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 (~10^{20}eV) and identify the source objects. Furthermore, we study the cosmic-ray acceleration by wakefield acceleration on am accreting blackhole.

(2) Current research activities (FY2020) and plan (until Mar. 2025)

①To 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. In fiscal year 2020, we produced adaptive optics code in C. As a result usual Linux work station can perform by factor of 100 compared with the MATLAB code. Furthermore, as for the wide field telescope, we manufacture the rear lens in FY2020. We also integrate lens and optical sensor into the frame and evaluated it performance. We found the optical throughput as 405nm light is as high as 85%(Figure).

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.

③We constructed wakefield acceleration theory in the jets of an accreting blockhole and apply to the microquasars (~10$M_\odot$) , intermediate BH objects (100~1000$M_\odot$) nucleus of Seyfert galaxies (~10$M_\odot$) , radio galaxies and blasars (10^7~10^9 $M_\odot$) and compared with the observation of neutrinos and gamma-rays as well as cosmic-rays. The results are summarized in a review paper (2).

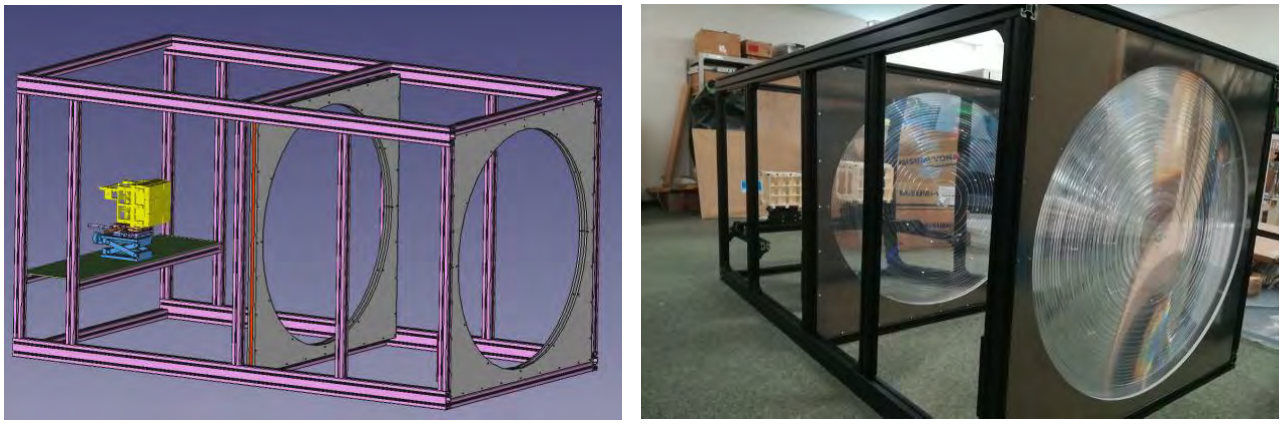

Figure: The drawing of the wide field telescope (left) and that manufacture (right).

(3) Members as of March, 2021

(Chief Scientist)
Toshikazu Ebisuzaki

(Research Staff)
Yoshiyuki Takizawa
Tomoki Matsuyama
Marco Casolino
Naoto Sakaki
Yoshiaki Kato
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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. "Astrophysical wake acceleration driven by relativistic Alfvenic pulse emitted from bursting accretion disk" ,Toshikazu Ebisuzaki, Toshiki Tajima, **Astroparticle Physics,** 128, 102567(2021)
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
http://atlas.riken.jp/en/