3D monolithic-sensor approach to particle detection

In this paper we suggest a novel approach to particle track reconstruction in vertex detectors by exploiting the capabilities of the vertical scale integration (3D) technology for the fabrication of CMOS VLSI circuits. Instead of using different tiers of the stacked 3D structure for heterogeneous integration (namely, by devoting different tiers to the sensing layer, and to the analog and digital circuitry), identical fully-functional pixel layers have been stacked in a monolithic device through silicon vias (TSV) connections.

This detector configuration has been extensively simulated by means of device level TCAD tools, and has been designed in a conventional VLSI design flow using a 130nm Chartered/Tezzaron CMOS technology, and is currently under production: first prototypes will be available at the beginning of 2010. In particular, several matrices of Active Pixel Sensors with high fill factor, featuring a 10um pitch have been included, along with some test structures.

In principle, such an integrated detector would be capable of giving accurate estimation not only of the impact point of a ionizing particle (with spatial resolution in the micrometers range), but also of his incidence angle (with angular precision around 1°) thus realizing a single detector allowing for particle momentum measurement, at the same time being a low material detector: negligible multiple scattering effects are expected, since incoming particles have to cross only few micrometers of bulk silicon.

Summary (Additional text describing your work. Can be pasted here or give an URL to a PDF document):

http://www.diei.unipg.it/PAG_PERS/passeri/VCI2010_summary_Passeri.pdf

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