Entwicklung eines Strahlkamerasystems zur Analyse von Ionenstrahlen

Development of a Beam Camera System for the Analysis of Ion Beams

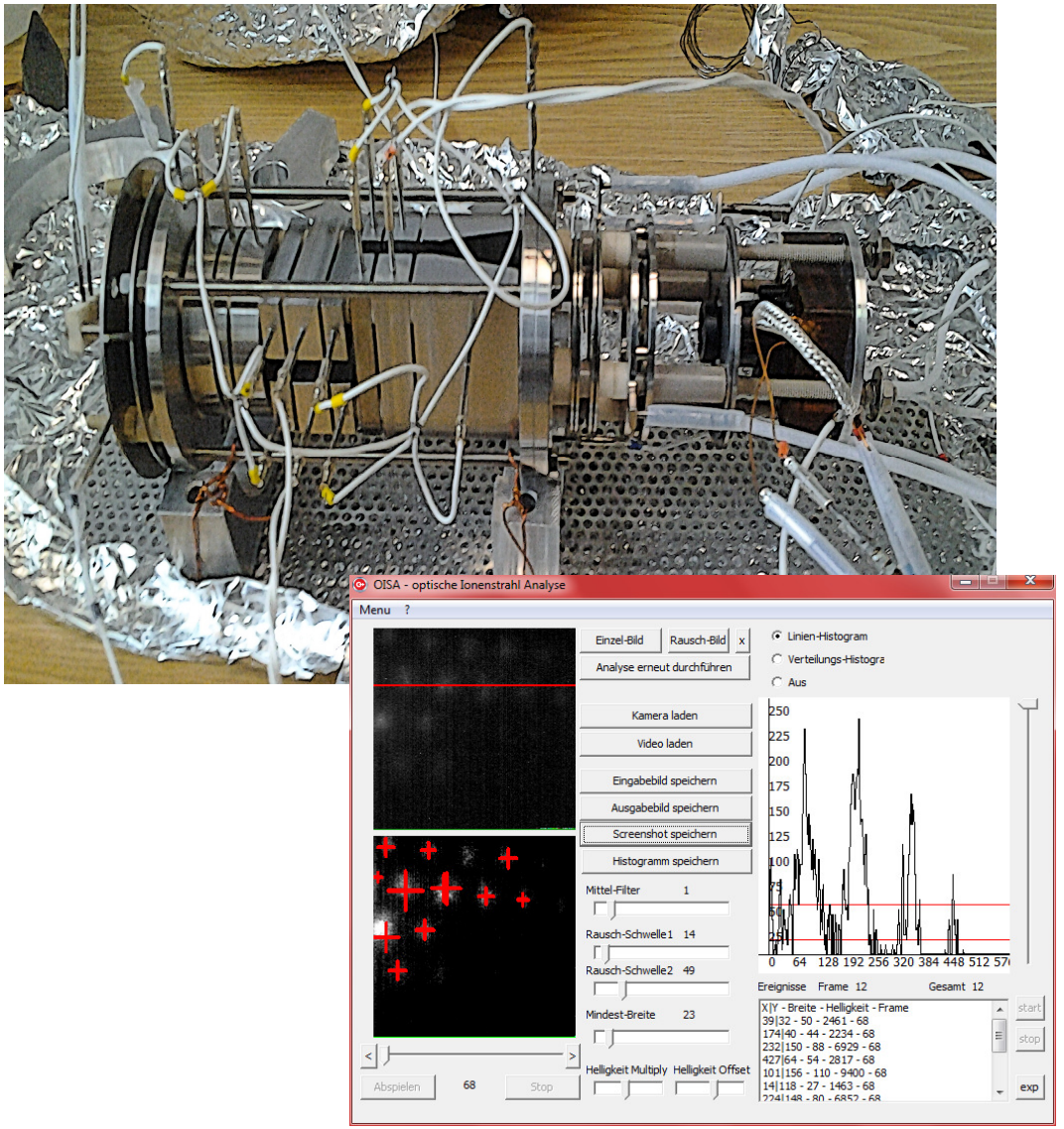
Bachelor-Thesis, Julian Bergmann, 2012

What has been done

Within the Ion Beam Camera a new digital camera sensor has been bought and integrated.

A software to control the camera and analyze its output has been developed.

The System has been tested within a vacuum for Ion Beam and Single Ion detection.



Benefits of the new camera sensor

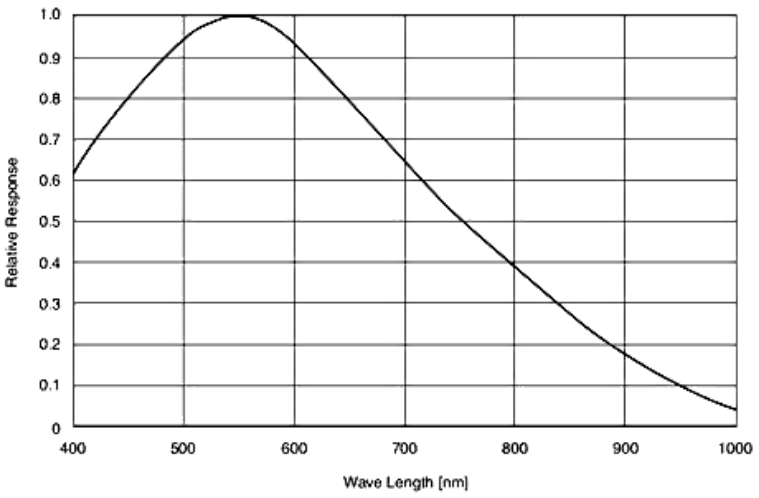
The new sensor has a luminosity of 0.005 lux

The signal is transported digital now → less noise

The camera's settings are changeable while it is working within the vacuum (Shutter speed, Gain)

The Sensor uses only 1.3 W and is powered and controlled via USB2 (5V)

It was possible to get a higher vacuum (2.2e-8 mbar instaed or 3e-8 mbar)

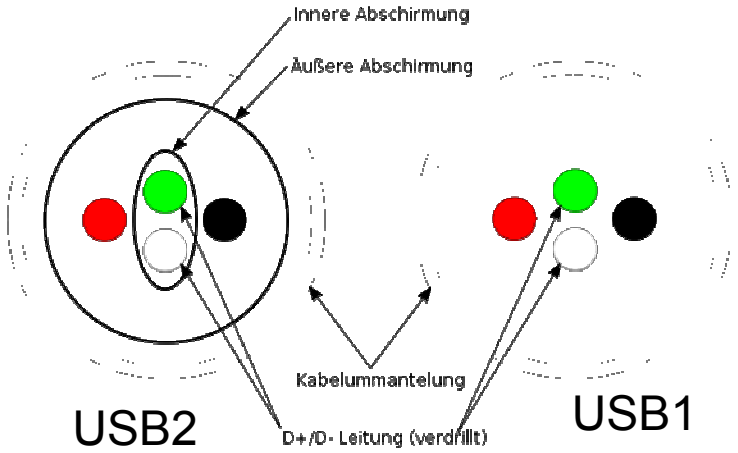


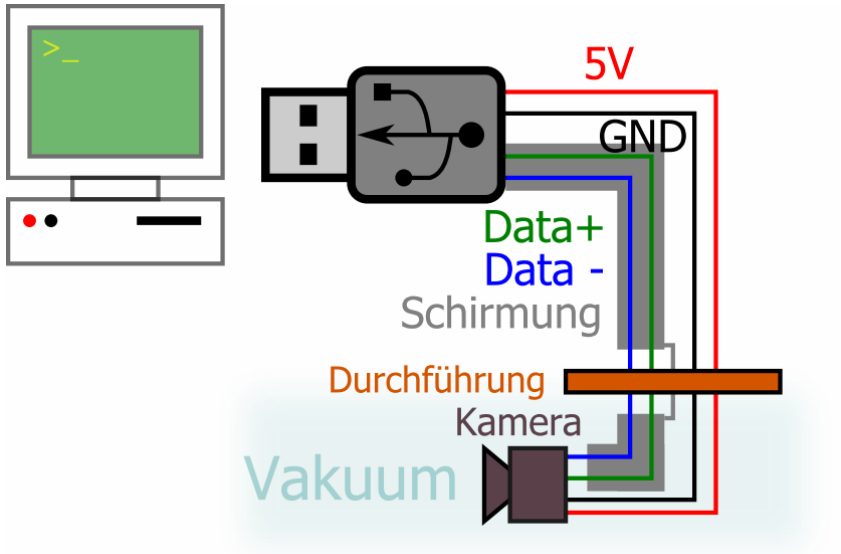
Modifications made on the new camera sensor

Embedding the sensor within a plastic-block onto a aluminum-plate

Soldering cables onto the sensors electric contacts

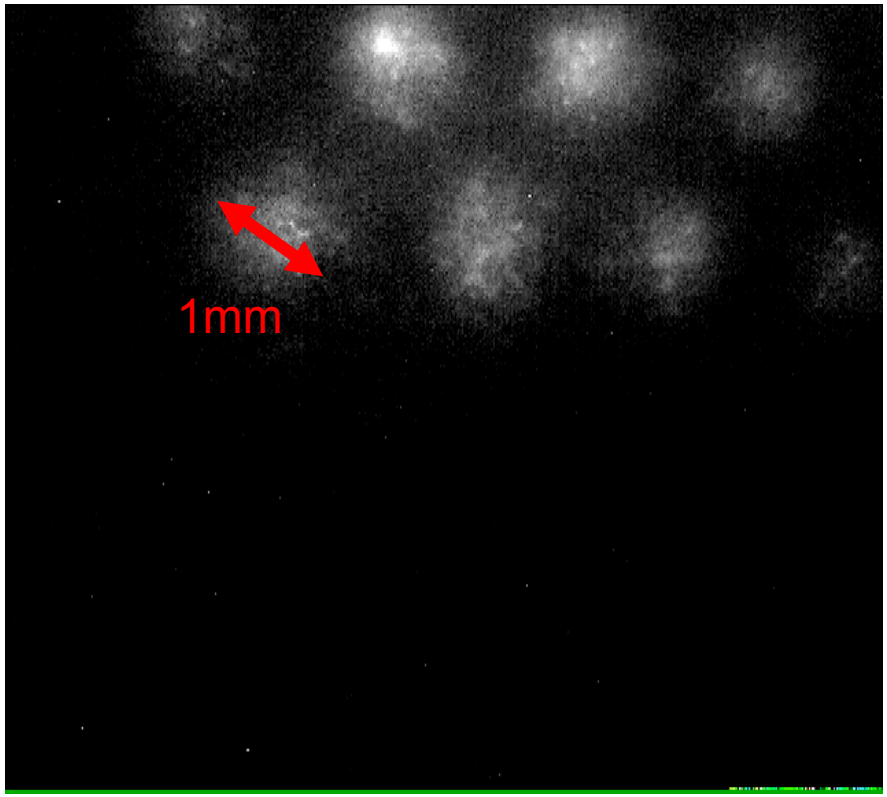
Shielding the cables to ensure USB2 speed

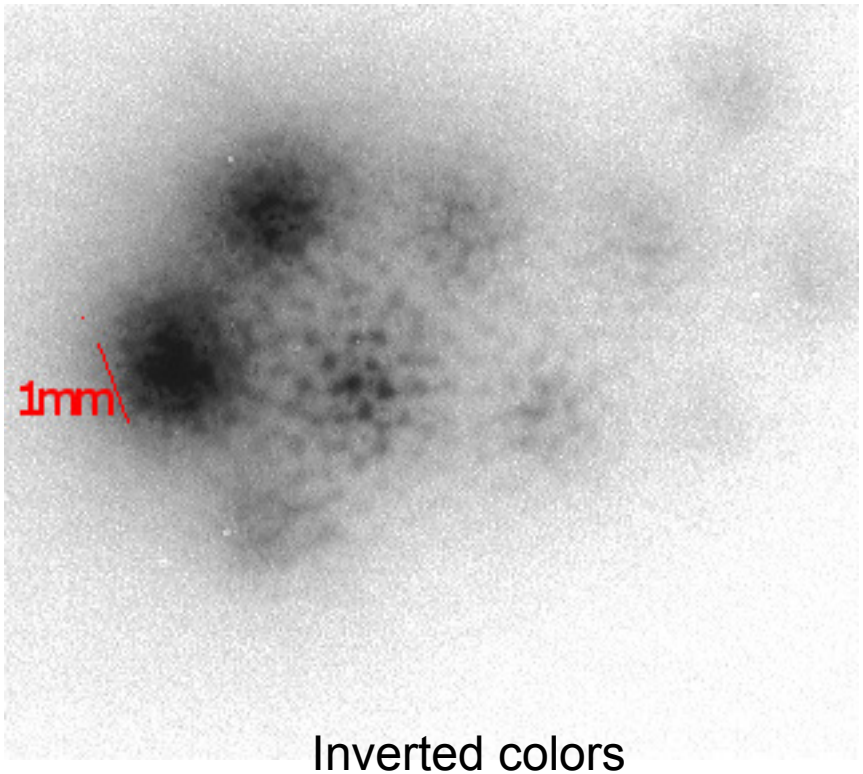




Camera sensor pictures

Pictures of the new beam camera system of a ion beam coming through a 1 mm grate

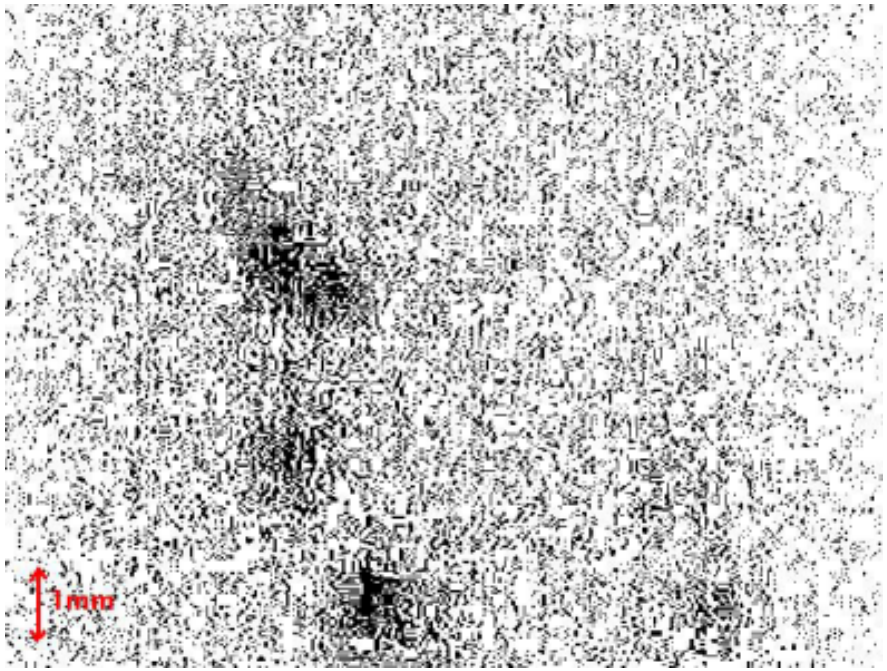




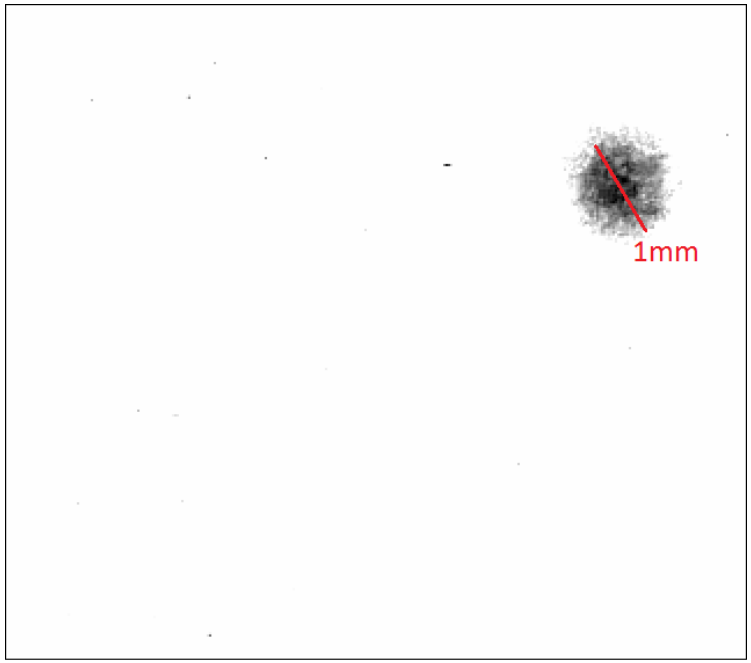
Inverted colors

Camera sensor pictures

Comparison with the old beam camera system
(single ion detection, inverted colors)



Old system



New system

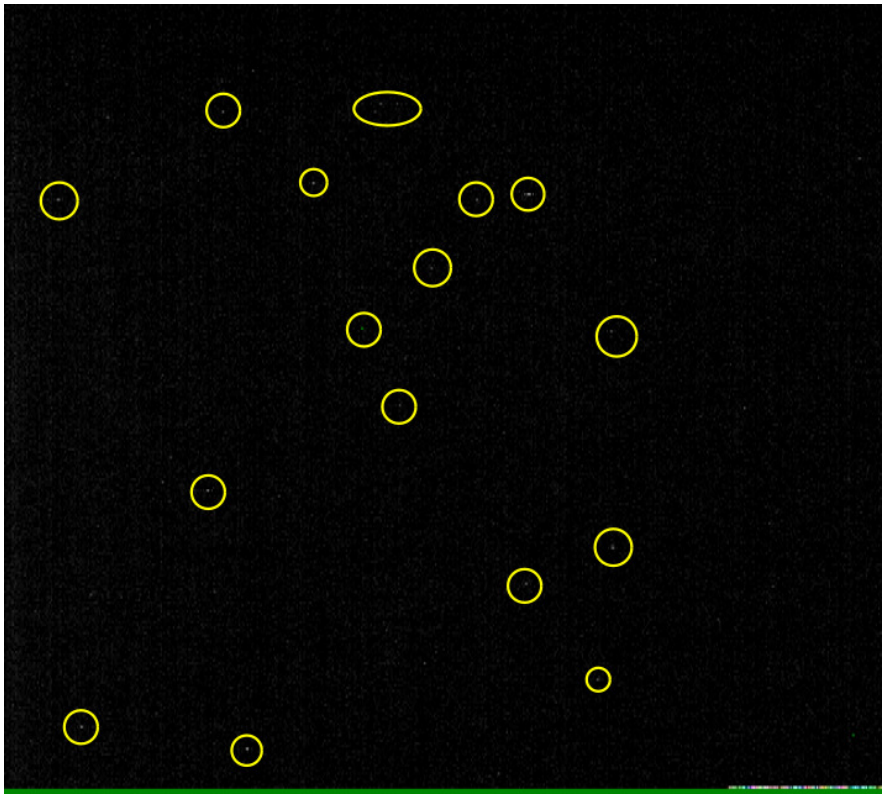
Camera sensor pictures

After using the system for an hour slowly faint vertical lines appears.
After disconnecting the sensor for 5 minutes they disappeared again

Camera sensor pictures

Depending on shutter speed, single bright pixel showed up

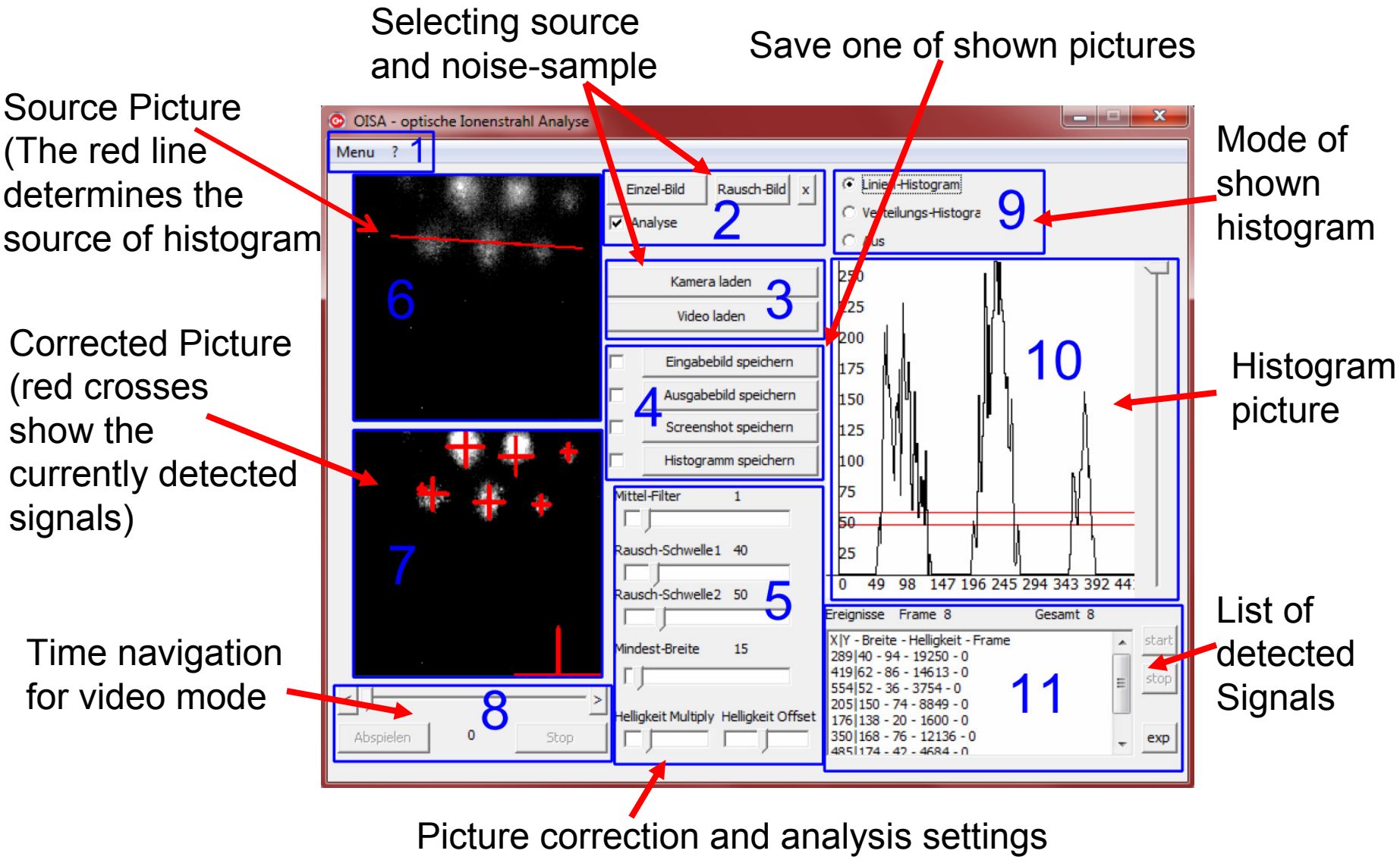
Shutter speed 1/500s



Shutter speed 4/25s

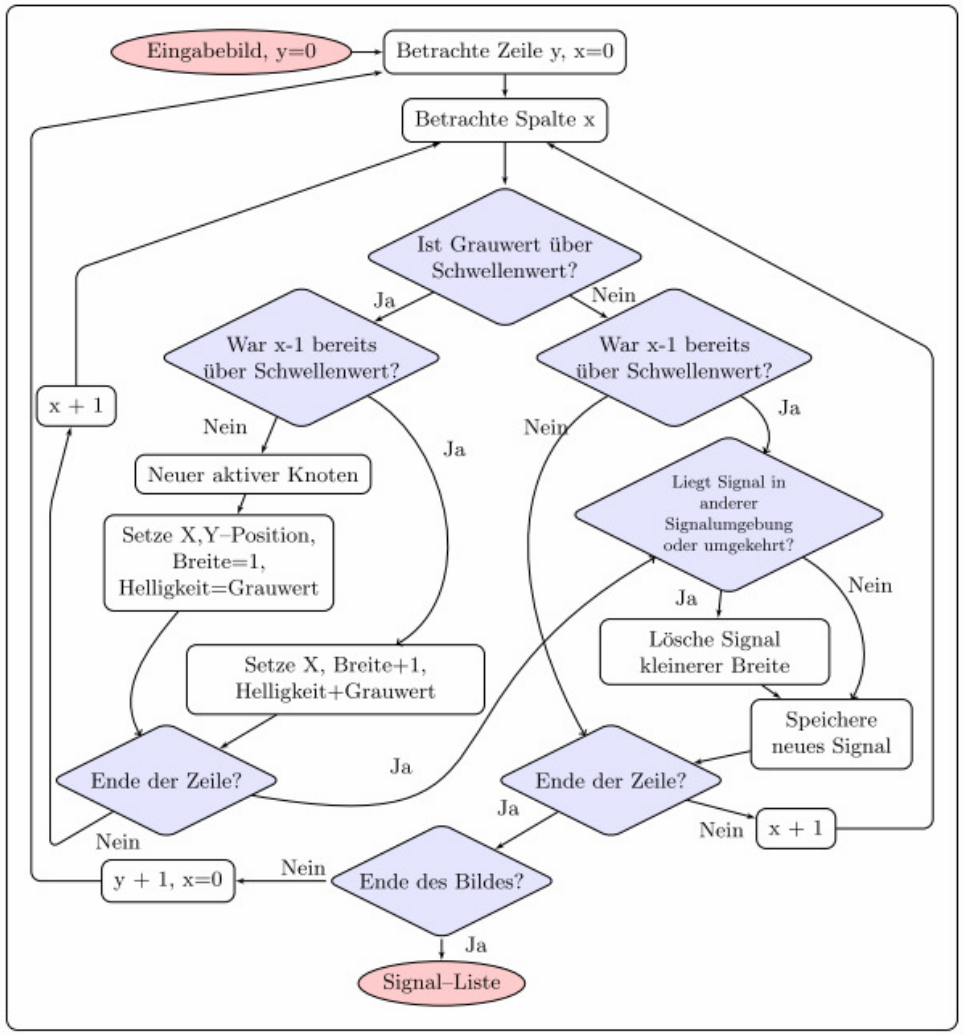
Software OISA

Optische Ionen-Strahl Analyse

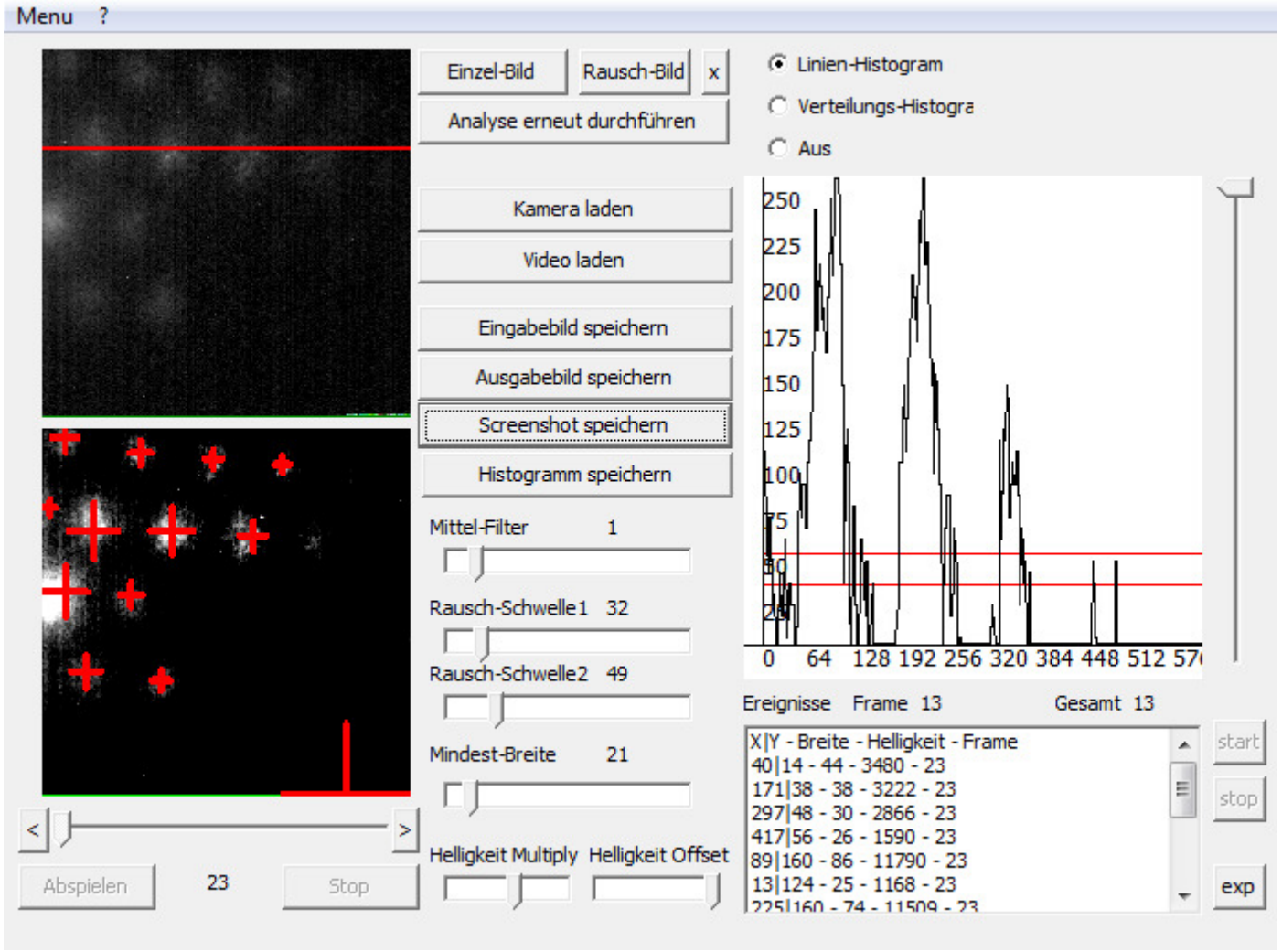


Software OISA – Signal detection

1. Scan every line for brightness over a certain constant
2. If it is over, uncrease a counter for the length/width of signal
3. Sum up the brightness of the pixel for signal-brightness
4. If the brightness is under the set constant, “finish” the signal and save its properties
5. Search for already finished signals that are within the signal’s area
6. If one is found, the current detected line is part of this signal. Delete the saved signal with smaller width then



Using the beam camera system



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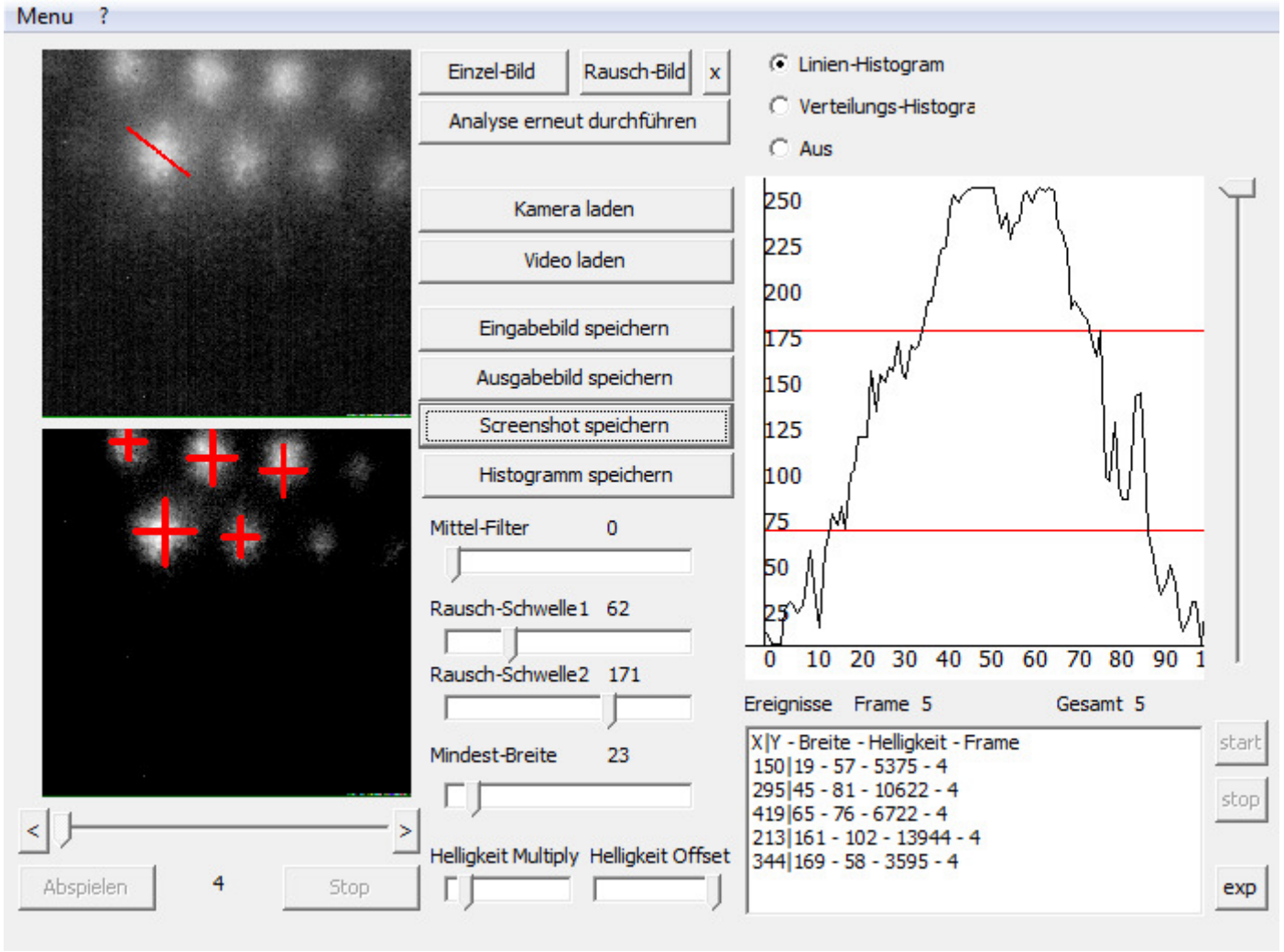

Tasks and future applications

Currently the system is able to…

- detect a signal and show its position, size and brightness
- use videos or a camera as source
- save pictures automatically to hard disk
- show histograms for a custom defined range
- generate a list of signals detected within a custom time

Later it is planned to be connected to a peltier-cooling and integrated into the Ambiprobe-MR-TOF-MS to enhance the ion beam guiding and a better phase advancing.