

# Investigation of Spatial Patterns of Elevated Cell Leakage Currents in HGICAL Silicon Sensors

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The High-Granularity Calorimeter (HGICAL) of the CMS experiment at CERN uses radiation-hard, fast-response silicon sensors to maintain stable and precise operation during HL-LHC conditions. The sensors are fabricated on 8-inch p-type wafers with three different thicknesses (120  $\mu\text{m}$ , 200  $\mu\text{m}$ , and 300  $\mu\text{m}$ ), two main granularities ( $\sim 0.5 \text{ cm}^2$  and  $\sim 1 \text{ cm}^2$  for standard cells), as well as so-called full-sensor and multi-geometry-sensor masks.

During the main production phase from February 2023 to May 2025, the manufacturer Hamamatsu performed quality control tests on all  $\sim 25000$  wafers, including per-cell current-voltage (IV) and capacitance-voltage (CV) measurements, as part of the vendor qualification process before delivery to CERN.

The presented data analysis is based on these IV measurements, focusing on cells and regions with elevated but moderate leakage currents (e.g., a few nA for cells of  $\sim 1 \text{ cm}^2$ ), which are hereafter referred to as “hot” cells. A volume normalization is applied to account for differences in cell geometry and type.

Distinct spatial patterns of hot cells were identified across certain wafer regions and delivery times, differing between sensor variants. Although a direct impact on the detector performance has not been established, these observations provided valuable feedback to the production process at the time and supported subsequent improvements in sensor quality.

## Type of presentation (in-person/online)

in-person presentation

## Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

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