

**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)\_\_\_\_\_

**Invited Student**

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**Responsible Researcher in Kyoto University**

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**Research Project**

Title	Study of Galactic Black Hole Binaries with Suzaku
Duration	1 month (May 2012)

**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 host 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 Kyoto University I focused on learning astronomical X-ray data reduction from the Japanese Suzaku X-ray satellite. The members of the astrophysics group at Kyoto are active members in both the Suzaku and the Monitor of All Sky X-ray Image (MAXI) teams and therefore Kyoto was the ideal place for me to visit and collaborate with the group. The Suzaku satellite's high pile up limit and a uniquely broad energy band, together with its excellent low energy calibration, makes it one of the best X-ray observatories in the world for detailed spectral analysis. The knowledge of calibration and instrumental effects is absolutely essential for a detailed analysis of all relativistically smeared atomic features seen in the time-averaged energy spectra of compact objects.

My main science goal was to obtain excellent quality accretion disc spectra from the black hole binary LMC X-3, and that goal was met with success. From the data I went on to test the currently best physical accretion disc model and saw that the model does not describe the data well at low energies in the soft X-ray band pass. This discrepancy will also affect the way the rest of the spectrum is modelled, and therefore make a big contribution to the final interpretation of the observation. These data will now be used to try and measure the black hole spin from this source,

Source, and combine it with similar data from the XMM–Newton satellite. Black hole spin is currently a very controversial topic in both stellar and super–massive black holes. It is a fundamental characteristic of a black hole, but unlike mass it leaves a mark on space–time only very close to the event horizon, and is therefore more difficult to measure. Understanding what drives the black hole spin and its evolution requires in–depth understanding of the instruments as well as the data analysis methods. The spin leaves only minor traces in the data, and often these small characteristics are not even the most significant features in the continuum. Resolving the spin controversy is crucial in expanding the knowledge to other spinning object such as neutron stars and active galactic nuclei. I will submit this work for publication to one of the world–class science journals.

While at Kyoto University I attended the weekly lunchtime seminars that were held in English for the purpose of the local graduate students to improve their language skills. I gave a talk on the life of a graduate student in the UK in one of these sessions. I also gave a scientific seminar at the university on my work on modelling the X–ray spectra of black hole binaries, which prompted interesting discussions in the audience. I imagine all of these discussions were very beneficial to everyone involved.

I am very grateful for the GCOE program for allowing me to visit Kyoto University, one of the top universities in the world, and to work with people who are directly involved with the space satellite programs such as Suzaku and MAXI. During my stay there I acquired professional skills that are essential to my future career as well as made interesting contacts with many new colleagues in Japan. I hope to get a chance to come back to Kyoto again soon.