

Dome A in Antarctica Proved the Best Site for Optical Astronomical Observation on Earth

A research team led by Prof. SHANG Zhaohui from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) has proved that Dome A in Antarctica is the best site for optical astronomical observation on Earth. The study was published in *Nature* on July 29.

Seeing, a factor crucial for optical astronomical observations, is subject to the atmospheric turbulence that makes stars twinkle or smears star images observed by telescopes. At an observatory with good seeing, weak turbulence results in a smaller seeing value and sharper images. This is especially good for viewing faint objects. A small-aperture telescope at such a site can compete with a larger one at other sites.

Due to the geographic and atmospheric properties at Dome A, atmosphere turbulence usually resides in the near-ground, shallow boundary layer, above which is the very stable free atmosphere with superb seeing.

The researchers reported a seeing measurement as good as 0.13 arcseconds and a median free-atmosphere

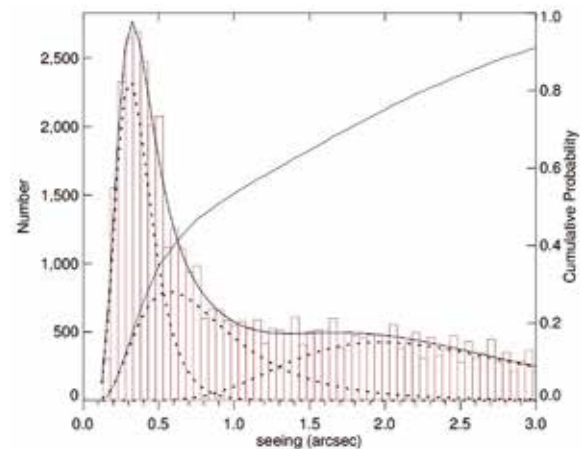


Figure 1: The peak in the data histogram indicates the median free-atmosphere seeing of 0.31 arcseconds. (Credit: MA Bin)

seeing of 0.31 arcseconds, measured with instruments on an eight-meter-high tower.

Currently, the best telescopes are located at good sites in Hawaii and Northern Chile, with seeing in the



Figure 2: The site for astronomy at Dome A. (Credit: SHANG Zhaohui)



Figure 3: Two redundant KL-DIMMs and their eight-meter-high tower. (Credit: SHANG Zhaohui)

range of 0.6 to 0.8 arcseconds. It is clear that Dome A has the potential to host a good astronomical observatory.

In addition, the median boundary layer thickness is about 14 m at Dome A, compared to 30 m at Dome C in Antarctica, making Dome A more feasible and cost-efficient for future construction.

Dome A is the highest place on the polar ice cap, with an altitude of 4,093m. Kunlun Station is the only station there, but has not yet been developed into a station for winterover. Therefore, the team had to design and build unattended instruments to cope with temperatures as low as -80°C and frosting problems.

The research team developed the instrument KL-DIMM independently, and participated in the 35th Chinese National Antarctic Research Expedition (CHINARE) in November 2018 to the inland Kunlun Station. Two redundant KL-DIMMs started to take data in January 2019. They worked fully automatically through winter and obtained precious nighttime seeing measurement data.

Dome A was first visited by humans in January 2005 via overland traverse from Zhongshan Station by the 21st CHINARE. CHINARE is managed and carried out by the Chinese Arctic and Antarctic Administration

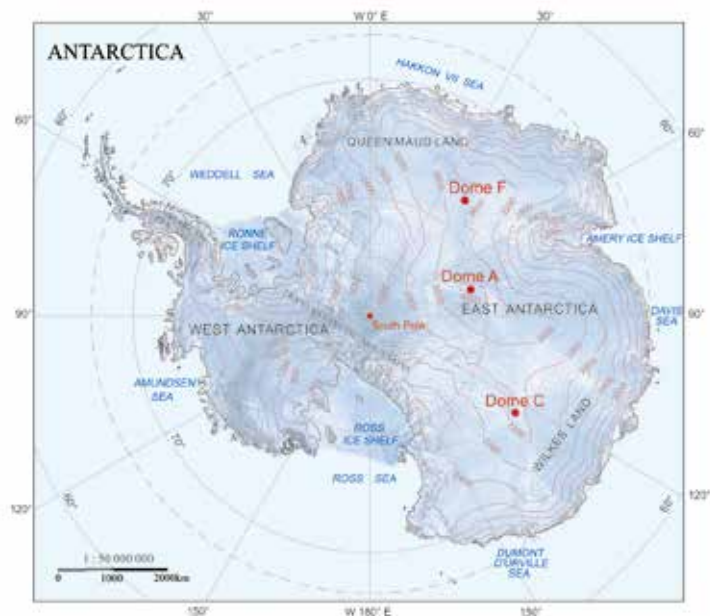


Figure 4: A map of Antarctica with red dots showing the locations of Dome A (site for Chinese Kunlun Station), Dome C (French-Italian Concordia Station), Dome F (Japanese Dome Fuji Station) and the South Pole (Amundsen–Scott Station), respectively. (Credit: PANG Xiaoping and WANG Shiyun, 2020)

(CAA) and the Polar Research Institute of China (PRIC), and has consistently supported the astronomy program at Dome A.

The combination of high altitude, low temperature, long periods of continuous darkness, and an exceptionally stable superb seeing makes Dome A a very attractive location for optical and infrared astronomy.

(NAOC)