Contribution ID: **19** Type: **Poster**

P1.1: RNDR-DEPFET detectors for single photon detection

Monday, 26 June 2023 14:45 (1 minute)

The detection of single photons within the visible and near infrared spectrum became a key requirement for future space-based observations. Examples are the direct detection of exo-planets, multi object observation of high z-shift objects or high-cadence searches for short duration transients. One option to achieve photon number resolved measurements at non-cryogenic temperatures with a high quantum efficiency are silicon detectors with deep sub-electron noise. Such highly sensitive devices are especially prone to radiation damage, which presents a crucial parameter for space applications.

In this context, RNDR-DEPFET detectors offer complement properties to established technologies. The active pixel concept enables a high time resolution and good radiation hardness, while the fully depleted bulk of high purity silicon wafers ensure a high quantum efficiency and low dark count rate.

We will demonstrate the capability of a kilo-pixel RNDR-DEPFET sensor to detect signals as small as single electrons with a high time resolution, by continuously repeating a non-destructive readout. To evaluate the radiation hardness of this technology, we irradiated conventional DEPFET detectors –without repetitive readout –with 60 MeV protons. The results of this campaign provide information on the radiation hardness of DEPFETs in particular and of scientific silicon detectors with high-resistivity material in general.

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Session Classification: Poster (incl. coffee)