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TCAD simulation studies of Fully Depleted Monolithic Active Microstrip Sensors (FD-MAMS) for the ARCADIA project

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Monolithic silicon sensors have become increasingly popular in the particle and applied physics community as a viable alternative to hybrid sensors for charged particle detection. In the framework of the INFN ARCADIA project, we have developed 10 um pitch Fully Depleted Monolithic Active Microstrip Sensors (FD-MAMS) to transfer the monolithic approach to microstrip detectors, with the aim of providing an innovative and cost-effective solution for tracking and timing applications. The FD-MAMS that we studied are fully compliant with commercial CMOS fabrication processes. The properties of monolithic microstrips were investigated by means of a TCAD simulation campaign, which was also aimed at identifying the most promising layouts to be included in the first ARCADIA production run. Special attention was given to the enhancement of the sensor performance in terms of reduced capacitance and fast charge collection in low-power operation. The fine pitch of 10 um enables high spatial resolution and still allows the monolithic integration of distributed readout electronics in the inter-strip region. A surface radiation damage model was included in the TCAD simulations to estimate the effects of 10 to 10^5 krad total ionizing dose on the sensors' electrical characteristics. In the presentation, the sensor concept, the layout choices and the results of the simulation campaign will be presented, and their implication will be discussed in view of the possible applications. The strategies adopted to boost the charge collection speed in the sensor also under heavily ionising particles will be reported. The first tape-out, which includes 1.1 cm long FD-MAMS, has been submitted to the foundry at the end of 2020. Experimental measurements on the test structures will be performed in the next months.

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