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Ultra-fast line camera based on TI-LGAD for beam diagnostics and photon science

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New generation of synchrotron and plasma accelerators will produce coherent radiation with extremely high brightness. Photon beams from these machines will greatly extend the present research capabilities and will reveal new opportunities in imaging, spectroscopy, structural and dynamic studies, and other applications. Development of beam diagnostic instrumentation with high precision becomes essential for these purposes. The energy spread of the electron bunch is an important parameter for the studies of the microbunching dynamics. At Karlsruhe Research Accelerator (KARA) a visible light diagnostics port (VLD) is utilized to measure the incoherent synchrotron radiation emitted at a 5° port front end at a dipole magnet. To accommodate several measurement modalities, this radiation is split in several spectral ranges, for example, to the range between 400 nm to 500 nm. At present, measurements are limited by performance of the detector. The major limitations are the frame rate of the camera as well as the low dynamic range [1]. In order to improve the performance, a line array camera with Trench Isolated Low Gain Avalanche Diodes (TI-LGAD) is in development. TI-LGADs are a new generation of segmented LGAD type sensors with fast timing, internal gain, high spatial resolution and good signal-to-noise performance [2]. The line array camera, named KALYPSO (KArlsruhe Linear arraY detector for MHz-rePetition rate SpectrOscopy), has been designed and produced. Several versions of TI-LGADs have been characterized and successfully mounted in the ultra-fast line camera KALYPSO, which is capable of frame rates up to 12 MHz [1]. In this contribution, the performance of the sensor as well as first results from the beam time measurements at KARA will be presented.

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