Contribution ID: **58** Type: **not specified**

# SCARLET: A new High-Rate and High-Resolution X-ray Spectroscopy Detector for Synchrotron XRF and XAFS Applications

Despite the effort in developing suitable detectors for X-ray fluorescence measurements at synchrotron light sources, e.g. for XRF and XAFS experiments, in many applications the capability of fluorescence spectroscopy detectors is rather limited. The high-rate performances of current detectors may be further challenged due to the ongoing machine upgrades or for the use in future sources where a factor between 10 and 100 of beam-on-sample fluxes may be increased with respect to the present conditions. Despite different commercial options for SDDs-based systems presently available, these are actually limited to single- or few-channel systems (4-7 units maximum). This motivates a new, sharp transition of this technology toward compact, multi-channels, high-density systems (hundreds of channels) to build high-resolution, high-rate and also versatile systems for synchrotron radiation applications. We propose the detector SCARLET (Sdd-asiC ARray for Large Events Throughput) aimed to cope with this challenge in the following years. The detector is based on monolithic arrays of SDDs (e.g. 8x8 units of 1mm2 area each) bump bonded to a readout ASIC containing the full CMOS readout chain, from the charge preamplifier to the ADC. Although the detector-ASIC bump bonding architecture is rather popular in X-ray imaging detectors domain, it has not been significantly explored for X-ray spectroscopy-grade detectors and surely not for SDDs. The challenge here is to obtain a hybrid, monolithic detector based on SDDs with a high channel density but still keeping the adequate spectroscopy performances required by the target synchrotron applications. The readout chip will be composed by a CUBE preamplifier, a state-of-the-art CMOS preamplifier for SDDs for the first time integrated on the same chip with the remaining electronics analog chain, an analog shaping amplifier and an ADC for the on-chip data digitalization, a feature which allows to transmit data out of the detector with high robustness with respect to external pick-ups. At the shortest possible processing time, e.g. 100ns, an energy resolution better than 150eV at 5.9keV can be obtained, with an output counting rate larger than 1Mcps/channel, that, multiplied by the number of channels could allow to achieve several tens of Mcps/detector. The monolithic detector unit will be designed to allow a compact assembly of several units which could increase the count rate capability of the overall detection system up to few hundreds Mcps. This development could lead to a new generation of X-ray spectroscopy detectors for the next generation of high-brightness synchrotron experiments as well as for X-ray industrial applications.

**Author:** FIORINI, Carlo (Politecnico di Milano - INFN Milano)

**Co-author:** BELLOTTI, Giovanni (Politecnico di Milano and INFN Milano)

**Presenter:** FIORINI, Carlo (Politecnico di Milano - INFN Milano)