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# The Trixy Tracking detector

We propose a new tracker which is based on the electron multiplier of the Tipsy single soft photon detector.

The electron multiplier consists of a stack of transmissive dynodes, placed on top of a pixel chip. Above this, an Electron Emission Membrane is placed, which has the property to emit, with a high probability, at least one electron at the point of passage of a MIP crossing the membrane. This electron is focused onto the first dynode, associated to a pixel. After multiplication in 5 - 7 dynode stages, the avalanche is detected by the pixel circuitry.

## Summary

We propose a radically new and generic type of detector for photons, electrons and energetic charged particles: a stacked set of curved miniature dynodes in vacuum, created through MicroMechanical Electronic Systems (MEMS) fabrication techniques on top of a state-of-the-art CMOS pixel chip. This combination in itself is an extremely efficient electron detector. By capping the system with a traditional photocathode, a highly sensitive timed photon counter can be realized, outperforming all existing photon detectors. By capping it with an Electron Emission Membrane, a timed particle tracking detector is realized with a time resolution far superior to current particle detectors.

The core innovation, i.e., the stacked curved dynodes on top of a pixel chip, will revolutionize electron detection in solid-state, atomic and molecular physics experiments. As a photon detector, it will have pico-second time resolution, much better than classical photomultipliers, at low noise. This will have impact on the field of medical imaging, optical communication, night-vision equipment and even 3D image recording by measuring the time-of flight of photons from a flashlight. As a particle detector, it will allow faster and higher-resolution measurements of the trajectories of fast charged particles, essential in modern particle physics experiments. Its time resolution is three orders of magnitude better than state-of-the-art Si planar detectors, opening new horizons for (vertex) tracking, time-of-flight spectrometers, track pattern recognition and trigger detectors.

The realization of this detector concept requires high-risk/high-impact developments in the area of (1) fundamental understanding of electron emission, (2) the MEMS-based fabrication of novel curved transmission dynodes and (3) high-efficiency Electron Emission Membranes.

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