Lumped Elements Kinetic Inductance Detectors maturity for space missions

Main author:

CATALANO Andrea

Co-authors:

Benoit Alain, Institut Néel, CNRS, Université Joseph Fourier Grenoble I, 25 rue des Martyrs, Grenoble, France

Bourrion Olivier, Laboratoire de Physique Subatomique et de Cosmologie, CNRS/IN2P3

Calvo Martino, Institut Néel, CNRS, Université Joseph Fourier Grenoble I, 25 rue des Martyrs, Grenoble, France

Catalano Andrea, Laboratoire de Physique Subatomique et de Cosmologie, CNRS/IN2P3

Coiffard Gregoire, Institut de Radio Astronomie Millimétrique (IRAM), Grenoble, France

D'addabbo Antonio, LNGS - Laboratori Nazionali del Gran Sasso - Assergi (AQ)

Goupy Johannes, Institut Néel, CNRS, Université Joseph Fourier Grenoble I, 25 rue des Martyrs, Grenoble, France

Le Sueur Hélène, Centre de Sciences Nucléaires et de Sciences de la Matière (CSNSM), CNRS/IN2P3, bat 104 - 108, 91405 Orsay Campus, France

Macias-Pérez Juan, Laboratoire de Physique Subatomique et de Cosmologie, CNRS/IN2P3

Monfardini Alessandro, Institut Néel, CNRS, Université Joseph Fourier Grenoble I, 25 rue des Martyrs, Grenoble, France

Lumped Elements Kinetic Inductance Detectors (LEKID) have now reached a maturity adequate for space instruments. This has been first demonstrated by the use of such detectors in ground-based experiments and in particular in the New IRAM KID Array (NIKA) instrument. Today LEKID are in competition with other cryogenic detectors like Transition Edge Sensors (TES) and Metal Insulator Sensors (MIS) in the development of future millimeter space missions such as PIXIE, CORE+, LiteBIRD. This work intends to give a state-of-the-art of the performance of LEKID at millimeter wavelength (from 80 to

200 GHz) in terms of sensitivity under low optical background conditions and in terms of interaction with ionizing particles to minimize the systematic effects induced by cosmic rays. The sensitivities of two hundreds pixels LEKID arrays observing at a central frequency of 100 and 150 GHz have been characterized in laboratory using a dedicated closed-circle 100 mK dilution cryostat and a sky simulator allowing to reproduce realistic space-like observation conditions. The impact of cosmic rays has been evaluated exposing the arrays to alpha particles (241Am) with a sampling resolution similar to the one used for Planck HFI (about 200 Hz) and also with an high resolution sampling level (until 2 MHz) in order to better characterize and interpret the observed glitches; in parallel we have developed an analytical model to rescale the results to what we would obtain if such a LEKID array observe at second Lagrangian point.

Test results show that even if LEKID design adopted for this study was originally developed for thin (less than 20 nm) Aluminum films and ground-based typical optical backgrounds, the Noise Equivalent Power (NEP) approaches the reference NEP goal for space application and the glitch contamination at L2 would give a few % level of discarded samples. Starting from these promising results, larger arrays (thousands of pixels) will be developed in order to improve the sensitivity for space application and further minimize the impact of cosmic rays.