# Application note

RoentDek Handels GmbH

Supersonic Gas Jets
Detection Techniques
Data Acquisition Systems
Multifragment Imaging Systems

# RoentDek DLD40 for low count rate LEEM application

Recently, the performance of a **RoentDek DLD40** detector was demonstrated in a Low Energy Electron Microscope. Due to the operation conditions of the instrument the count rate from the sample was very low so that the commonly used ICCD technique (cooled) reached its limitations.

Figure 1 shows a LEEM image taken from a micro-structured sample with a standard **DLD40** mounted in the image plane as sensor for electrons. The image diameter was restricted by an aperture to about 25 mm on the 45 mm active detector. The magnification was set to 600x for resolving the smallest structures (squares of 1 um) on the sample, 10 of those compose a 10 micron superstructure of squares.
The count rate on the detector was about 100.000 electrons per second or 10 femtoAmpere. It took about one minute to acquire this image.

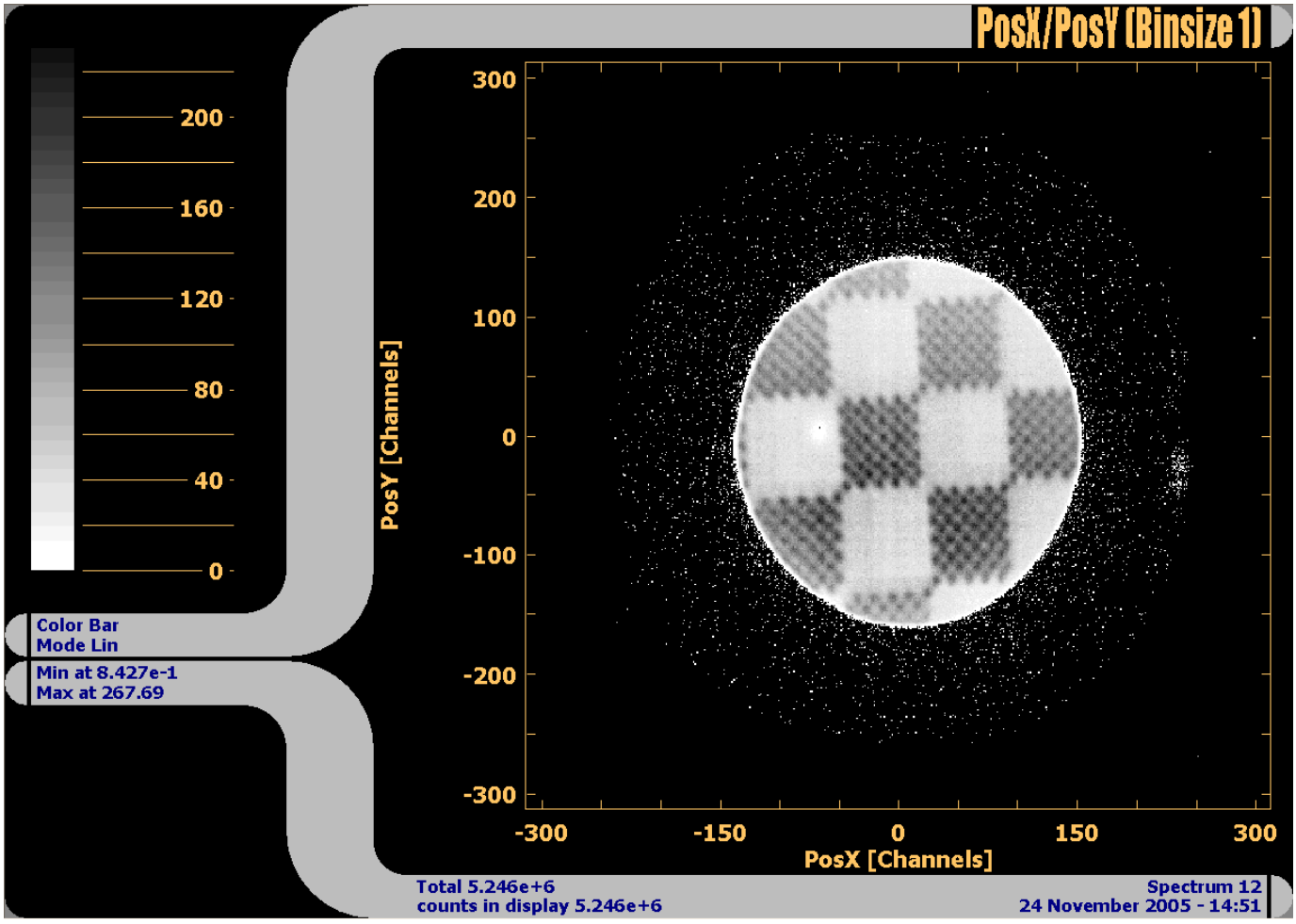



Figure 1: LEEM image taken from a micro-structured sample with a standard **DLD40.** Each white spot in the outer part of the image comes from individual dark counts of the microchannel plate (MCP).

While imaging at such a low electron current with standard ICCD sensors is already strongly affected by thermal camera noise, it can clearly be seen that here the only background contribution comes from the intrinsic “dark counts” of the microchannel plate, typically 1 count per second and square mm or total 10 counts/sec here.

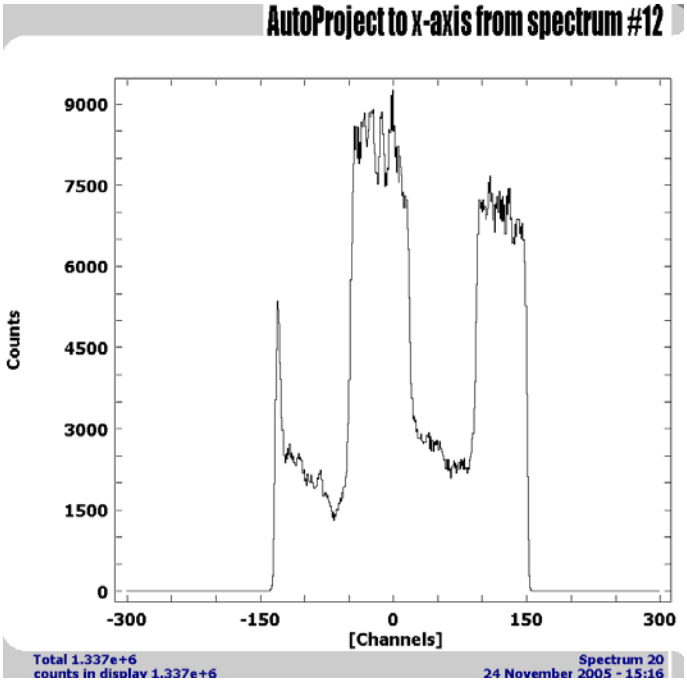



Figure 2: line scan through the image, linear scale

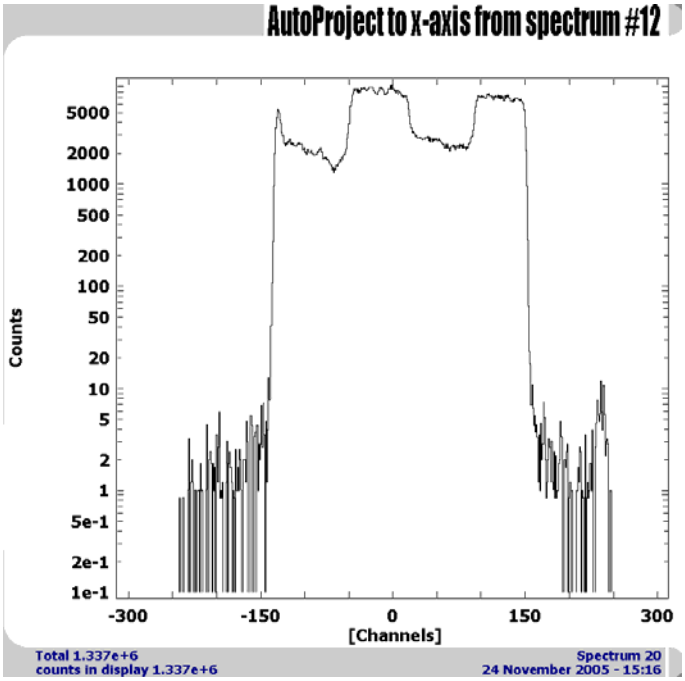
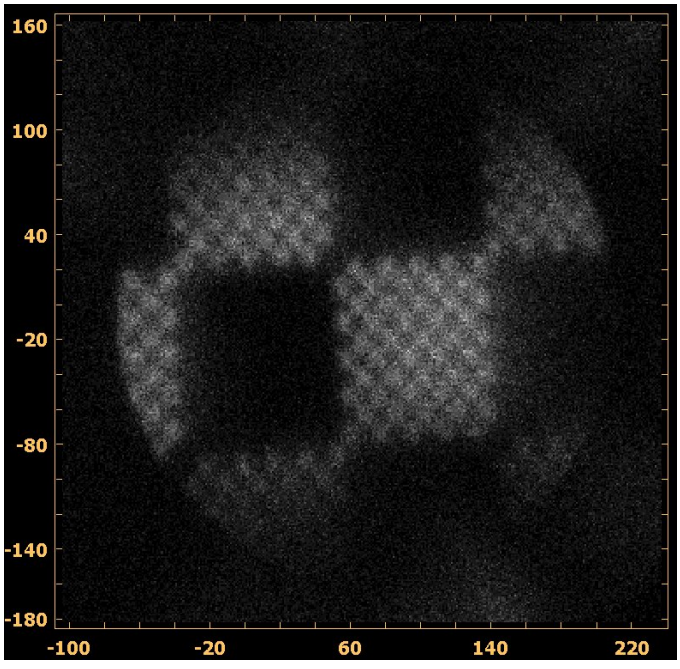



Figure 3: line scan through the image, as figure 2, but in logarithmic scale

Figures 2 and 3 show a line scan through the structure in lin and log scale. The “noise” from the MCP dark counts is negligible and only visible on logarithmic scale. There is no additional read-out noise.

Then the electron current was further reduced.

Figure 4 (right) shows an image taken from the same sample with about 1000x magnification at a count rate of only 10 electrons per sec or **1 attoAmpere** electron flux.
Even at this extremely low current the 1 micron structures can clearly be resolved and distinguished from the background. The background from MCP dark counts was NOT subtracted here.




Using a **DLD** as sensor for LEEM/PEEM or similar applications provides **highest imaging performance** at **lowest possible count rates**.

If you have such an application, feel free to contact us.