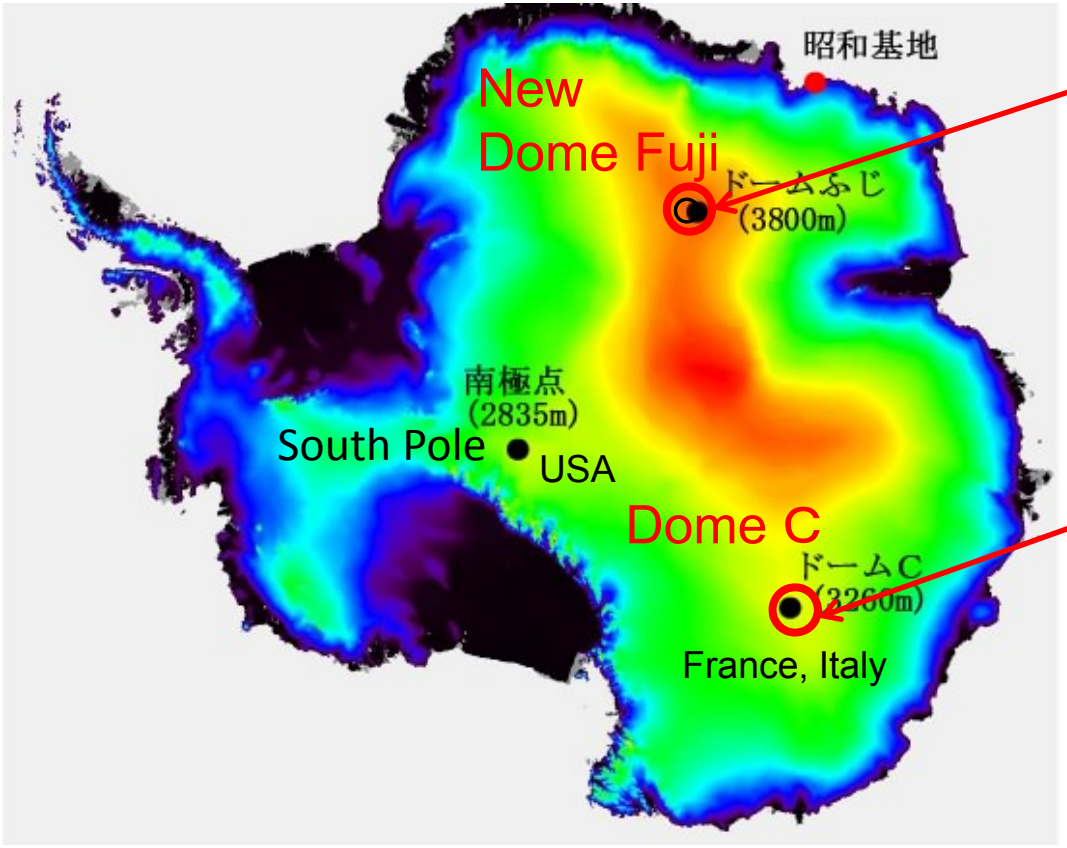
Collaborative observations of high-z AGN with SPICA and the THz telescopes

NAKAI Naomasa

Univ. of Tsukuba

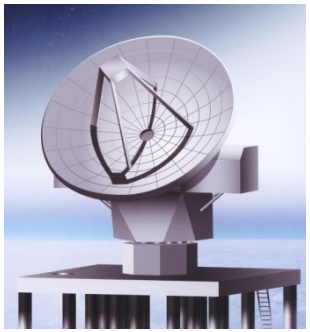
Antarctic Terahertz Telescopes



(2) 30-m THz telescope

- 200 GHz ~ 1500 GHz
- 200 μm ~ 1500 μm
- FOV~1 deg
- NAOJ+NIPR+Asia
- proposing to radio astronomy com.

(1) 10-m THz telescope



- 200 GHz ~ 1500 GHz
- 200 μm ~ 1500 μm
- FOV~1 deg
- Universities
- requesting a budget

○High altitude
3200 m ~ 4000 m

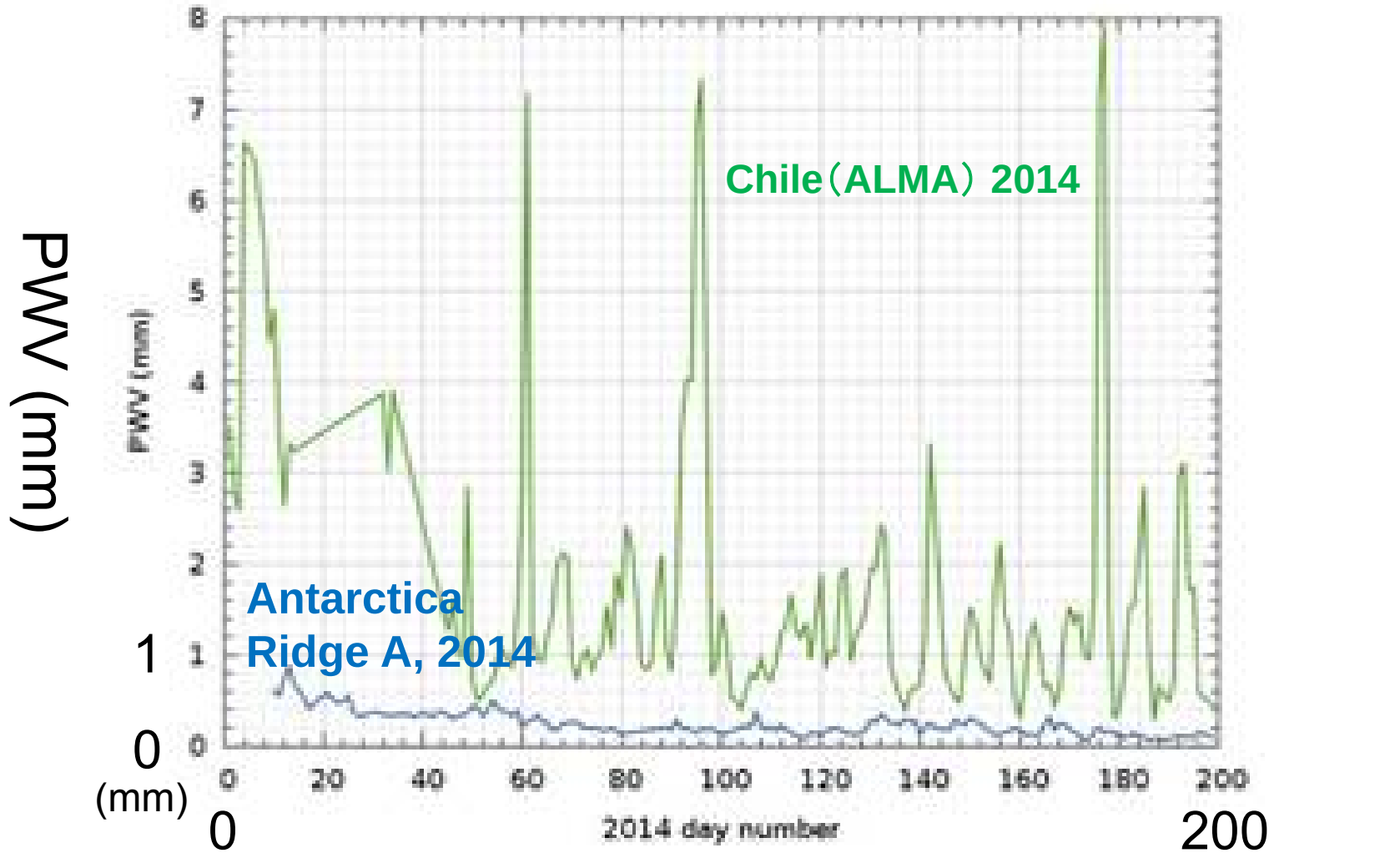
○Very low temperature
highest −20 ℃
mean −54 ℃
lowest −80 ℃

⇨

Very low precipitable water vapor

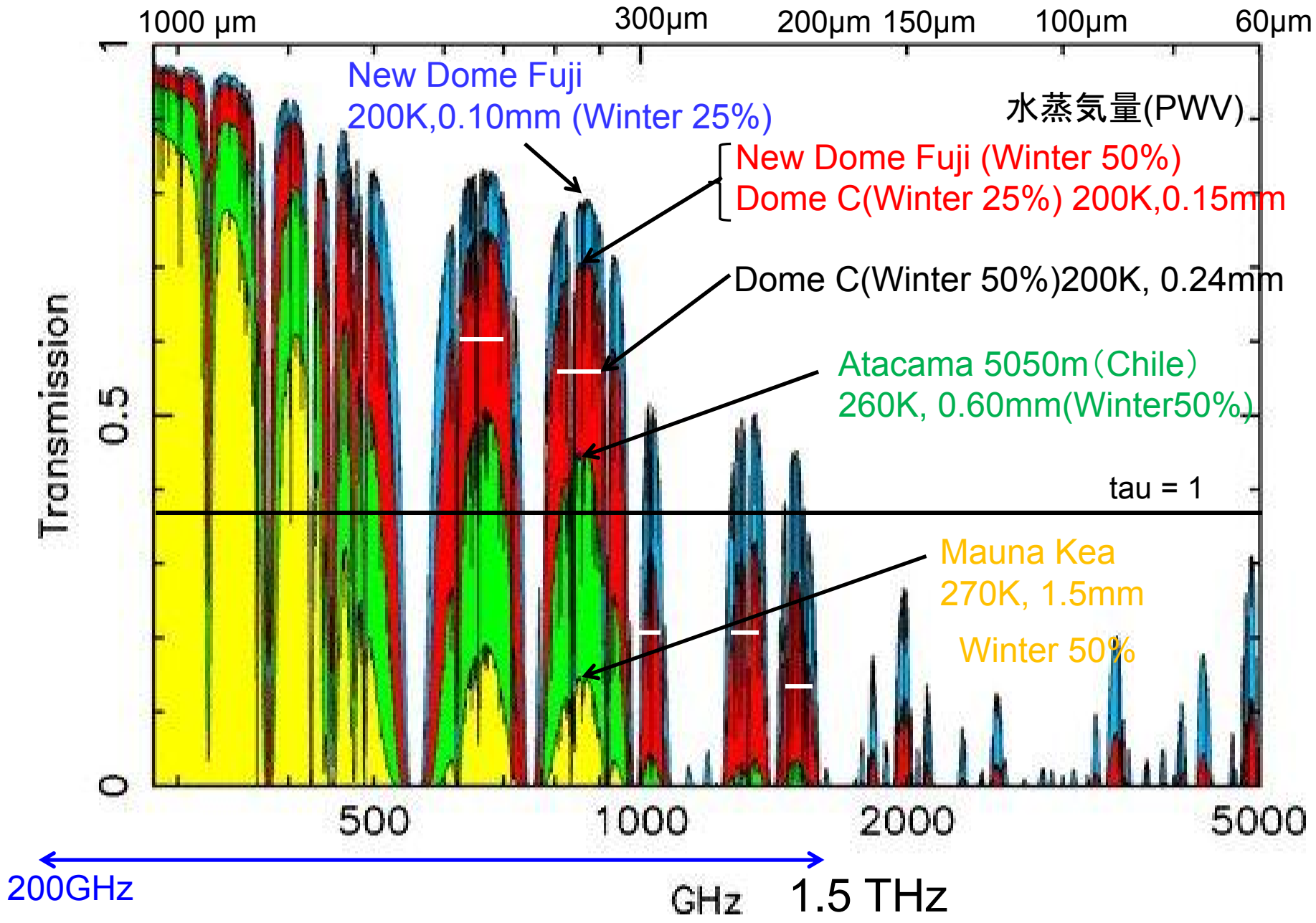
Clear skies rate～90 %
Wind speed ＜10m/s

Precipitable Water Vapor @ Ridge A (2014)

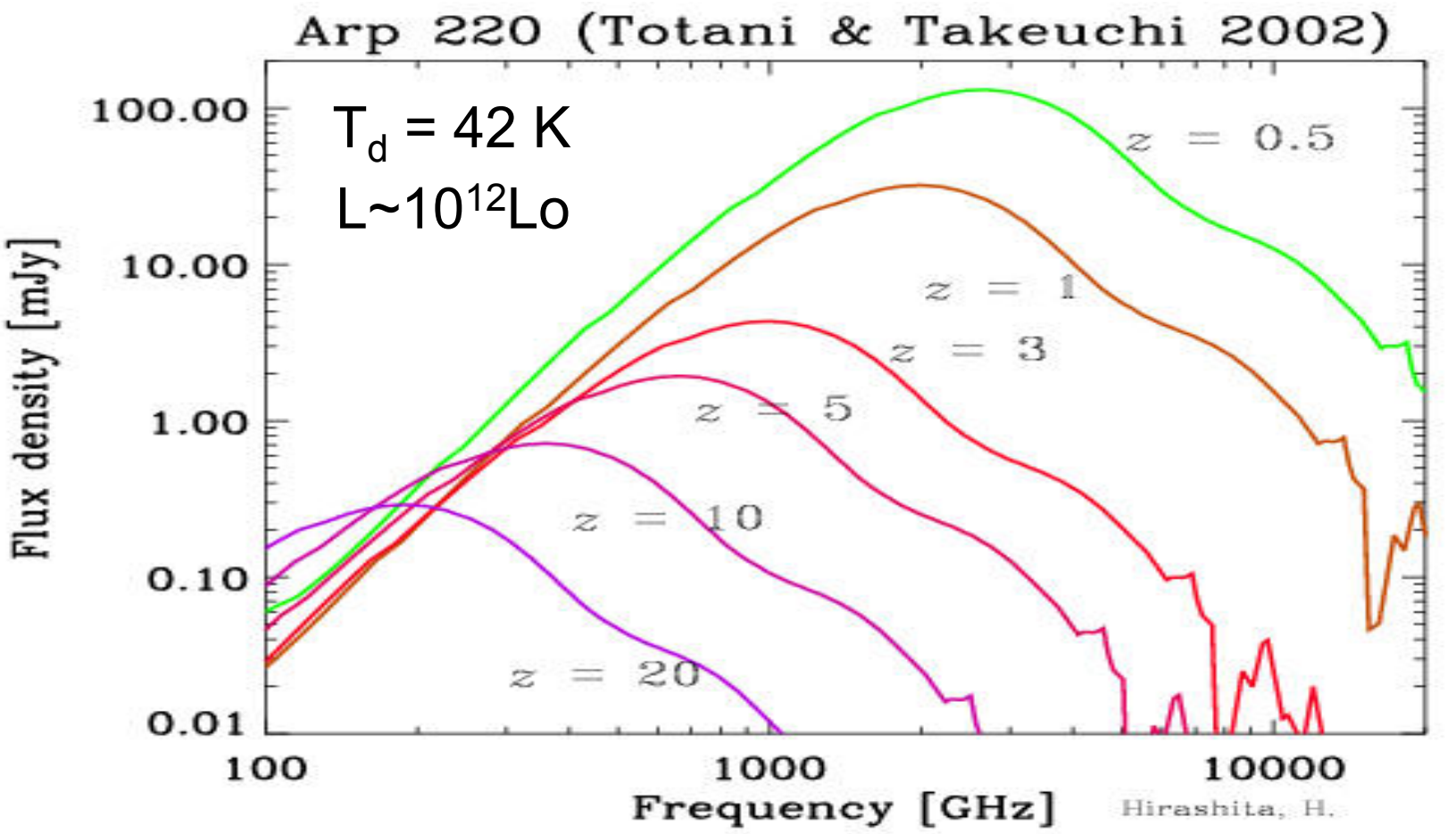


Burton+2015
From Kulesa

Transmission of the atmosphere



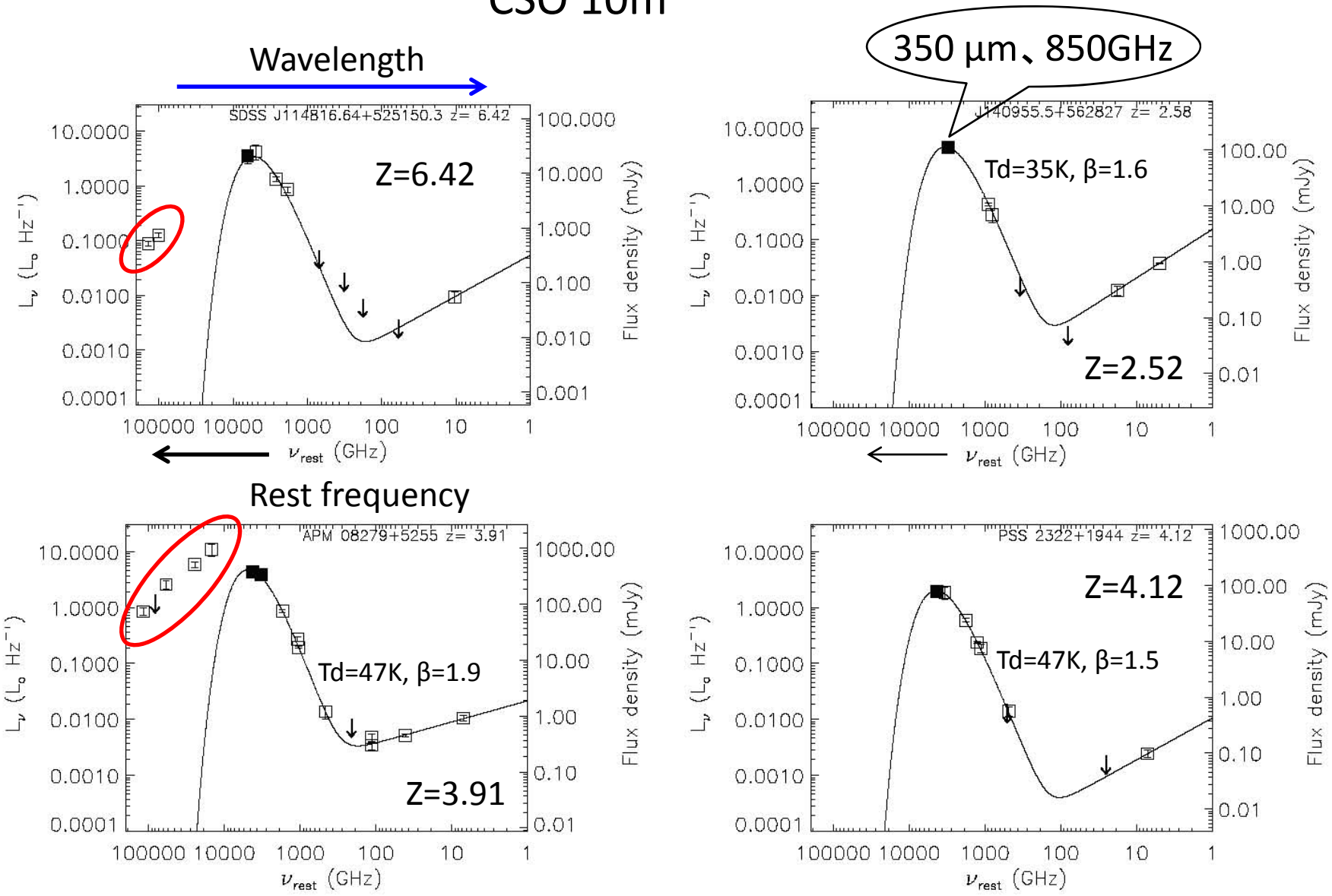
Dust radiation from high-z galaxies



Antarctic
THz telescopes

SAFARI
SMI
SPICA

Beelen etc 2006
CSO 10m



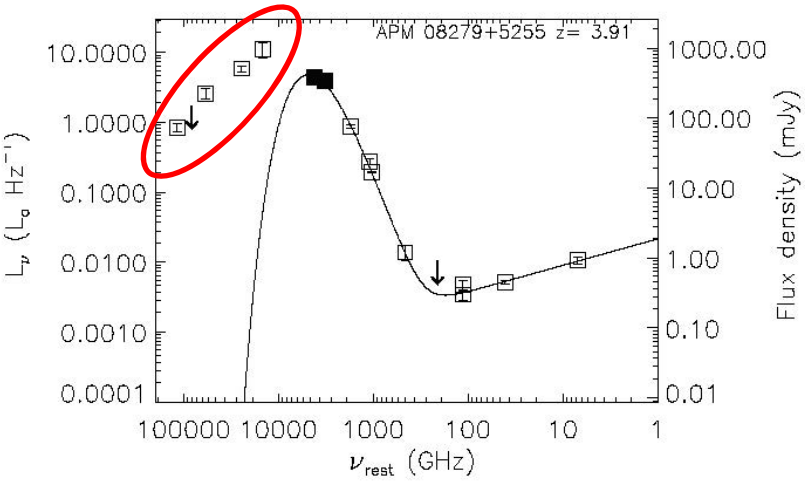
Herschel (Leipski+2014)

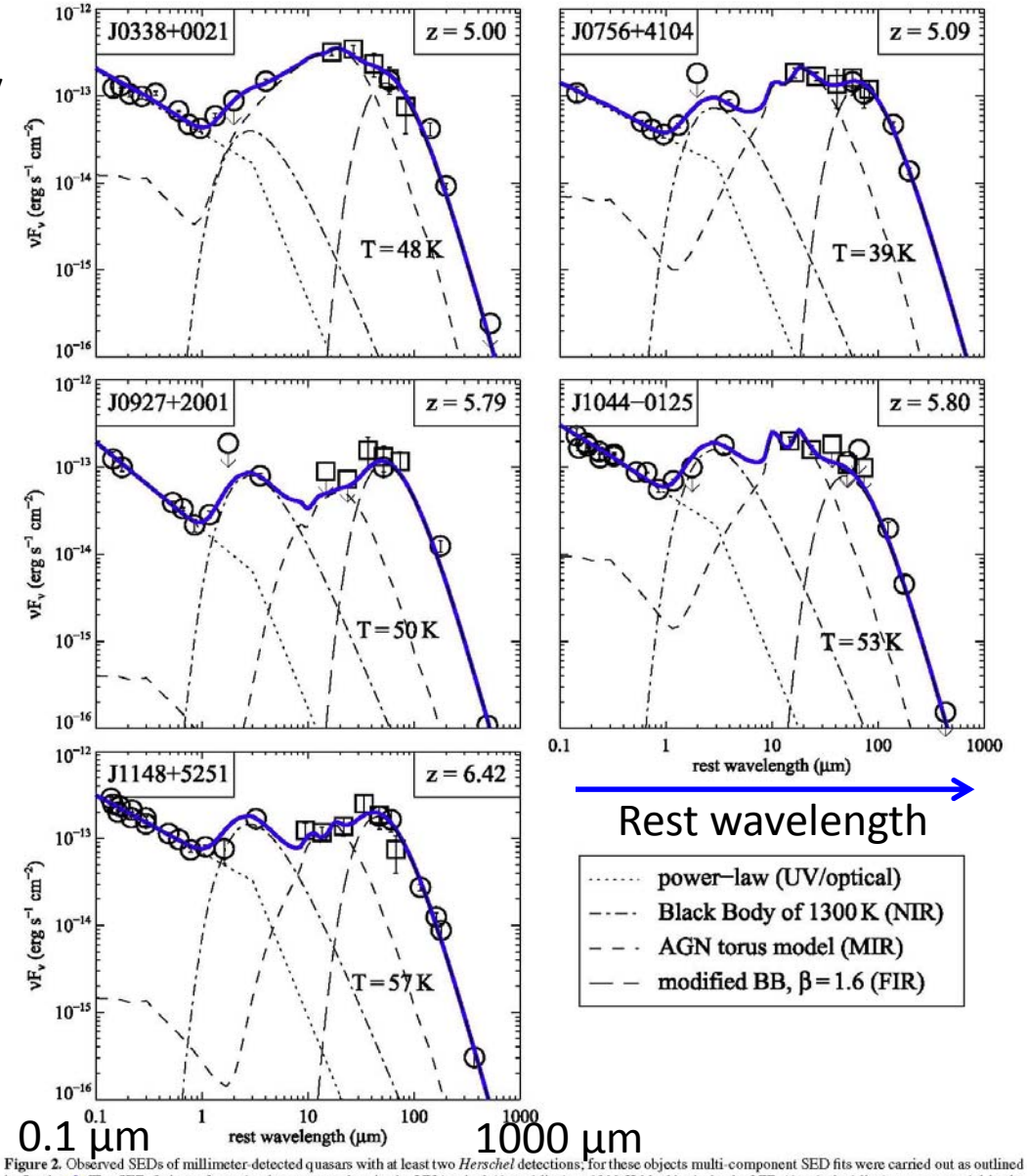
QSO at z>5

already detected with SDSS

vF_v

APM 08279+5255 (Beelen+2006)





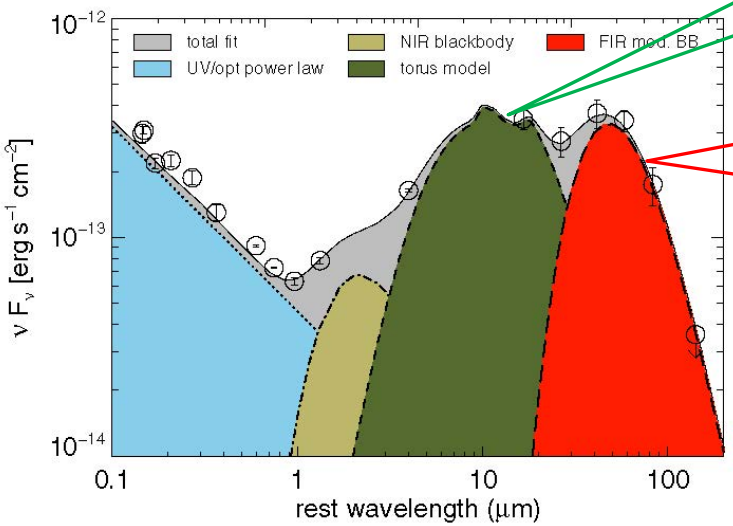
Rest wavelength

0.1 μm 1000 μm

Figure 2. Observed SEDs of millimeter-detected quasars with at least two *Herschel* detections. For these objects multi-component SED fits were carried out as outlined in Section 2. The SED fit is performed using a power-law in the UV/optical (dotted line), a 1300 K blackbody in the NIR (dot-dashed line), a torus model in the NIR/MIR (short dashed line), and a modified blackbody in the FIR with emissivity index β fixed to 1.6 (long dashed line). The blue solid line corresponds to the sum of the fitted components which here represent the overall best fit. Thus, the temperature of the FIR component here may differ slightly from the overall mean temperature determined from all acceptable fits as presented in Table 3. The squares correspond to the new *Herschel* data.

(A color version of this figure is available in the online journal.)

(Leipski+2014)



AGN-torus
Td>150 K

Star burst
Td～40 K

Figure 2. Schematic representation of the components used for SED fitting. As an example, we use the observed photometry of the $z = 5.03$ QSO J1204−0021. (A color version of this figure is available in the online journal.)

QSO

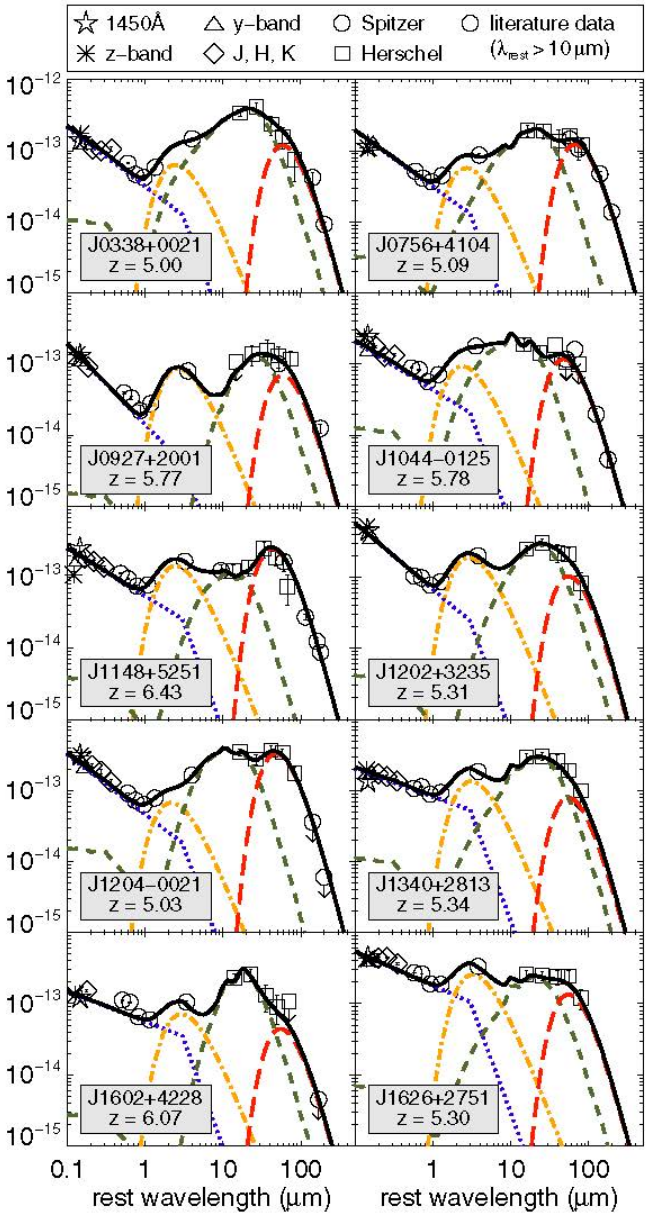


Figure 3. SEDs of the 10 quasars detected in at least four *Herschel* bands. T plots shows νF_ν in units of erg s^{-1} cm^{-2} over the rest frame wavelength. T colored lines indicate the results of a multi-component SED fit as describ in Section 4.1. They consist of a power-law (blue dotted), a blackbody $T \sim$ 1200 K (yellow dash-dotted), a torus model (green dashed), and a modifi blackbody of ∼47 K (see Table 6; red long dashed). The black solid line sho the total fit as the sum of the individual components.

(Leipski+2014)

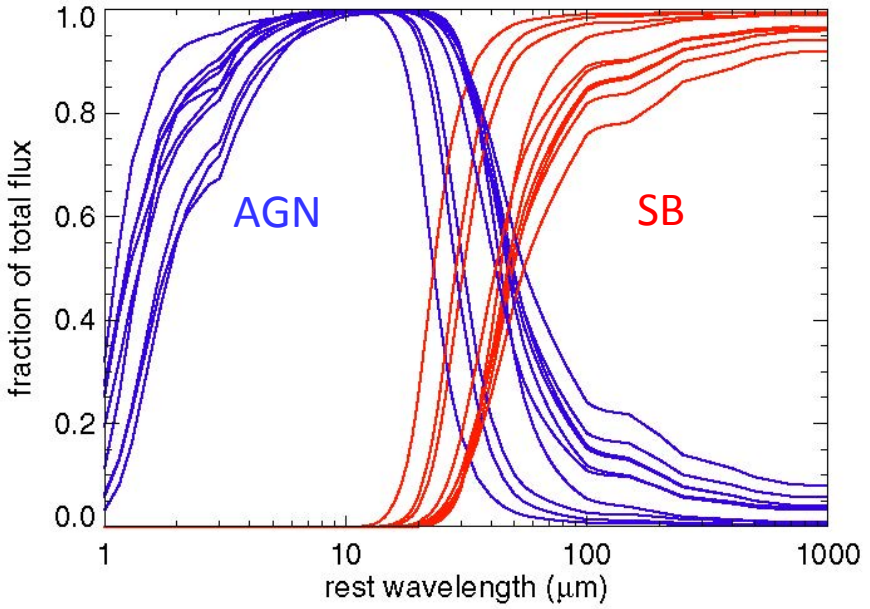


Figure 4. For the 10 objects where the FIR component could be well constrained due to additional millimeter data (see Figure 3) we here show its relative contributions (red) compared to the presumably AGN-heated dust (NIR blackbody plus torus model; blue) as a function of wavelength. For these FIR-bright sources, the FIR component dominates the total infrared emission at $\lambda_{rest} \gtrsim 50\,\mu$m.

$20 \sim 60\ \mu$m

$\times (1+z)$

Wien displacement law

$$\lambda_m T_B = 0.00288 \quad [\mathrm{m\ K}]$$

Maximum rest wavelength

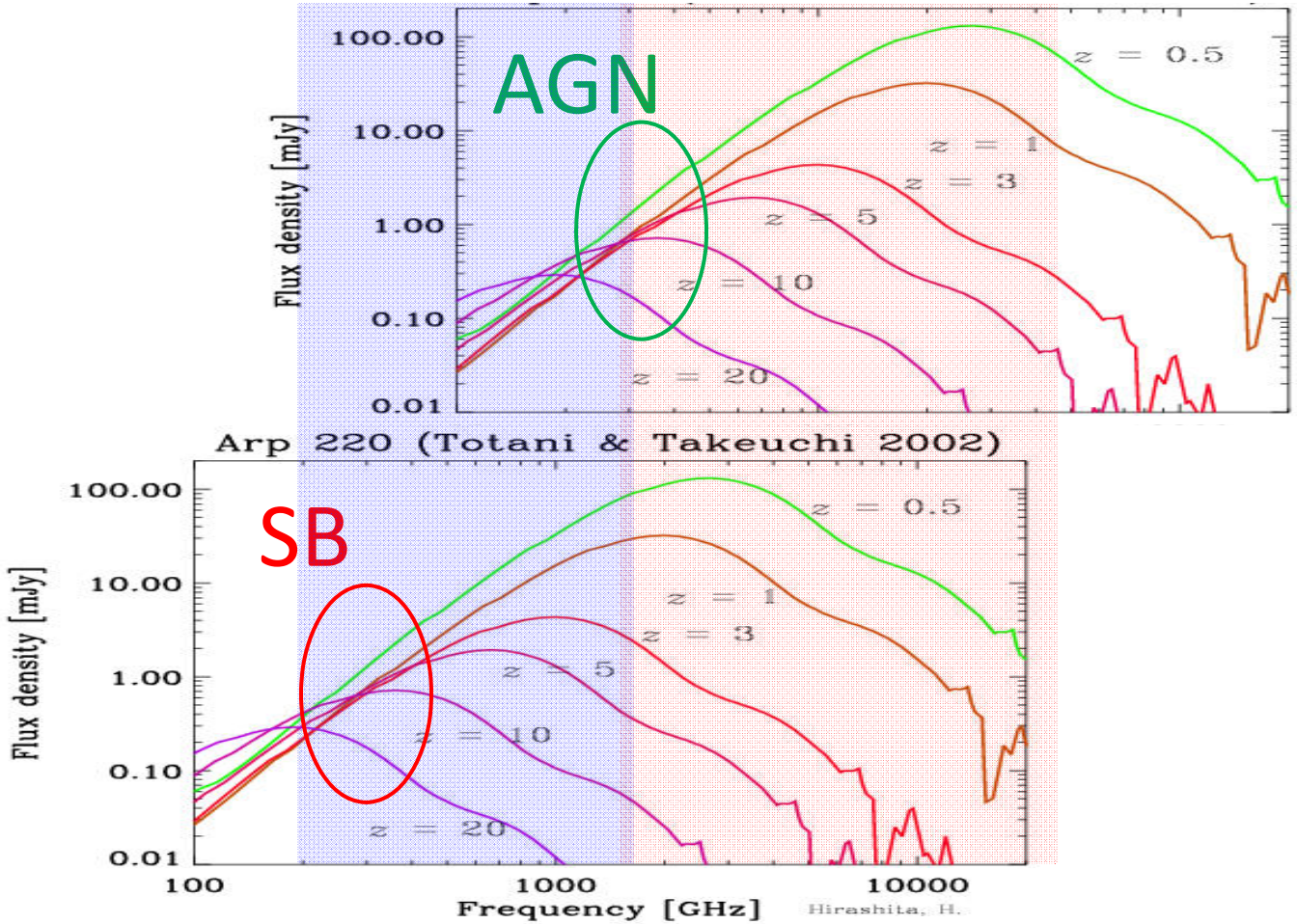
SB: Td ~ 40 K ⇨ $\lambda_m \sim 72\ \mu$m

AGN: Td ~ 200 K ⇨ $\lambda_m \sim 14\ \mu$m

⇩

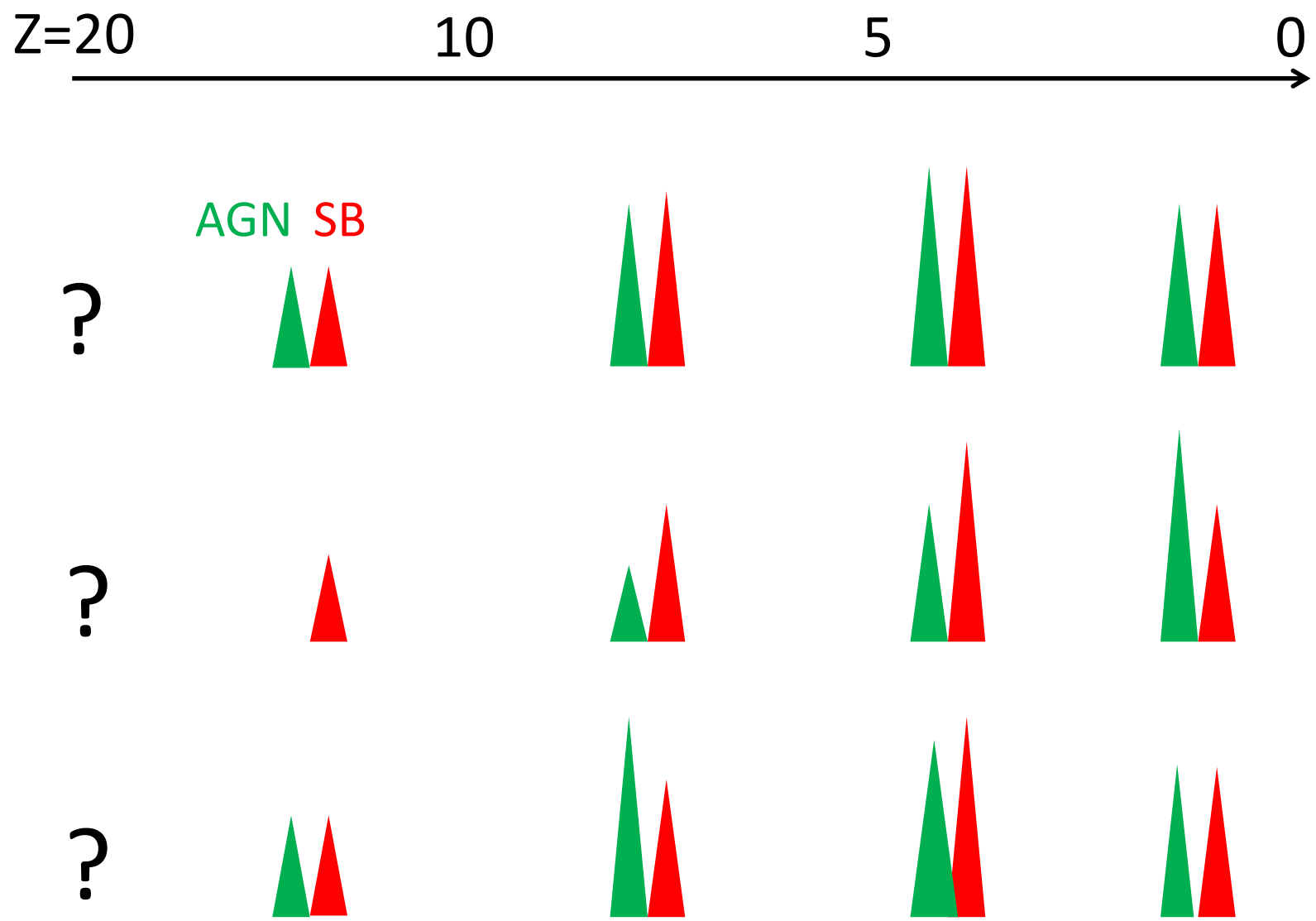
Separable

Collaborative observations between SPICA and Antarctic THz telescopes



Antarctic THz telescopes

SPICA


Z=20
10
5
0
AGN
SB
?
?
?

Sensitivity

(red = confusion limits)

	10m @ dome C		30m @ dome Fuji	
	5σ/1hr	HPBW	5σ/1hr	
230 GHz		32”	0.19 mJy	11”
350	1.8 mJy	22”	0.22	7.1”
460	2.1	16”	0.22	5.4”
650	3.4	11”	0.22	3.8”
850	5.1	8.7”	0.32	2.9”
1.0 THz	35	7.4”	1.5	2.5”
1.3	28	5.7”	1.8	1.9”
1.5	140	5.0”	6.0	1.7”

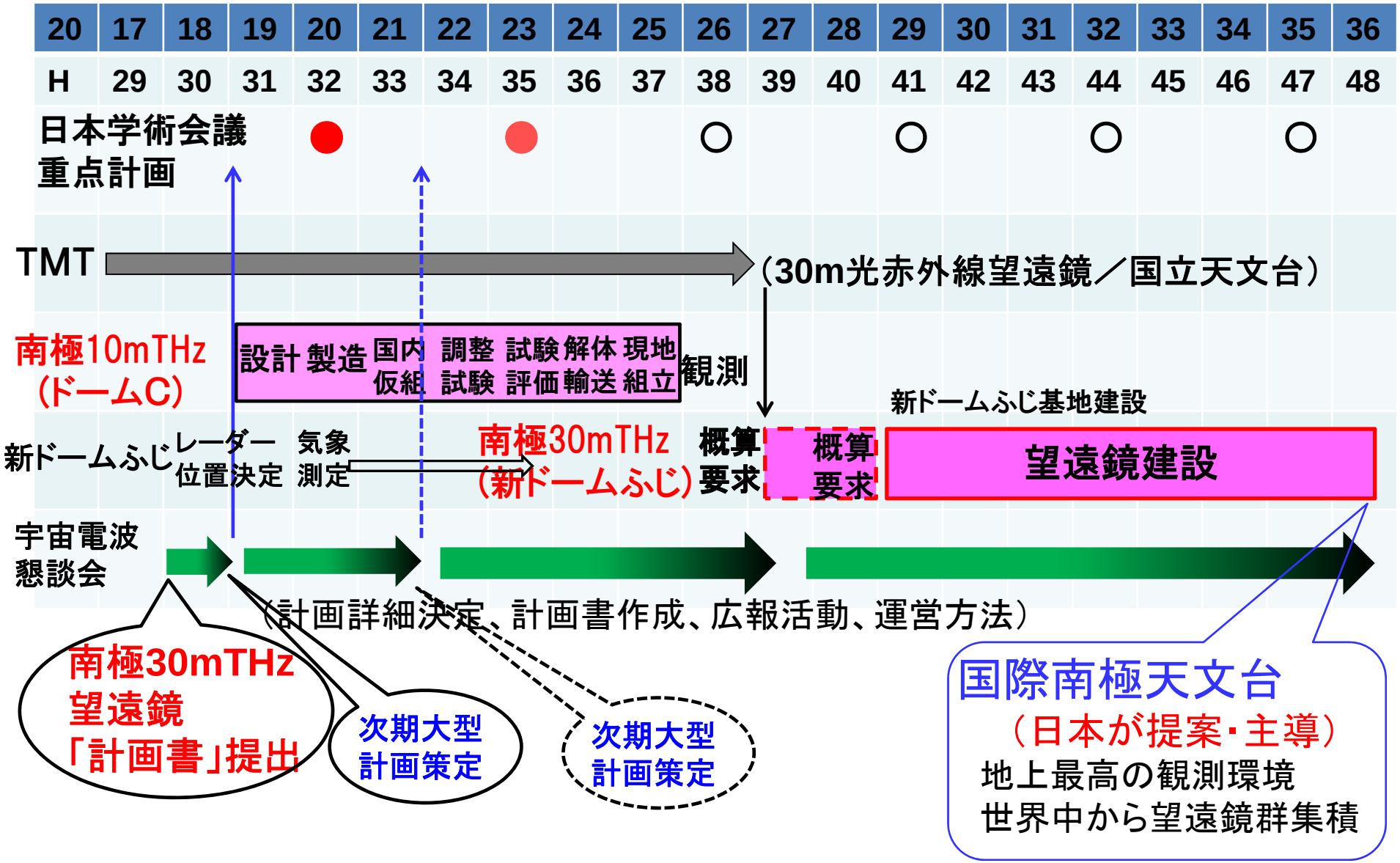
SB

Z <= 5 for L~10^{12} Lo

Z > 20 for L~10^{13} Lo

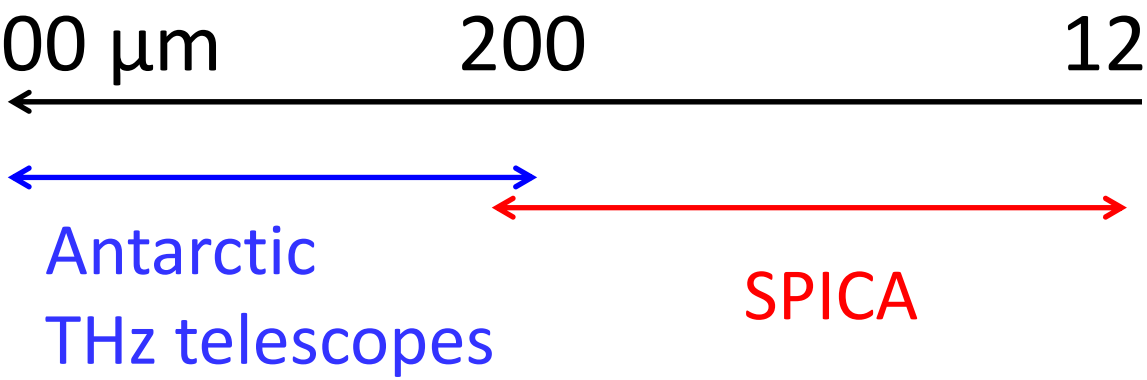
Z >20 for L~10^{12} Lo

南極テラヘルツ望遠鏡建設計画



Summary

Coverage :



Observations : Star burst + AGN of each galaxy
@ z=0 ～ 20

Large field survey
(MKID: 2×10^4@10m, 17×10^4@30m)

Science :
- Formation and evolution of SB and AGN as a function of redshift
- Relation between SB and AGN