

## 論文内容要旨

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## 論 文 要 旨

Dome Fuji, the second highest region on the Antarctic plateau, is expected to be one of the best astronomical sites on the Earth. Extremely low temperature at Dome Fuji produces both minimum thermal background and highest atmospheric transmittance on the Earth. In addition the excellent astronomical seeing, which originates from unique meteorological and geographical conditions on the Antarctic plateau, is also expected. However, the seeing measurements at Dome Fuji are yet to be investigated because of both the Antarctic harsh environment and logistical

limitations.

Snodar (high-resolution and low minimum sample height sonic rader), PLATO-F (PLATeau Observatory for Dome Fuji), platinum thermometers equipped on the 16-m meteorological mast, AIRT40 (Antarctic Infra-Red Telescope with a 40-cm primary mirror), and two DIMMs (Differential Image Motion Monitor) were developed for the site testings at Dome Fuji, while we used SODAR (SOnic Detection And Ranging), ultrasonic anemometers, and barometer, which were commercially available.

From our observations we found the height of the surface boundary layer at Dome Fuji in fine weather in the Antarctic autumn and winter to be  $15.3 \pm 0.8$  (statistical) $\pm 0.8$  (systematic) meters in median. The median absolute deviation (MAD) was 2.7-m. The height of the surface boundary layer remained low and stable for several days. The free-atmosphere and total seeings at Dome Fuji in the Antarctic summer were  $0.23'' \pm 0.01''$  (statistical) $\pm 0.01''$  (systematic), and  $1.1'' \pm 0.1''$  (statistical) $\pm 0.1''$  (systematic) in median. MADs were  $0.057''$  and  $0.47''$ , respectively. In addition, the atmospheric convection at the local daytime in the Antarctic summer and autumn was found near the snow surface. It would build the surface boundary layer. The local seeing minimum, which would be caused by the disappearance of the surface boundary layer, was observed at dusk in the Antarctic summer. Based on the study of the refractive-index structure constant, the turbulence strength in the surface boundary layer was two orders of magnitude larger than the atmospheric convection, and four orders of magnitude than the free atmosphere. Assuming constant refractive-index structure constant in each layer, we predict that the seeing is drastically worsen if the telescope height is lower than the surface boundary layer.

## 論文審査の結果の要旨

本論文は南極内陸、特にドームふじ基地における大気擾乱と星像の乱れの指標であるシーアイングについて論述したものである。国立極地研究所のドームふじ基地は南極内陸のドームと呼ばれる氷床高原にあり、ドーム A に続いて 2 番目に標高が高いので、大気の透過率が高く、また低温のため大気からの赤外線放射が少なく、地球上で最も天体観測に適した場所であることが期待されている。またその特異な地理的条件によって、大気擾乱が極めて少なく、シーアイングが良いことが期待される。しかしながらこの場所における天文学的見地からの大気擾乱に関する研究はこれまで行われてこなかった。本研究では SNODAR、PLATO-F、気象タワー、40cm 望遠鏡、DIMM 観測装置などの天文気象観測装置を開発、あるいは開発に参加し、さらに著者自ら現地で観測を行った結果に得たデータに基づくものである。論文の目的の設定、必要な観測装置の開発、現地での実測、観測データの理論的解釈の随所に斬新な視点がある。その結果、ドームふじ基地の接地境界層の厚みは天気の良い時には 15.3m であることが始めて確認し、また接地境界層の上の自由大気におけるシーアイングは 0.23 秒角であることを明らかにした。15.3m の厚みはドーム A に続いて 2 番目に薄く、0.23 秒角のシーアイングは地上で測定された数値としては最も小さい値であり、ドームふじ基地が世界で最も天体観測に適した場所であることを解明した。また地上から上層大気のなかでの大気の揺らぎ量とシーアイングの関係を明らかにしたことでも特筆に値する。

以上の論文の内容は、著者が自立して研究活動を行うに必要な高度の研究能力と学識を有することを示している。したがって、沖田博文提出の博士論文は、博士(理学)の学位論文として合格と認める。