Detectors at the European XFEL: Commissioning and First User Operation

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The European X-ray Free Electron Laser (XFEL.EU) is a high brilliance X-ray light source in Hamburg/Schenefeld, Germany, which commenced user operation at its first photon beam line in September 2018. In its final configuration the facility will provide spatially coherent ultra-short X-ray pulses (< 100 fs) in the energy range between 0.25 keV and 25 keV. The up to 27.000 X-ray pulses per second delivered by the machine are follwoing a unique time structure consisting of up to 2700 X-ray pulses at the repetition rate of 4.5 MHz, organized in 10 equidistant pulse trains per second.

The large variety of scientific applications at the European XFEL require different instrumentation, in particular large area 2D imaging detectors based on hybrid pixel technology, which can cope with high pulse repetition rate of 4.5 MHz, can provide a dynamic range of up to 10^5 photons per pulse per pixel and high angular resolution. The imaging detectors' on-sensor memory-cell and multi-gain-stage architectures pose unique challenges in detector-specific data corrections and subsequent calibration of scientific data.

The first two instruments, which were open for user experiments in autumn 2017 and spring 2018, are the Femto Second X-ray Emission (FXE) instrument focused on ultra-fast X-ray spectroscopy and X-ray scattering and the Single Particles, Clusters, and Biomolecules & Serial Femtosecond Crystallography (SPB/SFX) instrument aiming for coherent diffractive imaging and three dimensional structural determination ofsubmicron scale at atomic or near-atomic resolution. I will present an overview about the experience gained with our detectors during integration, commissioning and the first 6 months of user operation at the scientific instruments FXE and SPB/SFX, including first calibration and characterization results.