A compact setup of fast pnCCDs for exotic atom measurements

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Measurements at particle accelerators suffer from a high beam-induced background. For low-intensity X-ray measurements CCDs can solve this problem due to their pixel structure, which allows to reduce the background by a cluster analysis. Usual CCDs, however, have the disadvantage of only a thin depletion zone and long readout times possibly leading to over illumination. Fast read-out capable CCDs , so called pnCCDs, have been developed at the semi-conductor laboratory of the Max Planck Institute (MPI) for the XMM satellite misson.

One advantage of the chosen CCD setup is, that every channel of the pixel matrix is connected to its own amplifier in a multi amplifier chip (CAMEX). The parallel readout of one line reduces the readout time per frame allowing event rates of more than 100 K/s*cm^2 without loss in energy resolution. Secondly, the complete detector thickness of 300 μm is depleted and together with a very thin entrance window, the pnCCD reaches a quantum efficiency of better than 80% for energies between 1 and 10 keV. Recently an improved version of pnCCDs was developed. These chips will be available with different pixel size and geometries.

At the ZEL (Central Laboratory for Electronics) of the research center Jülich a dedicated electronics for fast readout was developed in collaboration with the MPI. The aim was toobtain a compact and flexible detector setup with an easily manageable user interface providing computer controlling of all relevant detector parameters. The prototype detector consists of a detector head installed inside a vacuum cryostat, supporting a first generation CCD-chip with its amplifier chip CAMEX and mounted on a ceramic platine attached to a cooling mask, the external electronics with power supplies, ADCs and a digital pulse generator.

The working principle and the present and future performance of pnCCDs, readout chip CAMEX and the external electronics will be demonstrated from first measurements at the high intensity pion beam of the Paul-Scherrer-Institut (PSI).