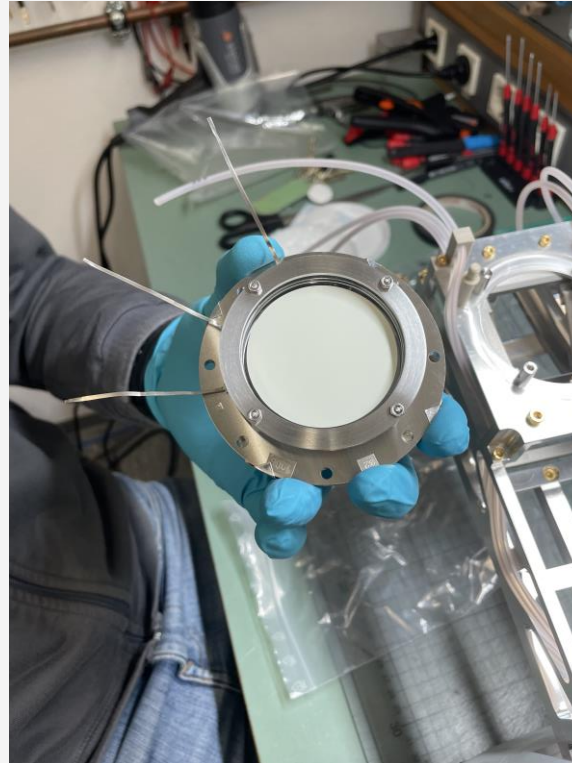
Prism for beam deflection

Mounting of the MCP

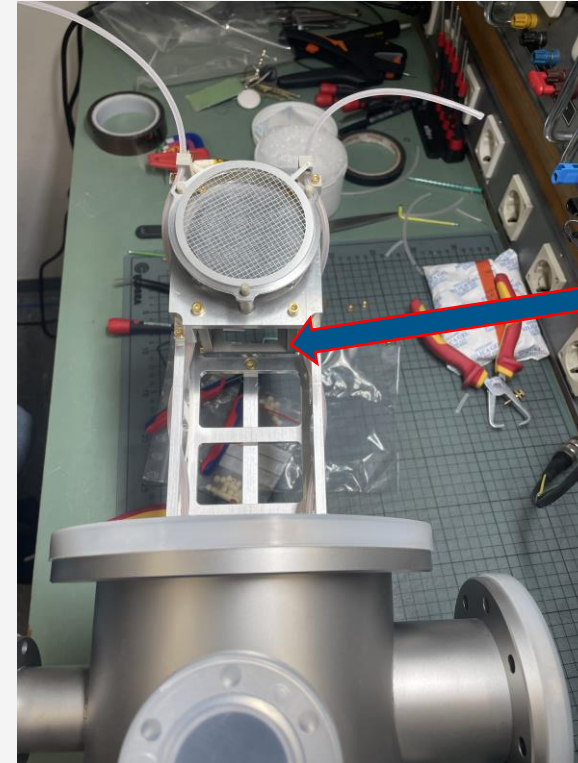


E. Köhler, doctoral thesis, WWU, 2015, edited

Back of the MCP with phosphor screen

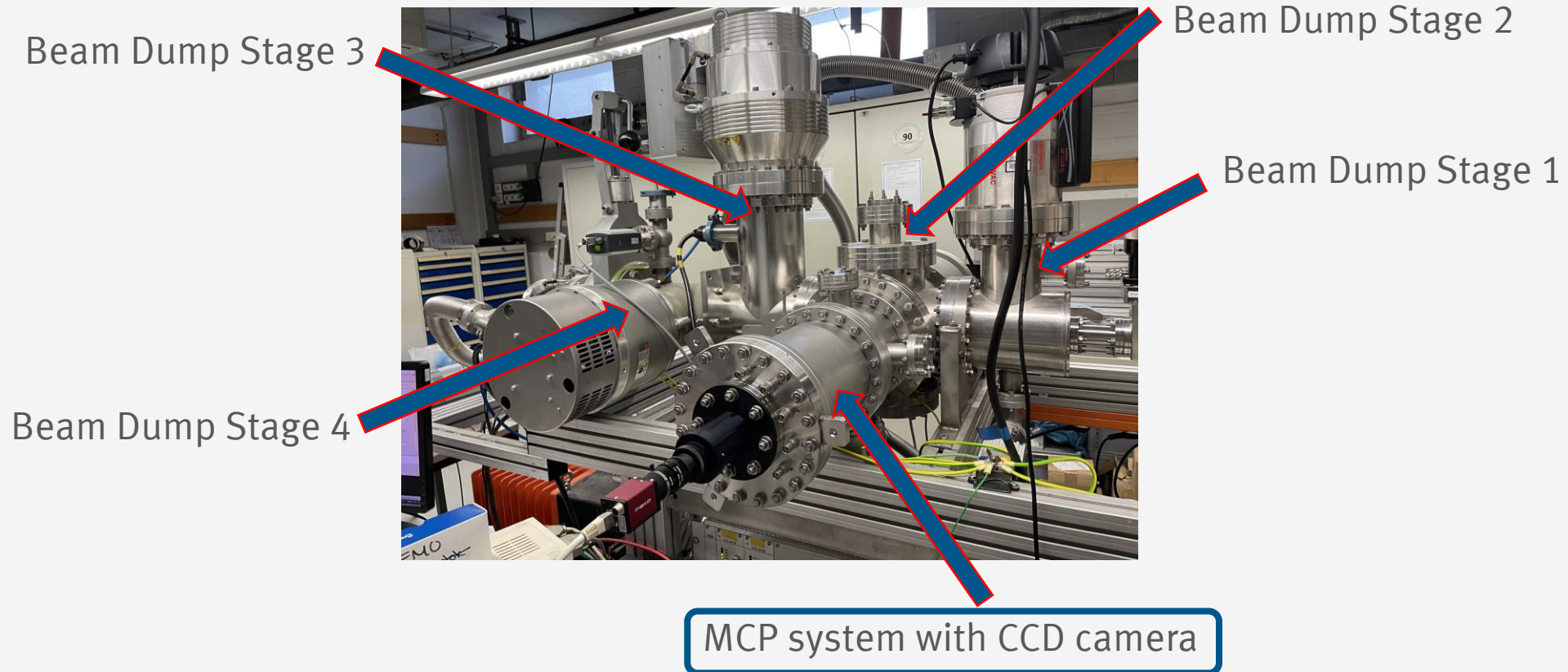


Grounded grid in front of MCP



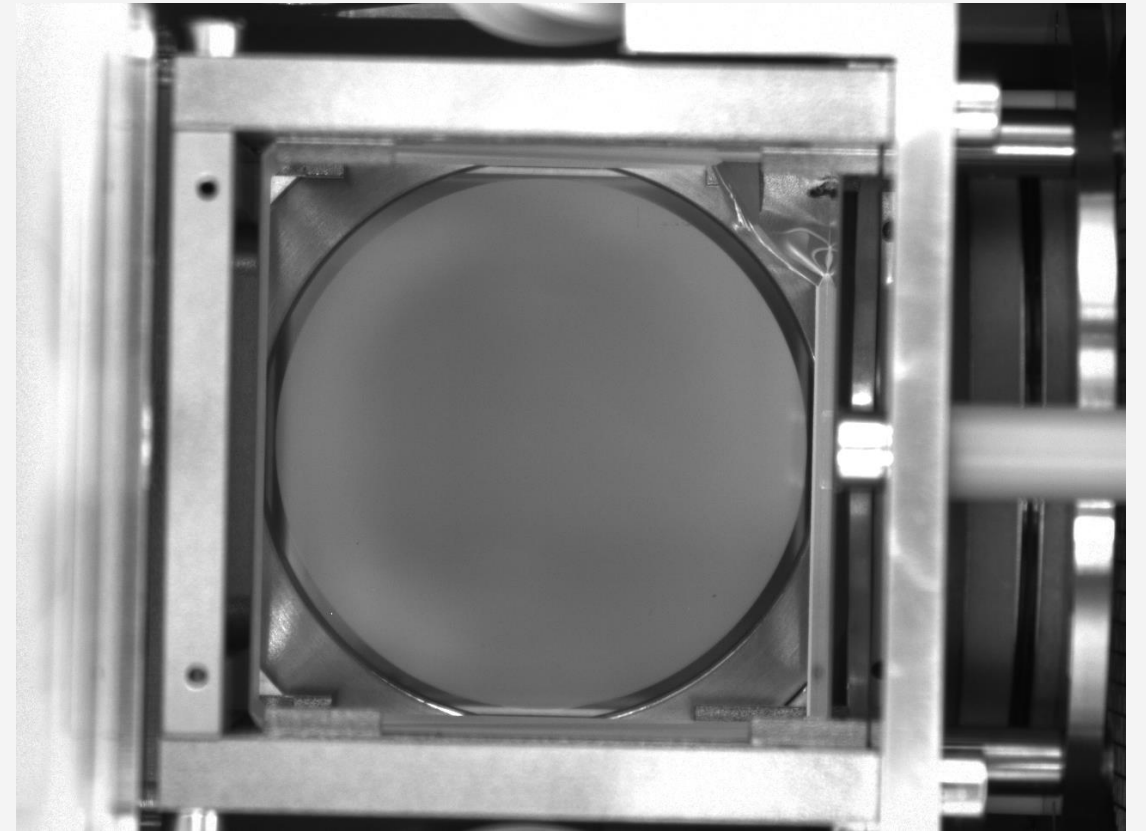
Prism for beam deflection

Installation at the Beam Dump in Münster

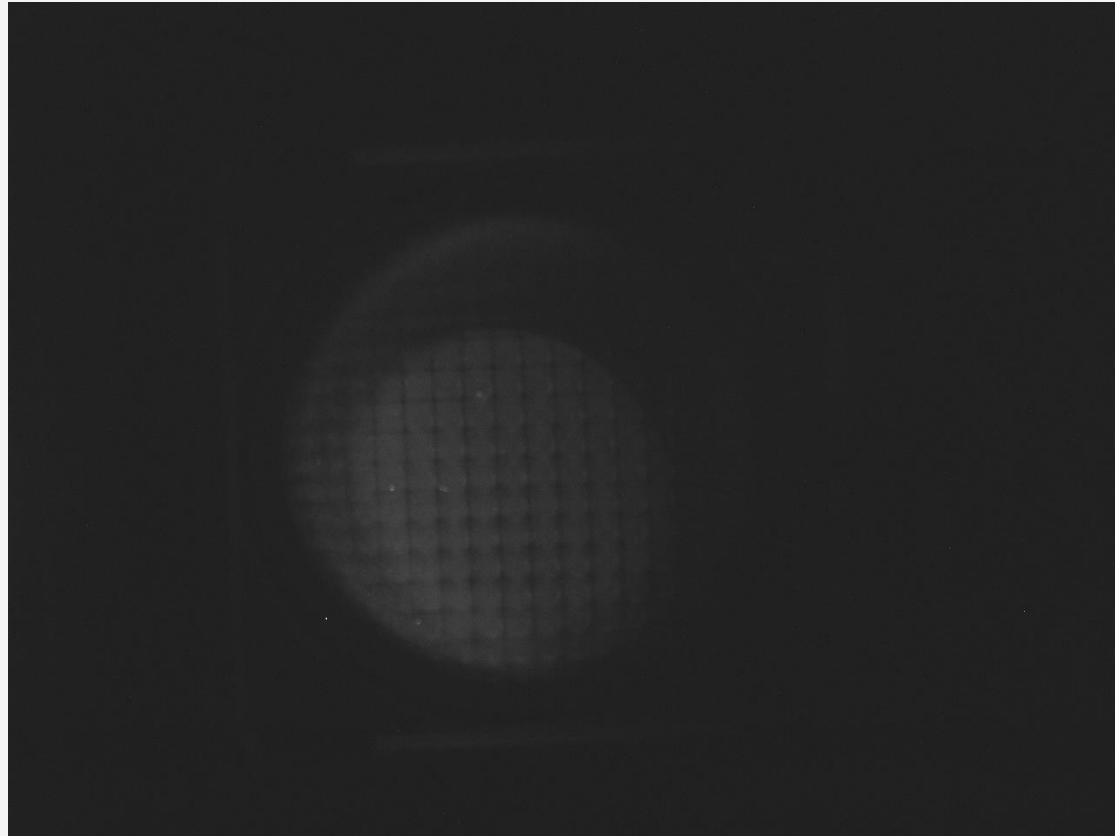


Focusing of the Camera and Ramp Up of HV

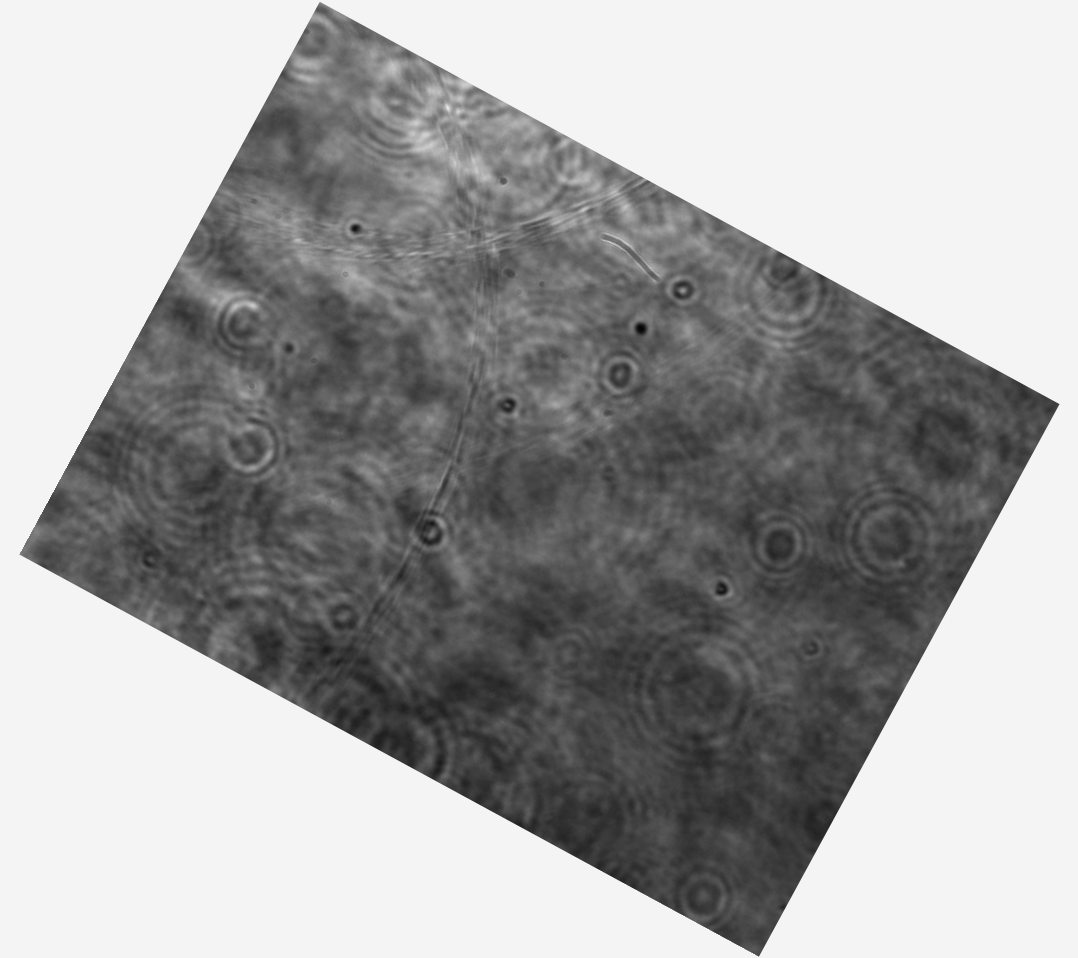
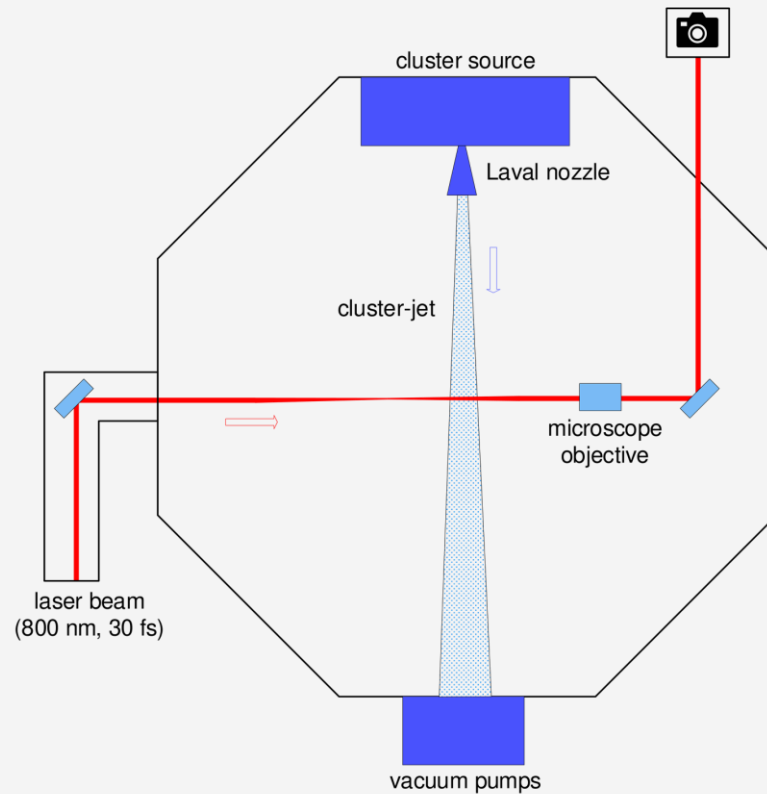
- Picture of the phosphor screen taken with the CCD camera
- The screen, which is rotated 90 degrees to the camera, is seen by a prism
- All edges of the screen are in focus
- At the first ramping of the HV of the MCP and the screen → slowly increase the voltage to avoid flashovers and discharges



First Test: Shadow Cast by the Rod System

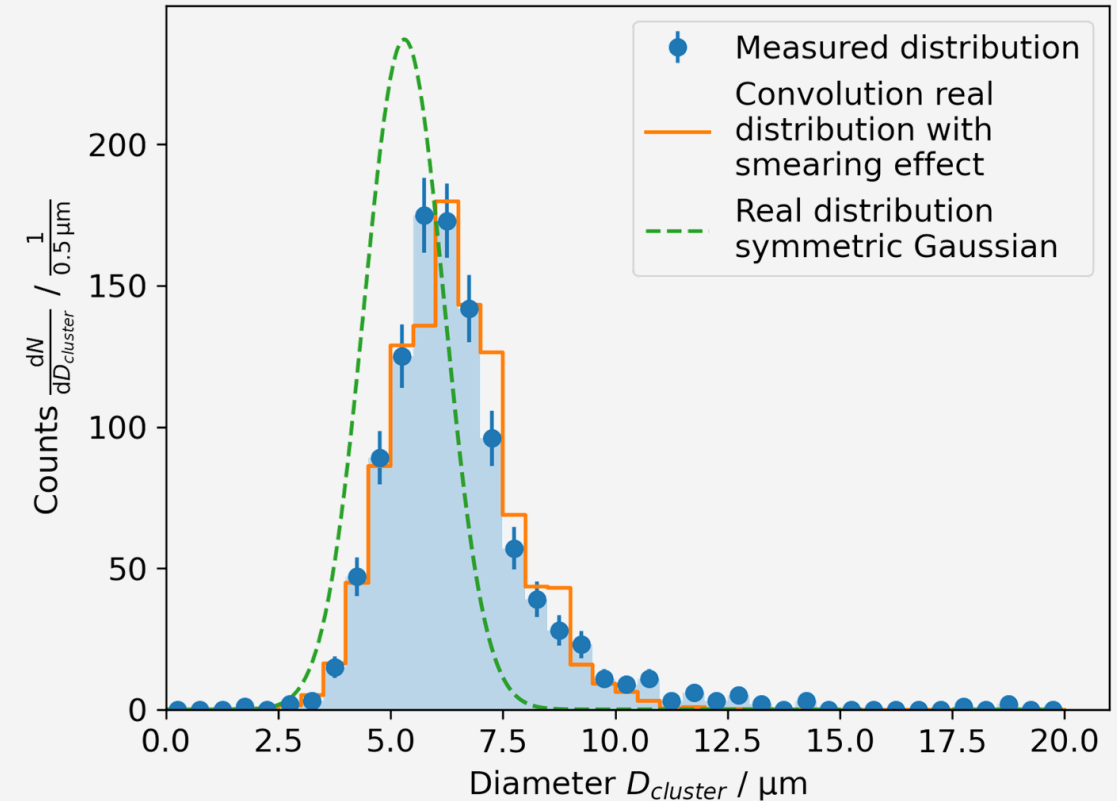


Reminder: Shadowgraphy Measurements



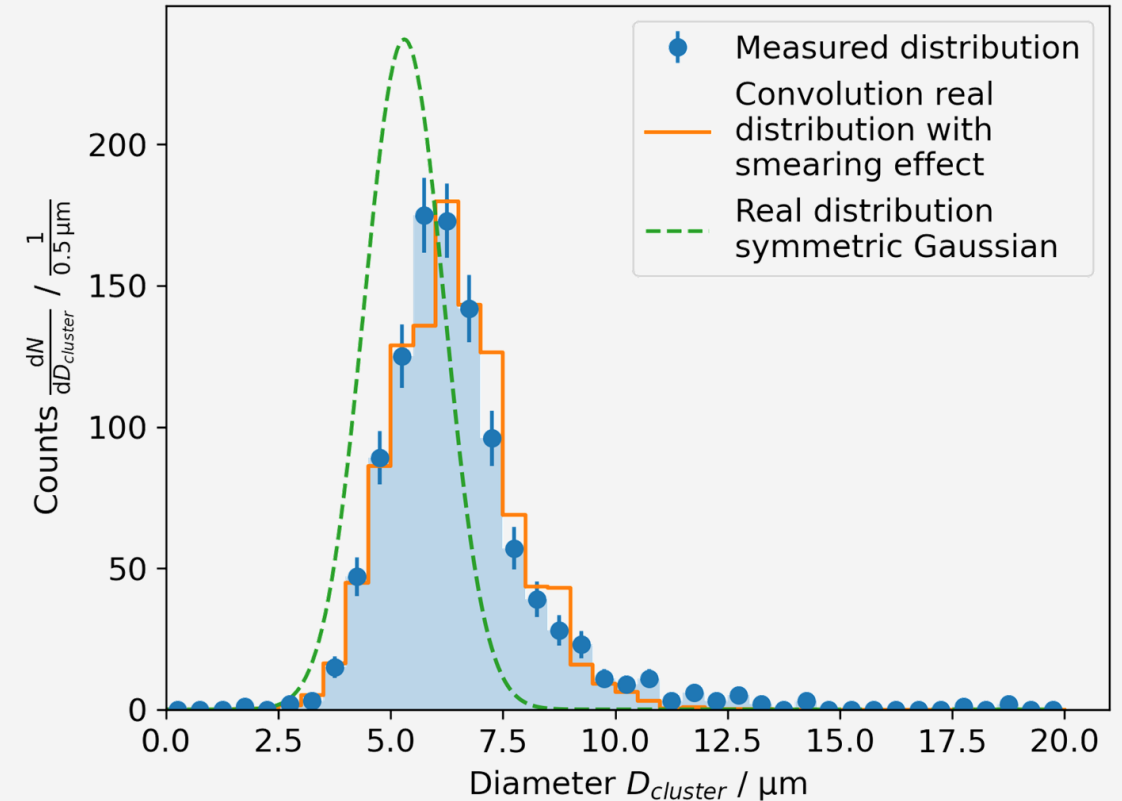
Cluster Size Distribution

- The **blue** distribution is measured and calculated from the shadowgraphy images
- To get *true* distribution, a **symmetric Gaussian-distribution** is convolved with toner measurement → **orange** function
- Optimization of the **green** input function to obtain best match between **blue** and **orange** distribution



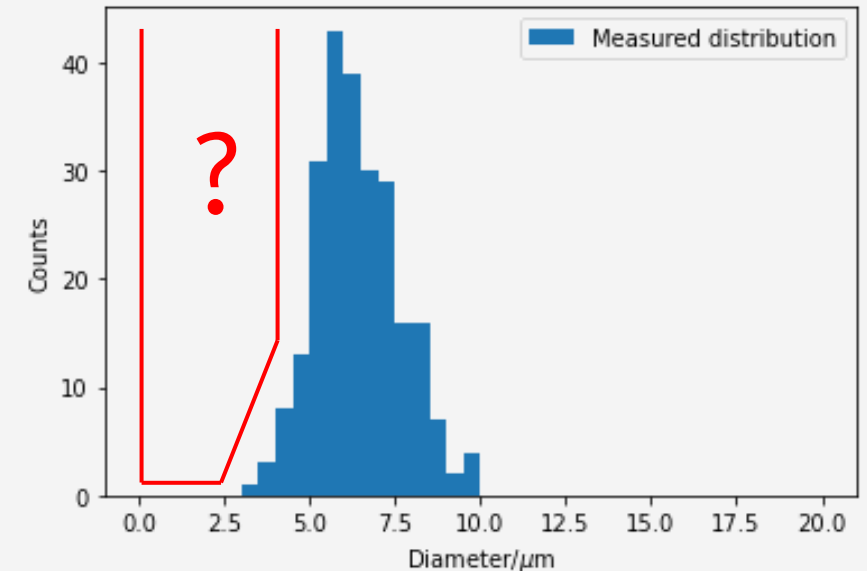
Cluster Size Distribution

Target setting	Mean value / μm	Standard deviation / μm
24 K, 6 bar	5.00 ± 0.20	0.91 ± 0.18
24 K, 8 bar	5.17 ± 0.20	0.96 ± 0.17
24K, 10 bar	5.18 ± 0.20	1.00 ± 0.16
24 K, 12 bar	5.24 ± 0.20	0.95 ± 0.16
24 K, 14 bar	5.34 ± 0.20	1.02 ± 0.17
24 K, 16 bar	5.58 ± 0.21	1.16 ± 0.17
26 K, 16 bar	5.37 ± 0.21	1.08 ± 0.16
28 K, 16 bar	5.41 ± 0.19	1.00 ± 0.15
30 K, 16 bar	5.06 ± 0.18	0.86 ± 0.15
32 K, 16 bar	4.62 ± 0.25	0.73 ± 0.25



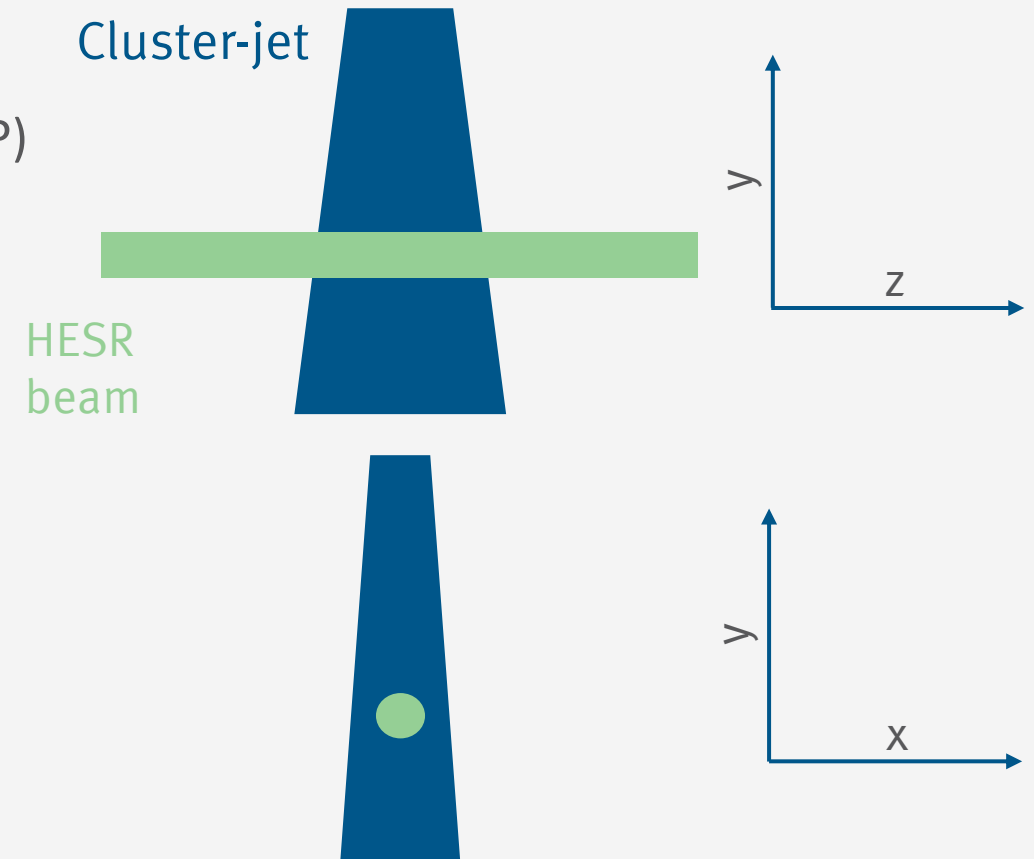
Distribution of Smaller Clusters

- It is very likely that there are also smaller clusters, but they cannot be found with shadowgraphy method (at the mentioned conditions)
- Methods to find the distribution of smaller clusters will be tested in the future (Mie scattering)



How many (large) clusters are hit by the accelerator beam at PANDA ?

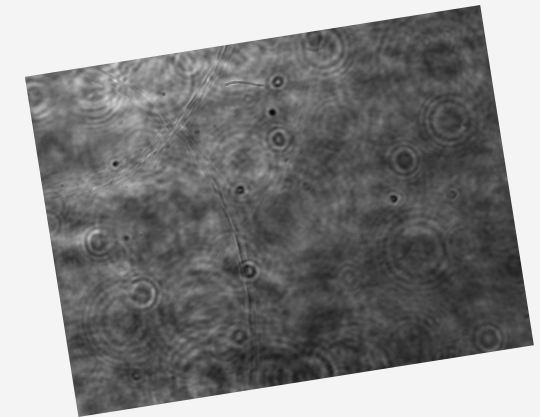
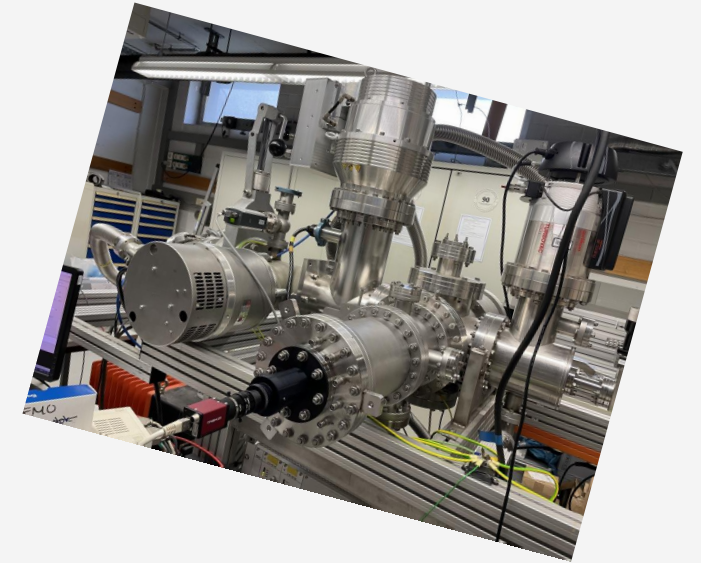
- Scale down number of clusters per mm^3 to 2.25 m (PANDA IP)
→ (0.029 ± 0.001) clusters / mm^3
- Width of cluster beam at IP: 13.39 mm
→ Clusters per area (0.39 ± 0.02) clusters / mm^2
- Assumption radius accelerator beam
→ $r = 0.5$ mm: (0.30 ± 0.01) clusters
→ $r = 1.0$ mm: (1.21 ± 0.06) clusters



Summary

MCP

- Commissioning of the MCP system at the prototype target in Münster was successful
- Further measurements with different parameters, e.g., target stagnation conditions, different exposure times,... necessary and commissioning of ToF system
- After its completion → Installation in Jülich at COSY to test the functionality of this new system with prism etc. in connection with the COSY beam



Summary

- After that, measure overlap of accelerator beam with cluster jet and to measure Tof of clusters

Shadowgraphy measurements

- Based on results of shadowgraphy measurements new method tested to find distribution of smaller clusters

