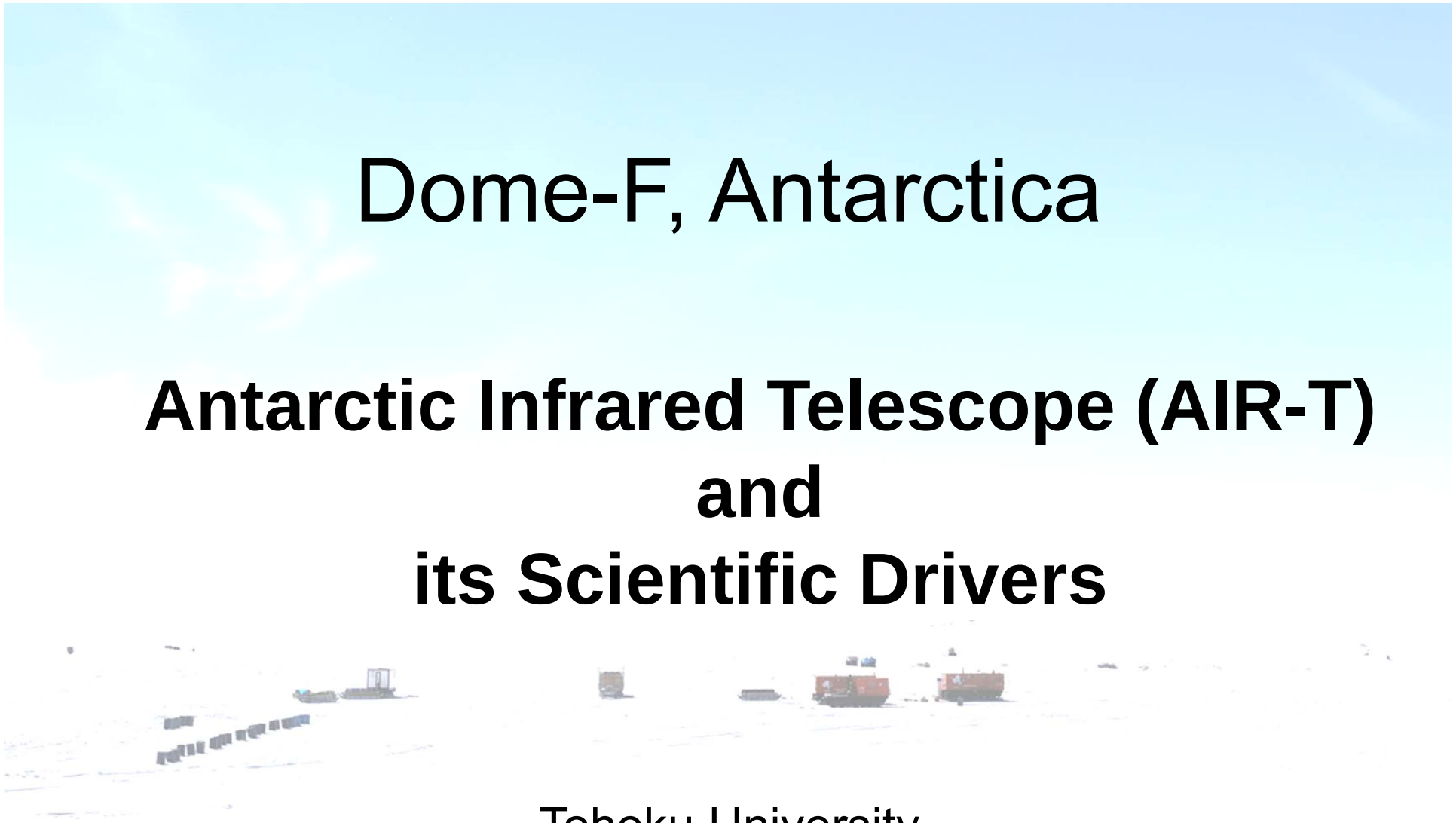


Dome-F, Antarctica

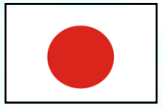
Antarctic Infrared Telescope (AIR-T) and its Scientific Drivers

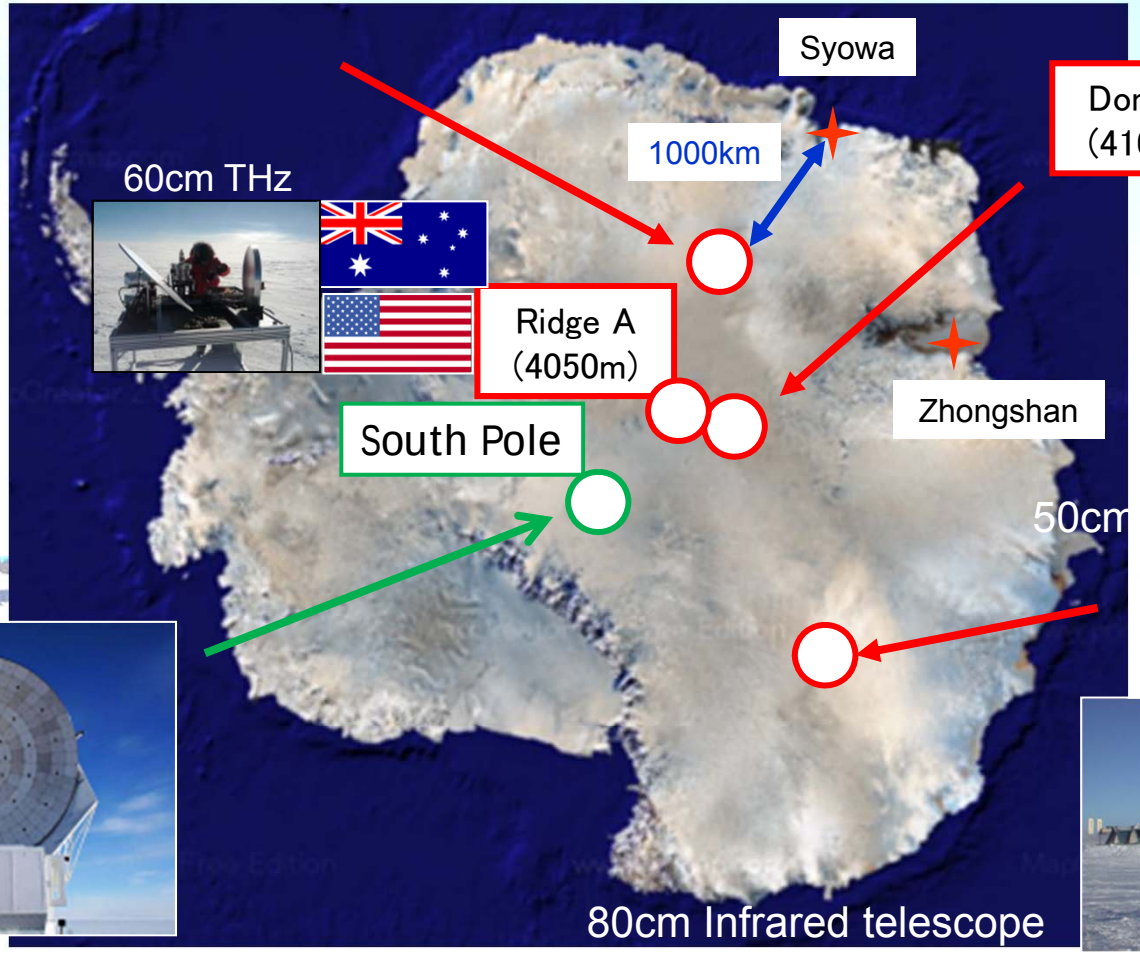
Tohoku University

Takashi Ichikawa

The ideal site for astronomy

Dome F
(3810m)





50cm Schmidt telescope

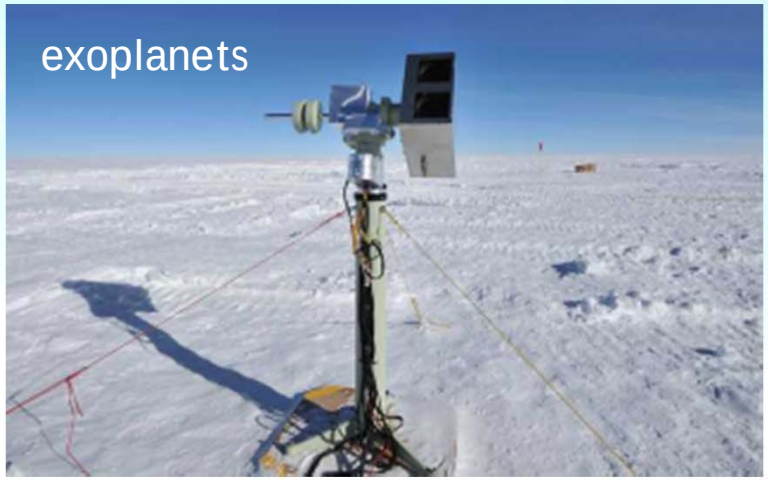
Dome C
(3250m)

10m Sub-mm telescope

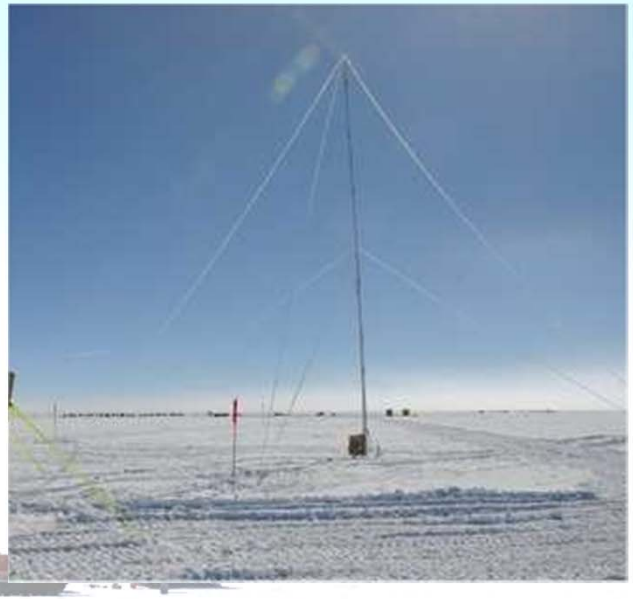
80cm Infrared telescope
40cm optical telescope

Astronomical Station at Dome-Fuji since 2011

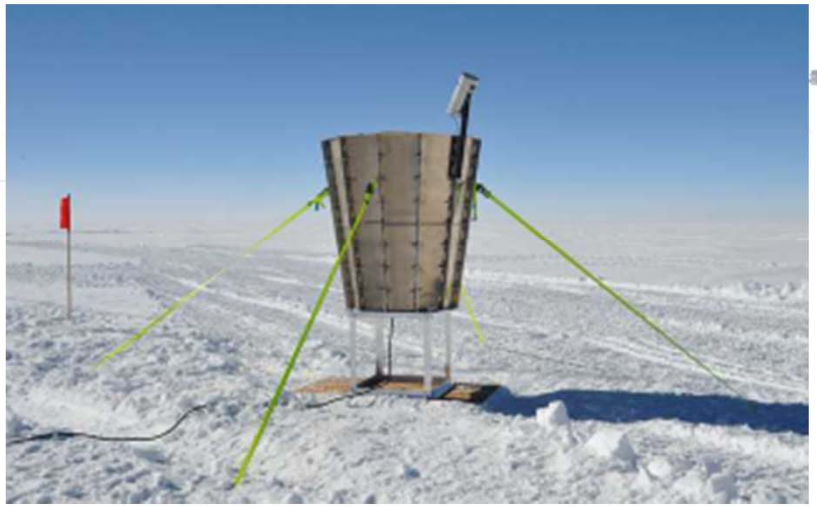
TwinCAM
10cmx2 telescopes



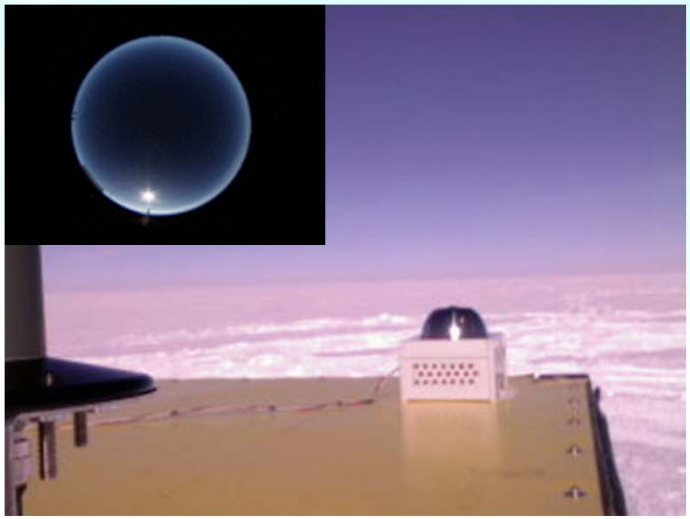
16m pole
temperature



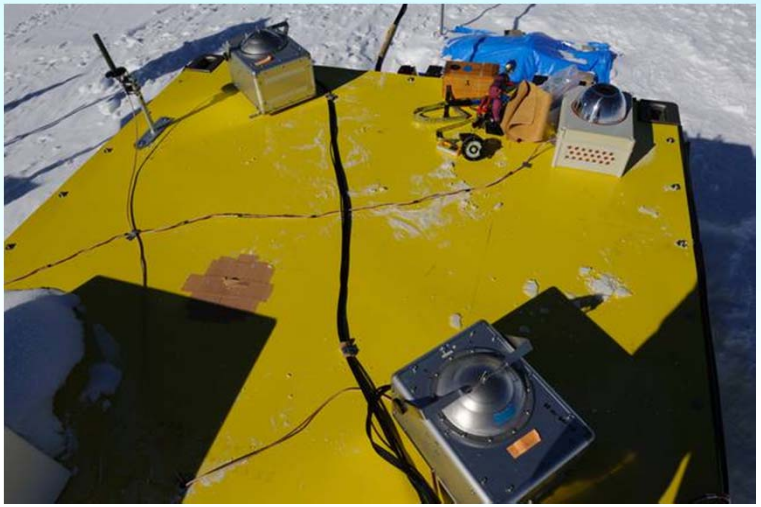
SNODAR (Bonner et al.)



Whole sky camera

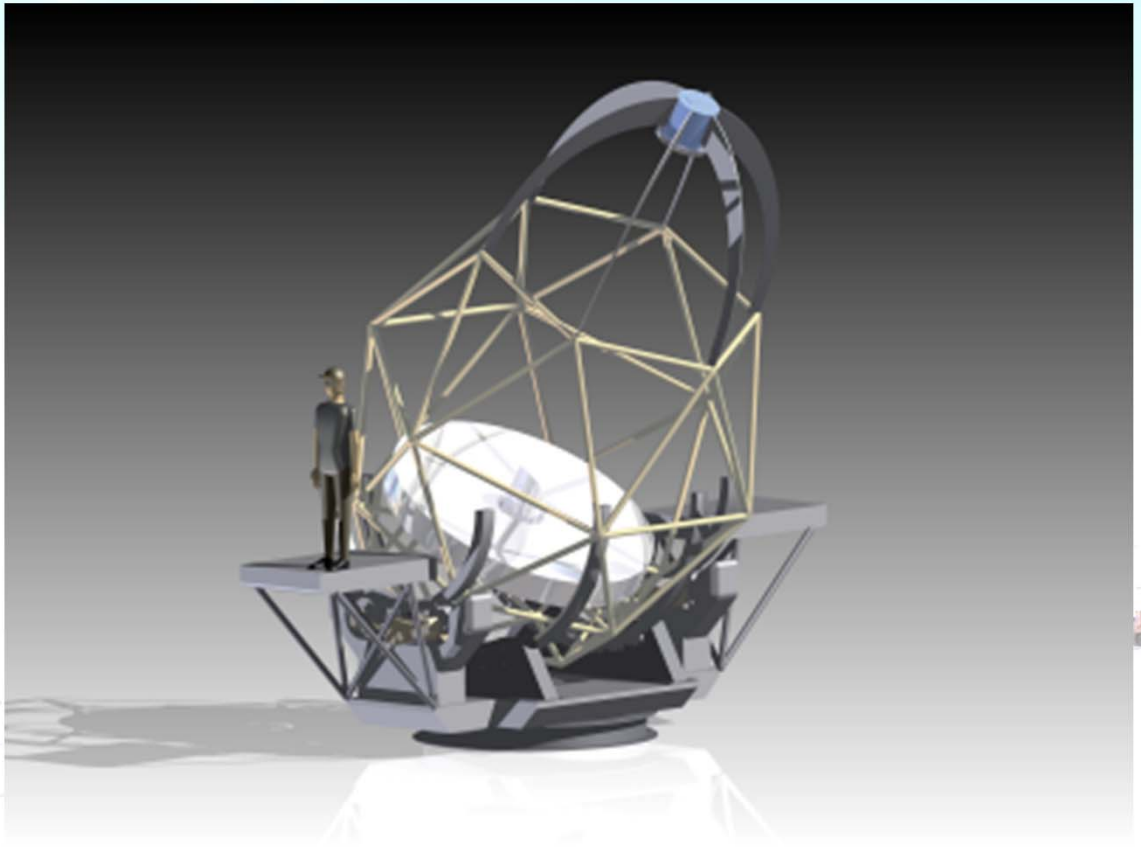


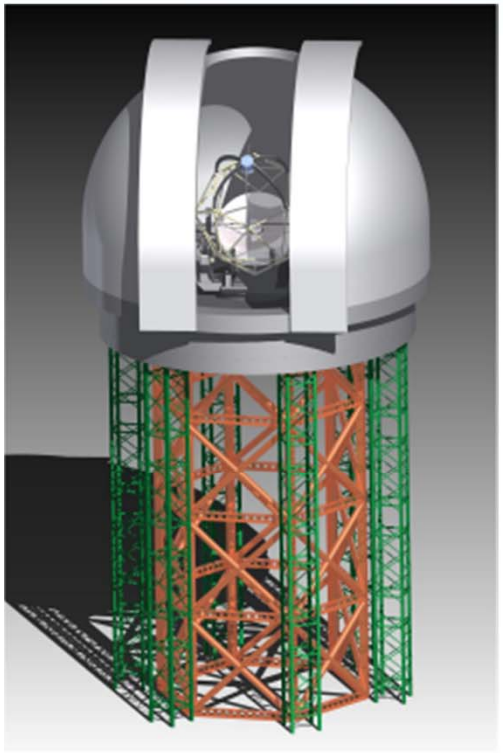
Aurora cameras



2.5m Infrared Telescope

Ultra-lightwieght telescope mount (Kurita+2009)





- Three-Color Infrared Camera (1~5μm)
  + simple multi-slit spectrograph (option)
- Heterodyne spectrograph (R~100000)
  10μm、17μm、(30μm)

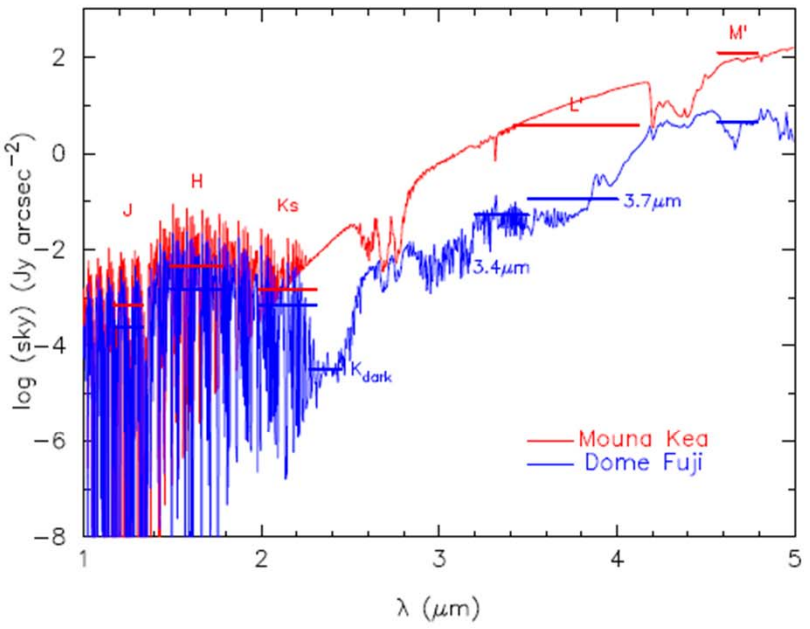
Good Reasons

- Clear sky (>65% photometric), weak wind
- Cold atmosphere: dark infrared sky (50 – 100 times darker)
- The free-atmosphere seeing 0.2”, the best in the world
- Dry atmosphere: 0.14mmPWV (~10 times lower) in winter
- Stable transparancy
- The atmospheric boundary layer is only 11m or lower
- Long periods of uninterrupted darkness for months

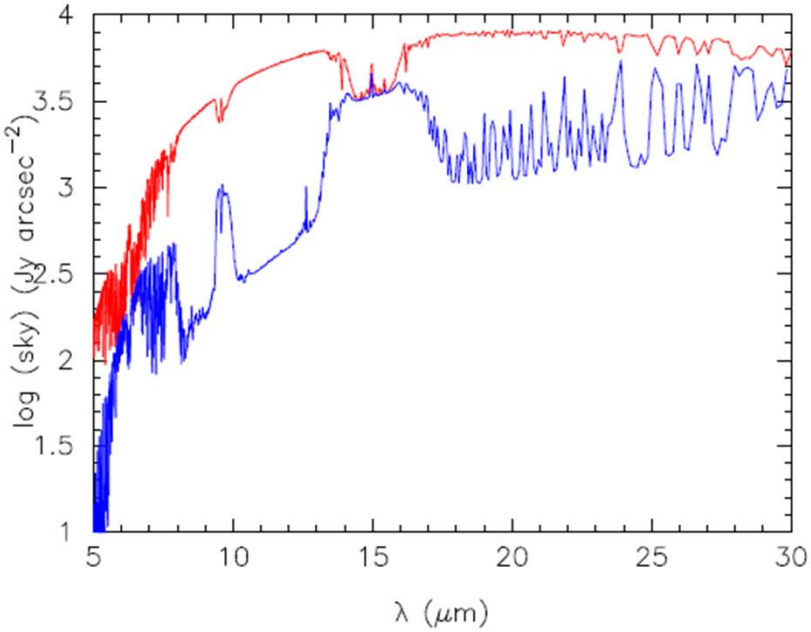
Low sky background

		altitude	temperature
blue	**Dome Fuji**	3810m	-70℃
red	**Mounakea**	4200m	0℃

Near-infrared



Mid-infrared

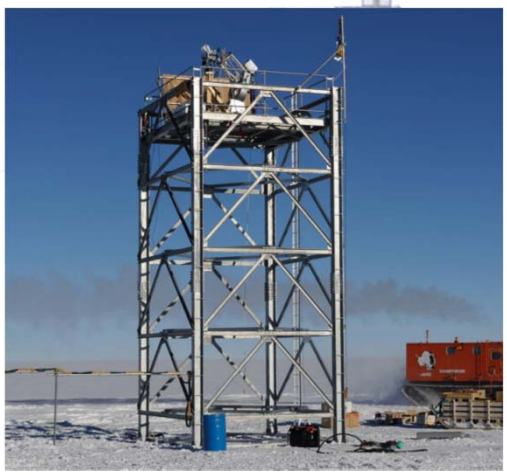


Good Reasons

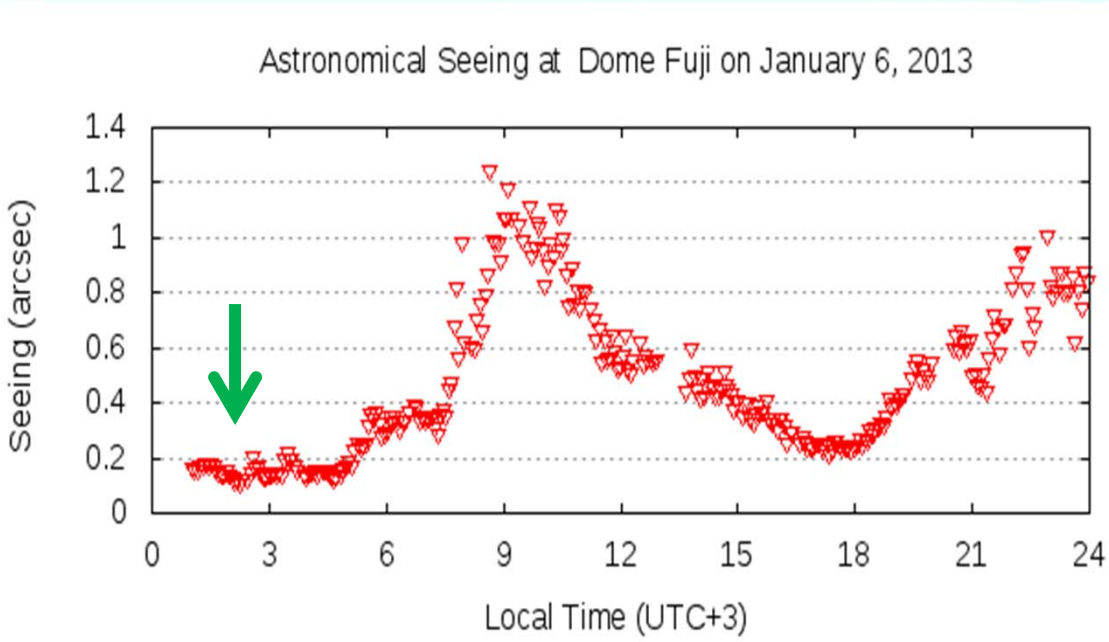
- Cold atmosphere: dark infrared sky (50 – 100 times darker)
- The free-atmosphere seeing 0.2”, the best in the world
- Dry atmosphere: 0.14mmPWV (~10 times lower) in winter
- Stable transparancy
- The atmospheric boundary layer is only 11m or lower
- Long periods of uninterrupted darkness for months

Excellent seeing

11m



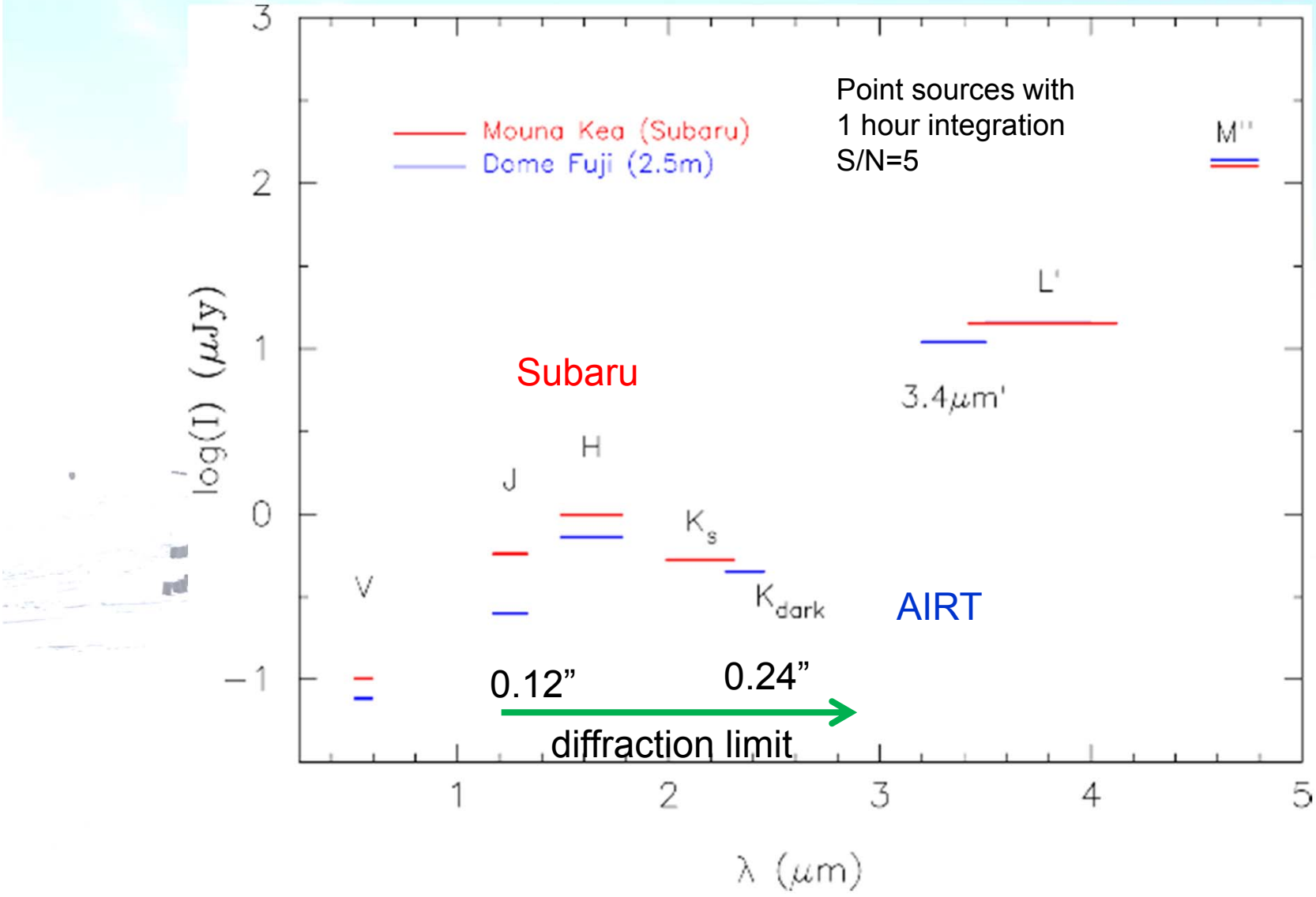
Okita's talk



~0.2"(λ=0.47μm)

Okita+ 2013

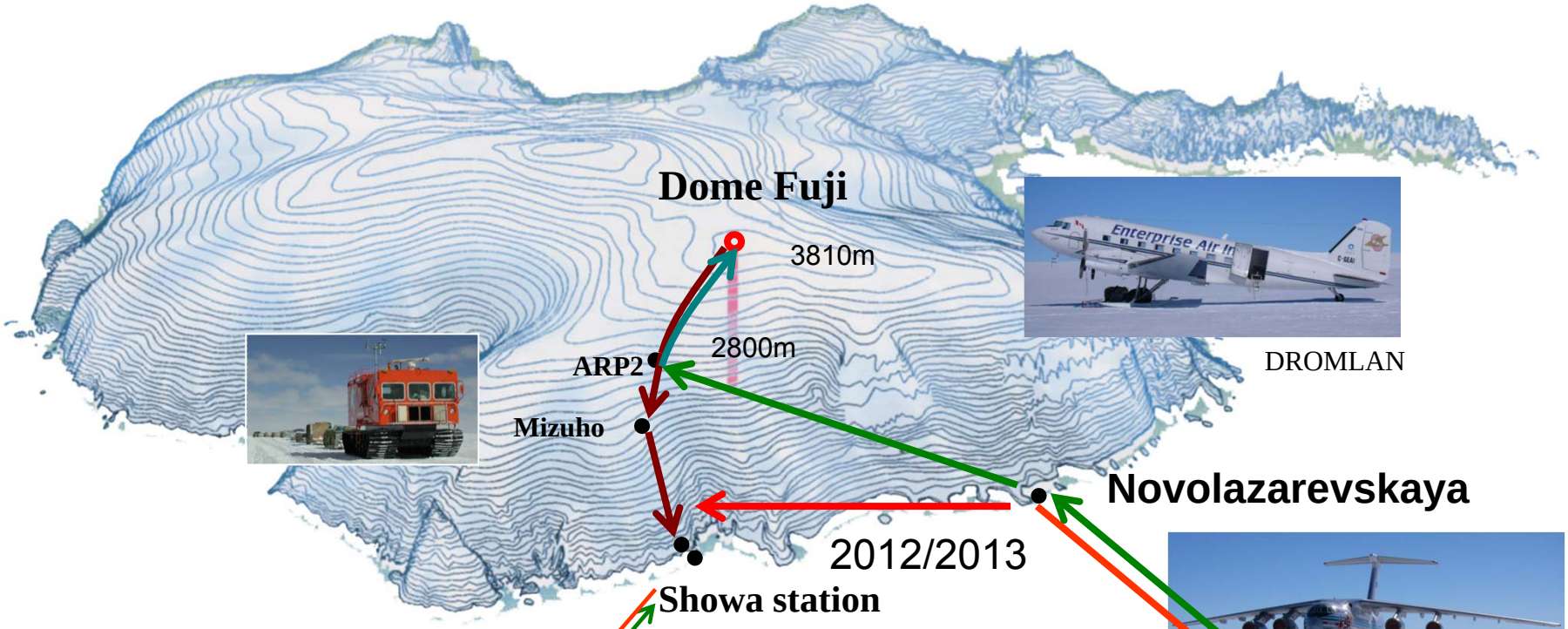
Comparison of Sensitivities - Subaru and AIRT



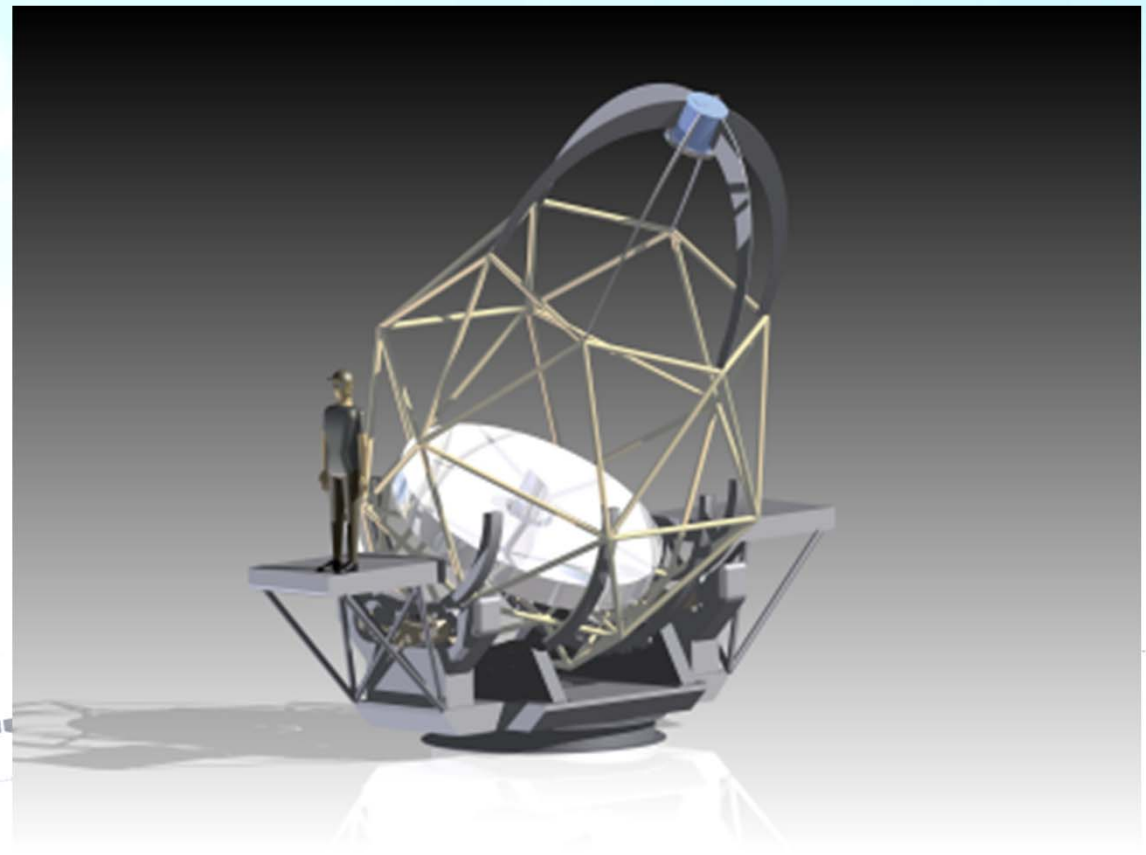
- ✓ High sensitivity of Subaru telescope
- ✓ High quality of HST

Unique opportunity for deep, high photometric and spatial precision astronomy

Long way to Dome Fuji and harshest environment



In near-infrared,

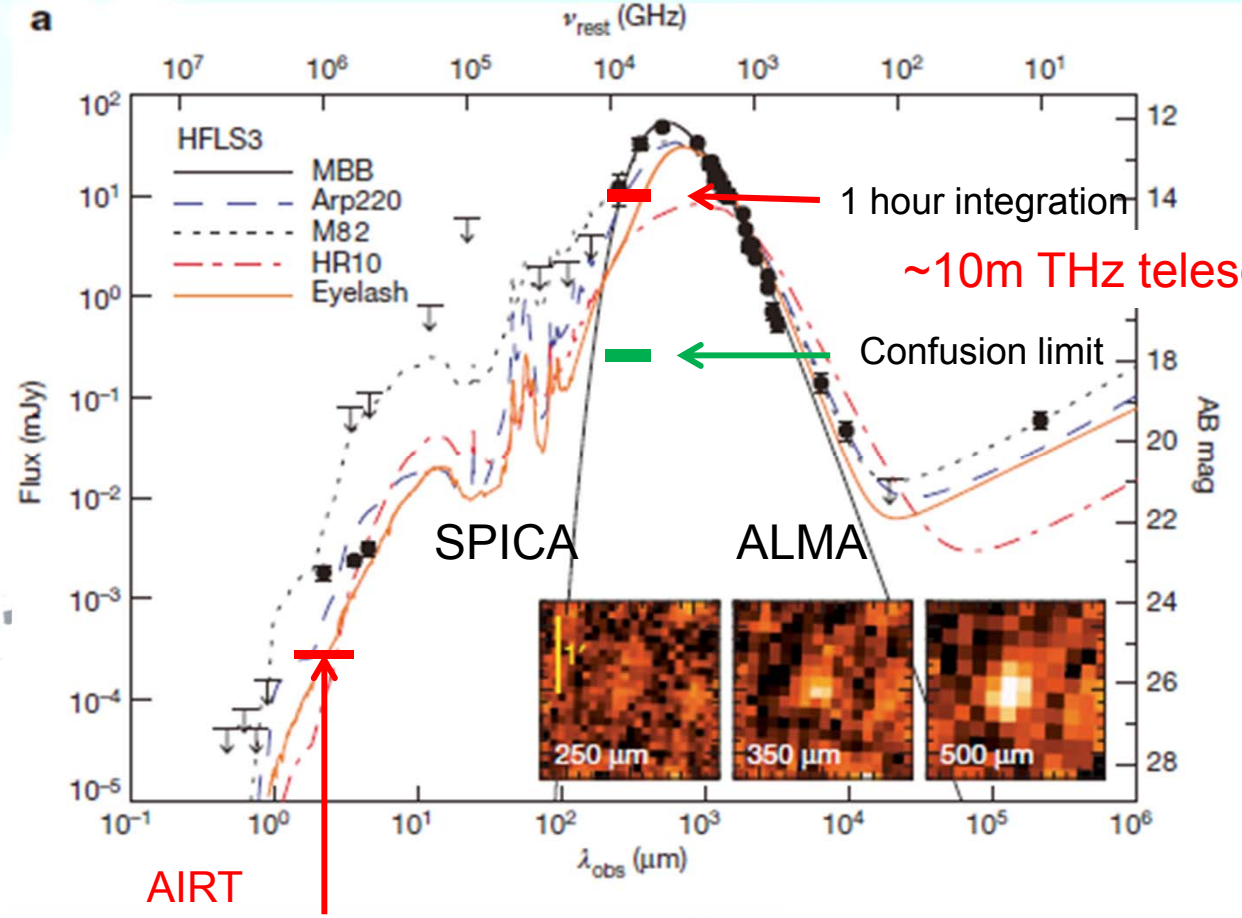


“Big science” with small telescope

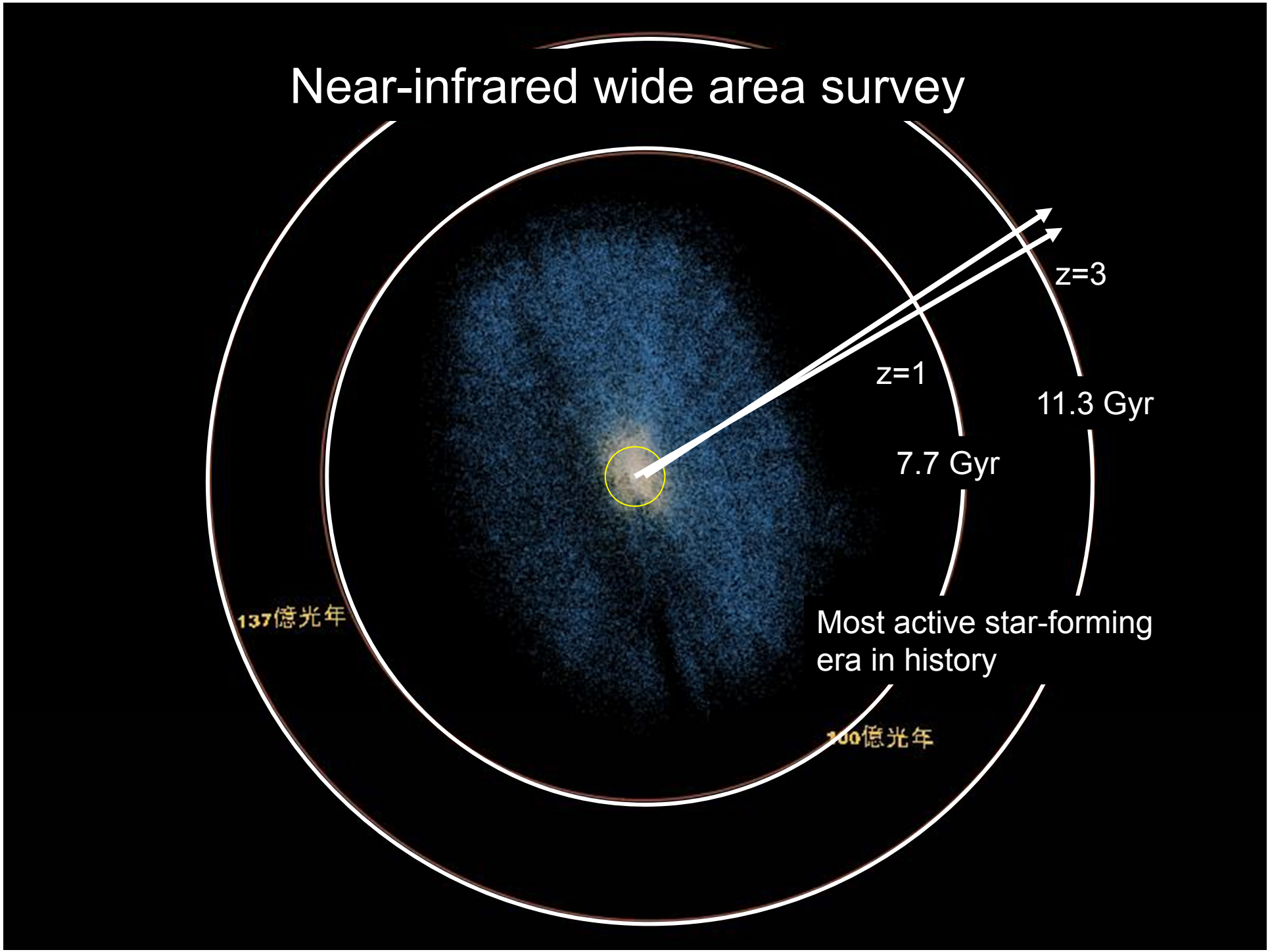
➢ Dusty Star Burst Galaxies

Hershel galaxy at z=6.5

Riechers+ 2013

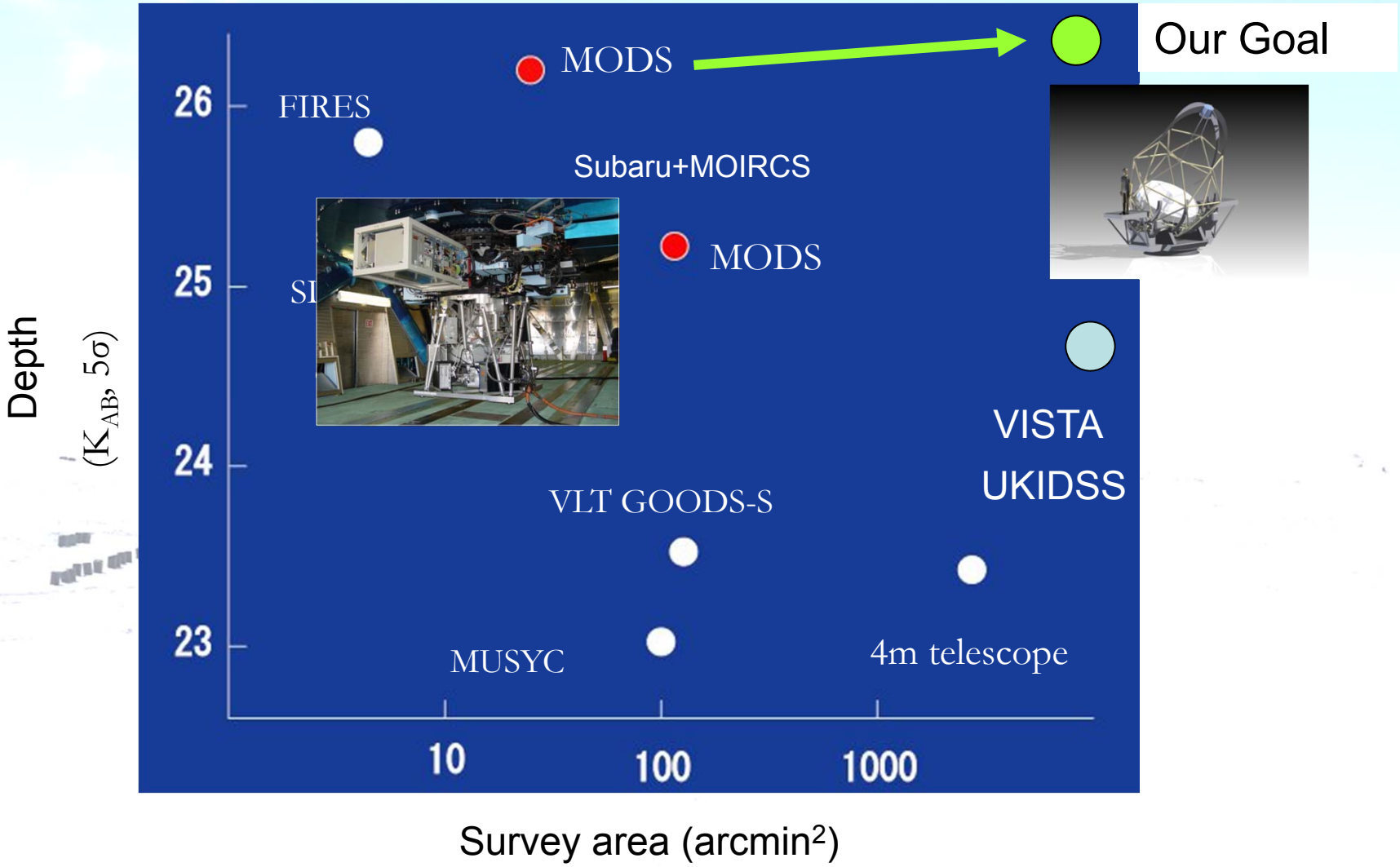


2.4μm, S/N=5 (1 hour)

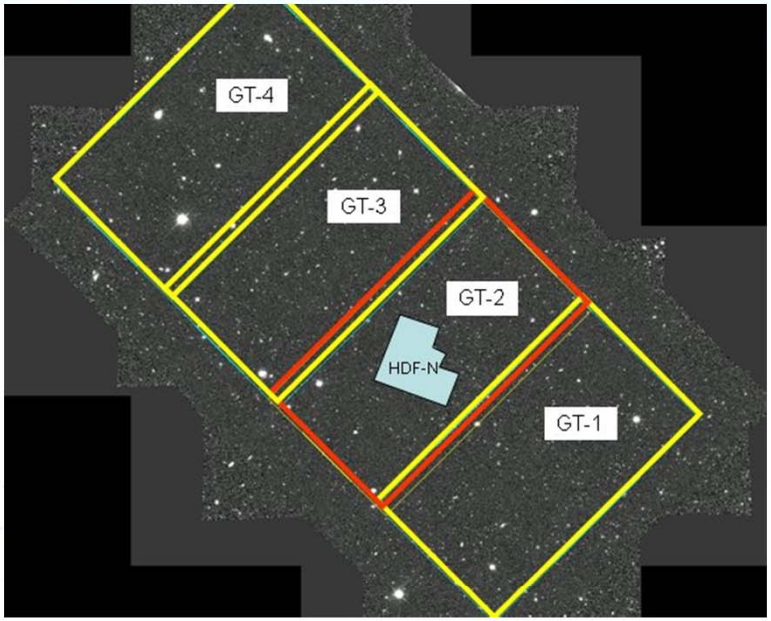

Near-infrared wide area survey
z=3
z=1
11.3 Gyr
7.7 Gyr
137億光年
Most active star-forming
era in history
100億光年

Widest and Deepest High-Redshift Galaxy Survey in K band

Complete samples of 10^9 M_{sun} at z~3

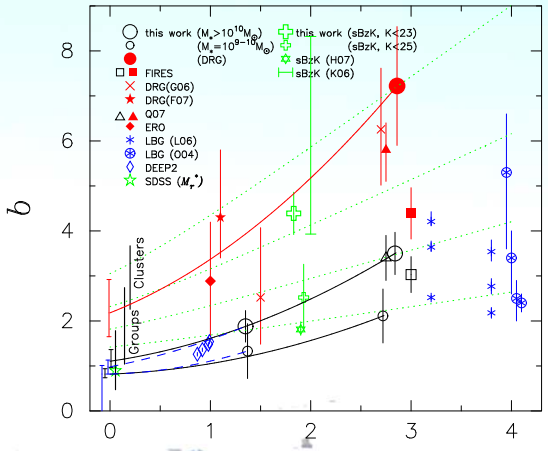


➢ Deepest K-band galaxies with MOIRCS + HST WFC3 data



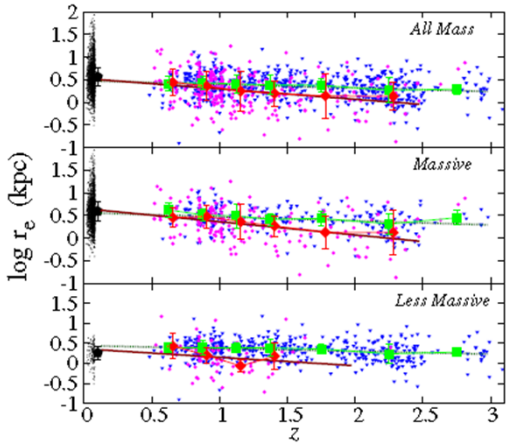
GOODS-N region

Clustering evolution of low mass galaxies



Ichikawa+ 2007

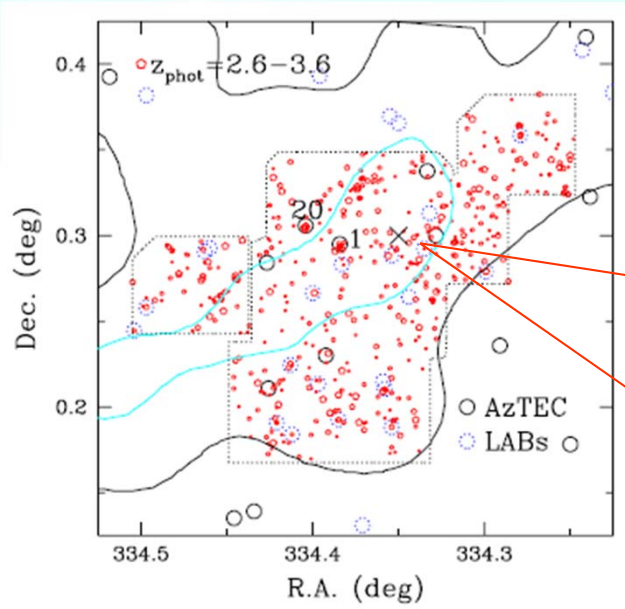
Size evolution



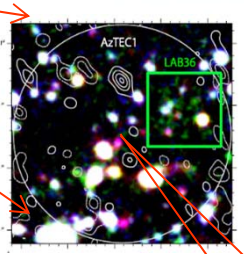
Morishita+ 2013 (submitted)

Large scale structure of galaxy populations

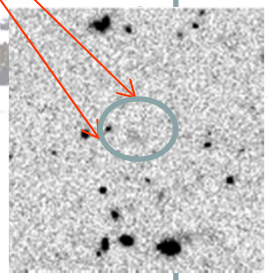
SSA22 (z~3) (Uchimoto+2012)



- Massive quiescent and SF galaxies
- Low mass galaxies (~10^9Msun)
- THz galaxies
- Morphology



100Mpc



AzTEC1

Proto-Quasar?

THz + near-infrared

Tamura+ 2010

Observations will be completed in one season

100Mpc

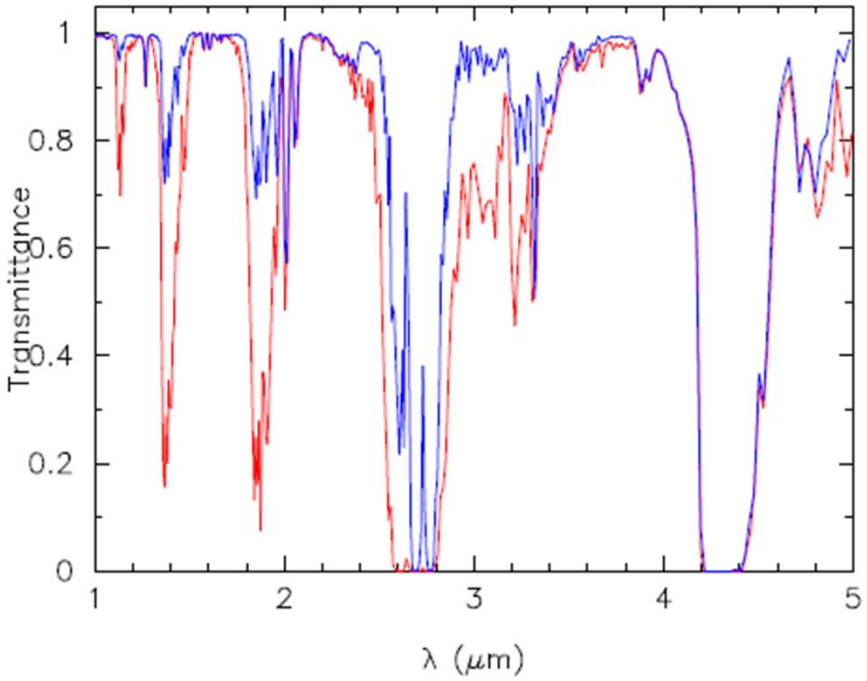
Good Reasons

- Cold atmosphere: dark infrared sky (50 – 100 times darker)
- The free-atmosphere seeing 0.2”, the best in the world
- Dry atmosphere: 0.14mmPWV (~10 times lower) in winter
- Stable transmittance
- Long periods of uninterrupted darkness for months

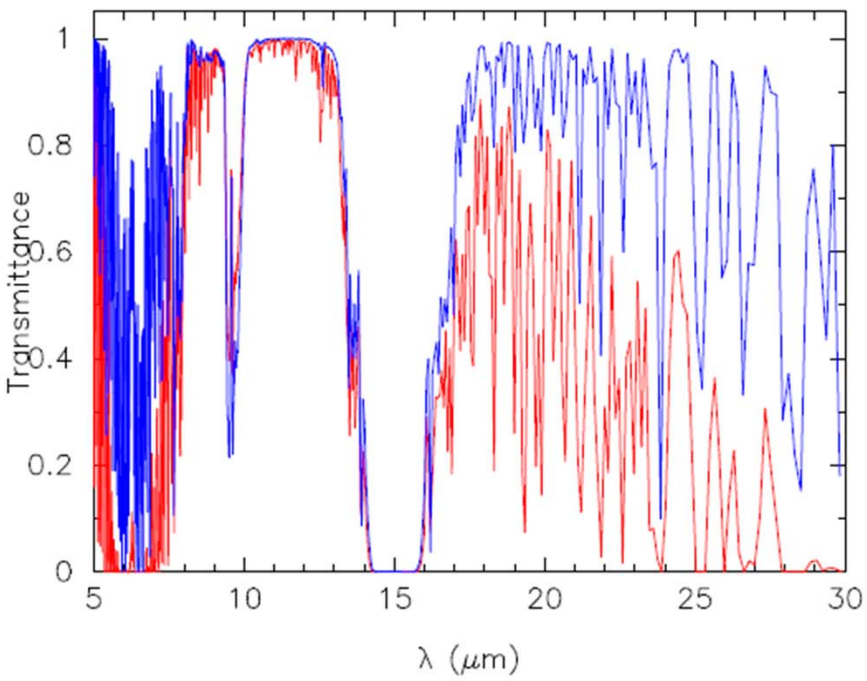
High Transmittance

		altitude	PWV
blue	**Dome Fuji**	3810m	0.2mm
red	**Mounakea**	4200m	1mm

Near-infrared



Mid-infrared



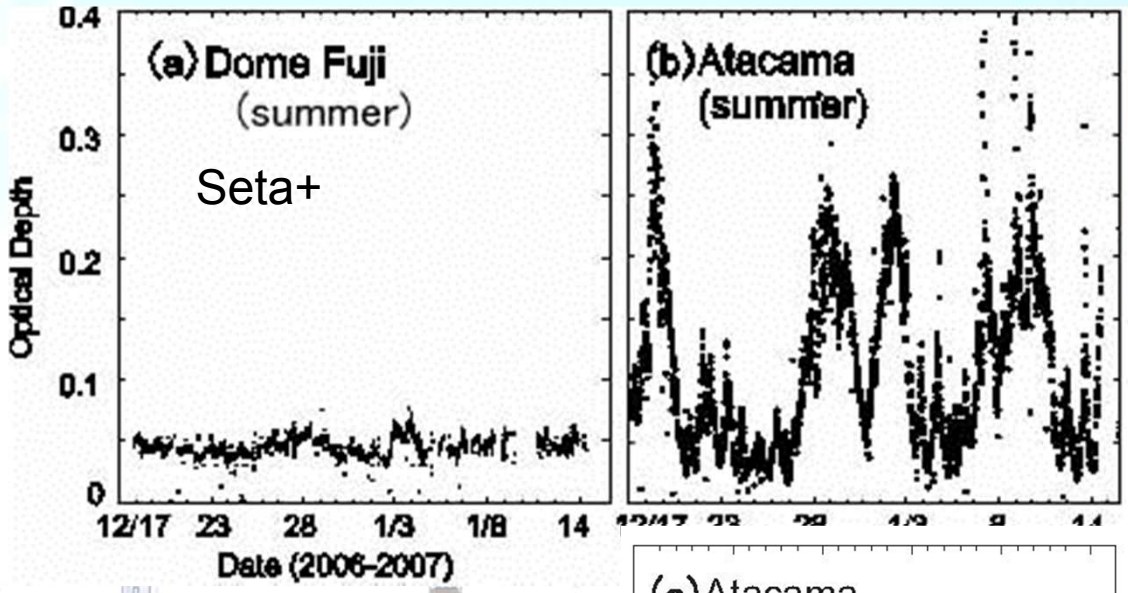
Good Reasons

- Cold atmosphere: dark infrared sky (50 – 100 times darker)
- The free-atmosphere seeing 0.2”, the best in the world
- Dry atmosphere: 0.14mmPWV (~10 times lower) in winter
- Stable atmospheric transmittance
- Long periods of uninterrupted darkness for months

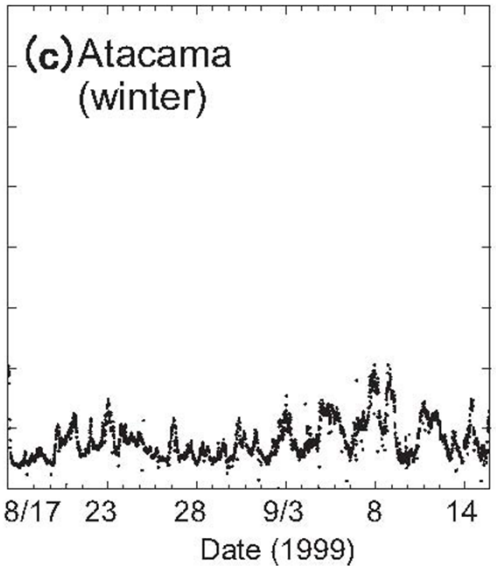
Stability of Optical Depth in Summer

Dome F

ALMA site



No data

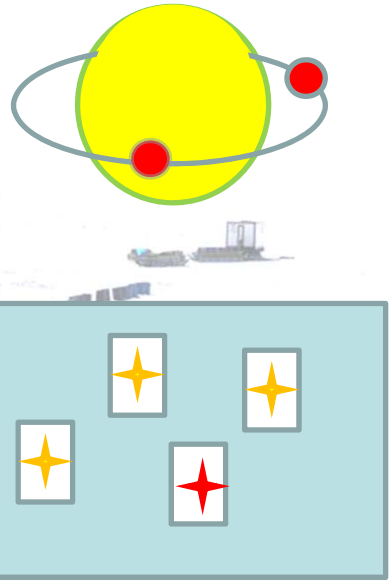


➢ water-dominated atmosphere on super-earths

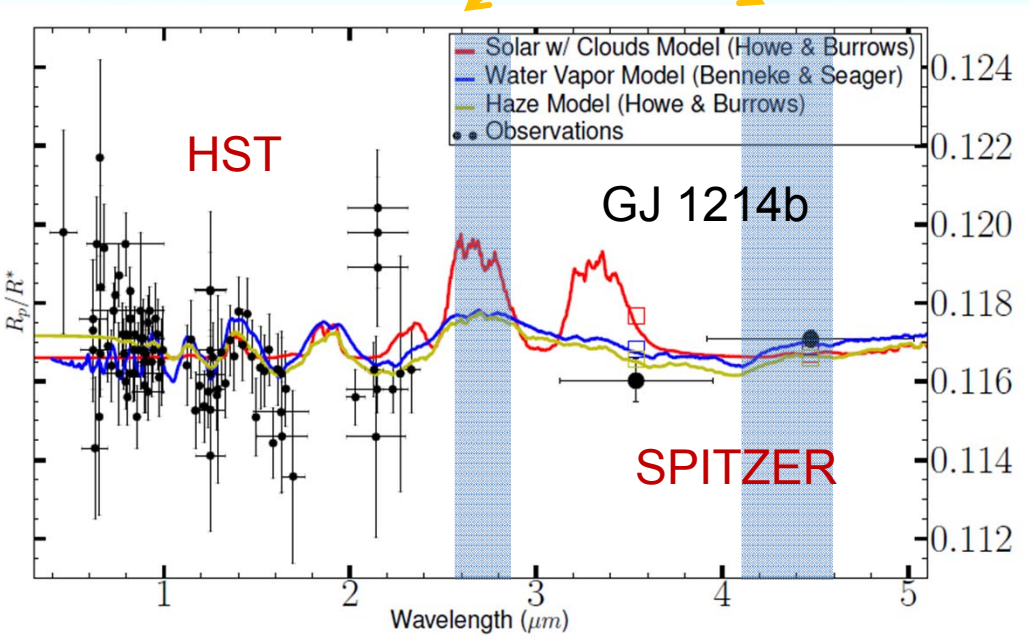
Spectroscopic transit observations with low resolution λ/Δλ~100 on multi-slits

Minimum effect of terrestrial water vapor in Antarctica

Transit and secondary eclipse



~10 reference stars in large slits

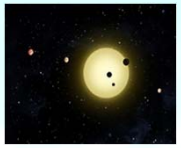


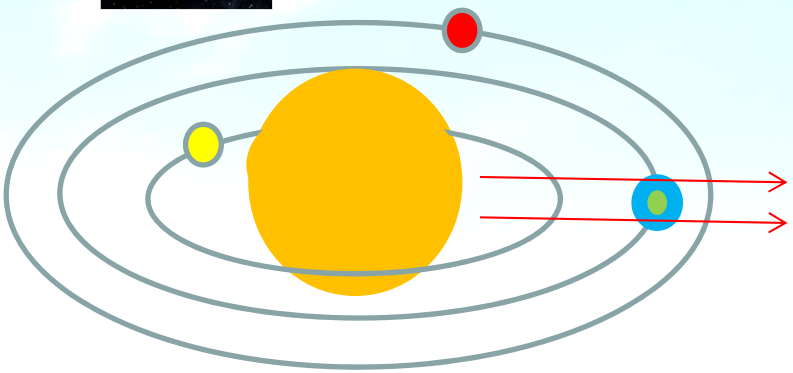
many molecular lines (H_2O,CO_2,CH_4…)

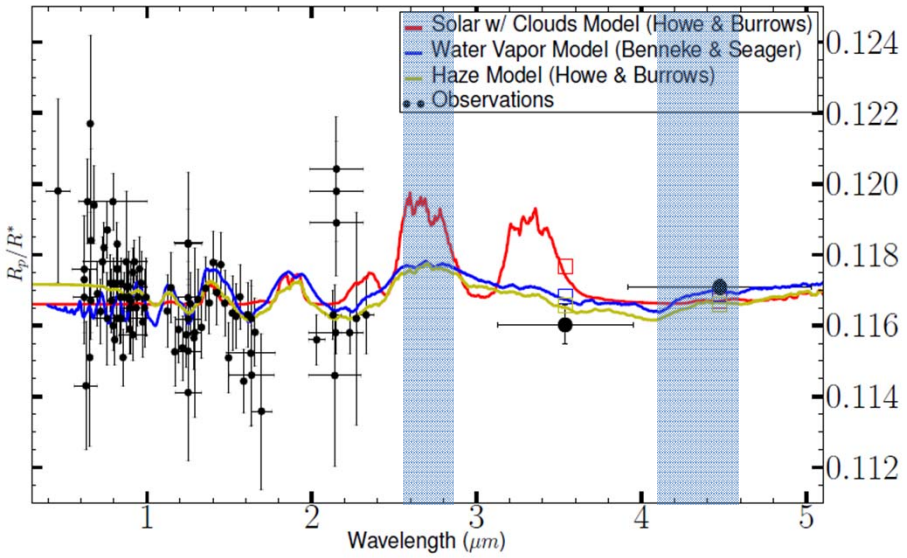
Good Reasons

- Cold atmosphere: dark infrared sky (50 – 100 times darker)
- The free-atmosphere seeing 0.2”, the best in the world
- Dry atmosphere: 0.14mmPWV (~10 times lower) in winter
- Stable transparency
- Long periods of uninterrupted darkness for months

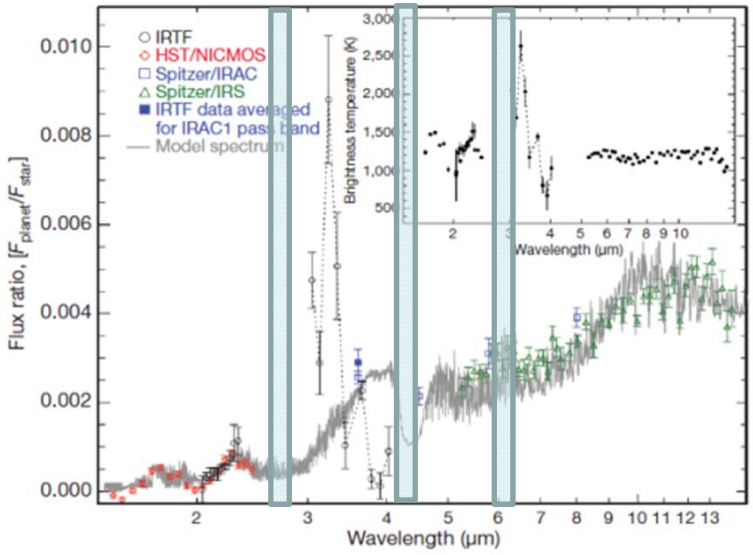
➢ Continuous observations of multiple systems







Super earth



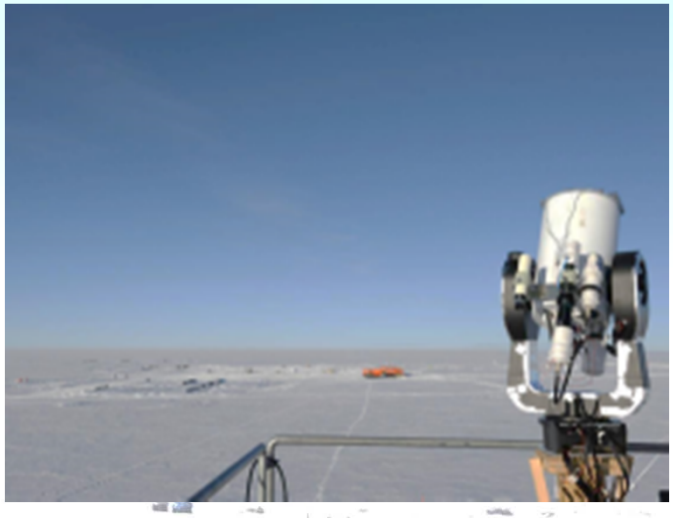
Hot Jupiter

Candidates of multiple systems

TESS (2017)

Bright G、K、M type stars

CCD camera at Dome-F



Collaboration with Dome A

50cm Schmidt x3