QUANTITATIVE DETECTION OF FEMTOSECOND X-RAY PULSES

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Abstract

A detection system for femtosecond X-ray pulses has been developed within close cooperation between the Deutsche Elektronen-Synchrotron in Hamburg and the Physikalisch-Technische Bundeanstalt in Berlin. It is based on photoionization of Xenon gas and, hence, radiation hard. Photoions generated are extracted by an electric field and, in contrast to former devices developed for the vacuum-ultraviolet spectral range [1], detected by an amplifying open electron multiplier. Operation is performed at low gas pressure in the range between 0.1 and 0.01 Pa. Thus, the detector is almost transparent and may be used as a fast online monitor for quantitative and pulse-resolved determination of photon numbers and pulse energies of X-ray free electron lasers. After design and construction, a prototype has been successfully characterized and calibrated for photon energies from 4 to 10 keV in the PTB laboratory at the electron storage ring BESSY II in Berlin. First application has recently been realized in collaboration with the Linear Coherent Light Source at the Sub-Picosecond Pulse Source in Stanford with up to $1{\cdot}10^6$ photons per pulse detected at a photon energy of 9.4 keV.

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[1] M. Richter et al., Appl. Phys. Lett. 83, 2970-2972 (2003)