

LARGE-SCALE KIDS PRODUCTION

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Content

- Labs collaboration in Grenoble: past and future projects in millimeter astrophysics
- KIDs Arrays Design and Production
- Towards an open facility

Labs collaboration in Grenoble

Millimeter Astrophysics (I.Néel, LPSC, IPAG, IRAM)



IRAM (Bure) – POM2 DIABOLO Instrument (1994-1997)



Planck – L2 HFI Instrument (2008-2010)



ARCHEOPS (1999 - 2002)



IRAM 30M - Spain NIKA&NIKA2 Instrument (2010 -)



Teide Observatory QUIJOTE Telescope/KISS Instrument (2019 -)



APEX - Chile CONCERTO Instrument (2020 -)

Labs collaboration in Grenoble

Instrumentation in Low Temperature

- Low noise electronics for LTD
- Cryogenics (Planck dilution refrigerator, customized DR for milimeter instruments and dark matter search)

- Detectors development
 - NbSi antenna-coupled arrays (Collaboration with CSNSM, Orsay)
 - KIDs arrays

- Motivated by the instrumental needs in millimeter astrophysics
- Production of the NIKA & NIKA2 detection chain (detectors arrays, readout electronics, software)
- R&D activity for space applications:
 - Low background
 - Sensitivity to cosmic rays
 - Material optimization (energy gap vrs frequency)

Design options for a LEKID array

- **Resonator geometry** (bandwidth, polarization, resonance frequency, frequency spacing)
- Material (Tc adaptation to the frequency)
- Background adaptation (coupling factor to the microstrip line)
- **Substrate** (HR Silicon, saphir)
- **Pixel design** (AR coating, backshort, front or back illumination)
- **Packaging** (magnetic shielding)
- **Temperature** (< Tc/10, ~100 mK for Aluminium)







Développements NIKA2, financés par le Labex



Réalisation de la couche Anti-réflexion



- Illumination au travers du substrat (Si)
- Epaisseur des gorges $\lambda/4$ (80 120 μ m)
- Indice équivalent n~1,8
- Orientation par rapport aux axes du cristal











A. Catalano et al.: Lumped elements kinetic inductance detectors maturity for space missions

- Impact limité à 30 pixels pendant < 1 ms</p>
- Impact sur les mesures (le temps mort est <1%) 10-12% sur Planck





Status

- Background limited detectors on NIKA2
- 4" wafer technology for 2000 pixels at $\lambda = 1 \text{ mm}$
- Available design for the main CMB bands (1-2-3 mm); extension to higher frequency (450 - 600 GHz)

Motivations

- Keep the expertise acquired on KIDs arrays design by job creation
- Strenghten the capability to handle large-scale projects (space or ground instruments)
- Outreach the technical developments and skills to other fields than astrophysics

Labs partners (Grenoble)

Institut Néel, LPSC, IPAG, IRAM

Activities

- Design of the detection chain (arrays, readout, sotfware)
- Production
- Test
- Quality Plan

Infrastructure



Dedicated microfab facility at IRAM



Integrated system optical test at I.Néel



An Open Facility

- Local management group
- Dedicated ressources allocated by the partners (material and human)
- Open to new projects, even outside astrophysics applications
- The agreement between the laboratories should be signed by the end of 2018