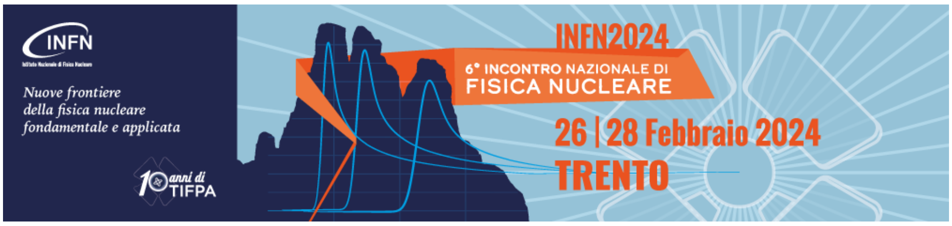

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The ARCADIA Depleted Monolithic Active Pixel: characterization and prospects for high precision tracking systems at future colliders

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In the last decades silicon detectors have had the leading role in the field of charged particles tracking. Although the mainstay for these devices is hybrid sensors, where a front-end die gets bonded to a silicon sensor, Monolithic Active Pixel Sensors (MAPS), which embeds the sensing volume and the processing electronics within the same silicon layer, have attracted interest for current and future applications thanks to their low power consumption, low material budget, and low production cost.

A further boost to the appeal of MAPS is their intrinsic lower noise, and the possibility to shrink the pixel pitch to 10 μm or less, depending on the required functionality, without incurring in the steep cost penalty of modern wafer-bonding processes.

The drawbacks of this approach, i.e reduced radiation tolerance and slower charge collection happening by diffusion, are partially overcome by recent Depleted MAPS (D-MAPS): MAPS where the depleted region is extended to the full silicon substrate, and charge collection happens by drift.

D-MAPS show larger and faster signal, and significantly improved radiation tolerance with respect to standard MAPS. These devices, therefore, represent an ideal option for trackers in future colliders and space experiments, and thanks to their competitive price and small pixel pitch, they are also of interest to many medical and industrial applications. In the field of high energy physics, next experiments to be built at operating or foreseen accelerators (HL-LHC, EIC, FCC, …) have stringent requirements in terms of material budget and granularity for their inner tracking systems.
Two key features of MAPS device, making larger than reticle size sensors through the stitching technique, and bending them in curved shapes thanks to their thinness (down to 50 μm or less), further increase their appeal to realize ultra low-mass, hermetic vertex trackers.

The INFN ARCADIA collaboration successfully designed and produced fully DMAPS, based on 110-nm CMOS technology and with deep active thicknesses (50-300 μm). The latest prototype produced has an active size of 1.28×1.28 mm^2, with a pixel pitch of 25 μm and has been succesfully characterized with several radioactive and laser sources.

This contribution will present the ARCADIA sensor characterization results in detail, together with discussion on their applications at future colliders trackers. Furthermore, an overview of commercial and medical applications currently under investigation will be given.

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