

## 編隊飛行による地球電磁気圏・熱圏探査衛星計画「FACTORS」搭載可視・紫外イメージャーによる微細オーロラと大気光観測

### Visible and ultraviolet imagers for auroral and airglow observations by FACTORS - a future satellite mission for understanding the coupling and transportation processes in the upper atmosphere

\*坂野井 健<sup>1</sup>、平原 聖文<sup>2</sup>、津田 卓雄<sup>3</sup>、浅村 和史<sup>4</sup>、三好 由純<sup>2</sup>、渡邊 智彦<sup>5</sup>、西山 尚典<sup>6</sup>、大山 伸一郎<sup>2,7</sup>、斎藤 義文<sup>4</sup>、細川 敬祐<sup>3</sup>、小嶋 浩嗣<sup>8</sup>、北村 成寿<sup>9</sup>、小川 泰信<sup>5</sup>、山内 正敏<sup>10</sup>、松岡 彩子<sup>4</sup>、八木 直志<sup>1</sup>、吹澤 瑞貴<sup>1</sup>、石澤 元気<sup>11</sup>

\*Takeshi Sakanoi<sup>1</sup>, Masafumi Hirahara<sup>2</sup>, Takuo T. Tsuda<sup>3</sup>, Kazushi Asamura<sup>4</sup>, Yoshizumi Miyoshi<sup>2</sup>, Tomo-Hiko Watanabe<sup>5</sup>, Takanori Nishiyama<sup>6</sup>, Shin-ichiro Oyama<sup>2,7</sup>, Yoshifumi Saito<sup>4</sup>, Keisuke Hosokawa<sup>3</sup>, Hirotsugu Kojima<sup>8</sup>, Naritoshi Kitamura<sup>9</sup>, Yasunobu Ogawa<sup>5</sup>, Masatoshi Yamauchi<sup>10</sup>, Ayako Matsuoka<sup>4</sup>, Naoshi Yagi<sup>1</sup>, Fukizawa Fukizawa<sup>1</sup>, Genki Ishizawa<sup>11</sup>

1. 東北大学大学院理学研究科惑星プラズマ・大気研究センター、2. 名古屋大学宇宙地球環境研究所、3. 電気通信大学情報理工学研究科、4. 宇宙航空研究開発機構宇宙科学研究所、5. 名古屋大学大学院理学研究科、6. 国立極地研究所、7. フィンランドオウル大学、8. 京都大学生存圏研究所、9. 東京大学大学院理学研究科、10. スウェーデン宇宙物理学研究所、11. 東北大学大学院理学研究科

1. Planetary Plasma and Atmospheric Research Center, Graduate School of Science, Tohoku University, 2. ISEE, Nagoya University, 3. Graduate School of Informatics and Engineering, School of Informatics and Engineering, The University of Electro-Communications, 4. ISAS/JAXA, 5. Graduate School of Science, Nagoya University, 6. National Institute for Polar Research, 7. University of Oulu, Finland, 8. RISH, Kyoto University, 9. Graduate School of Science, the University of Tokyo, Tokyo, 10. IRF Kiruna, Sweden, 11. Graduate School of Science, Tohoku University

We report science subject, design, development plan and identification of issues to be solved on the visible and ultraviolet imagers for a future satellite mission called FACTORS that aims to understand the coupling processes in the terrestrial magnetosphere/ionosphere/thermosphere and the acceleration and transportation of the space plasma and neutral atmospheric particles. FACTORS stands for Frontiers of Formation, Acceleration, Coupling, and Transport Mechanisms Observed by Outer Space Research System that is proposed as a multi-satellite formation flight mission. This will be a community exploration mission in Japanese space research after the success of the ERG mission. The working group was approved by ISAS, JAXA this year, and we have started the discussion on detailed science targets, instrumental design, feasibility and so on. We mainly concern on visible and ultraviolet remote imaging of aurora and airglow for this mission. A visible imager (VISAI) on FACTORS will measure small-scale auroral structures at a wavelength of auroral prompt emission line, such as N2 1<sup>st</sup> PG, with high-time (~0.1s) and high-spatial (~1km) resolutions using a science CMOS or EMCCD. The FOV of 8 x 8 deg covers an area of 400 x 400 km viewed from 3000 km altitude. The high-spatial and high-time resolution imaging data is essential to understand small-scale variations of Alfvén aurora, pulsating aurora, etc. Combined with particle and electric/magnetic field data by FACTORS, we will reveal the time and spatial variations of acceleration/scattering process in the complicated magnetosphere-ionosphere coupling system. A far-ultraviolet imager (FUVI) adopts a wide (~40 x 40 deg.) FOV objective mirror system which covers ~2500 x 2500 km area viewed from 3000 km altitude. We plan to adopt a filter wheel in FUV imager to change the wavelength between O 135.6 nm and the N2 LBH band at 140-160 nm. Wide-field multi-wavelength FUV images enable us to examine large-scale auroral dynamics like westward-travelling surge during substorm, omega-bands, and provide us to understand the global thermospheric activity from O/N2 airglow ratio. This year we plan to carry out specific studies for CMOS/EMCCD detectors

suited for this mission, and perform radiation tests of detectors.

Related to the future FACTORS mission, we are now carrying out the developments of aural cameras for two sounding rocket projects, G-CHASER (Rocksat-XN) and LAMP. The G-CHASER (Rocksat-XN) rocket was successfully launched from Andøya, Norway on January 13, 2019. We installed an auroral camera (AIC) on this rocket to measure N2 1<sup>st</sup> PG emission with wide-angle FOV lens (96x75 deg), RG-665 filter, and CCD (WAT-910HX). In addition, we are developing two CMOS cameras AIC2 on the LAMP rocket that is scheduled to be launched at Poker Flat Research Range in winter of 2019. AIC2 will be installed on a despun platform to derotate rocket spin. One CMOS camera AIC2-S1 measures N2 1<sup>st</sup> PG emission with a narrow FOV lens (F-number=0.95, f=17mm, FOV=27x27deg.), and another CMOS camera AIC2-S2 measures OI 844.6nm emission with a wide-angle lens (F-number=1.6, f=3.5mm, FOV=120x120deg.). Both cameras adopt the ZWO ASI 180 MM CMOS detector. AIC2-S1 will take fine structure of PsA in the region more than 100 x 100 km area around the magnetic footprint with a few kilo-meter resolution, while AIC2-S2 will obtain an altitude distribution of pulsating aurora in the F-region as well as distribution of PsA in wide-range. The precise imaging and altitude distribution of PsA are obtained with AIC2 at two wavelengths with 10Hz sampling. The imaging data combined with precipitating electron data in the wide energy range enable us to investigate the relativistic electron precipitation called microbursts that is probably caused by chorus waves in the magnetosphere.

キーワード：磁気圏、オーロラ、イメージャー、紫外、可視、電離圏

Keywords: magnetosphere, aurora, imager, ultra violet, visible, ionosphere