

# Leibniz Institute of Photonic Technology e.V. (IPHT)

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## Key Figures:

Employees: **355**

Including Doctoral Candidates: **>95**

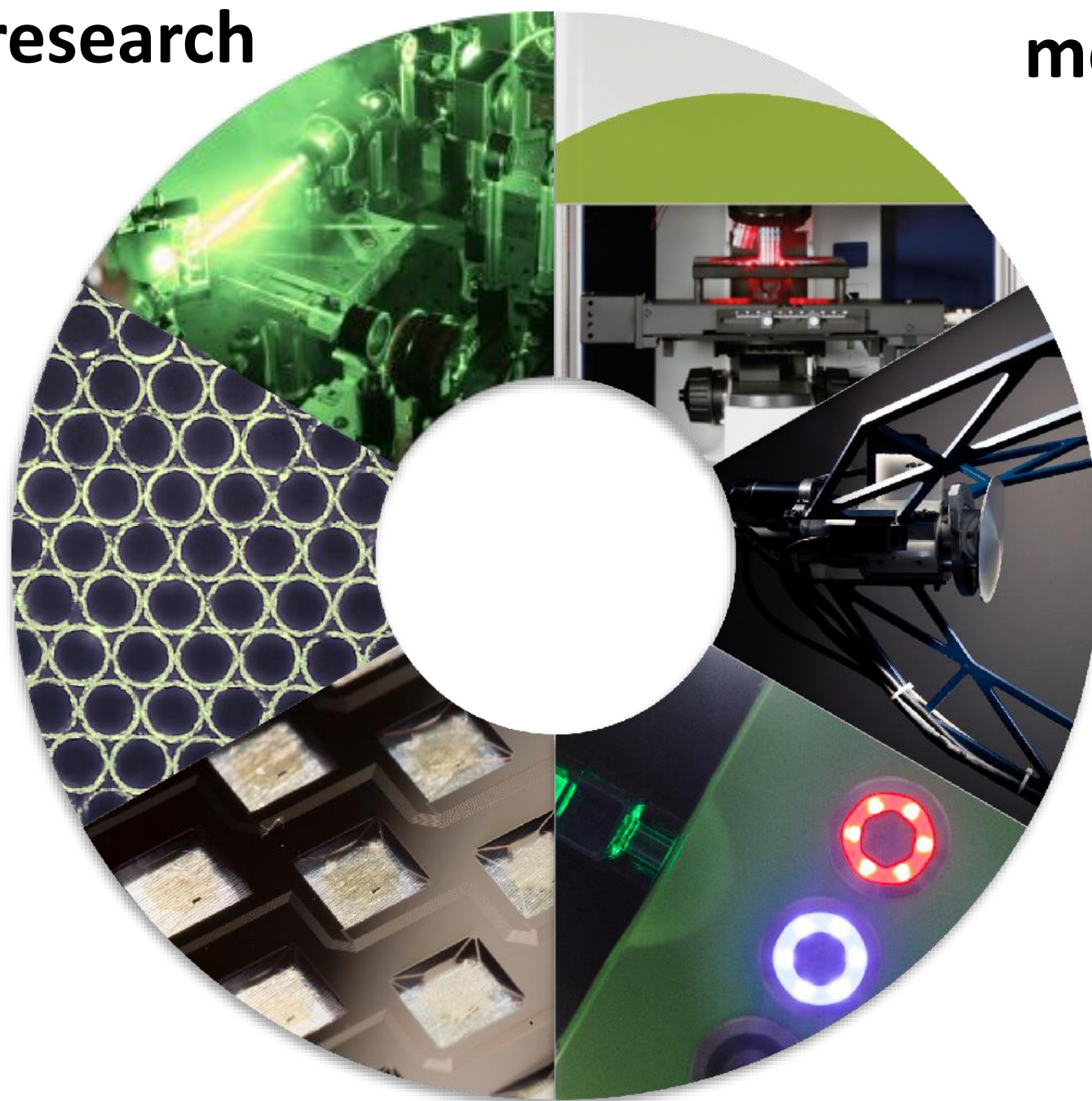
Publications/Year: **≈220**

General Budget: approx. **22 Mio. €**

Incl. Project Funding: **11 Mio. €**



**IPHT conducts  
basic research**



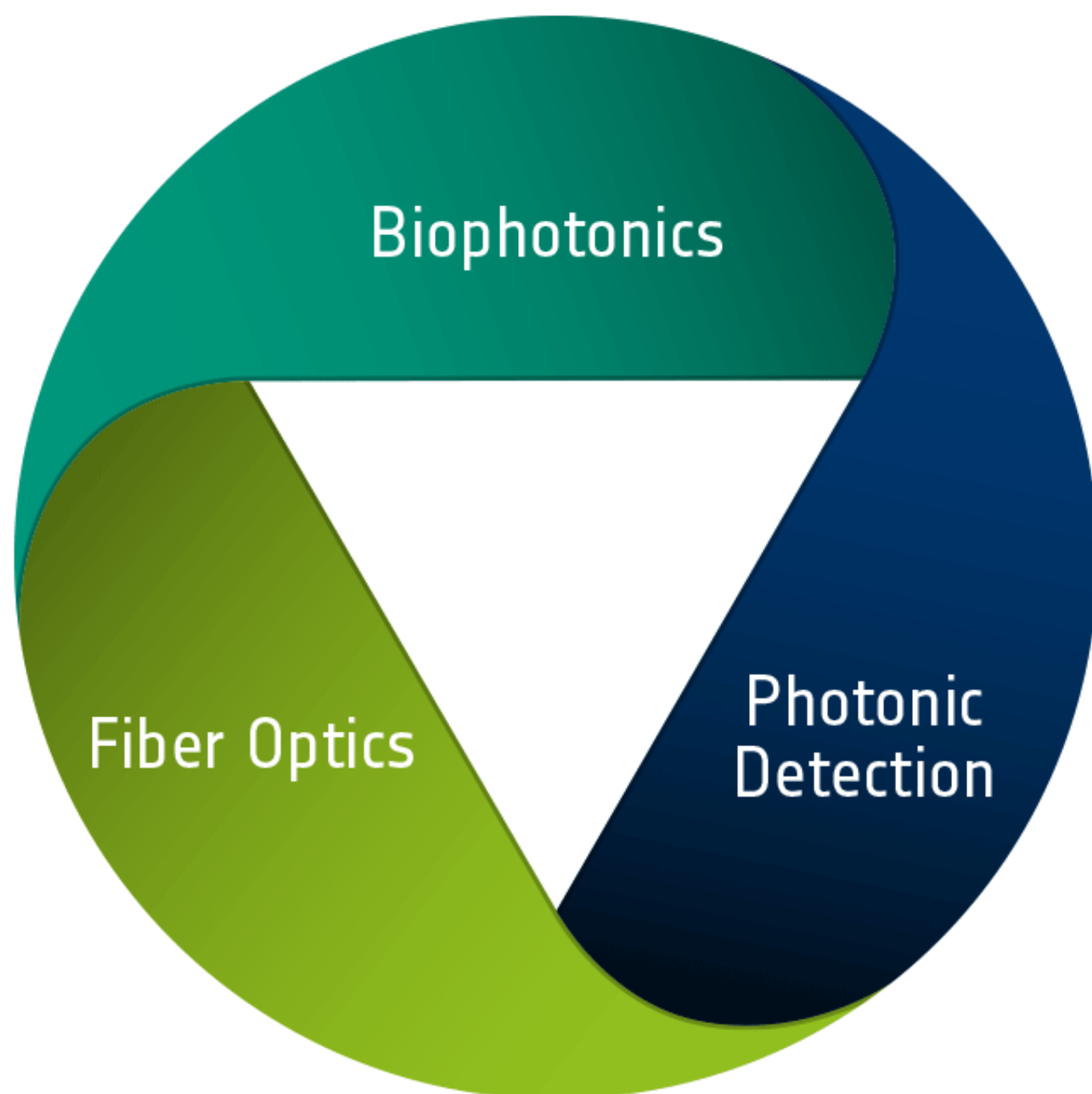
**towards photonics  
methods and  
systems**



**for addressing urgent social needs  
in the fields of medicine, health,  
the environment and security.**



# PHOTONICS



# FOR LIFE

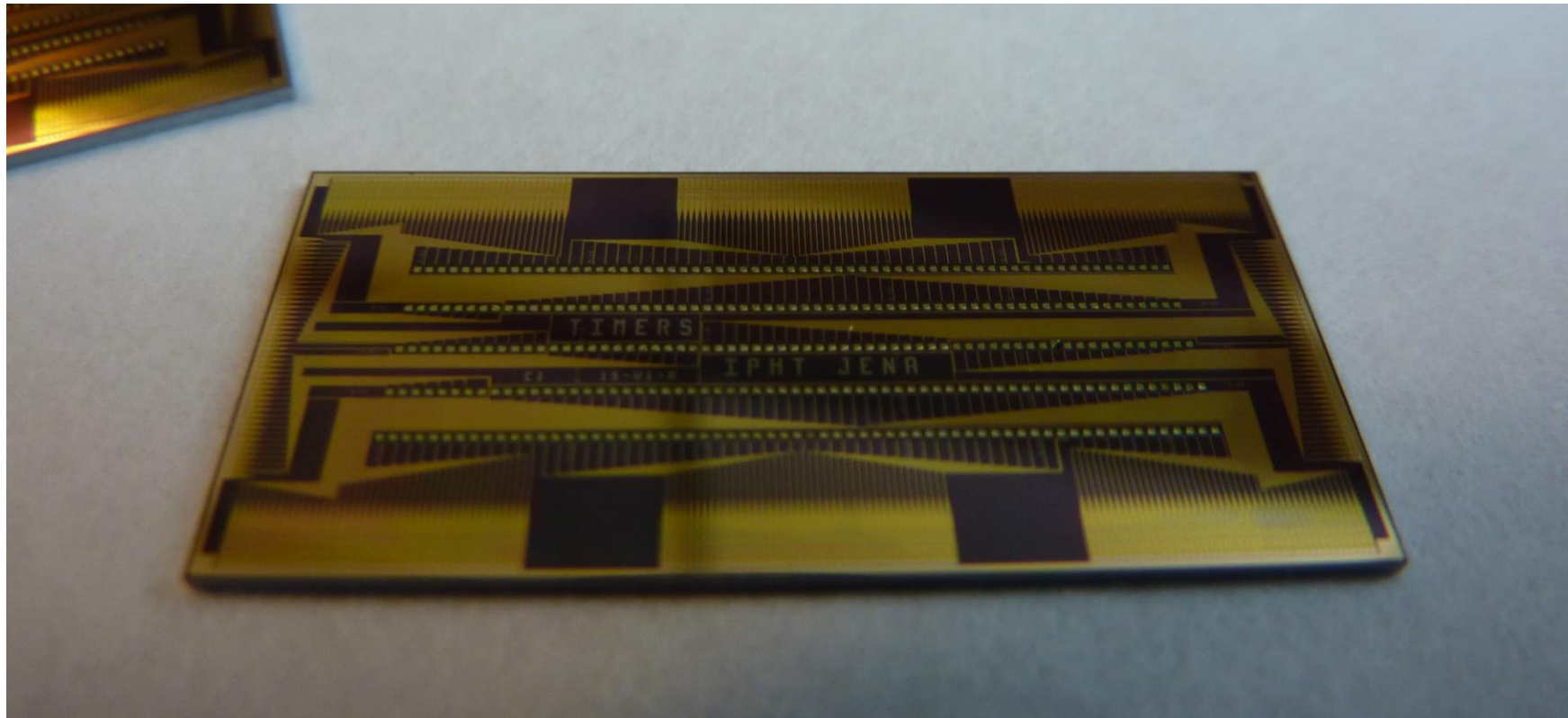


*from Ideas to Instruments*

# THz spectrometry and imaging using thermoelectrical and superconducting detector technologies at Leibniz-IPHT

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## THz spectrometry

## THz imaging

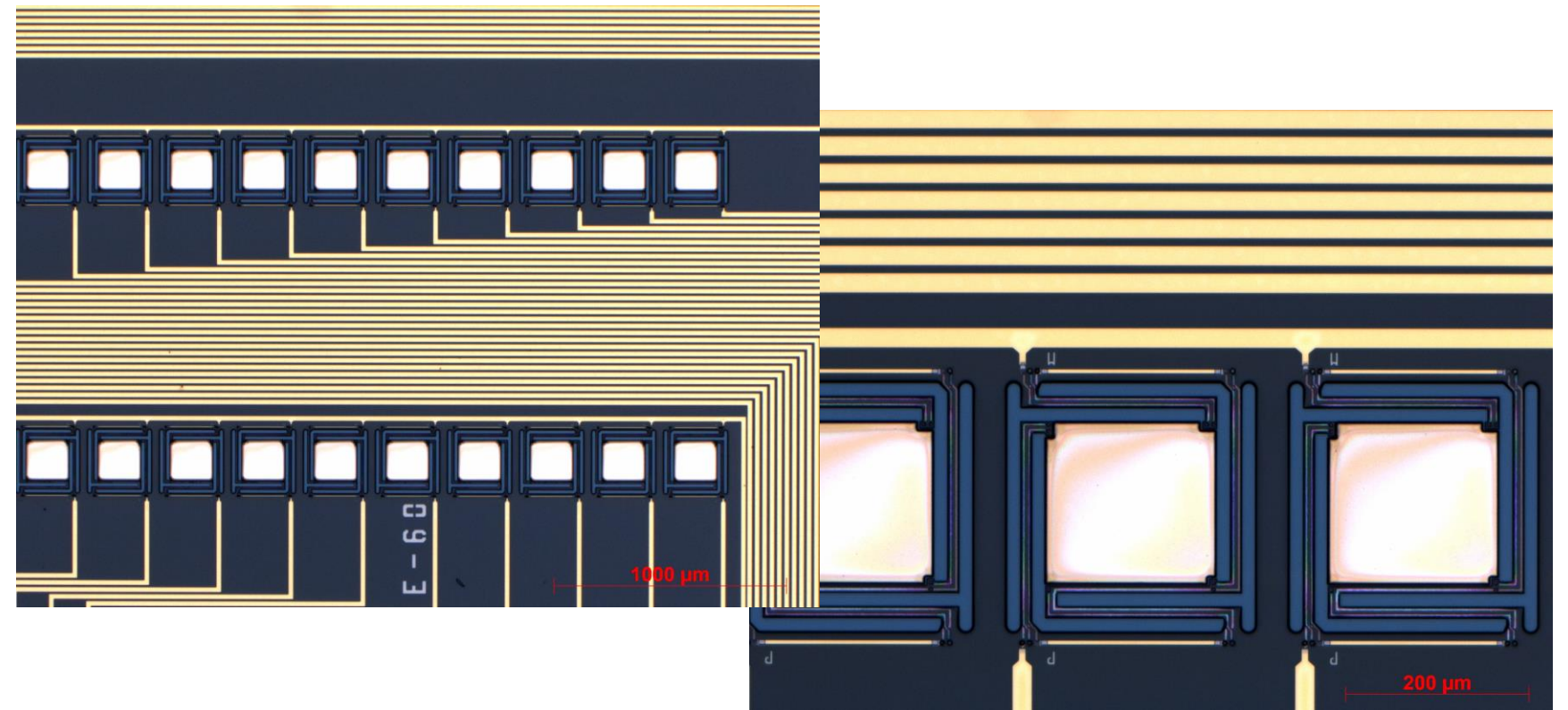
## using thermoelectrical and superconducting detector technologies



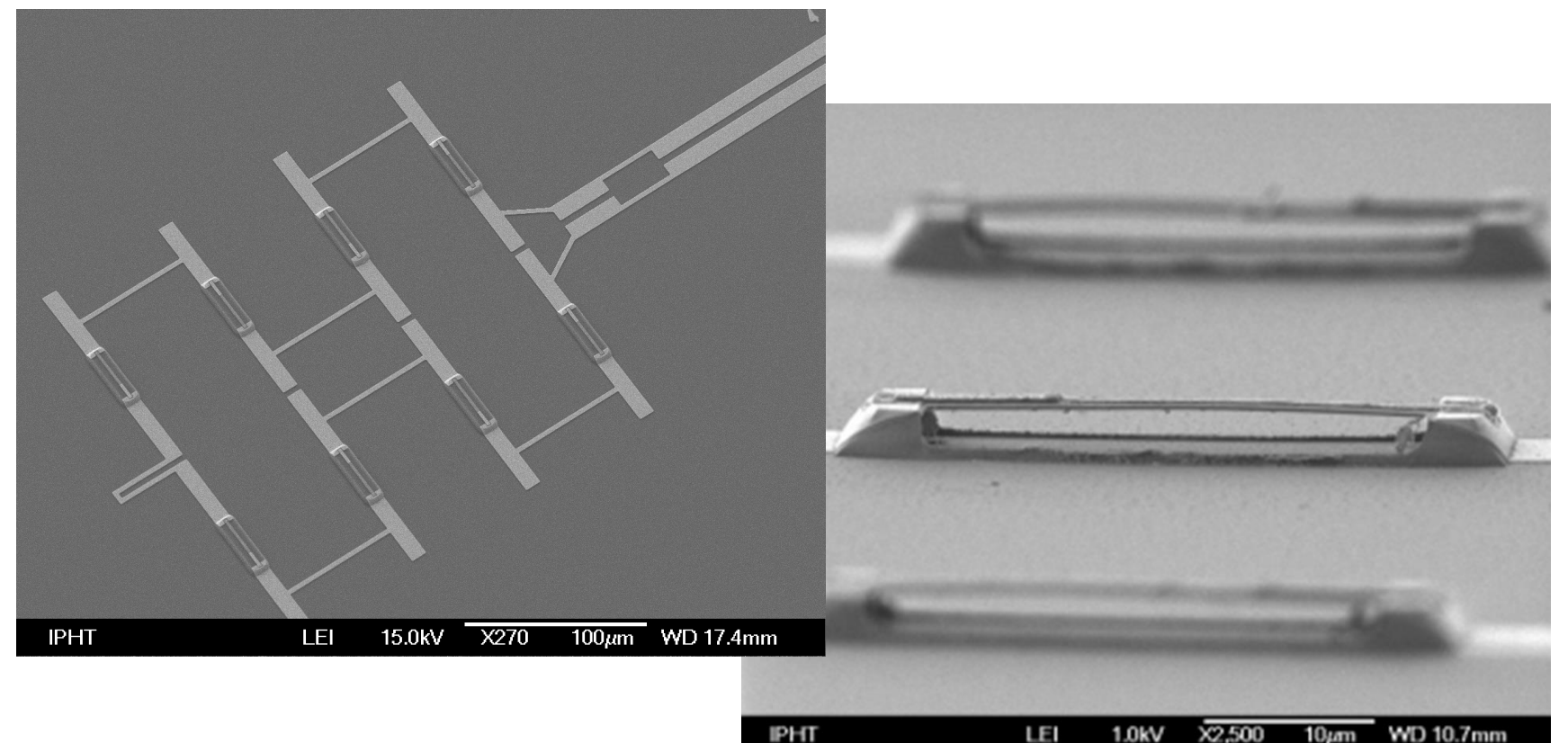
# Thermoelectrical detector technology

Thermoelectrical detectors on the base of Seebeck effect

- Thermocouple from BiSb/Sb or BiSb/BiSbTe,
- SiN membrane 0.3 - 1  $\mu\text{m}$ ,
- Spiral design, air bridge,
- absorber: silver nanolayer, antenna coupled,
- NEP = 13.7 pW/ $\sqrt{\text{Hz}}$ .



SiN membrane etched into Si wafer



free-standing membrane,  
SMM technology, NEP = 18.6 pW/ $\sqrt{\text{Hz}}$   
 $\tau = 90 \mu\text{s}$



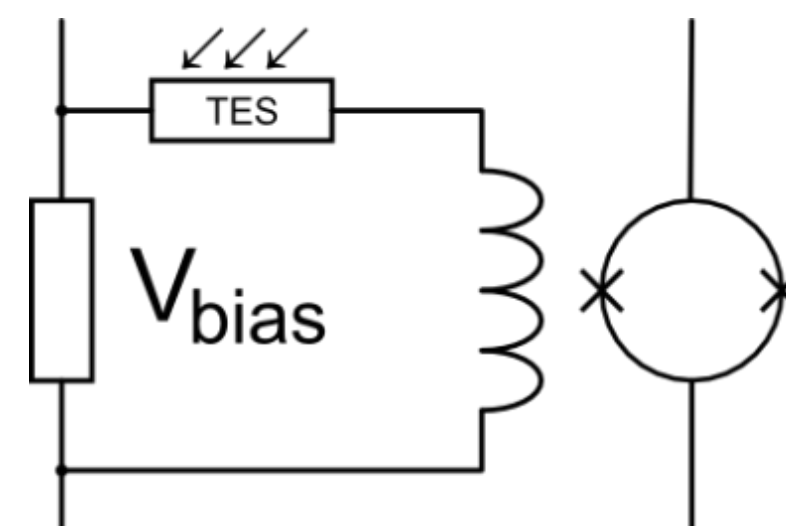
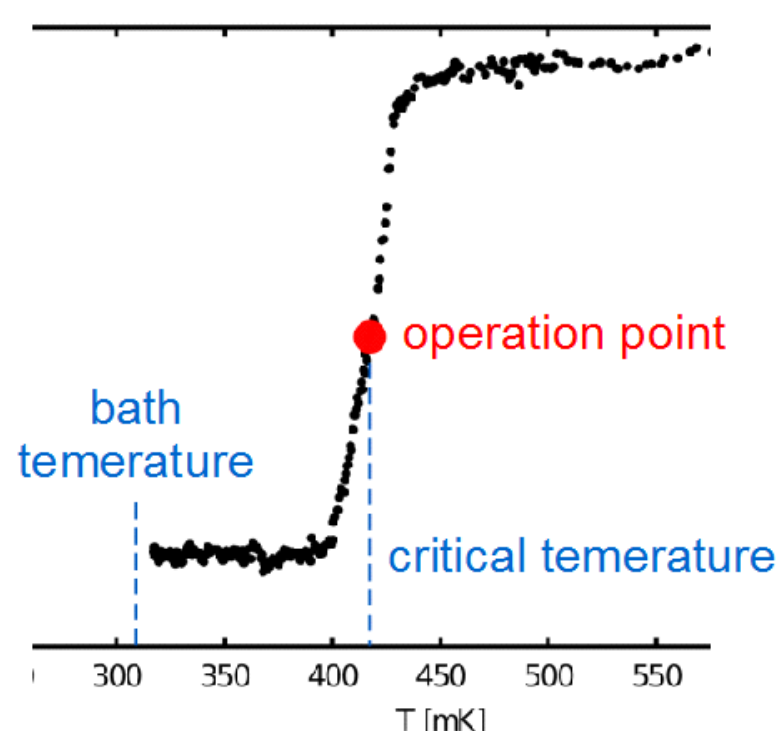
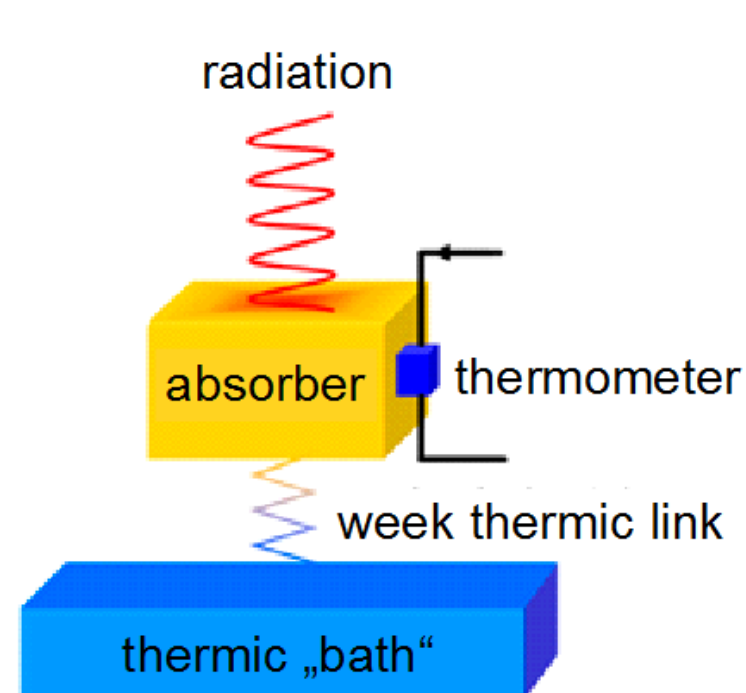
# Superconducting detector technology

## Transition Edge Sensors (TES)

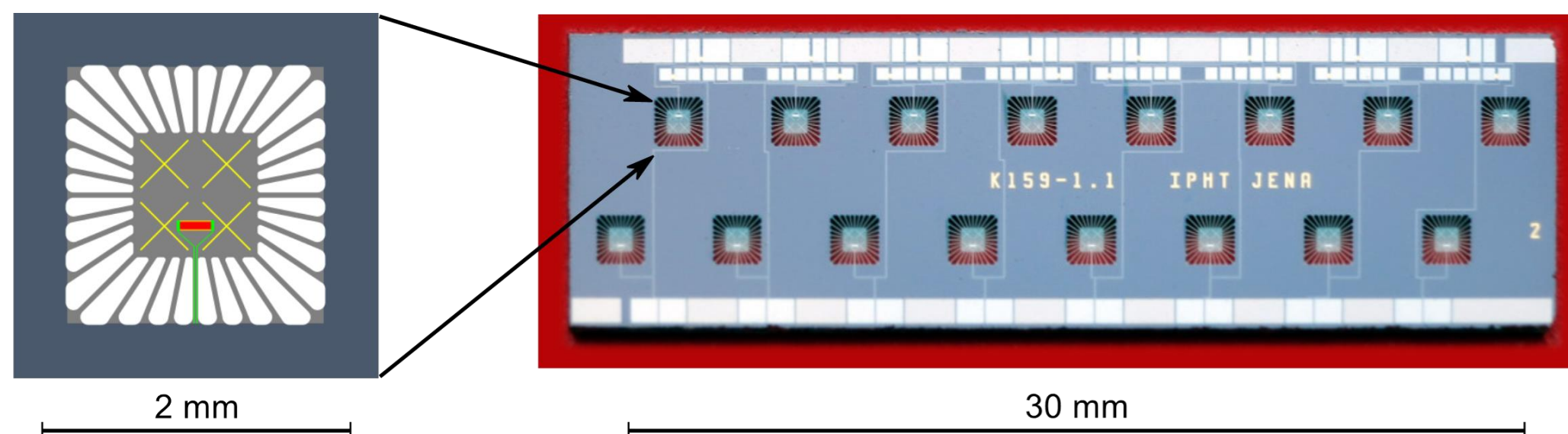
- unprecedented sensitivity in the terahertz band,
- cryogenically cooled to temperatures near absolute zero (below 1 kelvin),
- electro-thermally balanced with bias voltage

$$\Delta P \rightarrow \Delta T \rightarrow \Delta R \rightarrow \Delta I ,$$

- read-out by highly sensitive cryogenic current sensors (SQUID).



## TES bolometer array



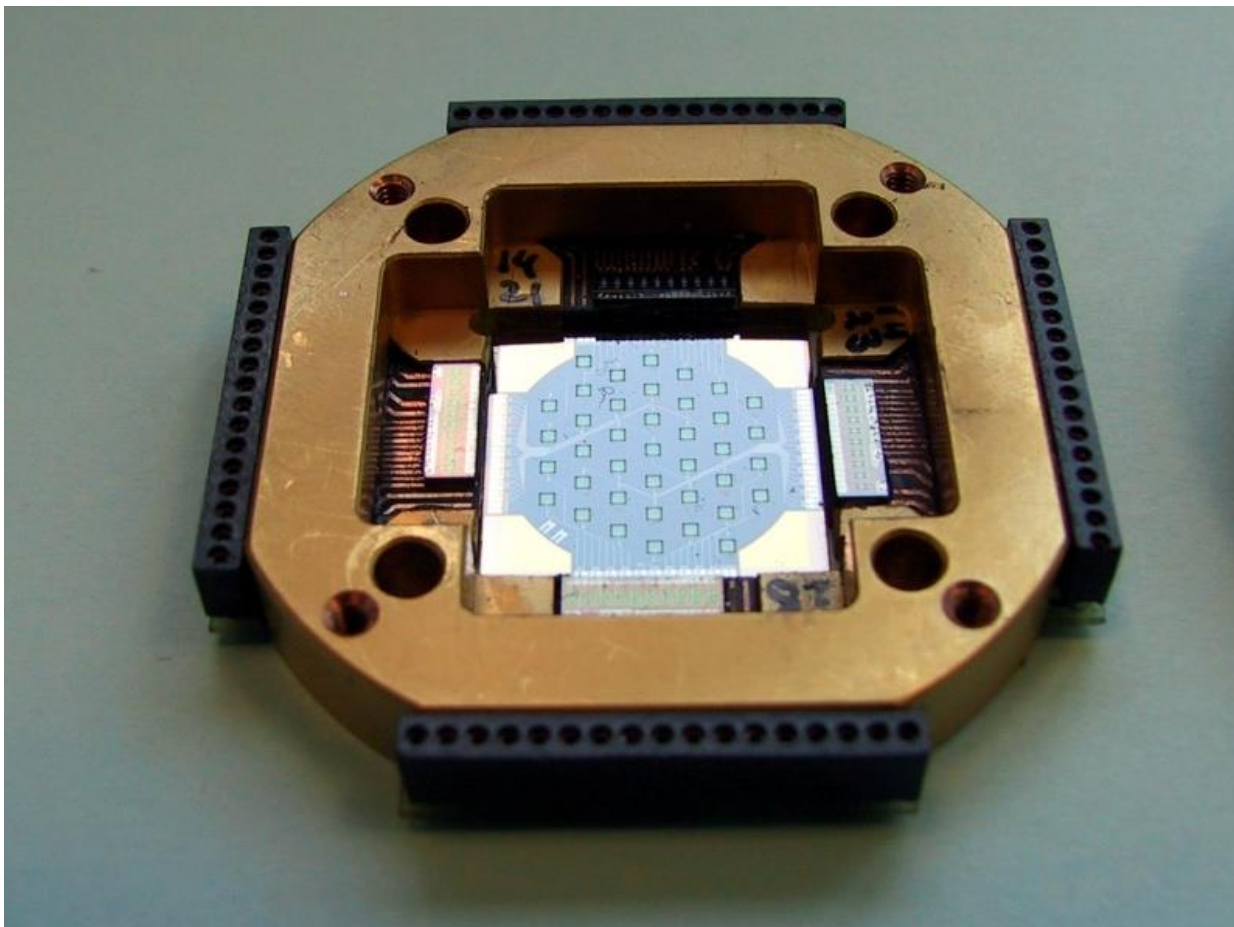


# Application example: THz imaging - Submillimeter-wave Astronomy

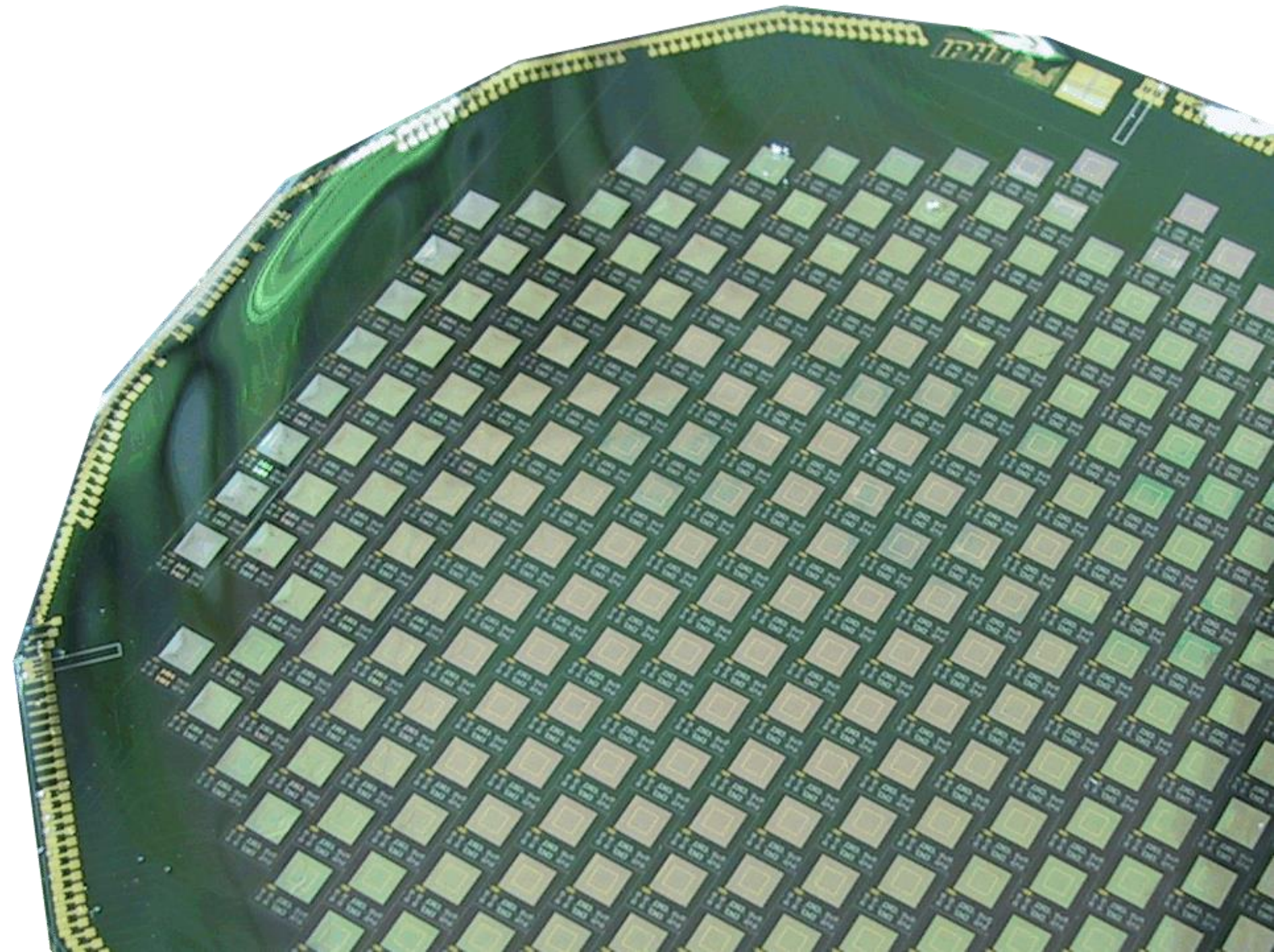
APEX: "Atacama Pathfinder Experiment", a 12-meter radio telescope in the Chilean Andes, on a 500m plateau in the Atacama Desert



Objective: Mapping of radio sources,  
typical recording times:  
minutes to several hours per image

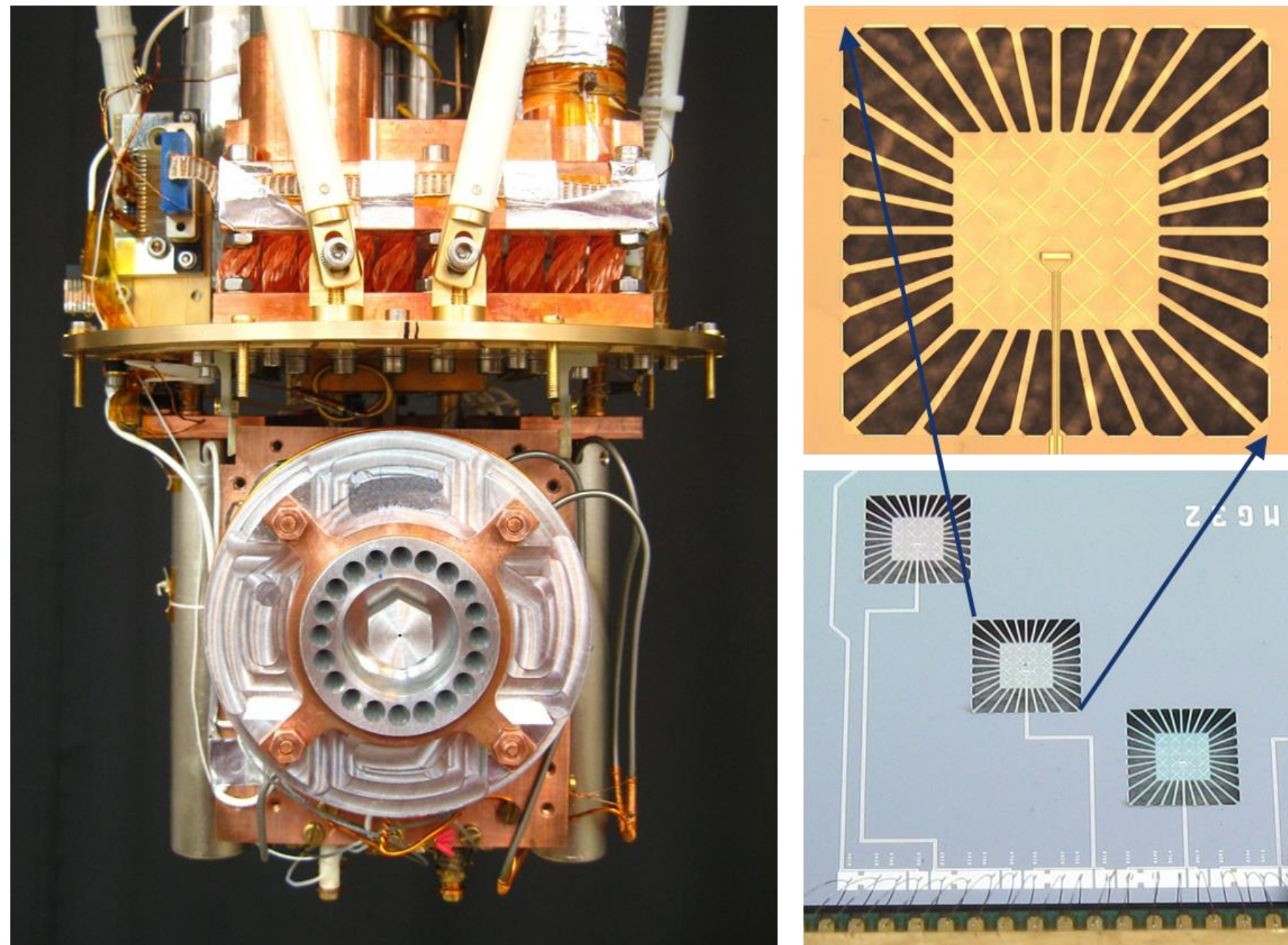


SABOCA: 37Pixel @ 350 $\mu$ m  
LABOCA: 300 Pixel @ 870  $\mu$ m



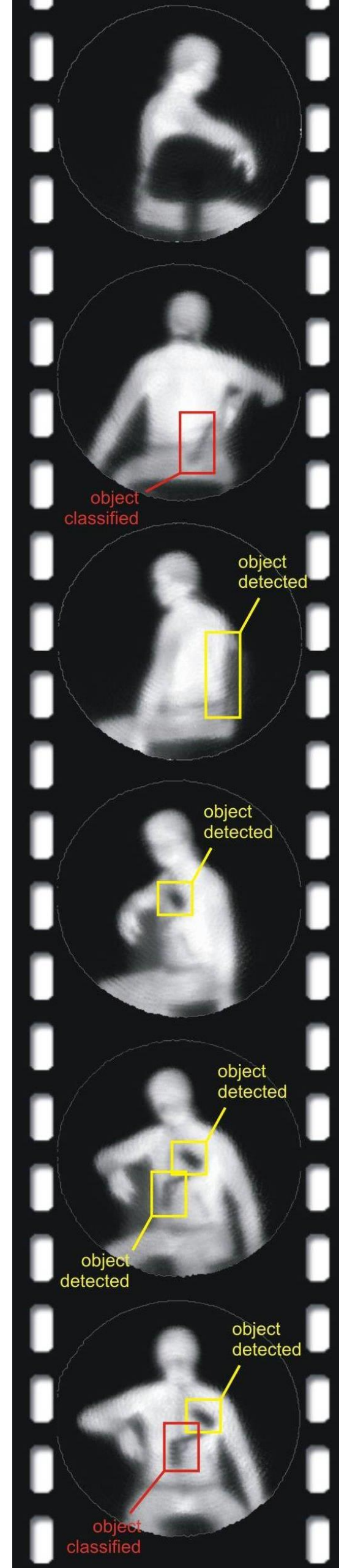


# Application example: THz imaging – Safety camera



Thermal camera (870 $\mu$ m wavelength) for safety applications:

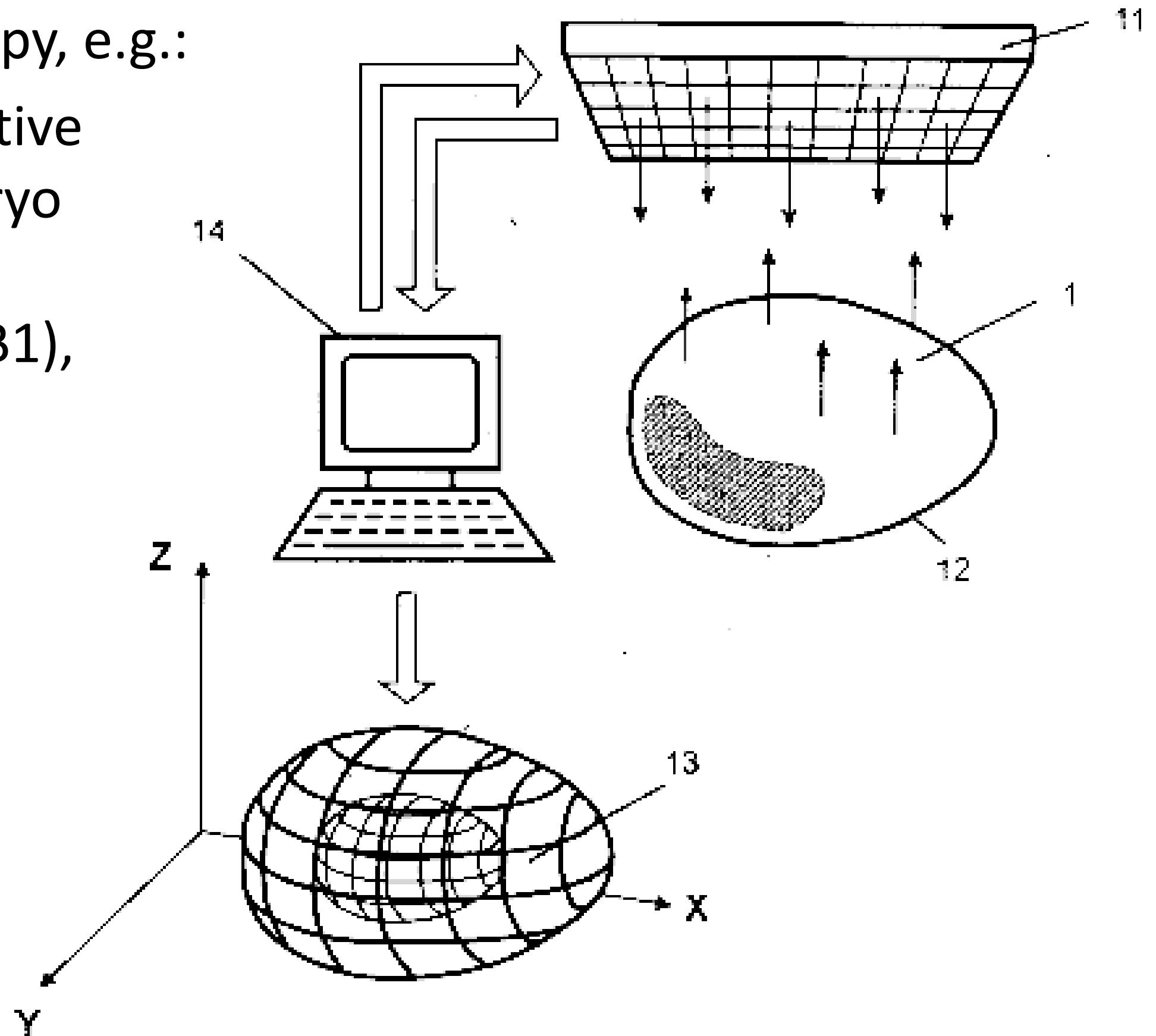
- Superconducting bolometers for high sensitivity,
- Terahertz lenses system for detection range of a few meters,
- Realtime imaging with 10Hz video refresh rate.





# Application example: THz spectroscopy

- biophotonic applications of THz-imaging and spectroscopy, e.g.:
  - non-invasive, non-destructive identification of bird embryo sexes in ovo (Patent EP000002926129B1),
  - spectroscopy of small & macro biomolecules.





**Thank you  
for your  
attention**

