Optical transition-edge sensor with high energy resolution

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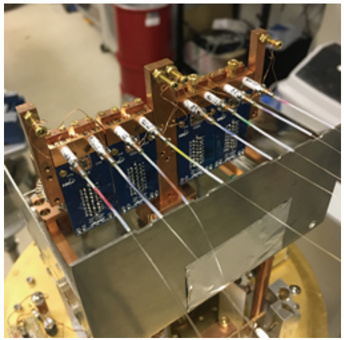
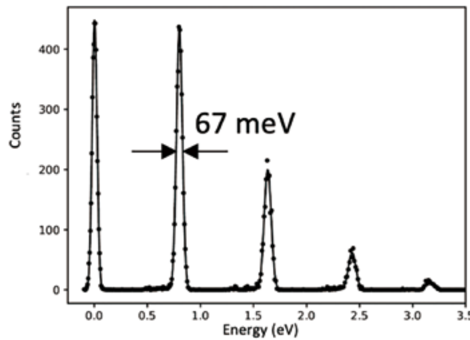
We successfully developed superconducting transition-edge sensors (TESs) that harness the superconducting characteristics of metals at low temperatures. The TESs exhibited remarkable detection efficiency and possessed the capacity to discern a wide spectrum of photons, spanning from visible to near-infrared wavelengths. Furthermore, precise energy measurement of each photon became possible by detecting a minute temperature increase induced by photon absorption within the sensor. Therefore, the TESs empowered spectroscopic measurements at the single-photon level. The versatility of TESs positions them as promising candidates for applications across various fields, including multicolor bioimaging and optical information communication.

Sensors that simultaneously measure photons of different wavelengths, such as those used in bioimaging and spectral measurements, must have high energy resolution. Notably, TESs are theoretically expected to achieve the highest energy resolution of approximately 50 meV. However, practical realization had hitherto eluded this aspiration, with energy resolutions higher than 100 meV. We accomplished a significant breakthrough by reducing the superconducting transition temperature from the conventional value of 300 mK to 115 mK. This achievement culminated in an enhanced energy resolution of 67 meV. We will further investigate the factors determining the energy resolution and aim for even higher resolution levels.

Reference: K. Hattori et al., *Supercond. Sci. Technol.* **35**, 095002, 2022, DOI:10.1088/1361-6668/ac7e7b





Transition-edge sensor modules (left) and spectra from the pulsed laser (right)