

"First light" for NIKA: Néel IRAM Kinetic Inductance Detector Array for mm-wave Astronomy

Last October, a new generation of detectors for millimetre-wave astrophysics was tested at the IRAM observatory on Pico Veleta near Granada (Spain). The KIDs (Kinetic Inductance Detectors) development is the result of a strong collaboration between a number of European groups, coordinated in Grenoble by the Néel Institute's HELFA group. The collaboration includes SRON-Holland (in particular A. Baryshev), University of Cardiff, Max-Planck Institute for Radioastronomy, Bonn and Università La Sapienza Roma.



The 30-m IRAM dish at Pico Veleta. 2850 metres altitude.

IRAM is an Institute for Millimetre Wave Radioastronomy funded by the Max-Planck Institute and the CNRS, with headquarters in Grenoble (Saint-Martin d'Hères). The IRAM operates an interferometer on the Plateau de Bure, south of Grenoble, and the 30 m telescope on Pico Veleta. Recently, the IRAM issued a call for proposals for a new generation imaging instrument for the 30-m telescope. The Néel Institute has proposed an instrument based on a ^3He - ^4He -dilution cryostat (developed in-house by the HELFA and Cryogenics Groups) and large arrays of low temperature millimetre wave detectors. The other proposals are the GISMO instrument of the Goddard Space Flight Center (USA) and further development of the present instrument, MAMBO-2 (MPI, Bonn).

The first (and only other) demonstration of an astrophysical application of KIDs type detectors was made by Caltech-JPL in 2007 at the Caltech Submillimeter Observatory (CSO) on Mauna Kea, Hawaii, for an antenna-coupled design. Our test at IRAM Pico Veleta is the first demonstration ever of the LEKIDs concept. The sensitivity was more than a factor of 10 better than that obtained in the trial at the CSO telescope. Several astronomical sources were detected in order to measure the instrumental sensitivity (see <http://www.iram.es/IRAMES/mainWiki/NéelBolometer> for a detailed description of the run history).

Two years ago, a new concept of detectors based on superconductor resonators, the Lumped Element Kinetic Inductance Detectors (LEKIDs) was proposed by Simon Doyle (University of Cardiff). This idea has been developed by our group in Grenoble, in close collaboration with Cardiff. LEKIDs are "lumped element" resonators coupled to the incoming radiation. Large arrays of such detectors can be made by changing slightly the geometry of each detector, and so adjusting their individual resonance frequencies. An electromagnetic wave incident on a given detector induces small changes in its resonance characteristics. The read-out electronics is based on the measurement of the overall transmission of the multi-detector microwave circuit, and the identification of the frequencies corresponding to the different detectors. Several hundred such detectors can be measured with a single RF read-out circuit. New frequency-multiplexing electronics has been developed for this purpose in-house by the Néel Institute's Electronics Group.

The success of the technical run, and in particular of the camera equipped with the LEKIDs array, shows the strong advantages of the Néel proposal and further improvements are planned for the next test in October 2010.

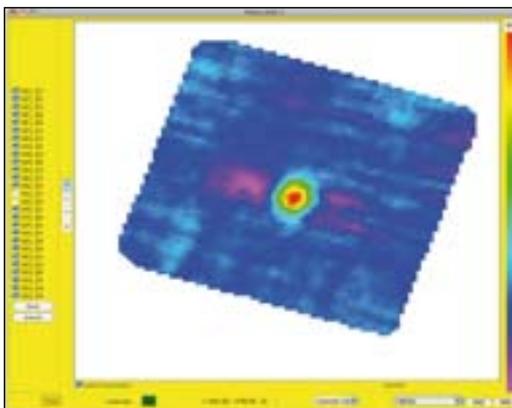
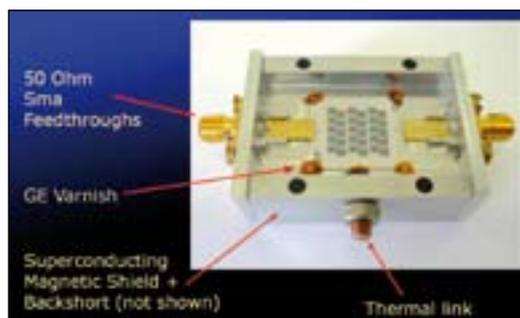


Image of Active Galactic Nucleus object BL1418+546.



LEKIDs array designed and fabricated in house (Nanofab, Service Cryogénie).

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FURTHER READING

LUMPED ELEMENT KINETIC INDUCTANCE DETECTORS FOR FAR-INFRARED ASTRONOMY
S. Doyle et al., Millimeter and Sub-millimeter Detectors and Instrumentation for Astronomy IV, Proc. SPIE, Vol. 7020, pp. 70200T (2008).

A NbSi BOLOMETRIC CAMERA FOR IRAM
A. Benoit et al., Millimeter and Sub-millimeter Detectors and Instrumentation for Astronomy IV, Proc. SPIE, Vol. 7020, pp. 702009 (2008).