

First prototypes of two-tier avalanche pixel sensors for particle detection

Wednesday 17 February 2016 10:15 (20 minutes)

In this paper, we present the proof-of-concept implementation and preliminary evaluation of a new type of silicon sensor based on Geiger-mode avalanche detectors. The proposed device, formed by two vertically-aligned pixelated detectors, exploits the coincidence between two simultaneous avalanche events to discriminate between particle-triggered detections and dark counts. This approach offers several advantages in applications requiring low material budget and fine detector segmentation as, for instance, for tracking and vertex reconstruction in particle physics experiments and charged particle imaging in medicine and biology. In addition, a timing resolution in the order of tens of picoseconds can potentially be achieved thanks to the fast onset of avalanche multiplication in Geiger-mode regime.

A two-tier sensor assembly was designed and fabricated in a commercial 0.15 μm CMOS process. The sensor consists of a 48x16 pixel array, and includes avalanche diodes of different sizes to evaluate the detection efficiency for different fill factors. Each pixel, having a 50 μm x 75 μm area, includes detectors and electronics on both layers, with the top-layer signal transmitted to the bottom layer using a vertical interconnection per pixel. The two layers were tested separately and proved to be fully functional. Several sensor samples are currently being vertically-integrated through bump bonding. The first test results on the vertically-integrated sensors will be discussed.

Primary author: PANCHERI, Lucio (University of Trento and TIFPA)

Co-authors: SAVOY NAVARRO, Aurore (Laboratoire APC, University Paris-Diderot/CNRS Paris); MORSANI, Fabio (INFN Pisa); DALLA BETTA, Gian-Franco (University of Trento and TIFPA); COLLAZUOL, Gianmaria (University of Padova and INFN Padova); RATTI, Lodovico (University of Pavia and INFN Pavia); BROGI, Paolo (University of Siena and INFN Pisa); MARROCCHESI, Pier Simone (University of Siena and INFN Pisa)

Presenter: PANCHERI, Lucio (University of Trento and TIFPA)

Session Classification: Semiconductor Detectors

Track Classification: Semiconductor Detectors