
Grenoble group: detectors and cryogenics instrumentation

19/03/2024 – BULLKID-DM Meeting – LNGS

Daniele Delicato on behalf of Alessandro Monfardini



The GRIK “groupment”

<http://grik.cnrs.fr>

The “**GR**enoble **I**nterested in **KID**” collaboration includes four laboratories collaborating since decades:

- **Institut Néel** (formerly CRTBT) - Solid State Physics, low temperature instrumentation, optics and detectors
- **LPSC** - Particle Physics and Cosmology, electronics, optics
- **IPAG** - Grenoble Astrophysics Observatory, data analysis
- **IRAM** - Millimeter wave astronomy (observatories in the Alps and Sierra Nevada - Spain), telescopes, operations

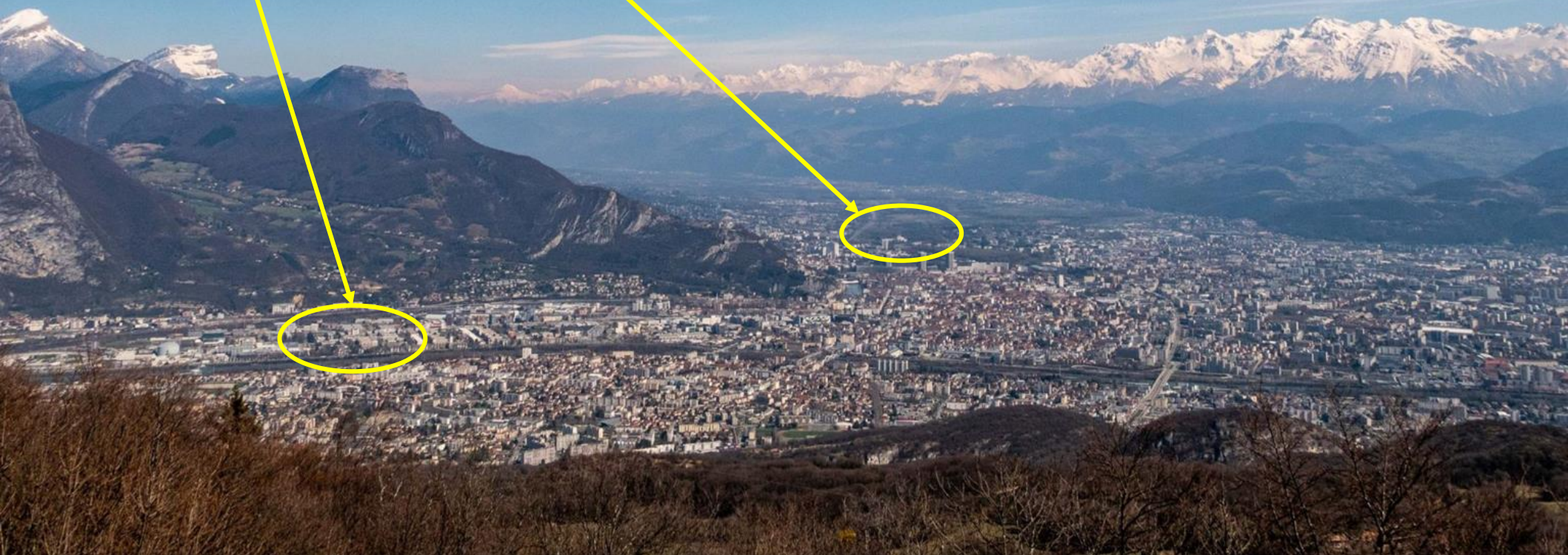


In a single shot the whole chain (unique ?)

From scratch to Cosmology: science cases, innovative instrumental concepts, ad-hoc cryostats, detectors, electronics, optics, telescopes, data analysis → PUBLICATIONS

NEEL & LPSC

IPAG & IRAM



The Néel Astrophysics Instrumentation Group

Permanents:

- Alain Benoit (Instrumentation) - **Emeritus**
- Martino Calvo (Instrumentation, Detectors, Cryo group)
- Usasi Chowdhury (Detectors)
- Florence Levy-Bertrand (Physics, Superconductivity group)
- Alessandro Monfardini (Instrumentation, Detectors)

Students:

- Daniele Delicato (PhD, Néel/Roma, BULLKID)
- Sofia Savorgnano (PhD, LPSC/Néel, Astrophysics)

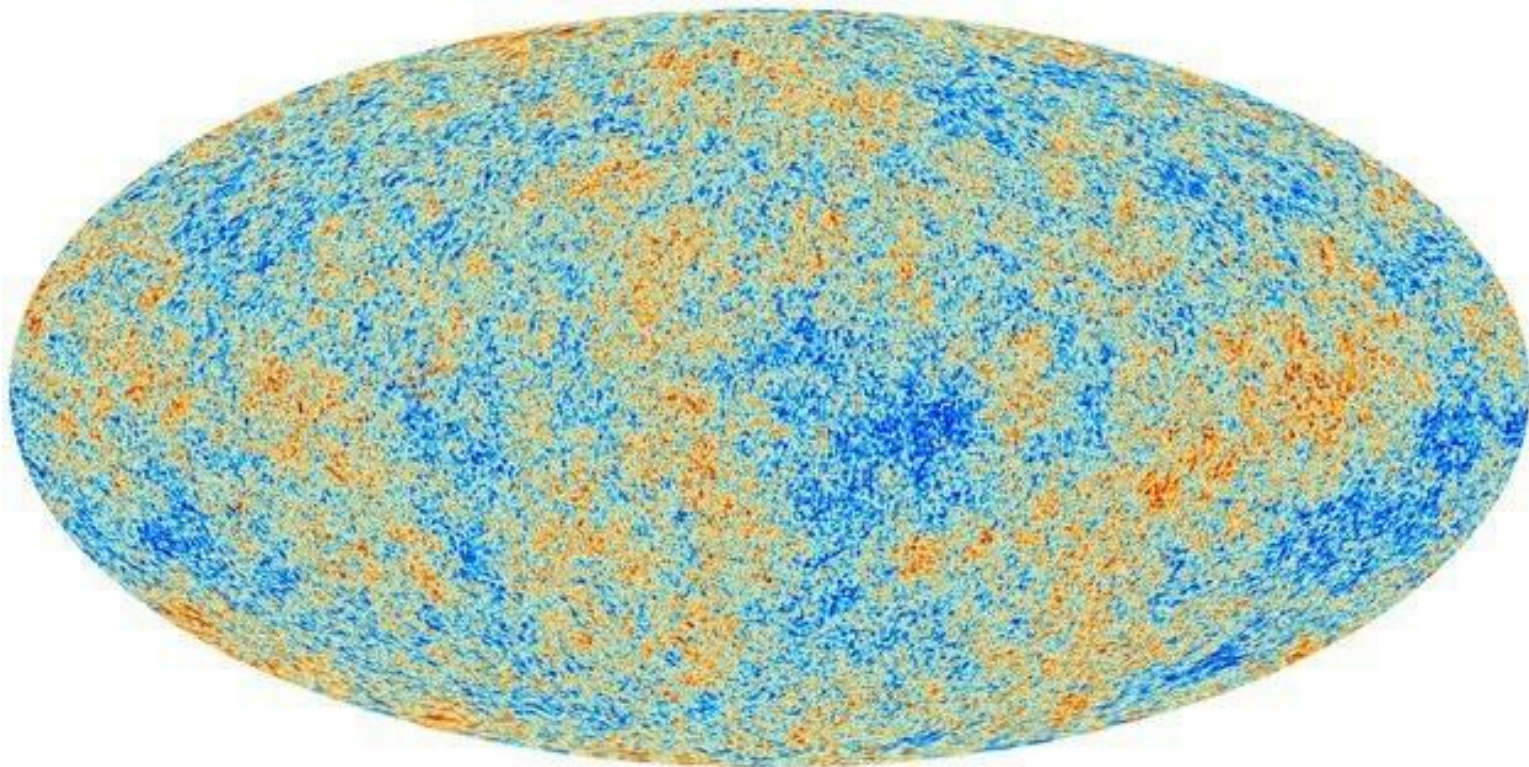
Relevant ex-students:

- Angelo Cruciani
- Nello D'Addabbo

Before the Kinetic Inductance Detectors

Before 2008 the CRTBT had already made a lot:

- Archeops (stratospheric balloon, Planck prototype)
- **Planck** (invention of the **gravity-free dilution cryostat**)
- EDELWEISS (cryostat and Modane installation)
- NbSi microbolometers (DCMB French collaboration)

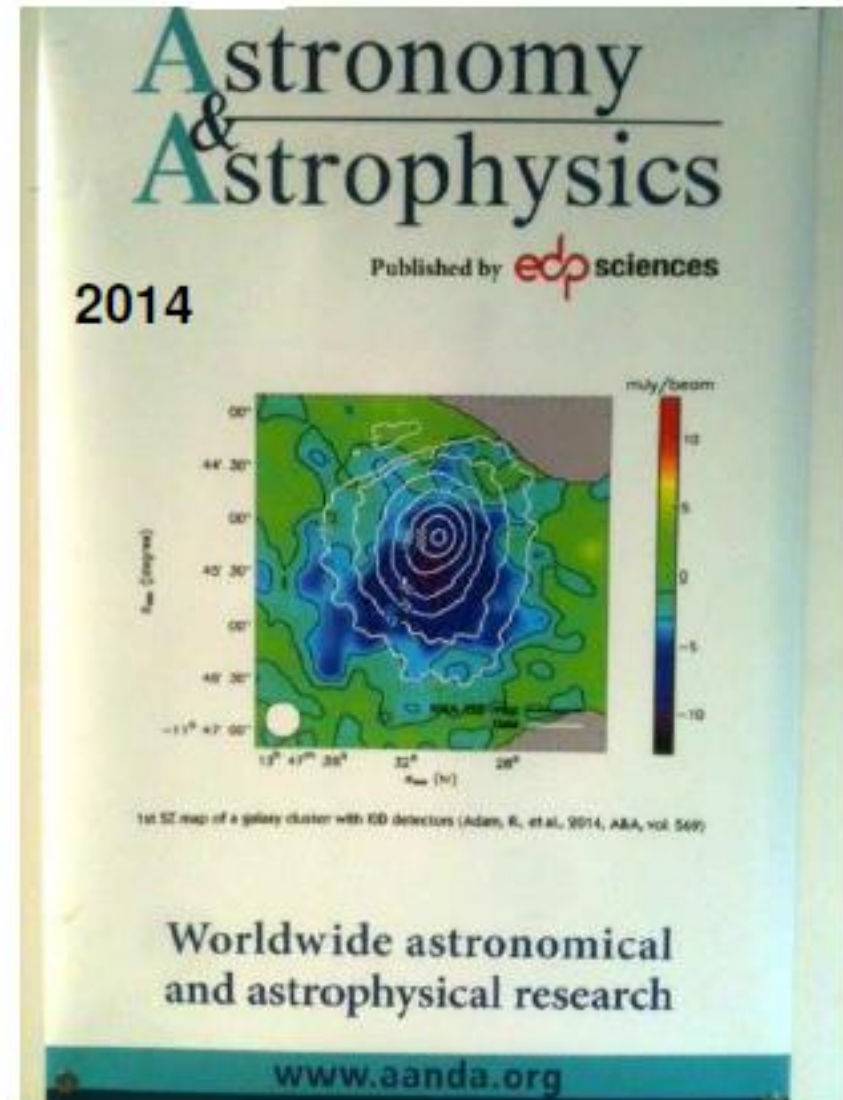


NIKA, the first KID camera (2009)



30-m IRAM Telescope
TGIR – CNRS
Néel IRAM KID Arrays
NIKA

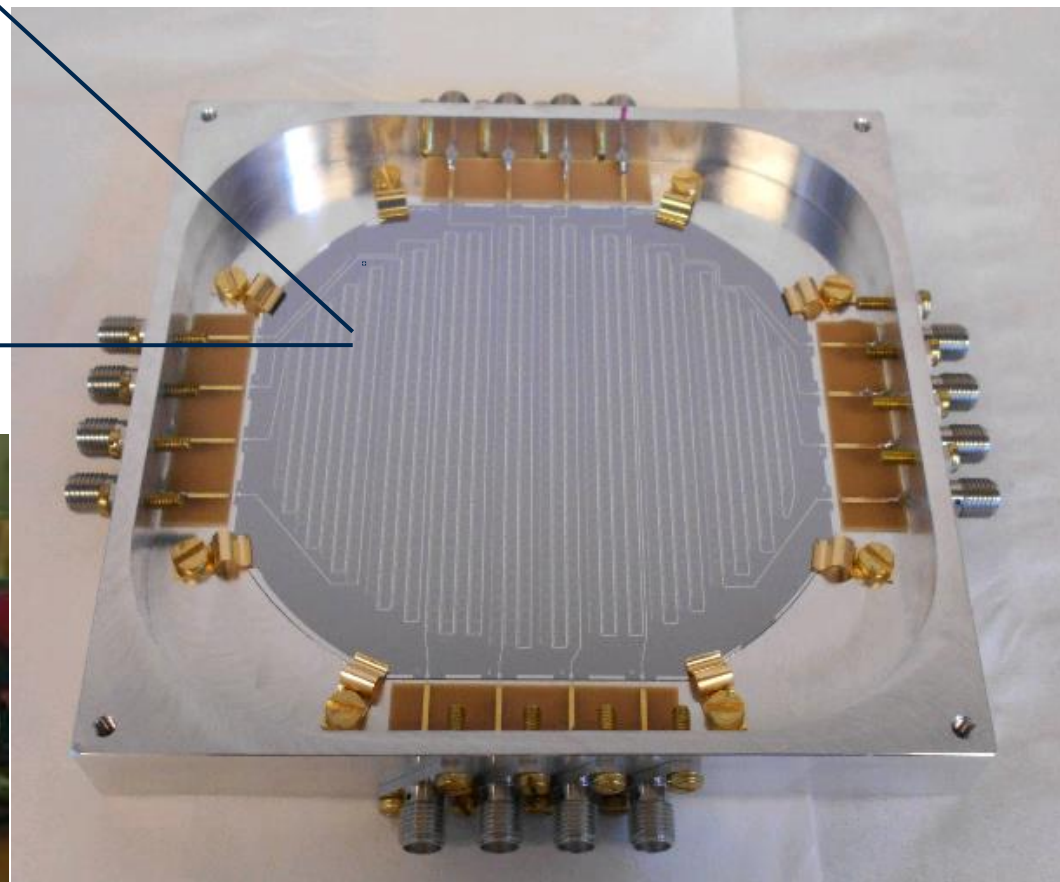
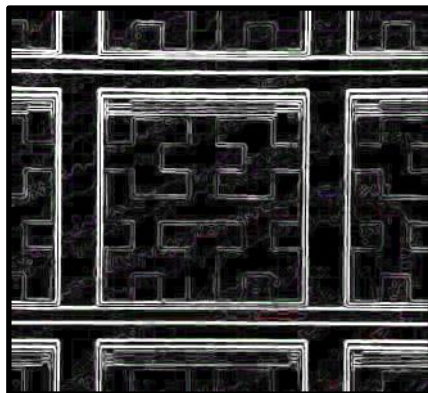
First KID camera in the World (2009-2014)



Going full-scale: NIKA2 (2015)



Pixel size 2mm
Cryo length 2.5m
2x2000 pixels
arrays
Dual color imaging

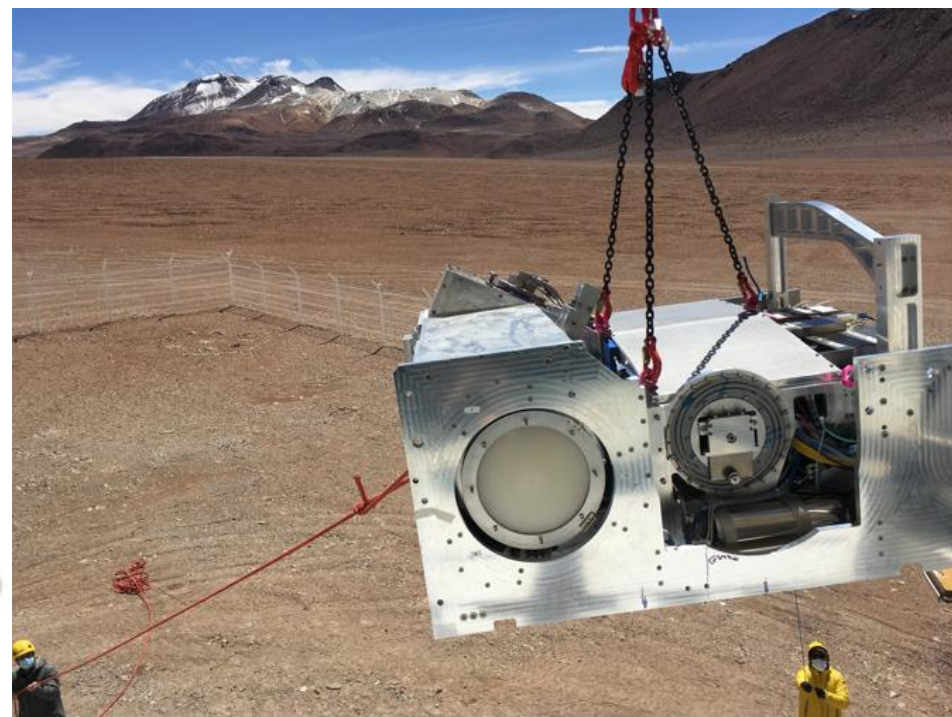
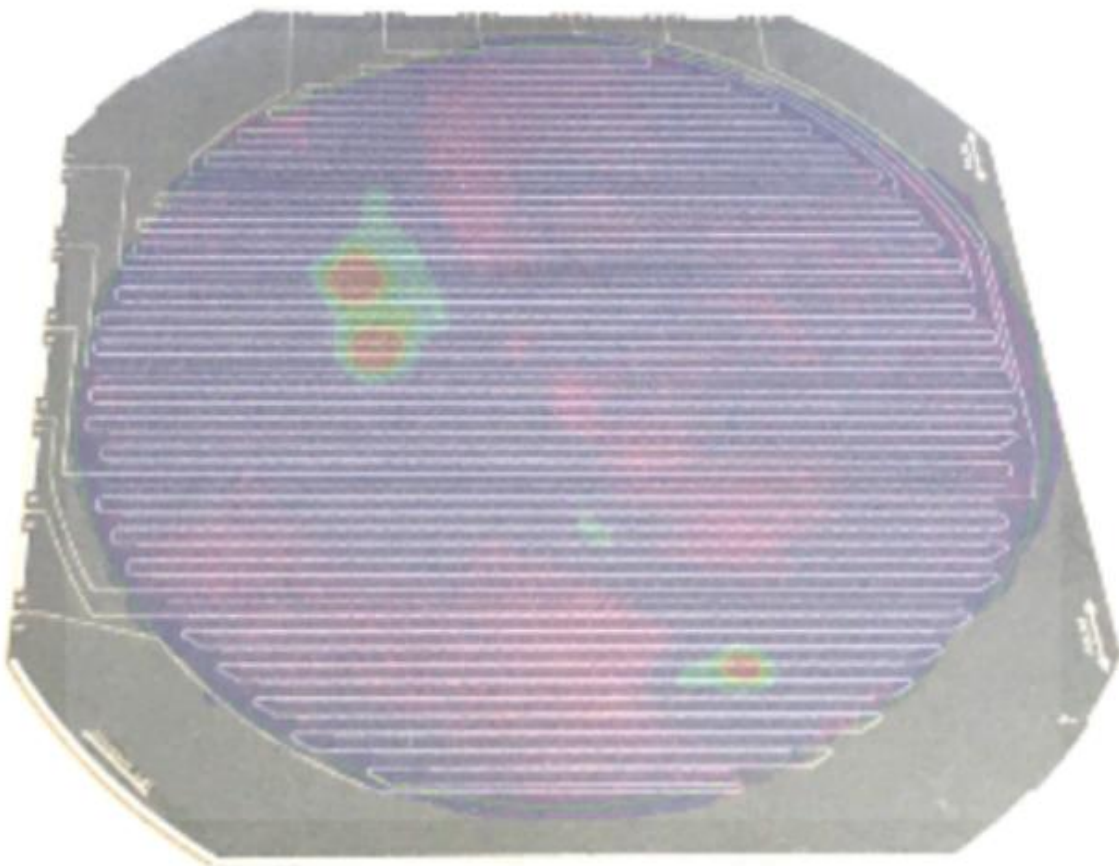


CONCERTO on APEX (Chile)



Thousands KID arrays

Installation at 5100 meters altitude



Frequency range: 125 – 310 GHz
Number of pixels: 2 x 2152

CII-intensity mapping survey
Observation of galaxy clusters

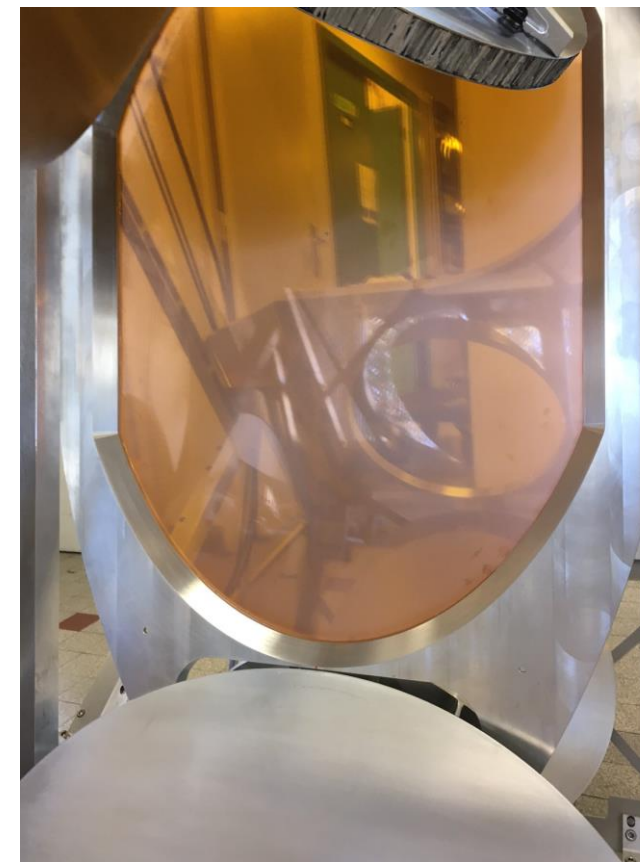
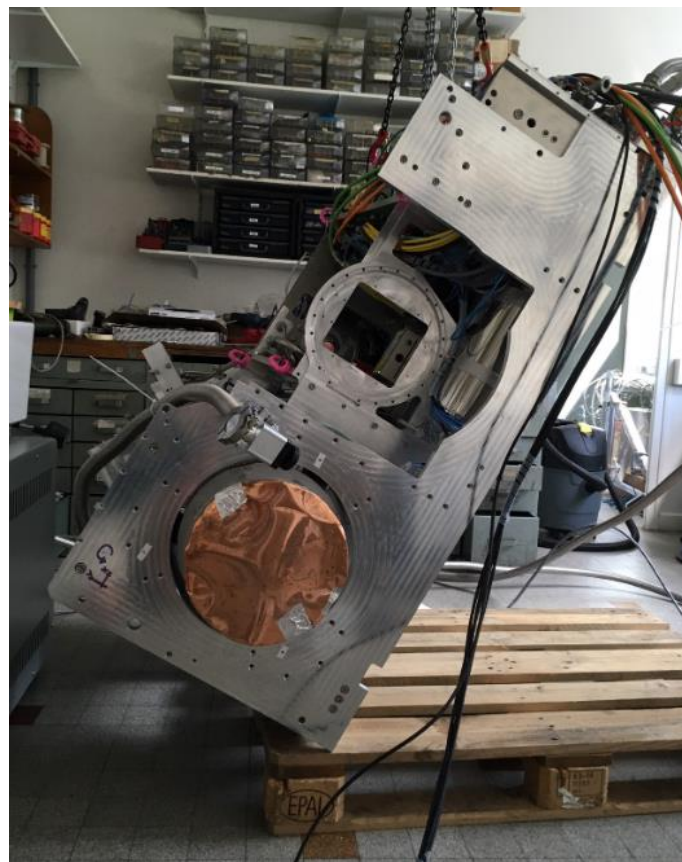
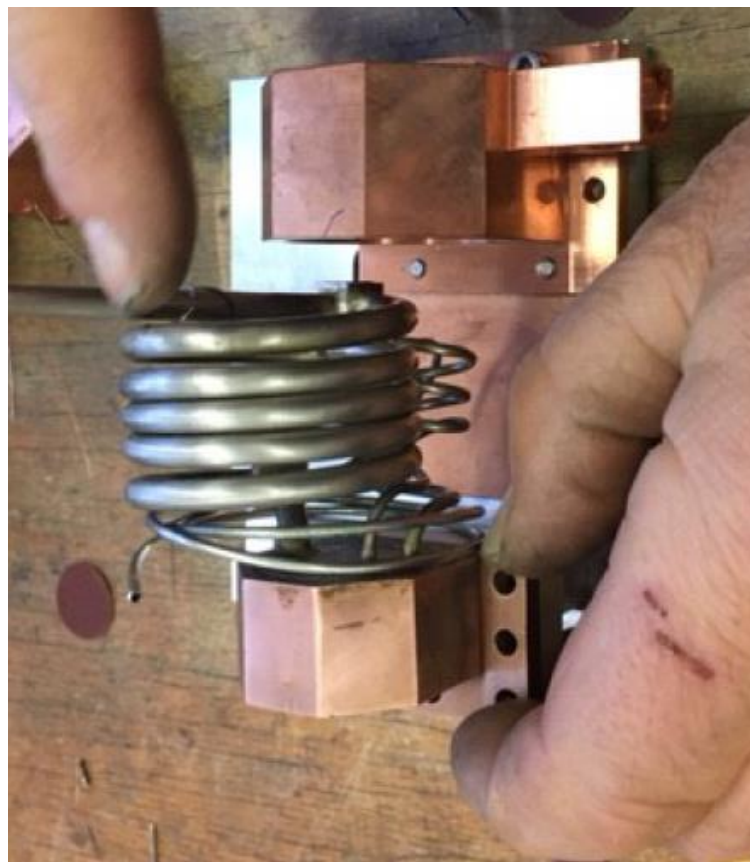


Non-detectors technologies for CONCERTO

Home-made (literally)
mini dilution insert

“Chassis” Tilting. The cryostat
is designed to **work up to 85**
deg inclination → **IT DOES**

80cm POLARIZERS

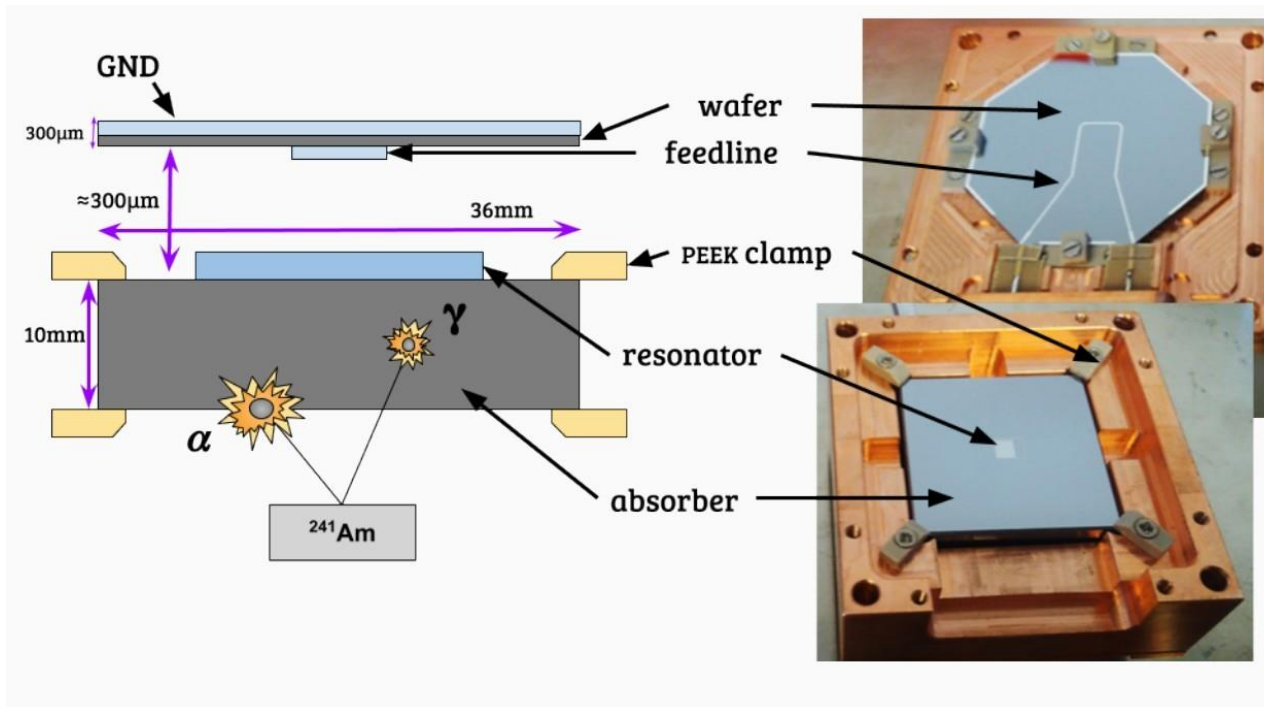


WiFi-KID

Developed in the framework of **RICOCHET** project (future R&D)

RICOCHET
A Coherent Neutrino Scattering Program

KID used with 'wireless' readout → maximized phonon sensing .. and other advantages



J. Goupy et al., APL 115, Issue 22, 223506 (2019)

Si absorber mass = 30 g (36x36x10 mm³)

KID (for astronomy) in Grenoble

1) **NIKA0**, 1st KID camera seeing astronomical light
(30 pixels, single band, 150GHz)

2009 – 20

2) **NIKA1** (30-meters IRAM telescope Spain)
(300 pixels, dual-band, 150GHz and 250GHz)

2011 – 20

3) **NIKA2** (30-meters IRAM telescope Spain)
(3000 pixels, dual-band 150-250GHz + polarisation)

2015 –

4) **KISS** (2.5-meters QUIJOTE telescope Canaries)
(600 pixels x 50 spectral bins eq. to 30 kpixels)

2018 – 20

5) **CONCERTO** (12-meters APEX telescope Chile)
(4000 pixels x 100 spectral bins eq. to 0.4 Mpixels)

2021 – 20

6) **TIFUUN** (10-meters ASTE Chile) ONGOING

2024 -

OBSERVING AND AVAILABLE TO THE COMMUNITY

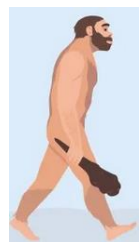
PATHFINDERS
OR
DE-COMMISSIONED

KID (for particles) in Grenoble - evolution of the species

ITALIAN PhD STUDENTS HAD AND ARE HAVING CENTRAL ROLES IN THIS ACTIVITY



1) The **SWENSON-CRUCIANI period (2009-2011)**, first phonon-mediated detection with KID, originating the current developments. Measured the phonons propagation velocity in a Silicon substrate .. just for the fun.



2) The **CALVO-D'ADDABBO era (2011-2014)**, many thoughts and experiments, found a way to prevent phonon propagation (for Astrophysics, SPACEKIDS EU project). Important for future KID experiments from space.



4) The **CALDER saga**. First collaboration with La Sapienza. Detectors fabrication, in collaboration also with. H. Lesueur (Orsay). Multilayers. Demonstration that KID could be useful for particles detection.

5) The **WIFI-KID**, first collaboration with IPNL Lyon after EDELWEISS.

6) **BULLKID** and the **DELICATO PhD period**. Now/here.

Many years (and kg) ago ... the origins of the GRIK

**.... AND THANKS
FOR YOUR ATTENTION**

From left to right:

Martino Calvo (Institut Néel)

Andrea Catalano (LPSC Grenoble)

Alessandro Monfardini (Institut Néel)

Juan Macias-Perez (LPSC Grenoble)

Nicolas Ponthieu (IPAG Grenoble)

... and the 30-meters telescope (IRAM)

... many missing in the picture

