

**Computational Astrophysics Laboratory**  
**Chief Scientist: Toshikazu Ebisuzaki (Ph.D.)**



**(0) Research field**

CPR Subcommittee: Physics,

**Keywords:**

high performance computing, space debris, Blackhole, adaptive optics, origin of life

**(1) Long-term goal of laboratory and research background**

In our laboratory, we explore the method of control of thermal blooming effect of a laser beam propagating through turbulent atmosphere in Innovative Science and Technology Initiative for Security, ATLA, Japan. In addition, we promote EUSO (Extreme universe Space Observatory) project to detect ultra-high energy cosmic rays ( $\sim 10^{20}$ eV) and identify the source objects. Furthermore, we study the cosmic-ray acceleration by wakefield acceleration on an accreting blackhole.

**(2) Current research activities (FY2019) and plan (until Mar. 2025)**

① To study thermal blooming effect by a high intensity laser beam, we developed beam propagation code. In addition, we made thermal blooming chamber to measure the absorption coefficient.

②. In the JEM-EUSO collaboration, we launched the mini-EUSO telescope with a diameter of 25 cm to the International space station. It was attached to the UV transparent window and have been observing the dark side of the Earth in near UV region, for the first time. It has already provided us many valuable observations of atmospheric discharge phenomena and meteors.

③ We constructed wakefield acceleration theory in the jets of an accreting blackhole and apply to the microquasars ( $\sim 10M_{\odot}$ ), intermediate BH objects ( $100\sim 1000M_{\odot}$ ) nucleus of Seyfert galaxies ( $\sim 10M_{\odot}$ ), radio galaxies and blazars ( $10^7\sim 10^9 M_{\odot}$ ) and compared with the observation of neutrinos and gamma-rays as well as cosmic-rays.

④ We joined “Large Scale Computational Science with heterogeneous many-core systems” project funded by MEXT, and developed a 2-dimensional FFT code and a beam propagation code. The source codes are available to public on the project home page. We also organized the project meetings and workshops bimonthly and distributed the scientific results on the home page. Furthermore, we had developed software for genome analysis “PZLAST” for “SATSUKI”, a heterogeneous many-core system of our laboratory. The system was developed in collaboration with National Institute of Genetics and had been opened to public.



Fig.1 Mini-EUSO installed in the Russian module of the International space station

### (3) Members

as of March, 2020

#### (Chief Scientist)

Toshikazu Ebisuzaki

#### (Research Staff)

Yoshiyuki Takizawa

Tomoki Matsuyama

Marco Casolino

Naoto Sakaki

Yoshiaki Kato

Lech Piotrowski

Junichiro Makino

Tomohiro Tsukihana

Iriko Kaneko

#### (Student Trainee)

Antonio Montanaro

#### (Assistant and Part-timer)

Tomoko Ohata

Shigeru Sato

Norio Tajima

Akane Shiho

Midori Takizawa

### (4) Representative research achievements

1. "Wakefield acceleration towards ZeV from a black hole emanating astrophysical jets", Toshikazu Ebisuzaki, Toshiki Tajima, **International Journal of Modern Physics A**, 34, (2019).1943018,
2. "Wakefield acceleration", Toshiki Tajima, X. Q. Yan, Toshikazu Ebisuzaki, **Reviews of Modern Plasma Physics**, 4-7, (2020).235
3. "Secondary cameras onboard the Mini-EUSO experiment: Control software and calibration", Turriziani S., Ekelund J., Tsuno K., Casolino M., Ebisuzaki T., **Advances in Space Research**, 64, (2019).1188-1198
4. "Mini-EUSO data acquisition and control software", Capel Francesca, Belov Alexander, Cambie Giorgio, Casolino Marco, Fornaro Claudio, Klimov Pavel, Marcelli Laura, Piotrowski Lech W., Turriziani Sara, **Journal of Astronomical Telescopes**, 5, (2019)1-1
5. "Large Scale Computational Science with heterogeneous many-core systems", Ryutaro HIMENO, Toshikazu EBISUZAKI, Junichiro MAKINO, Hide SAKAGUCHI, Mikito FURUICHI, Tadashi YAMAZAKI, Tadashi, ISHIKAWA, and Ken KUROKAWA, **Large Scale Computational Science with heterogeneous many-core systems** 1(2020)

### Laboratory Homepage

[https://www.riken.jp/en/research/labs/chief/comput\\_astro/index.html](https://www.riken.jp/en/research/labs/chief/comput_astro/index.html)

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