

Space It Up!

I 9 Spoke di SIU!

SPOKE 3

Firenze, 26 Gennaio 2026



AGENZIA SPAZIALE ITALIANA

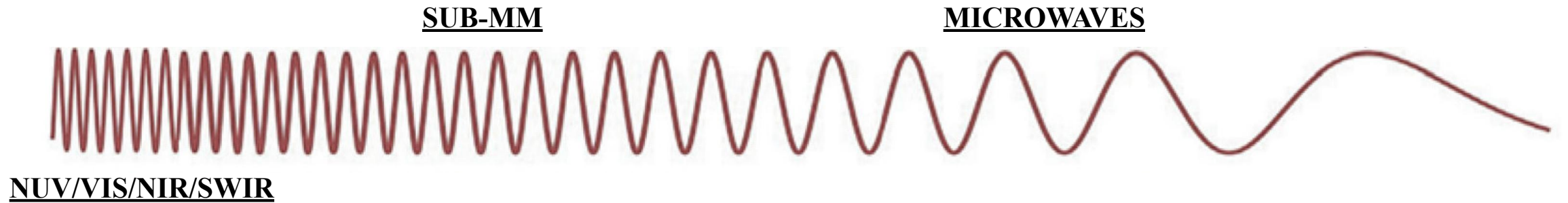


Ministero
dell'Università
e della Ricerca



The Space It Up! project is funded by the Italian Space Agency (ASI) and the Ministry of University and Research (MUR), under contract no. 2024-5-E.0 – CUP I53D24000060005.

Spoke Outline

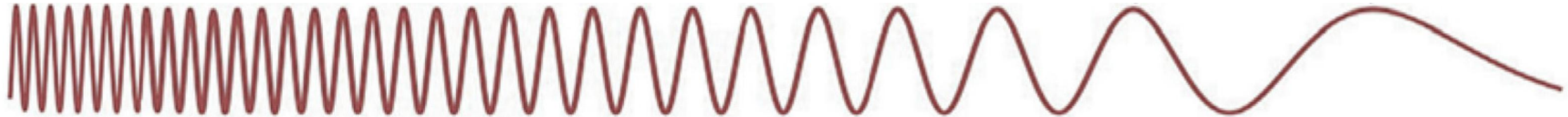


Statement: Fostering research and development activities to study new, high-performance sensors for Earth observation from space operating in the visible and infrared wavelengths, and in the microwaves. Thanks to improvements in miniaturization and formation flying, special emphasis will be on distributed functions among nanoplatforms.

Spoke Outline

SUB-MM

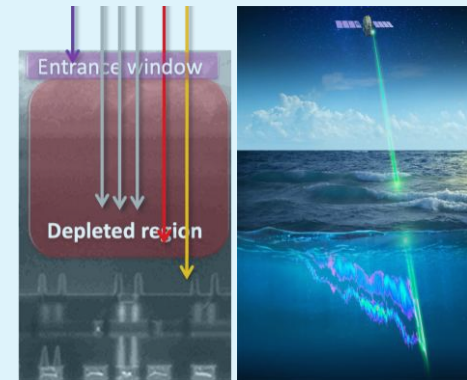
MICROWAVES



NUV/VIS/NIR/SWIR

Key enabling technologies for optical imaging payloads on CubeSats

- Free-form optics for compact payload realization
- Monolithic Active Pixel Sensors (MAPS)
- Single Photon Avalanche Diodes (SPAD)
- Compressive Sensing (CS) from Low Earth Orbit
- AI- fusion and resolution enhancement of optical images sensed by cube/nanosats



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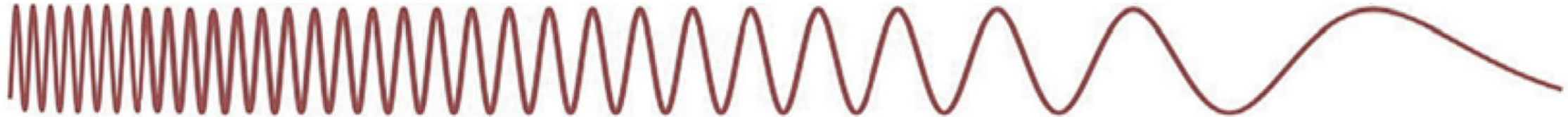
Spoke Outline

Spectrometer on-chip for sub-mm remote sensing

- Limb-sounder spectrometer
- Cosmic Background Spectrum
- Design and breadboarding



MICROWAVES



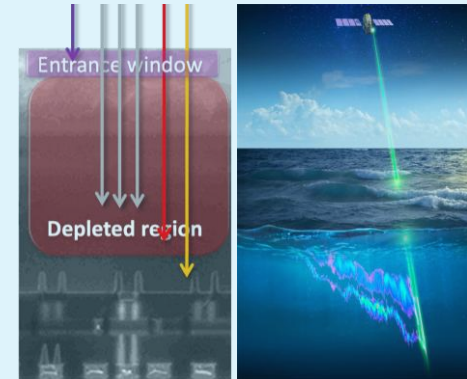
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POLITECNICO
MILANO 1863



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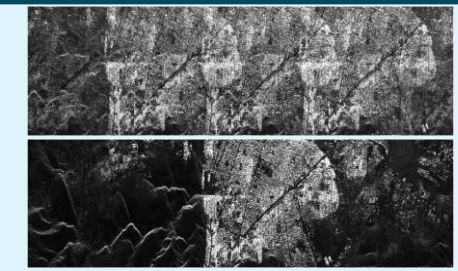
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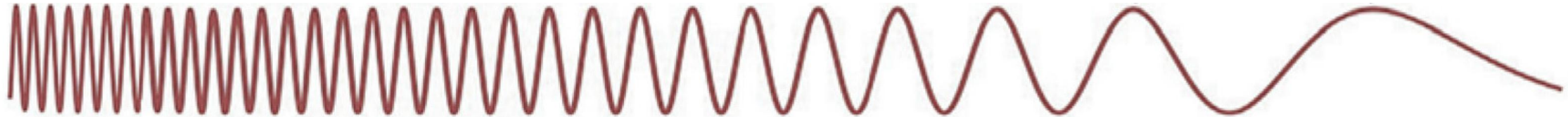


Distributed SAR and Digital Radar

- MIMO DSAR
- Passive operation of DSAR
- Digital Radar Architecture
- Design and breadboarding
- Drone experiments
- Additive Manufacturing
- Formation and Constellation Design



MICROWAVES



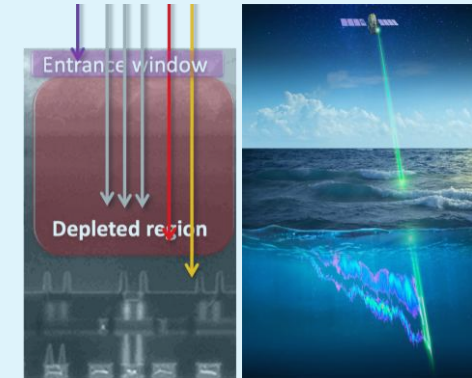
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Some Experimental and Lab Activities (1/2)

SPECTROMETER ON-CHIP – Breadboard delivered at M12

The breadboard wafer and holder include the most critical components of the on-chip submm spectrometer:

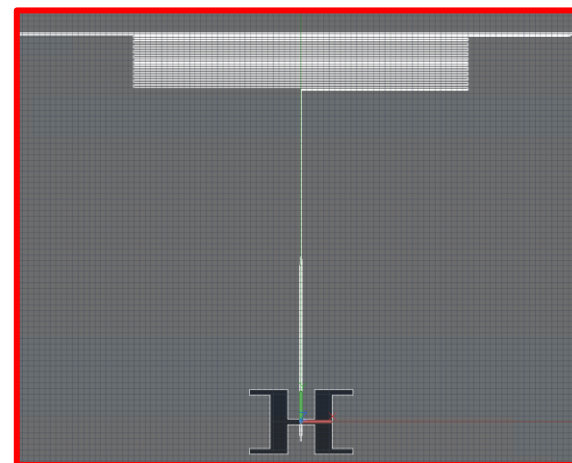
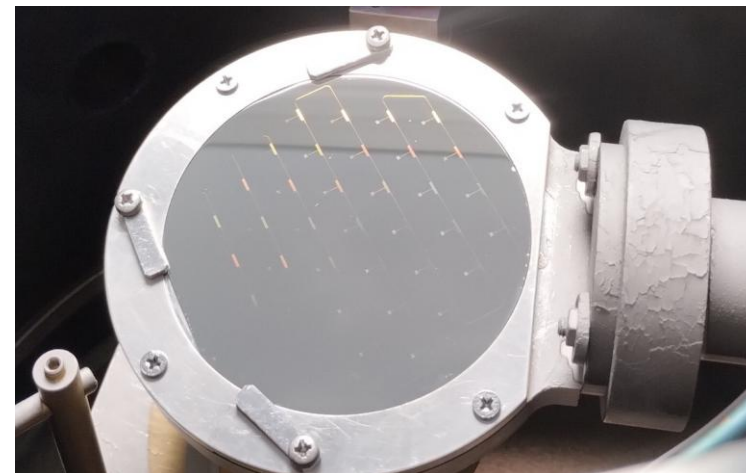
- kinetic inductance detector (KID)
- Feedline
- Resonators
- Connectors and launchers
- Thermal and electrical bonds

Their fabrication allowed the team to validate:

- The cleanroom production sequence
- The accuracy of the fabrication facility
- The quality and cryogenic performance of the metal films and of the wafer
- The interfaces (mechanical, thermal, electrical) between the on-chip device and the external world

All these measurements are being finalized, and no showstopper was found, to date.

The 2" wafer is filled with 37 pixels, fed by a meander feedline to read the KIDs. Each KID is coupled to a planar antenna via a coplanar waveguide.

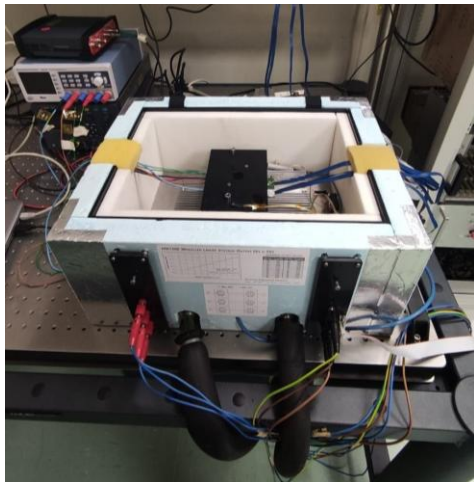


Zoom on a single pixel. The meander inductor of the KID and its capacitive coupling to the feedline are evident in the top, the coplanar waveguide is the center vertical connection, and the planar antenna is evident in the bottom.

Some Experimental and Lab Activities (2/2)

Monolithic Active Pixel Sensors (MAPS)

Characterization of MAPS for Earth observation (efficiency, resolution, general behaviour of sensor in NIR-VIS-NUV, radiation hardness of sensor, timing for fast localized image variation)



Cold box for dark current and noise measurements

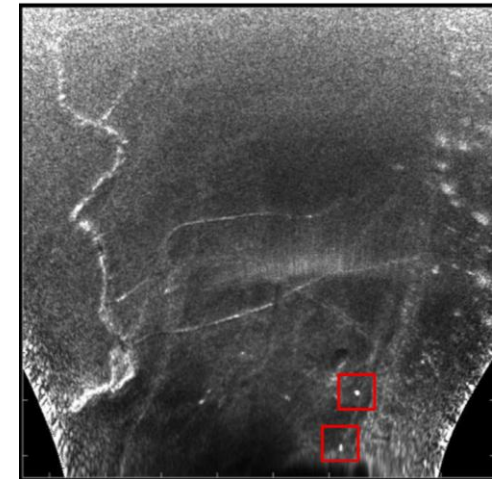
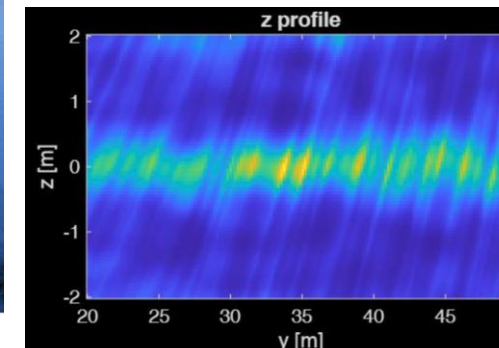
Ongoing tests

- Measurements with blue laser (405 nm) at the Department of Physics in Padua
- Measurements with different wavelength laser in Toulouse, France
- Estimation of sensor power consumption



UAV-based Tomographic SAR Imaging

Experimental campaign conducted on Feb. 2025 in Cheneil (AO) for demonstrating the tomographic capabilities of the X-band UAV SAR

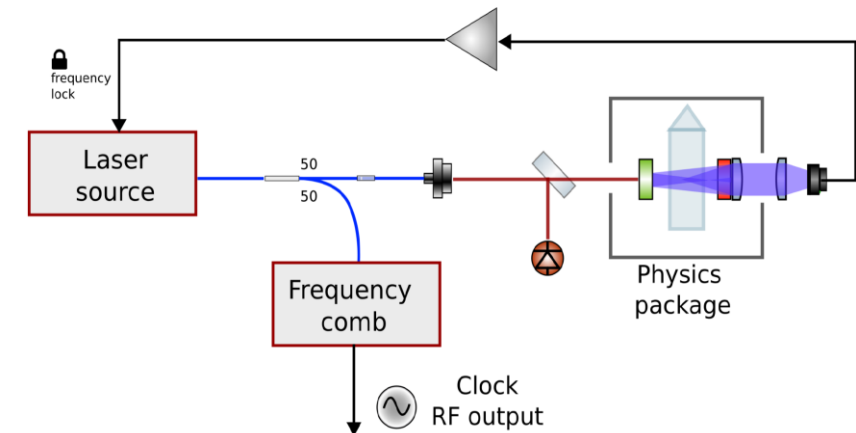
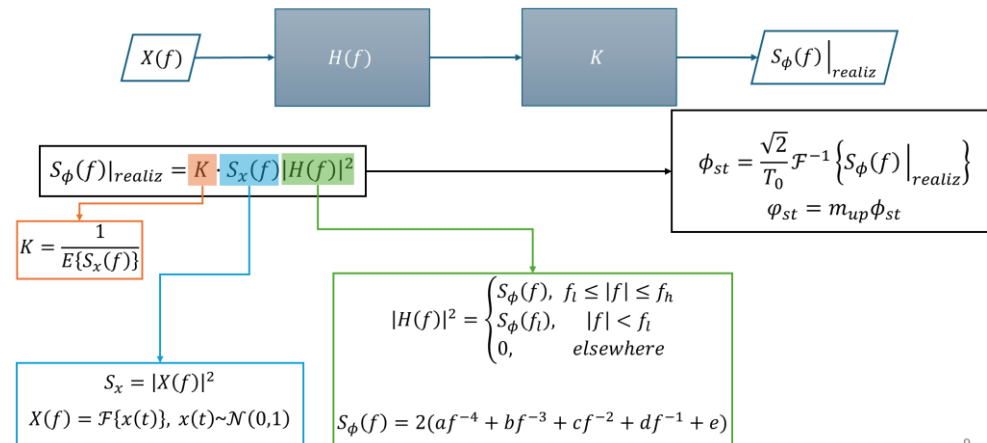
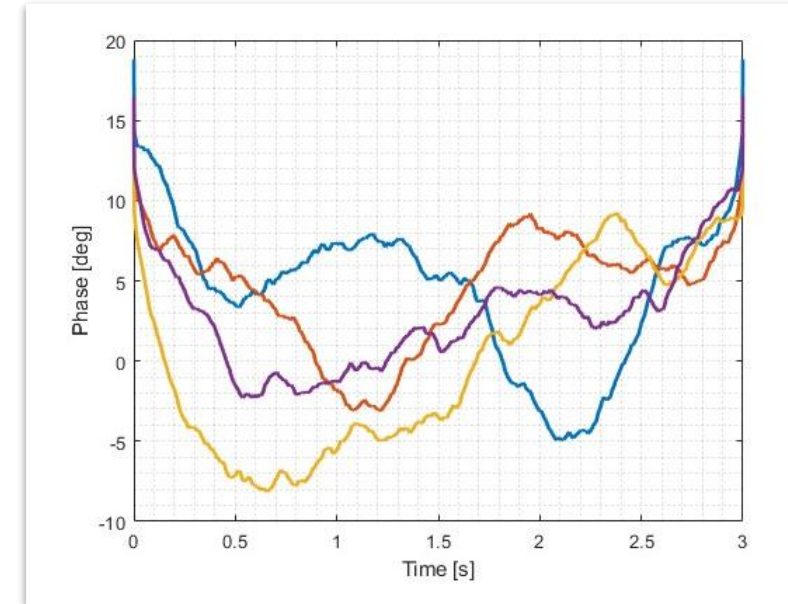


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- 80 cm tick layer distinguished, indicating the snow profile over the terrain

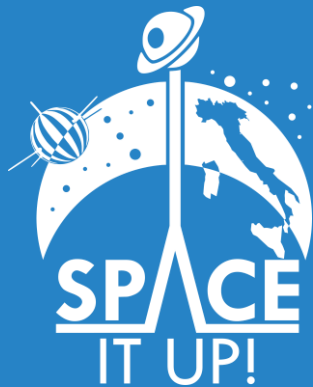
Identified Synergies and Actions Taken (1/2)

- Synergy established with Spoke 4 – Synchronization in distributed space systems
 - Involved institutions: UNINA, INFN e INRIM
 - WP 4.6 vs WPs 3.2/3.4
 - Meetings: (i) Dec. 2025; (ii) Jan. 2026
 - DSAR synchronization requirements
 - Information exchange in relation to oscillators currently available on the market
 - In-depth refinement of requirements in relation to long-term use of Rb two-photon transition atomic oscillators



Identified Synergies and Actions Taken(2/2)

SPOKE	TOPIC	STATUS	SPOKE 3 CONTACT POINT
2	Digital twin for synthetic generation of SAR images	Discussion under way with Telespazio	<i>A. Renga (UNINA)</i>
1	Use of electro-optic sensors studied within the VLEO environment	Potential interest for WP 1.2 and WP 3.5	<i>V. Raimondi (CNR IFAC)</i>
1	SAR formations design and GNC	Potential interest for WP 1.3 and WP 3.2	<i>A. Renga (UNINA)</i>
2	Additive Manufacturing	Potential interest for WP 3.2	<i>O. Peverini (CNR IEIIT)</i>
5 & 7	Data fusion/AI	Potential interest for WP 3.2 and 3.5	<i>A. Pepe (CNR IREA)</i>
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