

Science and Technology Group Annual Report FY2025

Ryuho Kataoka
Principal Research Scientist

1. Introduction

Ryuho Kataoka has been studying space physics, such as aurora and space weather, as the PIs of AuroraX project (G01: international all-sky camera network over Antarctica, since 2022) as the Visiting Associate Professor of NIPR (R02) and SMRAI project (G02: AI emulator for auroral space weather forecast and data assimilation, since 2024).

He has been serving as the Co-I of space weather team of International Space Station (G03: cosmic ray telescope project called CALET).

He is designing and building a tiny all-sky imager called TPI (see photo, I01) for auroral observations on the Earth and Mars (G04), with professional teaching activities as the External Associate Professor of the University of Tokyo (R03, L02, L03).

Roles (3)

R01: Visiting Fellow, Seikei Gakuen, Tokyo

R02: Visiting Associate Professor of National Institute of Polar Research, Tokyo

R03: External Associate Professor, The University of Tokyo

Fundings/Grants (4)

G01: JARE-AJ1007: Antarctic all-sky camera project: 6.2 M Yen for FY2025

G02: KAKNHI Kiban A, 24H00277: AI x Space Weather; 13 M Yen for FY2025

G03: KAKNHI Kiban S, 24H00025: ISS space weather co-I; 0.2 M Yen for FY2025

G04: NEW (accepted) from FY2026: SX-CRANE, 100 M Yen for 5 years till FY2030

Lecture/Teaching students (4)

L01: Space Plasma Physics, 105 min x 7, The University of Tokyo, 2025/9/29; 9/30; 10/1

L02: Kyutaro Yanagisawa, The University of Tokyo, M2; OIST visit for camera development 2025/6/16-20; 7/22-25; 10/9-11.

L03: Yukino Sato, SOKENDAI/NIPR, M1; OIST visit for camera development 2025/6/9-12; Alaska field trip 2025/ 9/17-23

L04: Miki Kurihara, JAXA/Univ. Tokyo, D3; OIST visit for ISS data analysis; 2026/1/30-2/19

2. Activities and Findings

A01: RK discovered unusual auroral appearance over Japan during extreme magnetic storms via Japanese literature survey as well as citizen science (P01, P02, P03, P04)

A02: RK newly developed TPI (Triple Pass Imager), using multi band-pass filter and RGB sensor (paper submitted), via the auroral observation in Alaska (T02)

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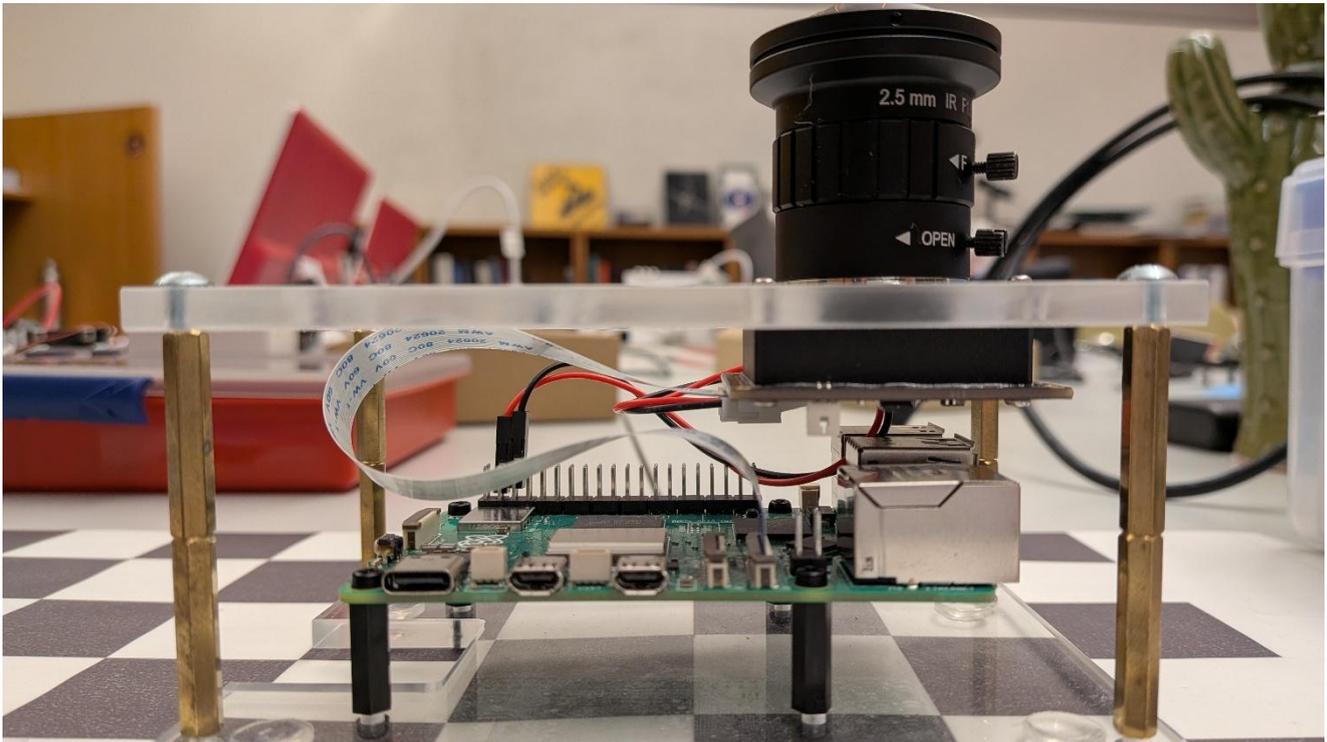


Photo of TPI (paper submitted, I01)

3. Collaborations

C01: AuroraX project collaboration is ongoing (G01: P09, P12, P13). Related student visited OIST (L03).

C02: SMRAI project, AI assisted study of space weather forecast via data assimilation is ongoing (G02: P07, P08), in collaboration with ISM, NICT, and NIPR, Japan. Dr. Nilam Bhosale, colleague and the project researcher at OIST, applied the new model to study actual auroral substorm events (paper submitted).

C03: ISS CALET space weather collaborations are ongoing (G03: P06, P10, P11). Related students visited OIST (L02 and L04) to study relativistic electron precipitation events (papers submitted).

4. Publications and other output

Peer-reviewed papers (First author 3; Co-author 11):

P01. Kataoka, R. (2026a), Red sign of Tachibana Soken Denrai Nencho Nichiroku, *The Bulletin of the National Institute of Japanese Literature*, Japanese Literature Vol. 52, 185-206.

P02. Kataoka, R. (2026b), Red sign records in 1770, *Report on Investigation and Research*, No. 46, 393-416.

P03: Kataoka, R. et al. (2025). "Extended red aurora associated with super substorm igniting the October 10, 2024 magnetic storm as revealed by citizen science" *Earth, Planets and Space*. 77, 64
<https://doi.org/10.1186/s40623-025-02178-w>

P04. Nakayama, T., and R. Kataoka (2026), Faint red auroras as seen from Japan associated with intense magnetospheric compression, *J. Space Weather Space Climate*, accepted. <https://doi.org/10.1051/swsc/2026004>

P05: Hayashi, Y., K. Munakata, M. Kozai, R. Kataoka, et al. (2026), Real-time monitoring of the rigidity spectrum of large Forbush decreases in May and October 2024 with the paired neutron monitor and muon

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detector at the Antarctic Syowa Station, *Earth, Planets and Space*. accepted. <https://doi.org/10.1186/s40623-026-02386-y>

P06: Miyahara, H. et al. (2026), Extremely Active Sun from 1190 to 1220 in the Medieval Period: Intercomparison of Historical Records and Tree-ring Carbon-14, *Proceedings of the Japan Academy, Ser. B*, accepted.

P07: Adriani, O. et al., CALET collaboration (2026), Charge-sign dependent drift effects in the time-lag of cosmic-ray variation relative to solar activity observed with CALET, *Progress of Theoretical and Experimental Physics*, ptag025, <https://doi.org/10.1093/ptep/ptag025>

P08: Nakano, S., Kataoka, R., and Nose (2025). "Climatology of Pi2 pulsations deduced from the Wp index" *Journal of Geophysical Research: Space Physics*, 130, e2025JA034345. <https://doi.org/10.1029/2025JA034345>

P09: Nakano, S., Reddy, S. A., Kataoka, R., Nakamizo, A., Fujita, S., and Yukimatu, A. S. (2025). "Data assimilation into a machine learning-based emulator of a global MHD simulation for analyzing the polar ionosphere" *Space Weather*, 23, e2025SW004488 <https://doi.org/10.1029/2025SW004488>

P10: Tanaka, T., Ebihara, Y., Watanabe, M., Fujita, S., & Kataoka, R. (2025). Roles of plasma sheet flow, plasma sheet dissipation and the M-I coupling in reproducing the substorm with the global simulation. *Journal of Geophysical Research: Space Physics*, 130, e2024JA033606. <https://doi.org/10.1029/2024JA033606>

P11: Adriani, O. et al. (CALET Collaboration) (2025). "Precision Spectral Measurements of Chromium and Titanium from 10 to 250 GeV/n and Sub-Iron to Iron Ratio with the Calorimetric Electron Telescope on the International Space Station" *Physical Review Letters*. 135, 021002. <https://doi.org/10.1103/py17-74rk>

P12: Zhang, X.-J., Artemyev, A., Katoh, Y., Hsieh, Y., Angelopoulos, V., Torii, S., et al. (2025). "Exploring outer radiation belt losses from the International Space Station" *Geophysical Research Letters*. 52, e2025GL116966. <https://doi.org/10.1029/2025GL116966>

P13: Mitthumsiri, W. et al. (2025). "Ground-based Observations of Temporal Variation of Cosmic Ray Spectrum during Forbush Decreases" *ApJL*, 986, L7. <https://doi.org/10.3847/2041-8213/add7d1>

P14: Murase, K., Kataoka, R., Tanaka, Y., Nishiyama, T., Hashimoto, T., Sato, K. (2025). Atmospheric ionization caused by EMIC-wave driven energetic electron precipitation at auroral latitude. *Geophysical Research Letters*, 52, e2024GL114248. <https://doi.org/10.1029/2024GL114248>

Incoming paper (First author 1; Co-author 2), under minor revisions

I01: Kataoka, R., et al. (2026), Compact all-sky auroral imager using multi band-pass filter and full color sensor, submitted to *Earth, Planet and Space*.

I02: Miyahara, H. et al., (2026), High-precision measurements of carbon-14 and its application for the space weather and space climate, submitted to *Phil. Trans. R. Soc. A*. doi:10.1098/rsta.10.1098/rsta.2025.0260

I03: Sato, T. et al. (2026), Estimation of Global Increase of Radiation Dose Rates during the Ground Level Enhancement on 11-12 November 2025 using WASAVIES, submitted to *Space Weather*.

Books (1)

B01: 『博士が愛した論文』, 共著 19名, 日経ナショナルジオグラフィック, 2025/10/6

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Newspapers (5)

- N01: 琉球新報, 「オーロラ研究者、沖縄に OIST の片岡龍峰博士 科学を身近に伝える活動も」, 2025/7/22
- N02: 沖縄タイムス, 「オーロラの実験を解明したい」 OIST 片岡龍峰さん、常識が変わった火星に注目 探査機カメラ開発に取り組む, 2025/8/22
- N03: 北海道新聞, 「市民の目、研究に一役」, 新五感紀行, 2025/10/21
- N04: 琉球新報, 「科学と金融 地域課題解決へ OIST 研究者ら 持続可能な未来議論」, 2025/11/7
- N05: 少年写真新聞, 理科教育ニュース, 「オーロラが発生する原理」, 2026/2/8

Selected Presentations (5)

- T01: Kataoka, R., Citizen science and Bayes inference of auroral oval evolution during super storms, JpGU 2025, May 27, 2025 (Oral)
- T02: Kataoka, R., B. Nilam, S. Nakano, S. Fujita, A. Nakamizo, and S. A. Yukimatu, Ionospheric space weather forecast by the data assimilation of SuperDARN data with AI emulator, JpGU 2025, May 27, 2025 (Poster)
- T03: Kataoka, R., B. Nilam, S. Nakano, S. Fujita, A. Nakamizo, and S. A. Yukimatu, Subauroral Joule-heat estimate using SuperDARN data assimilation via AI emulator of REPPU global MHD simulation, SGPSS, November 25, 2025 (Oral)

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T04: Nilam, B., R. Kataoka, S. Nakano, S. A. Reddy S. Fujita, A. Nakamizo, and S. A. Yukimatu, SuperDARN data assimilation for isolated substorm dynamics: machine emulator approach, NIPR Symposium, December 4, 2025 (Invited)

T05: Nilam, B., R. Kataoka, S. Nakano, S. A. Reddy S. Fujita, A. Nakamizo, and S. A. Yukimatu, T. Bag, Joule heat energetics of substorms and non-extreme geomagnetic storms in 2023-2024 by using SuperDARN data assimilated AI emulator, AGU Fall Meeting 2025, December 17, 2025 (Poster)

Science Education and Public Engagement (10)

S01: Research talk (about citizen science) for Onna Elementary School students at OIST B250, April 28, 2025

S02: Talk session (about sustainable space) for KOZAROCKS, July 11, 2025

S03: Career talk for Nago High School student at OIST B250, July 18, 2025

S04: Research talk for Kadokawa Dwango High School Summer Camp students, August 6, 2025

S05: Research Talk for OIST Kids Campus Tour 2025, August 22, 2025

S06: Talk session (about science x finance) at OIST B250, FDSF Japan Tour in Okinawa, October 29, 2025

S07: Book Club #1 at OIST Science Studio, Yun-Labo Mirai-Kan, December 6, 2025

S08: Textbook for science teachers and poster, Introduction of Aurora, Junior's Visual Journal, February 8, 2026

S09: Book Club #3 at OIST Science Studio, Yun-Labo Mirai-Kan, February 14, 2026

S10: Research talk (about Mars aurora) for Onna Elementary School students at OIST Auditorium, March 12, 2026

Arranging Seminar/Workshop/Symposium (5)

W01: JpGU Space Weather and Space Climate Session Convener, Makuhari, Chiba, May 25-30, 2025

W02: Mars Aurora Workshop, OIST Lab4 E01, August 28-29, 2025

W03: Prof. Kanako Seki seminar, OIST Lab5 D23, August 29, 2025

W04: Arts and Science Workshop, OIST B503, November 10, 2025

W05: Aurora Modeling Symposium, OIST B250, January 19-23, 2026