Contribution ID: **36**

Type: **Talk**

Development of Gotthard-II Detector for the European X-ray Free-Electron Laser

Thursday 7 September 2017 09:30 (20 minutes)

Gotthard-II is a silicon microstrip detector developed for the European X-ray Free-Electron Laser (XFEL.EU). Its potential scientific applications include X-ray absorption/emission spectroscopy, hard X-ray high resolution single-shot spectrometry (HiREX), energy dispersive experiments at 4.5 MHz frame rate, beam diagnostics, as well as veto signal generation for pixel detectors at the XFEL.EU. Gotthard-II uses a silicon microstrip sensor with a pitch of 50 µm or 25 µm and with 1280 or 2560 channels wire-bonded to readout chips (ROCs). In the ROC, an adaptive gain switching preamplifier (PRE), a fully differential Correlated-Double-Sampling (CDS) stage, an Analog-to-Digital Converter (ADC) as well as a Static Random-Access Memory (SRAM) capable of storing all the 2700 images in an XFEL bunch train will be implemented. Several prototypes with different designs of analogue front-end (PRE and CDS) and ADC test structure have been fabricated in UMC-110nm technology and their performance has been evaluated according to the XFEL.EU specifications. In addition, a prototype with complete circuit chain of 8 channels including analogue front-end, ADC and SRAM has been designed and fabricated. The performance of the prototype in terms of noise, linearity, dynamic range, coupling between channels and speed have been investigated and will be discussed.

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Session Classification: Detectors for synchrotron and free electron laser radiation (II)