X-ray crystal spectrometers based on HPC detector technology

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Hybrid Photon Counting (HPC) detector technology has advanced almost all X-ray based analytical methods used in basic research and industrial processes in the last decade. Besides their use in X-ray diffraction and scattering, HPC detectors have enabled progresses in many other fields including X-ray crystal spectroscopy.

X-ray crystal spectroscopy is an essential diagnostic for monitoring plasmas owing to its capability of detecting emission lines of impurities (Be, C, O, Fe, Ni, Cu, W) and dopant (Ar, Ne). Princeton Plasma Physics Laboratory has integrated HPC technology into X-ray Imaging Crystal Spectrometers (XICS) for routinely detecting line emission from highly charged elements including Ar16+, Ar17+, Fe 24+ and Mo32+ amongst a selection of other lines. Noise-free performance, energy discrimination, a sharp point spread function, a high frame rate, a high dynamic range, in-vacuum operation, a large detectable energy range (1.8-30 keV) and radiation hardness are underlying criteria for the superiority of PILATUS3, an HPC detector developed and manufactured by DECTRIS and successfully implemented in various plasma X-ray crystal spectrometers.

Here we present an overview of the usage of PILATUS3 in plasma spectroscopy and highlight the PILATUS3 900K-IPP, an instrument specifically designed for the study of fusion plasma at the EAST tokamak. We will show that the fast readout time of PILATUS3 of only 0.95 ms and its high frame rate of 500 Hz can enable real-time plasma condition feedback.

PILATUS3 900K-IPP in-vacuum detector for X-ray plasma spectroscopy