

南極高地における遠赤外線干渉計について

Far-Infrared Interferometry from Antarctic Plateaus

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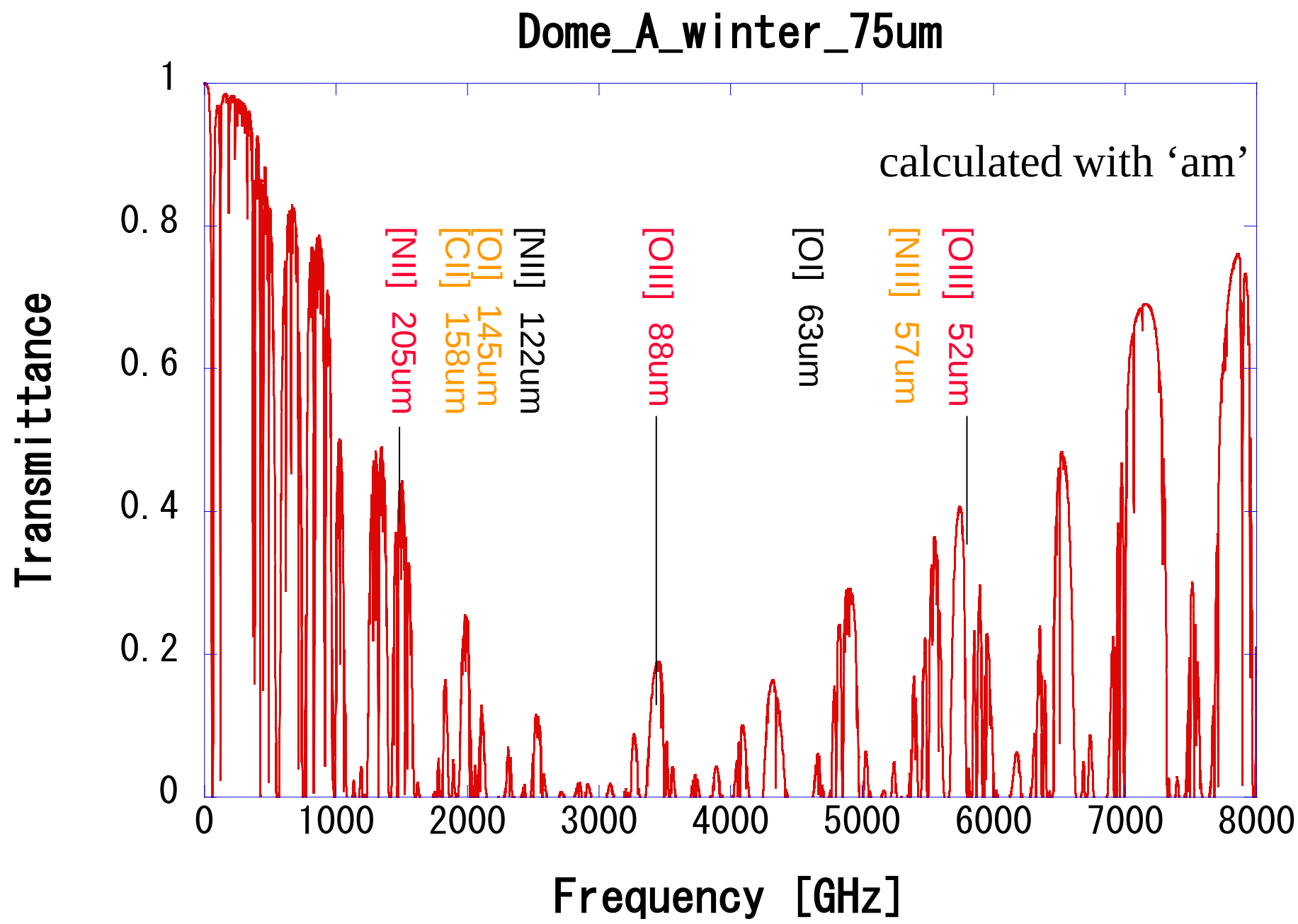
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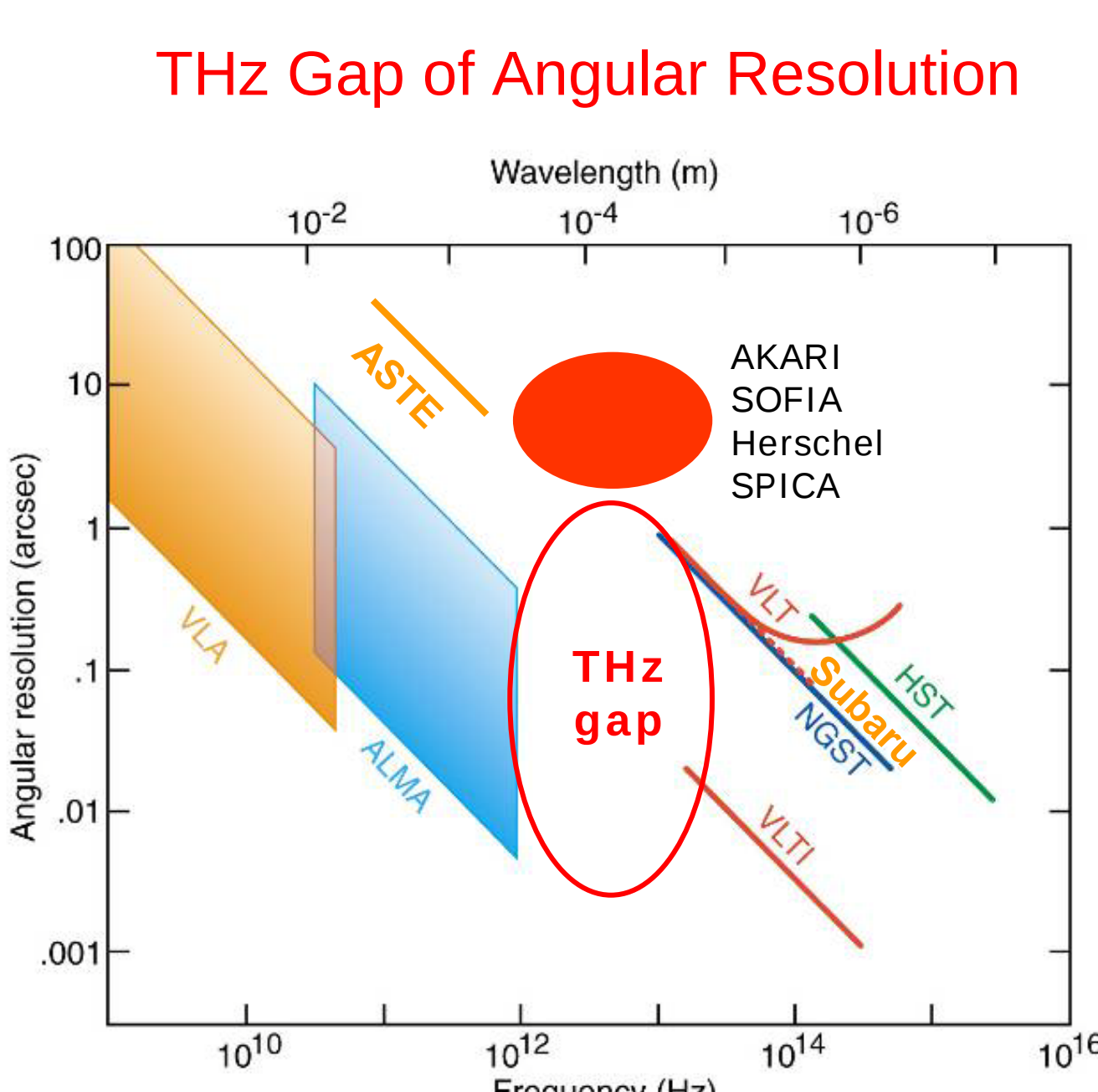
Abstract

- Antarctic Plateaus, such as Dome F and Dome A, provide us with environments similar to space.
- Far-infrared windows open at high and cold sites at the most remote place on earth.
- Far-infrared interferometry in space is required for future space astronomy, but we can start experiments in Antarctic Plateaus.

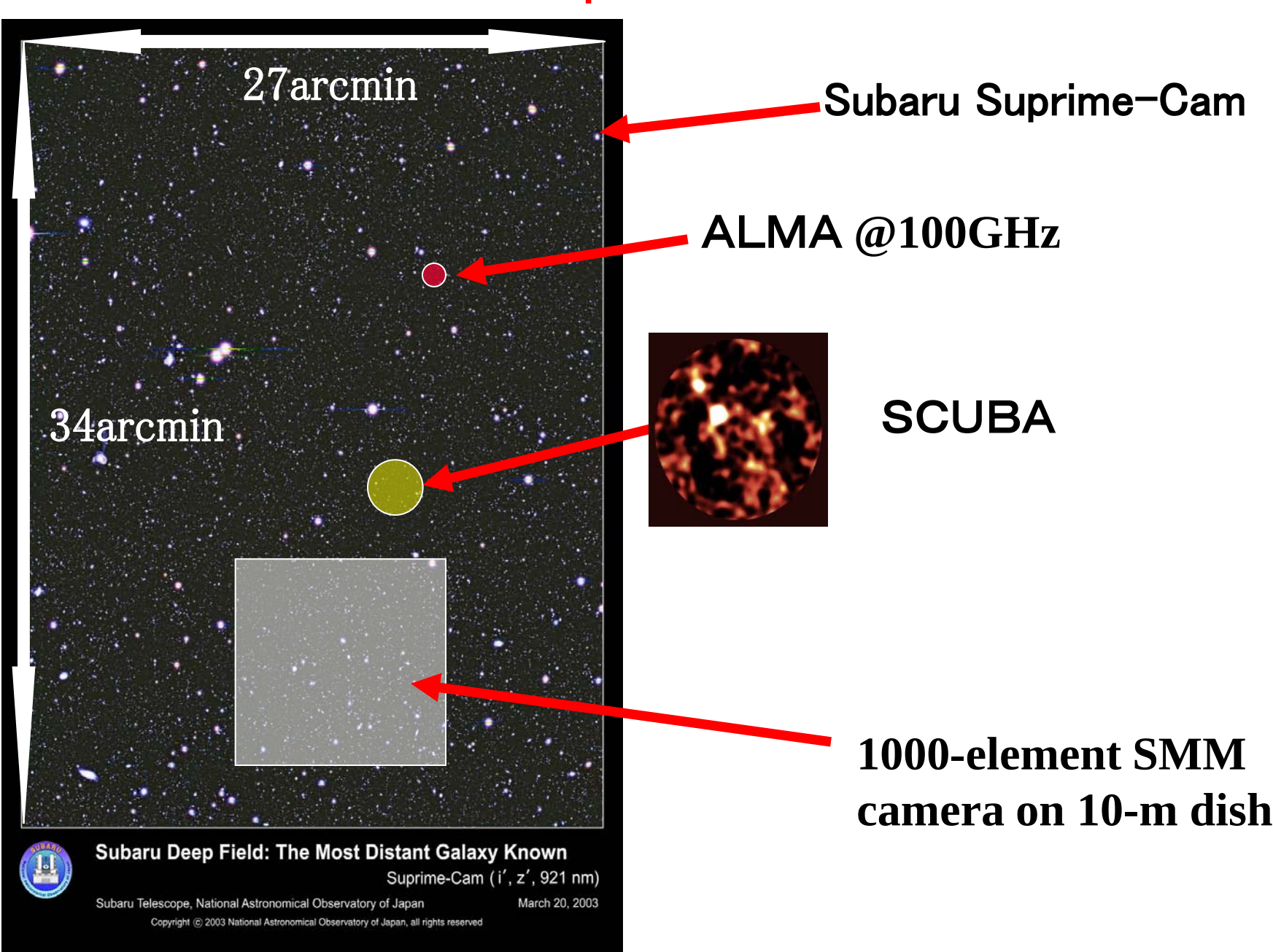
Atmospheric Windows



Requirements for Terahertz Astronomy



FOV comparison

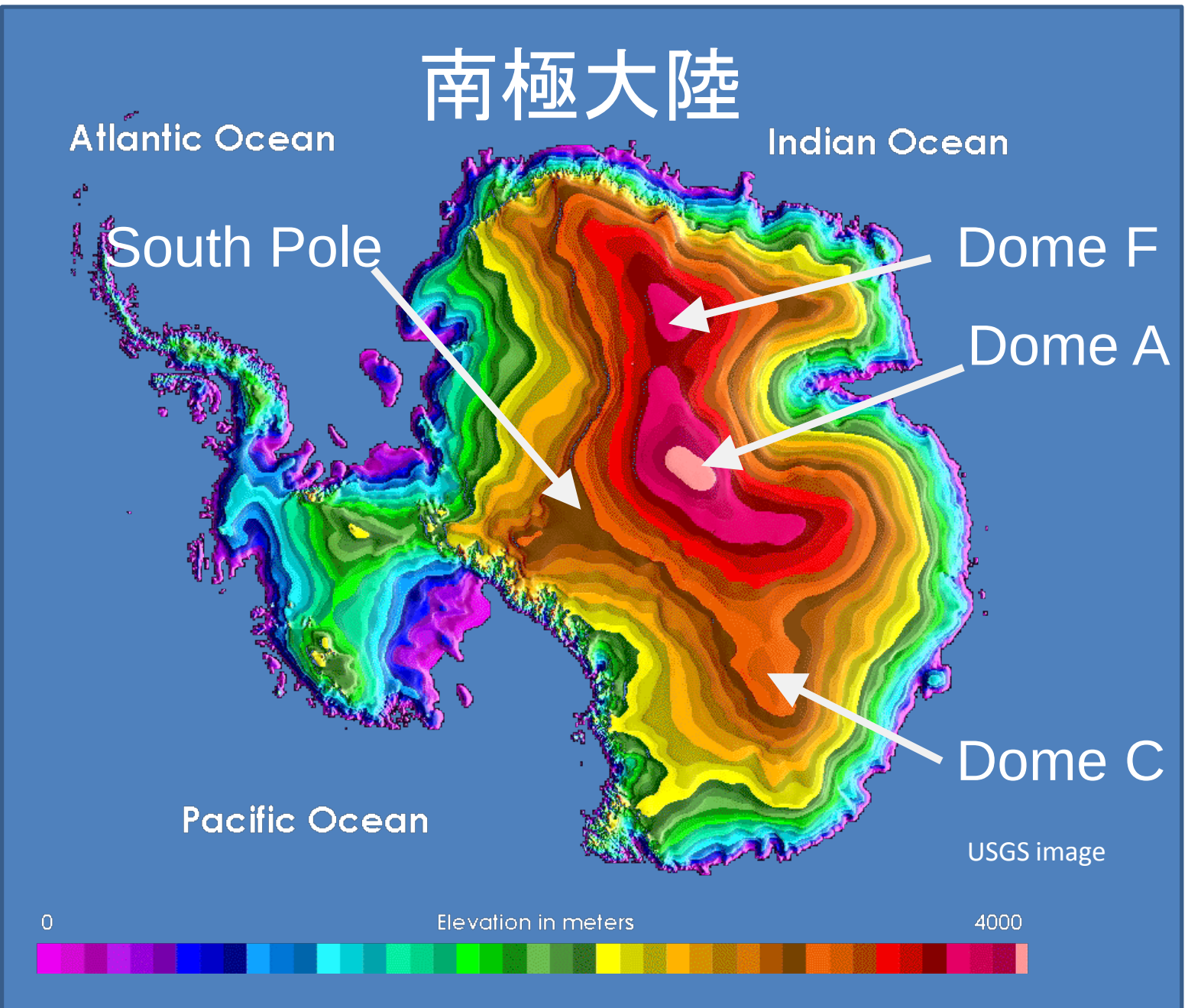


What is similar to space environments ?

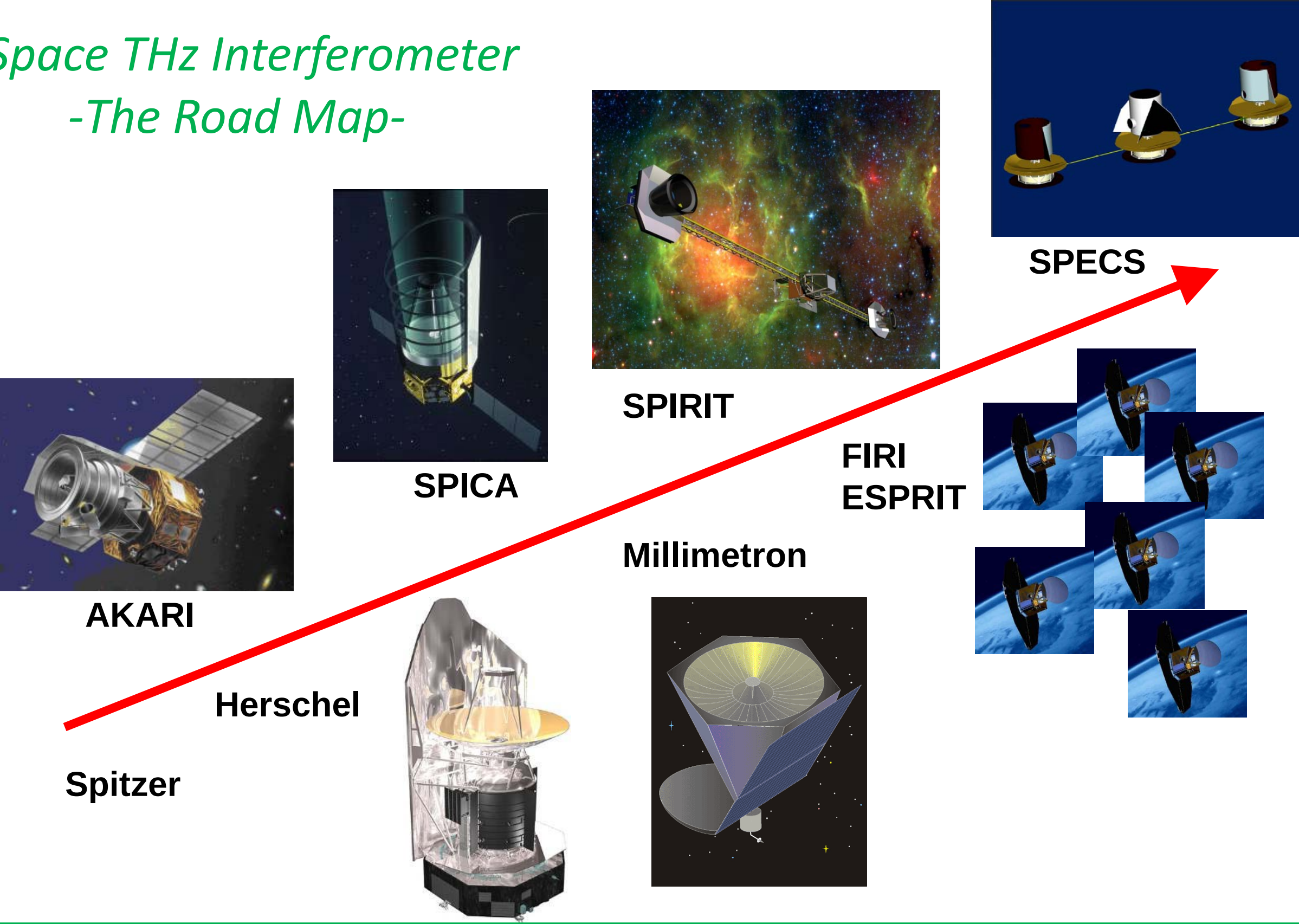
- Difficult place to reach
- Low temperature, less than -80 C
- Remote observation is required
- Limited power supply
- Compact system design
- Simple assembly
- Strong vibrations and shocks during transportation

Undergoing activities

Dome F by Japanese group
Dome A by Chinese group
Dome C by France/Italy group



Space THz Interferometer -The Road Map-

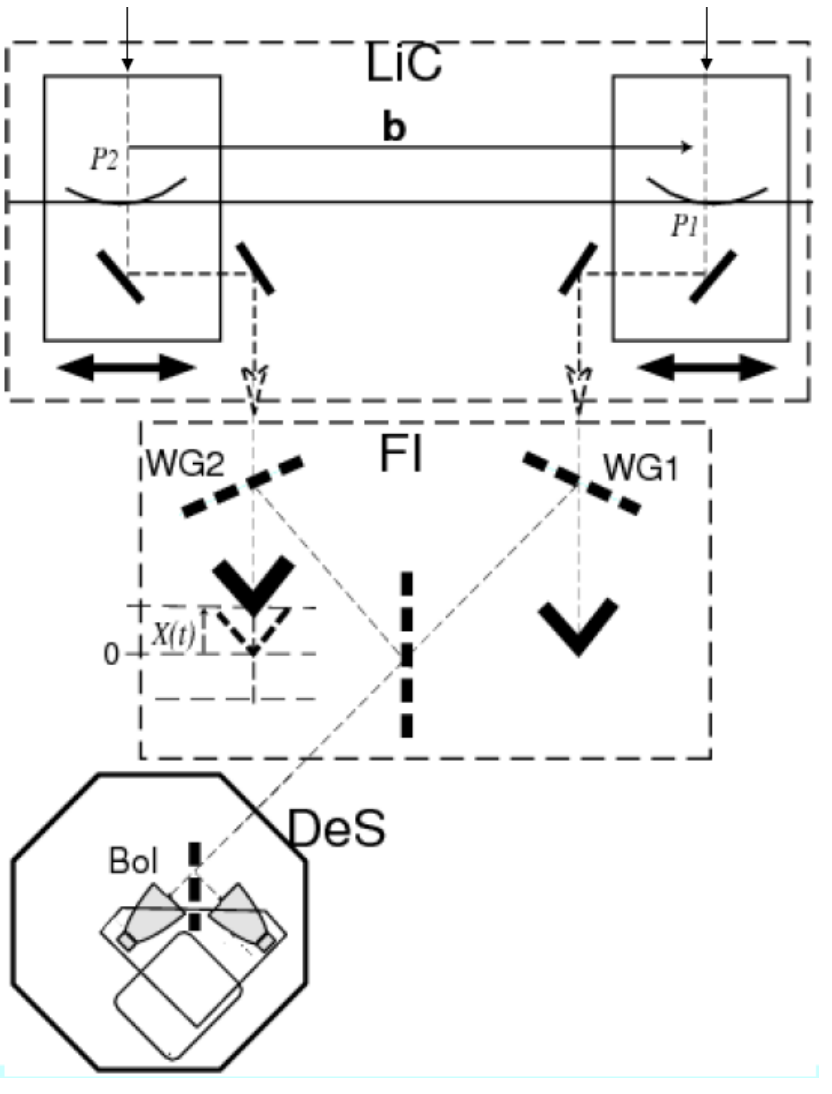


Possible Design and Performance of Far-Infrared Interferometer in Antarctic Plateaus

	Direct detectors	Heterodyne
Aperture diameter	1 m	1 m
Element number	4	10
Baseline	50 m	50 m
Wavelength	200 μ m	200 μ m
NEP/h or T_{sys}	10^{-15} W/Hz ^{0.5}	500 K
Bandwidth	10 GHz	10 GHz
Focal plane array	1000	1
Synthesized beam	1 "	1 "
Field of view	0.25 deg ²	0.5 arcmin ²
NEFD	15 mJy (1 σ , 12h)	10 mJy (1 σ , 12h)

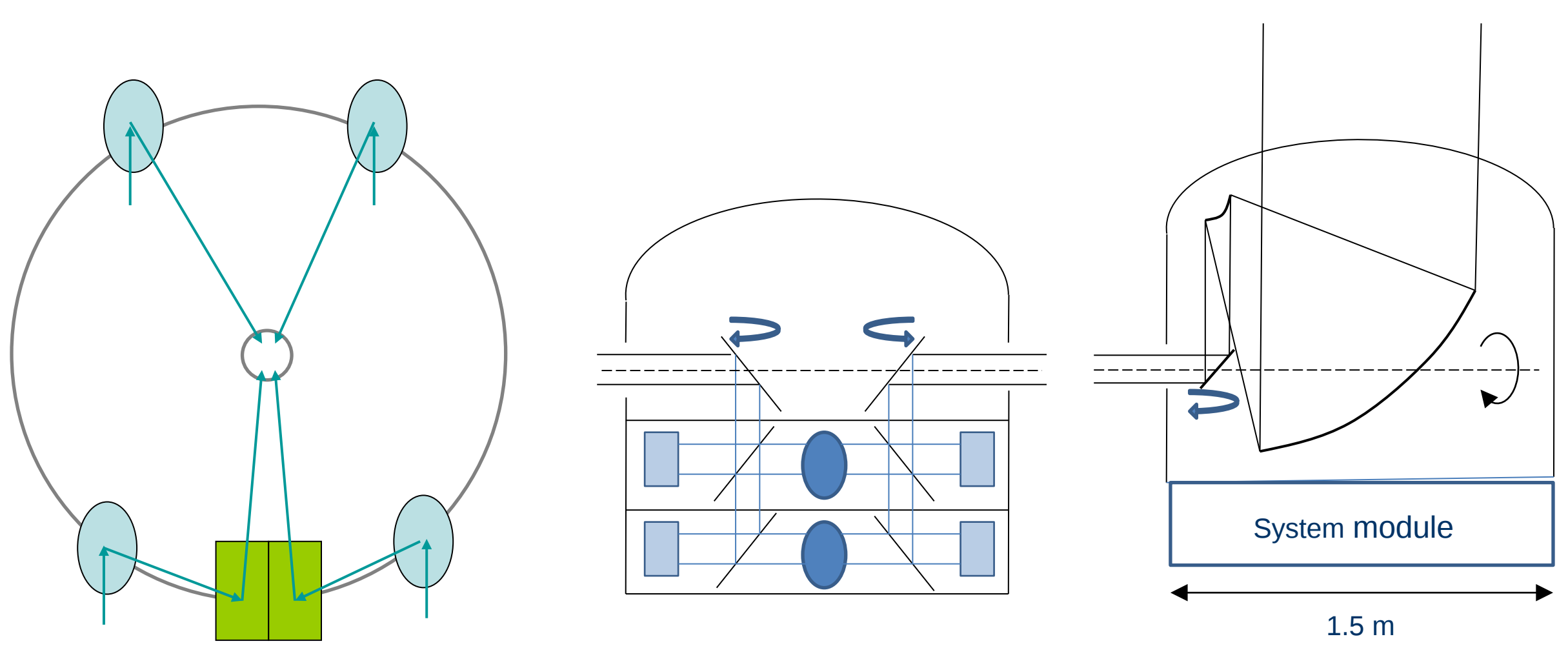
Multi-Fourier Transform interferometer

- High dynamic range
- Spectroscopy
- Polarization
- 2D imaging array



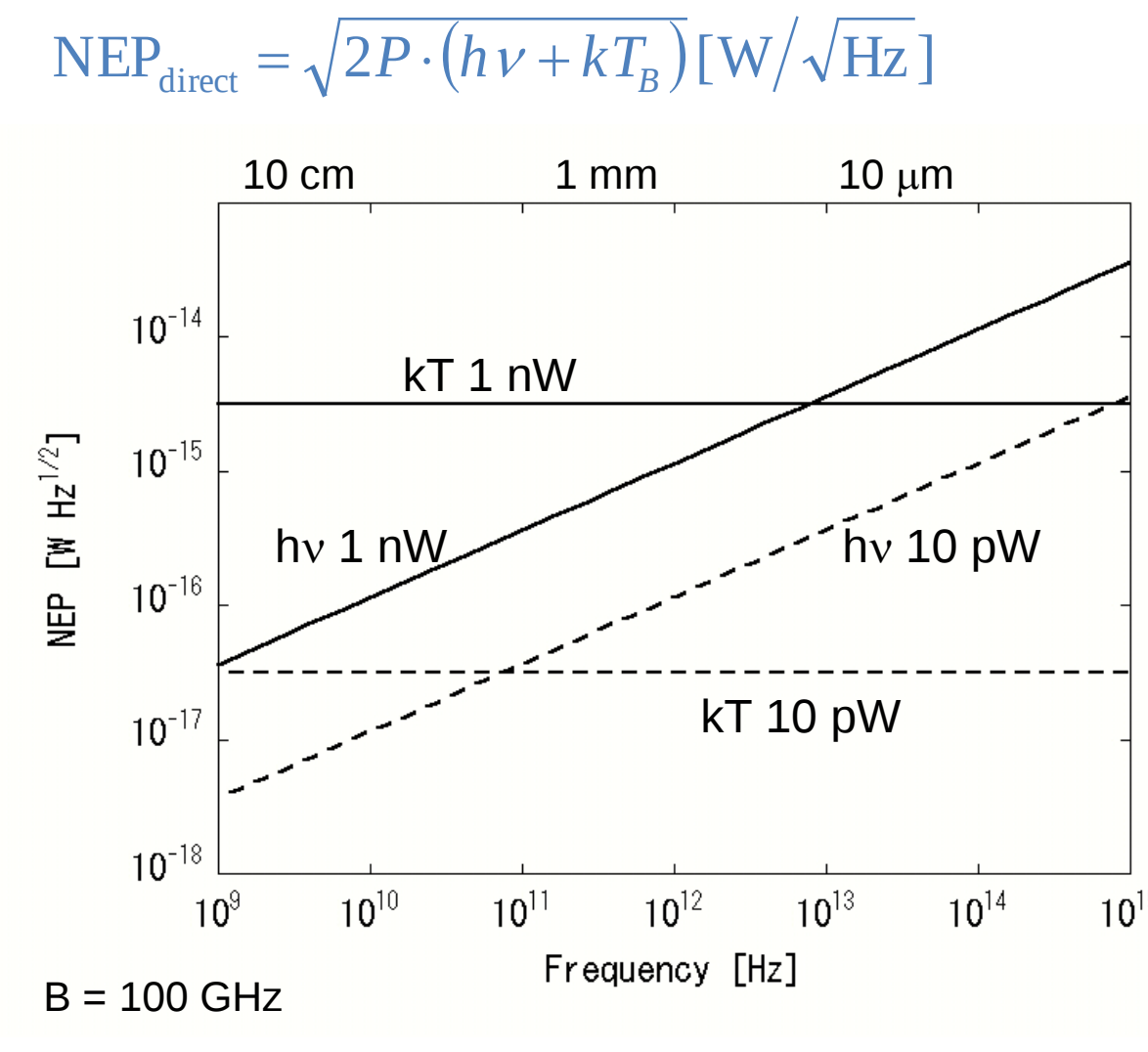
Ohta et al. Appl. Opt. 45, 2576 (2006)
Ohta et al. Appl. Opt. 46, 2881 (2007)

Configuration and Optical System Design



Another Possibility with Photon Counting Interferometry

How coherent are THz-photons ?



- It is like VLBI
 - Separate telescope, recording separately.
 - Photon statistics for correlation analysis
 - When, $T_B \geq hv/k = 160$ K @3.4THz
- Can we observe Earth like planets ?
- Earth-like planet at 1.3 pc from solar system
 - 2 μ Jy or 4×10^{-20} W/m² at 2THz.
 - 10^{-18} W from the planet with 6 m telescope, comparable to background noise in 1 Hz BW.
 - 300 kHz background and 1 kHz planet photon rates.
 - Photons from planets are countable and coherent !

Development Plans with MuFT

- Design of optical arrangements for Antarctic interferometer.
- Development of interferometer and 2D arrays.
- Imaging experiments in lab.
- Field experiments in Atacama or in Tibet.
- Deployment in Antarctic Plateaus.

Development Plans with Photon Counting Interferometer

- Basic study and demonstration of technology.
- Development of detectors and data acquisition systems.
- Imaging experiments in lab.
- Development of Antarctic interferometer, as in above.