Highlights of Astronomy, Volume 15
XXVIIth IAU General Assembly, August 2009
Ian F. Corbett, ed.

doi:10.1017/S1743921310010835

Future plans for astronomy at Dome Fuji

Takashi Ichikawa

Astronomical Institute, Tohoku University, Aoba, Sendai 980-8578, Japan
email: ichikawa@astr.tohoku.ac.jp

Abstract. In Antarctica the cold and dry air is expected to provide the best observing conditions on the Earth for astronomical observations from the infra-red to the sub-millimetre. To utilise these advantages of Antarctica, we have devised a plan to construct an astronomical observatory at Dome Fuji, which is located in inland Antarctica. For pilot research and site testing at Dome Fuji, we have developed 40 cm infrared and 30 cm THz telescopes, which are durable for the harsh environment of inland Antarctica. As our project for astronomical research at Dome Fuji is approved for the 3-year program of NIPR, we will start the site testing and pilot research for astronomy at Dome Fuji from 2010.

Keywords. Site Testing, Galaxies: evolution, Infrared: general, Submillimetre

1. Introduction

Antarctica is expected to provide the last windows open to space for ground-based astronomical observations. Especially, the highest regions of the Antarctic plateau above 3,000 m elevation are an attractive environment for observational astronomy. Due to the low temperature, thermal noise at infra-red wavelengths is much lower in Antarctica than other temperate sites. The dry atmosphere, with little water vapour, is more transparent from the infra-red to the sub-millimetre. At the summits of the plateau the wind speed is low and the atmosphere is stable, so that no violent storms and blizzards exist. Since the surface inversion layer is thin, we expect good seeing. As well as the South Pole, there are better sites for astronomy at several bases on the summits of the plateau, Dome C, Dome A, and Dome Fuji (also known as Dome F) (see Fig. 1). Astronomers in the world pay attention to these sites, which have extremely good conditions. In this context, a Japanese group has organized a consortium consisting of four universities (Tohoku, Tsukuba, Rikkyo, Nagoya) and two institutes (National Institute of Polar Research and National Astronomical Observatory) to promote astronomy at Dome Fuji.

2. Dome Fuji

Dome Fuji station is located at −77° 19' 01"S, 39° 42' 12"E; 1,000 km inland on the Antarctic Continent at 3,810 m above sea level (see Fig. 1), which is the second-highest summit of the Antarctic ice sheet. It was established in 1995 by NIPR for a deep ice drilling program and atmospheric observations. The year-round average temperature is about −54°C, and in winter the temperature falls as low as −80°C. Due to this low temperature, thermal noise at infra-red wavelengths is much lower in Antarctica than other sites. Although the site is on the border of the aurora oval, this is not a drawback for infrared and THz astronomy. In the 2006 summer we carried out monitoring observations of the atmospheric turbulence in the boundary layer (up to the altitude of 1,000 m) using a SODAR, and of transparency using a 220 GHz radiometer. However, it is in winter that the superior characteristics of Antarctica appear, so that it is necessary for us to examine turbulence and transparency then.

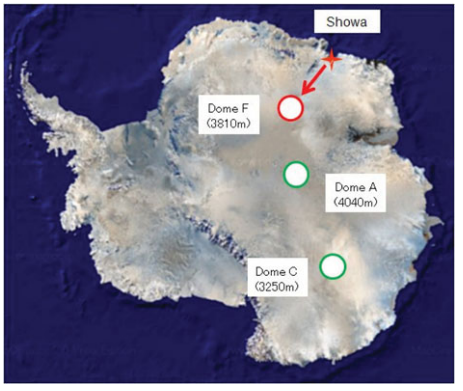

Figure 1. Dome Fuji and Syowa stations.

Figure 2. 40 cm infrared telescope at Rikubetsu, the coldest place in Japan

3. Science Goals

To enjoy the advantages in Antarctica, we are planning to construct 2m-class infrared and 10m-class THz telescopes. Thanks to the low background and high transmittance, a 2m-class telescope has the capability of 8m-class telescopes located at Mauna Kea in the near-/mid-infrared. An infrared survey observation in K-dark band at 2.4 μm will give the deepest and widest dataset for the high-z universe with reasonable cost and observation time. It will reach deeper than those of VISTA and UKIDSS by 1–2 mag. The THz telescope will target dusty galaxies at the high-z universe to study galaxy evolution in its early phase of star formation enshrouded in dust. The long polar night in winter is favourable for searching for variable objects with long periods, such as extra-solar planets in orbit in a habitable zone. The observation of molecules (e.g., CO, H_2O, CH_4) at the second eclipse will provide information on the exo-planet's atmosphere. To undertake such observations we are making near-/mid-infrared instruments for imaging and spectroscopy.

4. Future Plans

NIPR has planned the construction of a new permanent winter-over station with raised floors at Dome Fuji in the next 6-year program, because the old station was buried under snow. Astronomical facilities are also expected. Before the completion of the station, we will start astronomical site testing and pilot research (e.g., CO survey in Galactic plane, faint stellar halo of nearby galaxies, second eclipse of exoplanets) with small telescopes (Lundock & Ichikawa 2008; Murata *et al.* 2008) and site-testing equipments from 2010. In collaboration with an Australian group (Storey *et al.*), we will construct a PLATO observatory for Dome Fuji, which will enable us to make unmanned operation of the instruments before the winterover station is constructed.

Acknowledgements

This work has been supported in part by a Grant-in-Aid for Scientific Research (21244012) of the Ministry of Education, Culture, Sports, Science and Technology in Japan.

References

Lundock, R. & Ichikawa, T. 2008, SPIE, 7014, 89
Murata, C., *et al.* 2008, SPIE, 7019, 79