NIKA2: revolutionary camera for millimetre waves sees first light

An important fraction of the matter in the universe is very cold, and emits only far infrared, microwave or millimetre wave radiation. To detect cold astronomical objects, a radiotelescope's detection instrument must be cooled to even lower temperatures, to avoid the thermal noise of the detector. NIKA 2, the second generation Neel-IRAM-KID-Array, is a dual-band millimetre-wave camera operating simultaneously at 150 and 260 GHz. The instrument is based on large arrays of superconducting Kinetic Inductance Detectors (KIDs) operated at temperature 0.1 Kelvin. NIKA 2 was built by an international consortium, led by the Institut NÉEL. Successful installation took place in October 2015 at the 30 m diameter telescope of the IRAM (Institut de Radioastronomie Millimétique) on Pico Veleta at altitude 2850 m in the Sierra Nevada, Spain.

NIKA 2's field of view has a diameter of 6.5 arcmin (0.1 degrees), with angular resolutions of 12 and 18 arcsec (3 and 5 millidegrees), at 1.15 and 2 mm wavelengths (260 and 150 GHz) respectively.

It is designed as a facility instrument (open to the astronomy community via competitive calls) that will remain at its present position for at least a decade.

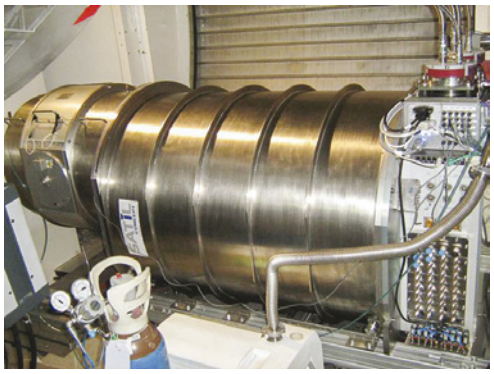


***Fig. 1**: The NIKA 2 dilution cryostat (about 1 m diameter, base temperature 100 mK), which was designed and fabricated at the Institut NÉEL, is shown mounted in the receiver cabin of the 30 m Pico Veleta Radio telescope.*

NIKA2 will address a vast range of scientific topics. For example, it will serve for studies of the intensity and polarization of the thermal emission coming from dust in galactic star-forming regions, and for observations of dust-obscured, optically-faint galaxies during their major episodes of formation in the very early universe. Over the next four years, the NIKA2 instrument consortium will carry out five, large, dedicated programmes during 1300 hours of guaranteed observation time on the Pico Veleta telescope.

The first testing and characterization of NIKA 2 took place only two weeks after installation, and showed

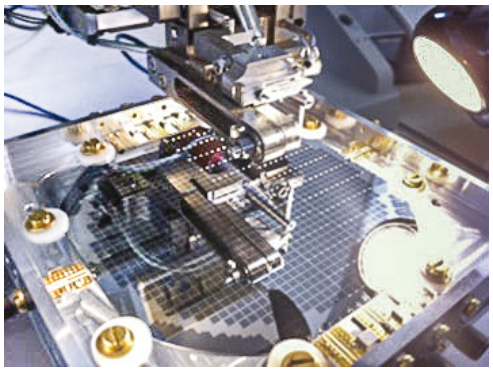


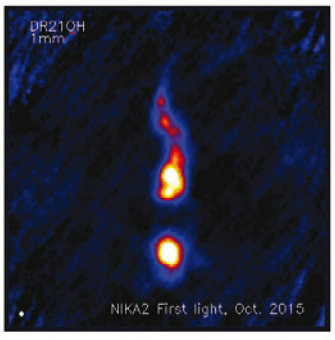
***Fig. 2**: One of the NIKA 2 camera's arrays being prepared at the Institut NÉEL's bonding machine. Each tiny square on the 80 cm diameter circular substrate is a millimetre-wave detector (a KID).*

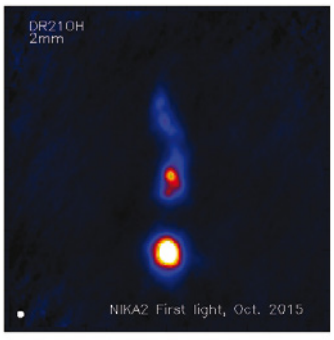
that 80% of the KIDs were working as planned, with sensitivities in line with the original specifications and our in-lab tests. The readout electronics installed in January 2016 allowed simultaneous readout from the 3300 installed detectors. Further upgrades and in-depth characterization of the instrument are being done through 2016.

To give an idea of the sensitivity achieved, we have calculated that NIKA 2 could easily detect, from its current location in southern Spain, the thermal emission of one of the rabbits that populate the Institut NÉEL's car park in Grenoble, more than a thousand km away.

Access will be opened to international astronomers during the winter semester 2016/2017. To illustrate the system's performance, we show here (Fig. 3) a "first light" image obtained on the object DR21OH, a well-known star-forming region inside the Cygnus X molecular cloud complex.

***Fig. 3**: NIKA 2 maps of the DR21OH star-forming region at 260 GHz (left) and 150 GHz (right). The detected emission is mostly coming from cold interstellar dust, and would appear as a dark "string" at visible wavelengths. The maps are 13 arcmin (0.2 degrees) wide, the angular resolution in each band is represented as a white disk at the bottom left of the images.*





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FURTHER READING...

"The NIKA2 instrument, a dual-band kilopixel KID array for millimetric astronomy"

M. Calvo, A. Benôit, A. Catalano, J. Goupy, A. Monfardini, N. Ponthieu, E. Barria, G. Bres, M. Grollier, G. Garde, J.-P. Leggeri, G. Pont, S. Triqueneaux, and 35 national & international authors

***J. Low Temp. Phys* 184,** 816 (2016).

See also:
CNRS Press release

http://www2.cnrs.fr/presse/communique/4401.htm