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In this contribution, we present new developments in the production of Ultra-Fast Silicon Detectors at the Fondazione Bruno Kessler (FBK, Trento, Italy).
Ultra-Fast Silicon Detectors (UFSD) are innovative silicon sensors optimised for timing measurements based on the Low-Gain Avalanche Diode design. UFSD recently obtained a time resolution of $\sigma_t \sim 30$ ps in beam tests and are now being considered in the upgrade of the CMS and ATLAS experiments as timing detectors.
After the successful production of the first batch of 300 μm thick UFSD in 2016, FBK has recently delivered its first 50 μm thick UFSD sensors. These sensors use high resistivity Si-on-Si substrates, and have a variety of doping profiles and strategies based on Boron, Gallium, Carbonated Boron and Carbonated Gallium to obtain a controlled multiplication mechanism. Such variety of gain layers will allow identifying the most radiation hard technology to be employed in the production of UFSD, to extend their radiation resistance beyond the current limit of $\Phi \sim 10^{15}\ n_{eq}/cm^2$.
In our contribution, we will show the timing performances of this new FBK production and we will present results on radiation damage tolerance for the 4 different types of gain layer design.