Microcalorimeter based on transition edge sensor

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Time: 10am, Mar.18, 2024 (Monday) **Host:** Prof. Jianglai Liu (刘江来)

Location: meeting room N602, TDLI

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https://meeting.tencent.com/dm/DZHBHyuFpNzj Meeting ID: 132 528 056 No passcode)

Abstract:

The Transition Edge Sensor (TES) stands as a thermal equilibrium photon detector. Operating through the absorption of photons, it thermalizes the incident photon energy and channels it into a superconducting film. This infusion of energy elevates the temperature of electrons within the film, inducing a discernible increase in resistance. The distinctive sharpness of its transition edge positions the TES as a promising detector for microcalorimetry.

The energy resolution of the TES hinges on its noise characteristics. I will delve into a review of concerted efforts aimed at mitigating various noise contributions. These strategies encompass lowering the critical temperature of the superconducting film, introducing noise-canceling metal bars, and curbing thermal conductance to the heat bath through advanced phonon engineering. Currently, the most exemplary TES energy resolution demonstrated is in the range of 1.3-1.6 eV for 5.9 keV X-ray photons. Ongoing research centers on addressing unexplained excess noise in the TES noise spectrum, with the ultimate goal of refining the detector design to achieve sub-eV energy resolution.

The TES showcases an exceptional capability to detect a single photon with remarkable energy resolution, rendering it an ideal detector for astronomy and rare event searches. Exploratory ventures into diverse fields, such as X-ray spectroscopy for chemical state analysis and X-ray tomography for nanometer-scale imaging, are underway. The majority of these applications necessitate a multi-pixel TES array. Several sophisticated multiplexed readout techniques have been developed to facilitate the simultaneous readout of hundreds or even thousands of TES pixels. I will elucidate some examples of these applications and deliberate on the conceivable technical pathway towards eventually reading a mega-pixel TES array.

Biography:

Bo Gao received his bachelor's degree in physics from Fudan University in 1999. He obtained an engineering diploma from Ecole Polytechnique (Palaiseau) in 2002. Bo entered the joint Ph.D. program at Ecole Normale Superieure (Paris)/University Paris VI and successfully earned his Ph.D. degree in 2006. Following this, he conducted postdoctoral research at Delft University of Technology and the Max-Planck Institute for Solid State Research over the subsequent years. His primary research interest focused on electron transport in various materials, including carbon nanotubes, organic molecules, and topological insulators.

In 2012, Bo Gao joined the Shanghai Institute of Microsystem and Information Technology, Chinese Academy of Sciences. In 2015, he shifted his research direction to superconducting electronics and served as a visiting scholar at Stanford University from 2015 to 2016. His current focus lies in the development of transition edge sensor micro-calorimeters and SQUID-based readout techniques for low-temperature detectors. He is also interested in exploring new conceptual superconducting device using exotic quantum state.