

# An ultra-light helium cooled pixel detector for the Mu3e experiment

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The Mu3e experiment searches for the lepton flavour violating decay  $\mu^+ \rightarrow e^+ e^- e^+$  with an ultimate aimed sensitivity of 1 event in  $10^{16}$  decays.

To achieve this goal, the experiment must minimize the material budget per tracking layer to  $X/X_0 \approx 0.1\%$  and use gaseous helium as coolant.

The pixel detector uses High-Voltage Monolithic Active Pixel Sensors (HV-MAPS) which are thinned down to  $50 \mu\text{m}$ .

Both helium cooling and HV-MAPS are a novelty for particle detectors.

In this talk, I present my work on successfully cooling a pixel tracker using gaseous helium.

The thermal studies focus on the two inner tracking layers, the Mu3e vertex detector, and the first operation of a functional thin pixel detector cooled with gaseous helium.

The approach, which circulates gaseous helium under ambient pressure conditions with gas temperature around  $0^\circ\text{C}$  using a miniature turbo compressor with a mass flow of  $2 \text{ g/s}$  allows the vertex detector to operate below  $70^\circ\text{C}$  at heat densities of up to  $400 \text{ mW/cm}^2$ .

Finally, performance data of the final HV-MAPS used by Mu3e, the MuPix11, is presented.

These results demonstrate the feasibility of using HV-MAPS combined with gaseous helium as coolant for an ultra-thin pixel detector exploring new frontiers in lepton flavor.

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