

# Picosecond Timing Sensor Development Employing MicroPattern (Gaseous or Si) Detector Technology

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## Abstract

Soon after the development of “reach-through” technology avalanche diodes (*i.e.* Silicon with internal gain) by McIntyre and collaborators in the '70's-'90s it was shown that these sensors could be used for MIP(minimum-ionizing particle) timing at the level of  $\approx 50$ -picosecond resolution. While there has been some progress in the related technologies (*i.e.* SiPM and LGAD) over the past 20 years an alternate route we have explored using Deep Depleted Silicon Structure and “mesh readout” has resulted in sub-20 picosecond resolution in detectors with a useful pixel size ( $64 \text{ mm}^2$ ). Perhaps more surprising (and a  $\sim 2$  order of magnitude advance in the state of the art for gas detectors) has been the rapid development over the past year of PICOSEC, which is a gas-detector-based timing technology achieving sub-60 picosecond single-photoelectron time resolution and MIP resolution below 25 picoseconds. I will report on progress in 2017- including large area pad arrays, high-rate capability MMegas and radiation-damage studies of HFS as well as the electronics development that has enabled this.