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Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme

Ansprechpartner: Prof. Harald Giessen
E-Mail: giessen@physik.uni-stuttgart.de
Telefon: 0711 - 685-65111

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Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart-Vaihingen

Gastgeber: Prof. Martin Dressel & Dr. Scheffler, Universität Stuttgart, Telefon: 0711 - 685-64944

Superconducting detectors and sub-Kelvin instrumentation for astronomy

Alessandro Monfardini
CNRS Neel Grenoble

Abstract

Astronomy is historically the main driver for developing new detectors. The ultimate search of sensitivity, strict requirement for most astronomical applications, ends up inexorably in lowering the temperature of the sensing part until reaching almost the absolute zero. In fact the thermal noise "hides" the tiny amounts of energy that we try to resolve. Moreover, these small amounts of energy can only be measured adopting even smaller "units" like individual excitations in superconductors (quasi-particles) or ultra-low temperature phonons.

It is also thanks to the efforts deployed by the low temperature physics community if the state-of-the-art today shows multi-thousands pixels, i.e. large field-of-view, cameras operating at IR-to-radio frequencies and unveiling the details of the cold and primordial Universe.

After a general introduction, I will mainly focus, as a case study, on our own NIKA2 (New IRAM KID Arrays 2) millimetre-wave imager/polarimeter operating at the 30-meters radiotelescope at Pico Veleta. NIKA2, based on Kinetic Inductance Detectors (KID), is today the biggest mm-wave camera available to the astronomers for general purpose observations, ranging from the local Universe to cosmological distances. General context will be given.

Reference:
R. Adam et al., "The NIKA2 large-field-of-view millimetre continuum camera for the 30 m IRAM telescope", Astronomy & Astrophysics, Volume 609, id.A115 (2018), arXiv:1707.00908