

# Design of an integrated particle detector-cell based on latchup effect

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The paper describes a novel approach to detect particles by means of an integrated device susceptible to latchup effects; it is proposed as a powerful means of achieving the precise detection and positioning of a broad range of particles with a micrometer spatial resolution. The cell is designed using state-of-the-art AMS 0.35 micron BiCOMS technology. We show the design of a mixed-mode Bipolar-MOS circuit that is going to be fabricated and tested. Previous investigations indicate that the recognizable charge might be comparable to that collected into to-date detectors. The idea is proposed for possible a implementation as beam monitor or ion-selector in future high-energy experiments.

## Summary

Here is described a novel approach to detect particles by means of a solid-state device susceptible to latchup effects [1]. The stimulated ignition of latchup effects caused by external radiation has so far proven to be a hidden hazard. Here this is proposed as a powerful means of achieving the precise detection and positioning of a broad range of particles with a micrometer spatial resolution. The basic latchup circuit is built up of a two-transistors positive feedback loop that provides a current amplification and an output latch, all in one. Here the cell is designed using state-of-the-art AMS 0.35 micron BiCMOS technology. In particular, a mixed-mode Bipolar-MOS circuit is designed and it is going to be submitted. The circuit is basically composed of a p-channel bipolar and a n-channel MOS transistors, plus some biasing resistors. The choice of the transistors are based upon the technology features and models. These devices show a good latchup ignition after a charge injection. After this, the sensitive cell retains the position of the crossing particle by means of a self-locked thyristor-like component that provides, digital, robust and stable signal until the whole system has been powered off. During the ignition, the cell's output signal does not depend on the input deposited charge, provided it is over threshold and capable of making the positive feedback current loop start. Conversely, the output voltage of the circuit saturates towards ground level in any case as the two transistors are forward biased. In addition, the charge here is collected only in the base-emitter, for the bipolar, and gate, for the MOS, regions of the transistors. For this reason, in principle, a thick detector is not required. Previous investigations [2-3] indicate that the recognizable charge might be comparable to that collected into to-date detectors. In fact, a prototype made up of discrete components was realized and exploited and the tests with daylight, electrons, via a current pulse generator and with a laser beam showed a charge sensitivity of the order of 1 pC. It is expected to scale the charge sensitivity with an integrated version of the prototype. According to the features described above, the application fields may range from beam monitors, where high radiation hardness is required, to heavy ion selectors where tunable sensitivity is crucial.

## References

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**Co-author:** Dr DEMARCHI, Danilo (Chilab Laboratory, Electronics Department, Politecnico di Torino, Corso Duca degli Abruzzi, 24, 10129 Torino Italy)

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