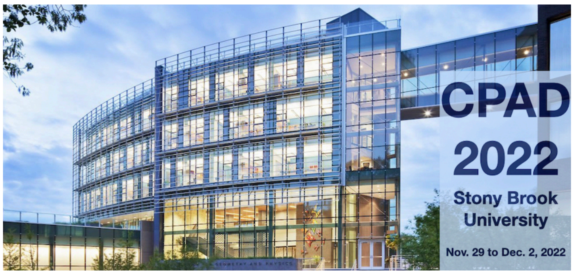

Contribution ID: **53** Type: **Contribution Talk**

The Array of Saturated-Gain Avalanche Diode (ASGAD) concept

Wednesday, 30 November 2022 10:55 (20 minutes)

We are introducing a new detector concept that we are labeling Array of Saturated-Gain Avalanche Diode (ASGAD) for the detection of charged particles and individual scattering processes associated with neutrons and possible "dark matter" particles. This concept leverages recent progress in the development of the photon to digital converter technology under the leadership of the Universite de Sherbrooke (QC, Canada). PDCs are an assembly of silicon sensor chip, an array of Single Photon Avalanche Diodes (SPAD), and a readout chip assembled in 3D. The readout chip includes for each SPAD a comparator and a quenching circuit that are used to detect and control the Geiger-mode avalanche. The comparator output is associated with Time to Digital Converter and a counter on the same chip. Single photon timing resolution of 20ps has been achieved. The PDCs should be sensitive to Minimum Ionizing Particle going through its roughly 20 microns of silicon; however, a MIP and a thermal carrier create the same signal and therefore the rate of fake signal is huge, on the order of 100kHz/mm^2. In the ASGAD concept we are proposing to add a layer of silicon above the layer of silicon where the avalanche takes place. In the case of MIP detection the layer is tuned to enhance lateral electron diffusion such that several diodes fire for every MIP. In this concept, the timing signal is generated by the electrons created in the high field region and its resolution should be as good if not better than photon's, which has been demonstrated to be 20ps f(FWHM) for PDCs. We are expecting that ASGADs will have better timing resolution than LGADs. The rate of thermally induced background can be simulated and it is a competition between diffusion induced avalanches and thermally induced avalanches with additional avalanches due to light emission (internal cross-talk). The ASGAD concept can then be extended by making the top layer of silicon thicker in order to offer a significant mass of silicon for "dark matter" particle to scatter. The advantage of ASGADs compared to CCDs (DAMIC and SENSEI) is the ability to correlate interaction in time, i.e. a cosmic ray or gamma ray producing infra-red photons for example. In this talk, we will described the ASGAD concept including high level simulation showing that it is a promising solution for charged particle and dark matter detection.

Primary author: RETIERE, Fabrice (TRIUMF)

Presenter: RETIERE, Fabrice (TRIUMF)

Session Classification: WG1: Solid State Detectors and ASICs

Track Classification: WG1: Solid State Detectors and ASICs