Strengthening the radiometric link to the SI: Achievements from the chipSCALe project

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The EURAMET European Metrology Programme for Innovation and Research (EMPIR) project chipS·CALe aims to improve and simplify radiometric traceability with a focus on strengthening the link between radiometric measurements and the international system of units (SI). In this project, several national metrology institutes (NMIs) and research institutions in Europe have collaborated to develop improved low-loss Predictable Quantum Efficient Detector (PQED) photodiodes with an external quantum deficiency in the 10 ppm range or below from 400 nm to 850 nm.

These induced-junction photodiodes are simple in their structure, making them suitable for 3D computer simulations. In a 2 minute animation video developed in the chipS·CALe project, we will show the photodiode structure, the working principle, and how to use simple I-V measurements combined with a 3D model fit to extract photodiode defining loss parameters. Once the parameters are known, the fitted model is used to predict the responsivity of the photodiode in the spectral range from 400 nm to 850 nm.

The chipS·CALe photodiodes have also been combined with thermal detection, in a dual-mode self-calibrating detector. By using thermal detection as a built-in reference in the detector, the internal losses of the photodiode can be determined directly, without the need of an external reference. We will present results for room temperature, with an uncertainty of 0.04 %, and our latest results of the ongoing measurements at cryogenic temperatures.

By combining the 3D model fit and the dual-mode methods, we can extract the fundamental constants ratio *e/hc* from our measurements. This makes the dual-mode detector self-assured, serves as a validation of the two primary methods through a cryogenic high-accuracy comparison on one device, and provides a direct link between radiometric measurements and the new SI.

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