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4D tracking systems at future hadron colliders

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In the present design of the ATLAS and CMS silicon trackers for the HL-LHC, the silicon sensors are exposed to fluences above 1E16 n/cm2. These systems foresee the replacements of the inner layers once or twice during the HL-LHC lifetime.

On the other hand, the design of future high-intensity hadronic machines, such as FCC-hh, foresee a much higher level of radiation, above 1E17 neq/cm2, that, with the present tracker design, implies a replacement of a large part of the tracker almost every year.

Given that the physics requirements at FCC-hh require excellent 4D tracking capability, or the order of 10 microns and 10 picoseconds, a strong research development effort is required.

In this contribution, we propose a possible approach to the design of the tracker systems for FCC-hh that employs very thin silicon sensors (20-30 micron) with moderate gain (gain 3-5) in the internal layer, where the radiation is the highest (up to radii ˜ 20 cm), for position measurement, and slightly thicker sensors (40-50 micron) for 4D measurement (with gain 10-15) at a radius where the fluence drops below ˜1E16 neq/cm2

For the inner layer, this design relies on the fact that very thin sensors are intrinsically radiation resistance (almost absent trapping, low depletion voltage, low leakage current), and that the interplay of the gain mechanisms, either in the gain layer and/or in the bulk, provides enough charge (the present ASIC designs require a signal of ˜1fC) for a fully efficient detection. In the external layers, an evolution of the present state-of-the-art 4D UFSD (Ultra-fast Silicon Detector) design will ensure enough charge to make possible the accurate measurement of position and time.

Submission declaration

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