

**滞在型研究員報告書**  
**Activity Report for the NAOJ Visiting Fellows Program**

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|-----------------------------------|-----------------------------------------------------------------------------------------|
| 所 属<br>(Institution)              | Max Planck Institute for Extraterrestrial Physics and<br>Technical University of Munich |
| 氏 名<br>(Name)                     | Roland L. Diehl                                                                         |
| 研究課題名<br>(Research subject)       | Cosmic radioactivity and high-energy astrophysics                                       |
| 滞在期間<br>(Period of stay)          | 2016 年 5 月 26 日～ 2016 年 6 月 25 日<br>YYYY MM DD YYYY MM DD                               |
| 受入責任者氏名<br>(NAOJ host researcher) | Toshitaka Kajino                                                                        |

1. 滞在型研究員として国立天文台滞在中に行った活動について簡単にお書きください。  
(Summarize your activities during the stay using the NAOJ Visiting Fellows Program.)

With Prof. Kajino and his students and post docs, we had intensive discussion meetings on supernova interiors, on the physical processes and dynamics herein, including the role of neutrinos,  $\alpha$  particles and  $^{44}\text{Ti}$  and  $^{56}\text{Ni}$  isotopes, and the explosion mechanism itself. This resulted in linking observations of high energy radiation (gamma rays from  $^{44}\text{Ti}$  and  $^{56}\text{Ni}$ ) and neutrinos to the explosion physics.

We also discussed gamma-ray bursts and magnetars, more importantly the variety of end stages including black hole formation, and the links to microquasars and black hole accretion. Converting gravitational energy of accreted matter into radiation and particle outflows is a fundamental physics problem that we addressed. The link to positrons in the galaxy's interstellar medium, alternative origins and annihilation characteristics were discussed. Finally, the link to r-process physics and sources, in particular in the nearby Ret II dwarf galaxy that was recently discussed as a neutron star merger proof, was discussed extensively and towards common future work.

In the first week of my stay, above discussions were initiated. Then, specific projects of Seiji Zenitani, Kanji Mori, Yutaka Hirai, Shota Shibagaki, and Michiko S. Fujii were reviewed, evaluating the status and issues, providing corresponding feedback. I gave two lectures for NAOJ scientists including these students, post docs and junior professor, one on gamma ray telescope instrumentation, and one on the astrophysical implications of a radioactive isotope, exemplified on  $^{26}\text{Al}$ . Visits to three collaborating institutes in the greater Tokyo area at ISAS (Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency), IPMU (Kavli Institute for the Physics and Mathematics of the Universe, The University of Tokyo) and The University of Tokyo at Hongo Campus were made, giving colloquia at each of these, as at NAOJ, in addition to discussions with institute scientists. I also gave an invited talk at the 14<sup>th</sup> International Symposium on Nuclei in the Cosmos. Finally, the graduate course lectures at the Graduate Course of Science, The University of Tokyo were given on high energy astrophysics.

2. 今回滞在型研究員として得られた成果について簡単にお書きください。

(Summarize your research products from the stay.)

The core collapse supernova mechanism includes neutrino oscillation issues, which result in changes to spherical symmetry from amplifications of instabilities, and corresponding  $^{44}\text{Ti}$  ejection differences. The MHD modeling was found not advanced enough to make quantitative comparisons. For SN Ia, the nucleosynthesis calculations will be put on new/improved basis (thesis of Kanji Mori), including lessons learned from gamma ray observations of SN2014J; a collaborative paper is in planning. On r-process sources and in particular the Ret II dwarf galaxy, the consequences of a neutron star merger or a core collapse supernova source are under deeper investigations, considering the INTEGRAL detection of positron annihilation gamma rays from this source; this will be assessed in near future, a collaborative paper is considered here as well.

3. この制度について何か御意見がありましたら、お書きください。

(Please provide any comments about this program.)

Since Prof. Kajino's group integrates observational astronomers and astrophysicists as well as cosmologists and theoretical physicists in Japan, my stay and discussions here at NAOJ Mitaka was therefore very fruitful. He plays internationally important and leading roles in astronomy and astrophysics. This NAOJ fellowship program is an excellent framework for seeding scientific collaboration on specific science topics between scientists at NAOJ with many domestic institutes and even overseas science groups. It provides the support so that contacts, which otherwise only are brief during international conferences, can be deepened enough to set the basis for really collaborative projects. Moreover, it is a very effective program to develop better mutual understandings of science opportunities at the respective institutions. Short-term, but also long-term international science connectivity is helped by this program in a rather direct and, I believe, also very cost effective way.