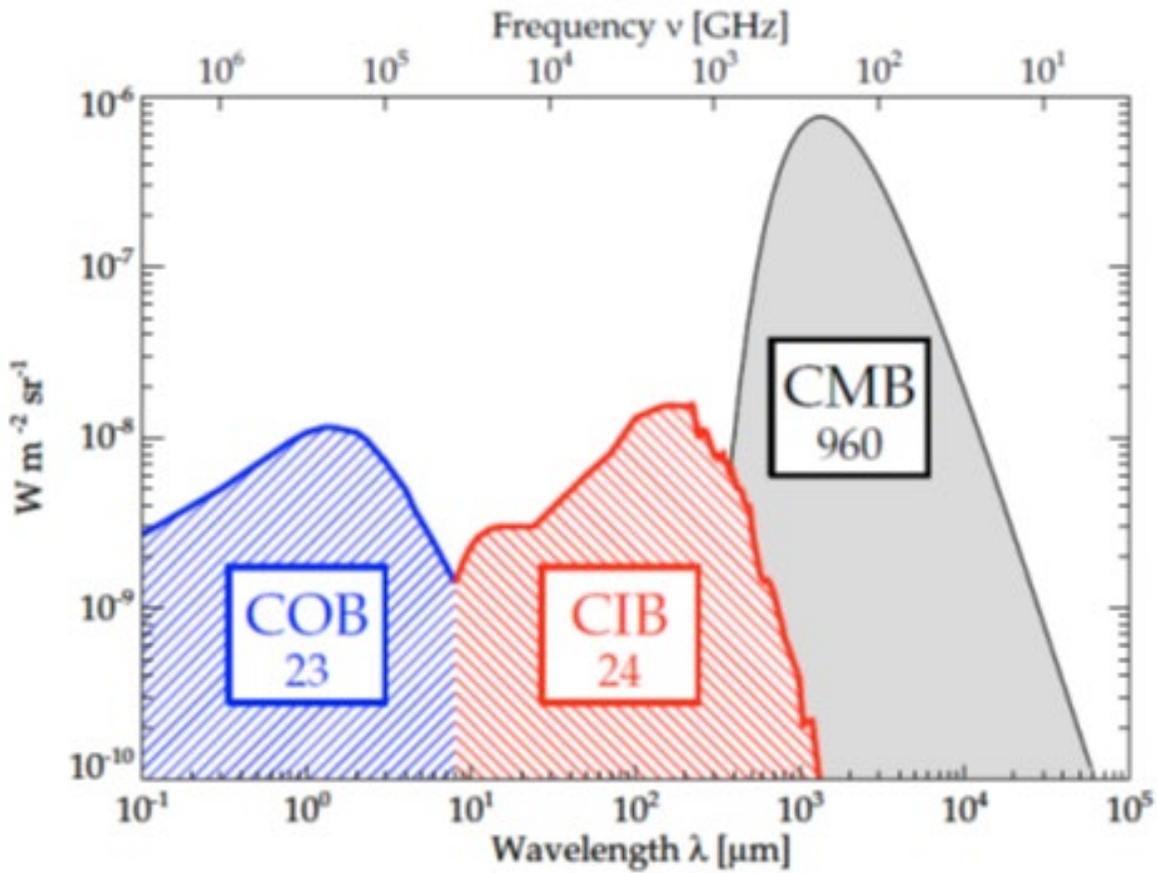


遠赤外線テラヘルツ干渉計による 天体の形成と進化の解明

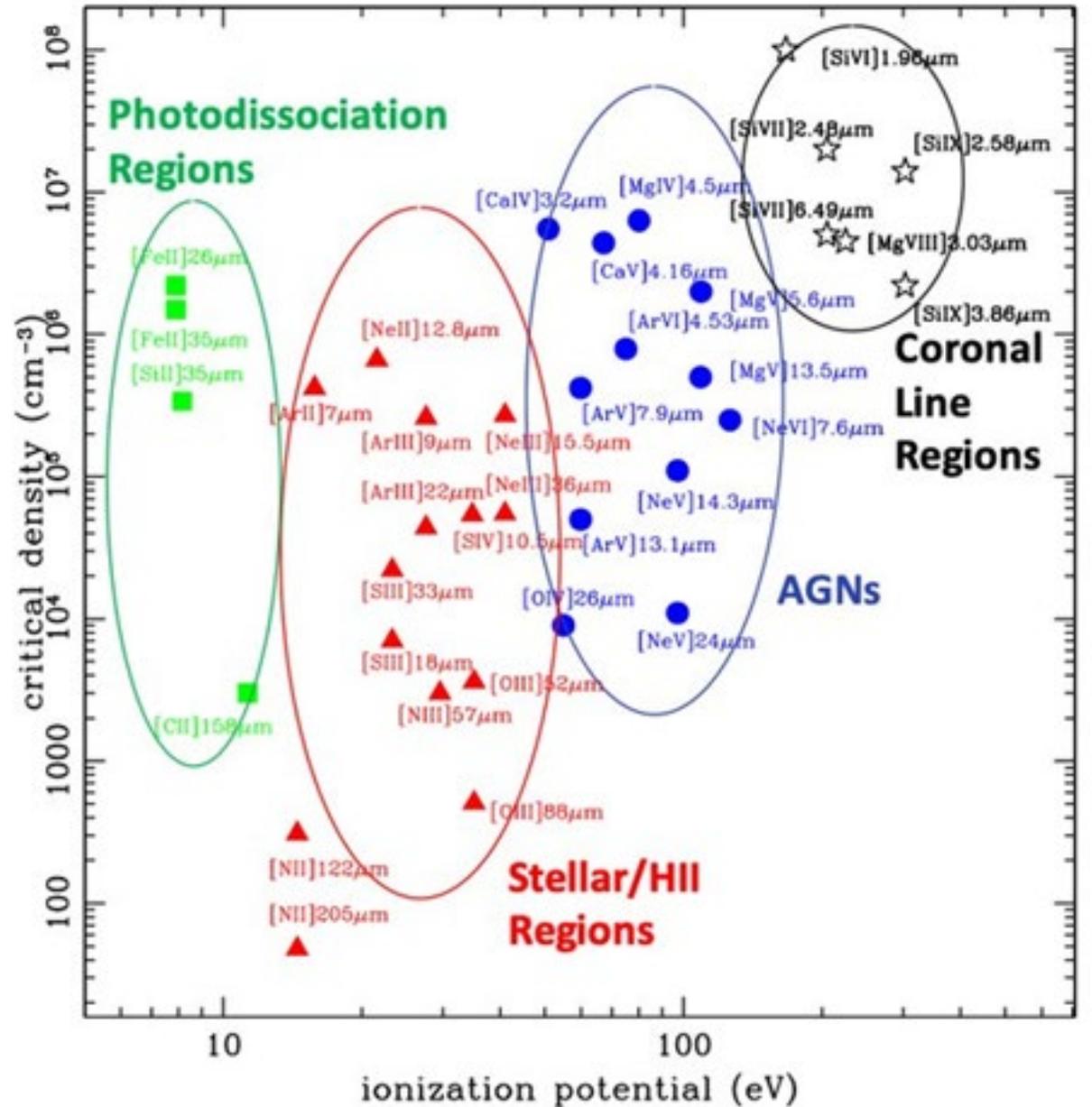
Elucidating formation and evolution of
celestial bodies using far-infrared and
terahertz interferometers

H. Matsuo, H. Ezawa, T. Oshima, T. Kamazaki, T. Wada (NAOJ),
N. Kuno, S. Honda, T. Hashimoto (U Tsukuba),
M. Seta, N. Nakai (Kwanseigakuin U), T. Kamizuka (U Tokyo),
H. Inami (Hiroshima U), T. Nagao (Ehime U),
K. Izumi, T. Nakagawa (JAXA), T. Matsuo (Nagoya U)

Astronomical Background Radiation (Dole et al. 2006)



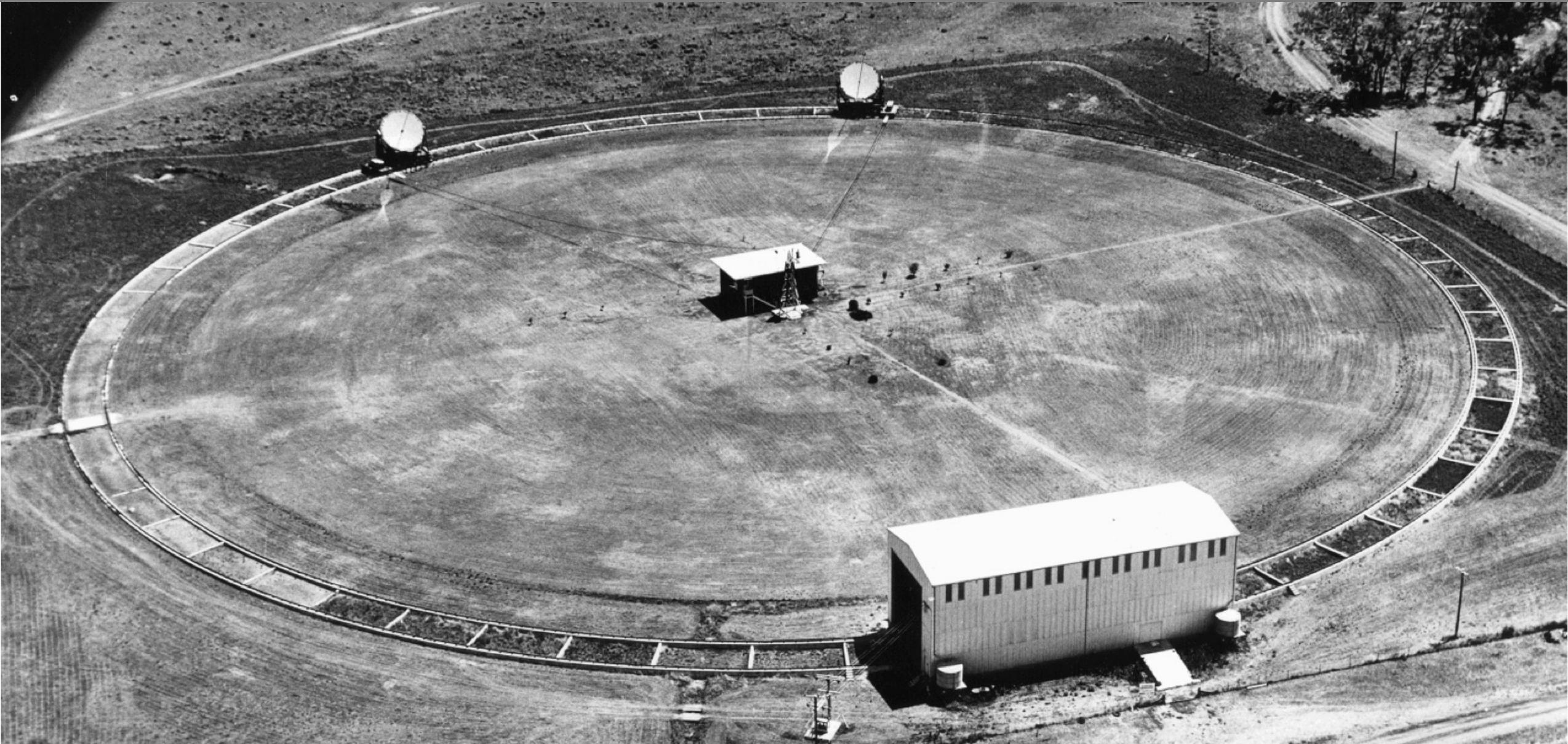
FIR atomic lines (Spinoglio et al. 2021)



Science goals & objectives

- Identifying existence and form of heavy elements in our universe by observing far-infrared and terahertz frequencies (**FIR/THz**) to elucidate emission from astronomical sources under formation and evolution.
- High angular resolution (**~ 1 milli-arcsec**) and background limited observations (**$\text{NEP} \sim 10^{-19} \text{ W/Hz}^{0.5}$**) together with other facilities like ALMA, JWST etc.
- Dust and atomic/molecular emission lines to study their physical/chemical and kinematic structures in galaxies, AGN, stars and planetary formation.

Narrabri Stellar Intensity Interferometer



ATNF Daily Astronomy Picture
17th of August 2015

Comparison of FIR interferometers

	Telescope	Wavelength	Sensitivity	Baseline	Elements	Phase Stab.	Imaging
Heterodyne Interf. (inc. VLBI)	warm 10 m	> 60 μm	×	Long	Any	×	○
Michaelson Interf. (Double Fourier)	cryogenic 1 m	25-400 μm	○	Short	Two	×	○
Intensity Interf.	cryogenic 3 m	30-300 μm	○	Long	Any	○	?

—> Imaging with Intensity Interferometry

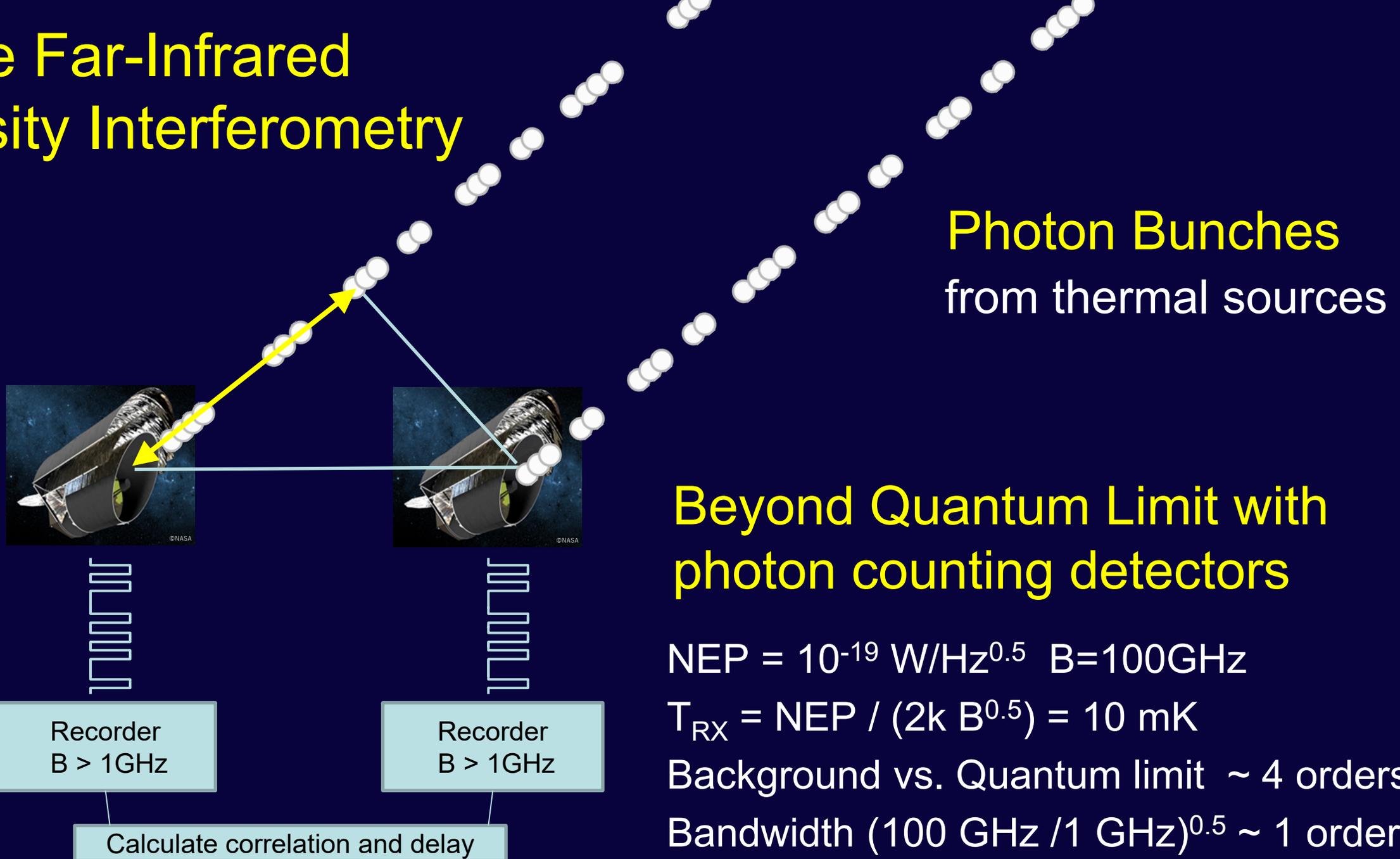
テラヘルツ強度干渉計

II

遠赤外線VLBI

基礎的な内容（光子統計、検出限界）は
現代の天文学 第16巻「電波天文学」5.5章

Space Far-Infrared Intensity Interferometry



Photon Bunches
from thermal sources

Beyond Quantum Limit with
photon counting detectors

$$\text{NEP} = 10^{-19} \text{ W/Hz}^{0.5} \quad B=100\text{GHz}$$

$$T_{\text{RX}} = \text{NEP} / (2k B^{0.5}) = 10 \text{ mK}$$

Background vs. Quantum limit ~ 4 orders

Bandwidth $(100 \text{ GHz} / 1 \text{ GHz})^{0.5} \sim 1$ order

Timeline

	2025		2030		2035		2040		2045
Develop	Detector Imaging								
Antarctic THz		30cm Exp. at D-F	1.5 THz [NII]		ATT12m PMO			ATT30m PMO	
Space FIR		Pre Study	PRIMA	SILVIA	Phase A	Phase B	Phase C	Phase D	Launch

