

The Global COE Program
“The Next Generation of Physics, Spun from Universality and Emergence”
Bilateral International Exchange Program (BIEP, invite) report

Send report to: Your responsible Professor in Kyoto University

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(Year/Month/Day) 2010/11/21

Invited Student

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Research Project

Title	Study on Light Curves for Peculiar Supernovae/GRBs
Duration	Aug. 20, 2010 --- Nov. 18, 2010

Please summarize your activities and results during your stay in Kyoto University. Also please describe how your stay has been beneficial to the graduate students in the institute. You can add a sheet, if you need more space.

You can also write any comments and requests to the GCOE program.

During my stay at Yukawa Institute of Theoretical Physics, Kyoto University, Prof. Shigehiro Nagataki is my supervisor. He is a specialist in high energy astrophysics, especially, Gamma-ray Bursts (GRBs). GRBs are the most powerful explosion in the universe and their outflows are confirmed to be ultra-relativistic. They are considered as promising candidates as sources of high energy cosmic rays, and related with supernova explosion and neutron stars. My major is also high energy astrophysics and my research interests are also GRBs, supernovae and compact stars. So I discussed with Prof. S. Nagataki several times a week. I have learned a lot form the discussions. In the course of the discussions, we find some new ideas and decide to study on failed GRBs and the some peculiar supernovae, such as SN 2007gr and SN 2008iy.

At first, we studied the emissions from failed GRBs. Failed GRBs are different with ordinary GRBs. The Lorentz factors of failed GRBs are much smaller than those of ordinary GRBs. Our work shows that the photosphere of “Failed GRB” whose bulk Lorentz factor is much lower than 100 can be outside of internal shock.

Our conclusion is as follows: The resulting radiation from the photosphere is thermal and bright in UV/Soft X-ray band. The photospheric emission lasts for about one hundred seconds with luminosity about several times 10^{48} erg/sec. These events can be observed by current and future satellites. We also conclude that the afterglows of failed GRBs are peculiar at the early stage which makes it possible to distinguish failed GRBs from ordinary GRBs and orphan GRBs. We have submitted this paper to a refereed journal with Prof. Y.-F. Huang.

Secondly, we studied a Type Ic supernova SN 2007gr. The velocity of outflows of this supernova is controversial, either relativistic or non-relativistic. Here, we propose an off-axis relativistic jet model to explain its peculiar light curves. Our work shows that the multiband emissions of theory are consistent with the observation. It is found that the parameters of SNe jet model are different with GRBs jet model. This study is still on-going with Prof. Y.-F. Huang, and it will be submitted to a refereed journal in the very near future.

At last, we also studied an unusual Type IIn supernova SN 2008iy. The peculiar characteristic is its long-term rising phase (~ 400 days) in light curves. We suggest that this phase is resulted from magnetic reconnection process in a clumped wind. This work is still on-going with Prof. Y.-F. Huang.

During the stay of three months at YITP, I have enjoyed a pleasant time. Thank Prof. S. Nagataki very much for inviting me to the institute. I met many good friends here and I am honored to have the opportunity to work with them. I would like to thank Junichi Aoi for helpful discussions and Secretary Kuniko Tsuruhara for excellent accommodation.

YITP hosts a number of workshops on various topics and I have listened to some very interesting reports. It is pleasure to talk with Tsvi Piran and Guido Chincarini at the institute. I am so much obliged to the bilateral international exchange program (BIEP) of the global center of excellence (GCOE) program "The Next Generation of Physics, Spun from Universality and Emergence".

This visit has grave influence and significance to my graduate study. Prof. S. Nagataki's enthusiasm for scientific research has affected me greatly. I hope we have a cooperative opportunity in the future.