

# Physics potential of timing layers for future detectors

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## Abstract

*Keywords:*

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## 1. Introduction

Such the promising future colliders as the Future Circular Collider(FCC)[1] have been being proposed for exploring the potential of the high energy physics. Meanwhile, the state-of-the-art techniques will be invited for overcoming the dilemma happening to the imminent era of the future colliders, for instance, the approach of using the energy correlation function[2] inspired by the theorists is the one of useful ways that can be applied on tackling the highly-boosted condition showing up in handling distinguishing the different number of the subjects in a fatjet. In this paper, the timing known as the time of flight(TOF), which has been carrier out to be raised as another dimension of applying to do discriminating the different particles in the detector[3], is implemented into our facilities to see whether we can take advantage of using the merits of it to solve the same problem.

Speaking of the timing, we can't talk about it without mentioning the benefit of the timing-capable material - silicon. In the future era, caused by the high radiation and pileup, the fast-response with nano-second resolution limited by the TOF and the radiation-tolerated material as silicon should be well-prepared to fight with them. Many collaborations such as Compact Muon Solenoid(CMS) within the Upgrade 2 for High Granularity Calorimeter(HGCAL)[4] are going to make the silicon be their passive material as measuring the energies of the particles . In our studies, since the silicon sensors are installed to be the passive material in our tracker and ECAL, these two of the detectors are obtained as doing our studies.

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The same detector as our first paper[4] is applied in our studies to be the candidate for the 100TeV pp colliders. Instead of using the method of employing jet substructure variables as our second paper[5] in distinguishing the different number of the subjets in a large radius jet, we use the timing in different ways approaching to find out the potential of distinguishing different particles/number of subjets in our detector for many future experiments.

- 2. Timing layers for single particles**
- 3. Timing layers for ee experiments**
- 4. Timing layers for FCC and jets**