

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**

Name	Timothy Clunan
University and Country	Cambridge, UK
Grade	PhD Student
Phone and FAX	
e-mail address	tpc29@cam.ac.uk
URL	
Name and Position of Ph.D. advisor	Prof. S. Hawking, Lucasian Professor
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**Responsible Researcher in Kyoto University**

Name	Prof. M. Sasaki
Group and Faculty	Astrophysics
Position	Professor
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**Research Project**

Title	Higher derivative theories of gravity
Duration	3 months

**Please summarize your activities and results during your stay in Kyoto University .  
You can add a sheet, if you need more space. You can also write any comments and requests  
to the GCOE program. We will appreciate them.**

My time in Kyoto has been very interesting and fruitful. I have mainly been working on ghosts in consultation with Prof. Sasaki, but I have also had very useful discussions with others, notably Prof N. Deruelle who was also visiting Kyoto. Prof. Deruelle and I exchanged notes on the literature and I learnt about some great papers of significant relevance to my work. We discussed the two obvious approaches to the problem. We decided that it would be instructive to work on the problem in our two different approaches. Their approach (Deruelle, Sasaki, Sendouda) is to use the Hamiltonian formalism and try to be as general as possible, our approach (TC, Sasaki) is to construct the wavefunction in the specific case of a de-Sitter background (hence this will approximate slow roll inflation too) using the Euclidean formalism, and also consider the Hamiltonian approach in this simplified case. Since the construction of the Hamiltonian is interesting we have also done some work on this. I have added to what the group knew about the literature in various ways, including specific sectors where one finds ghosts and also a solution to the problem of ghosts in a simple theory in the case of the Euclidean approach. I am presently writing up my work so that other members of the group can see some of the problems I have solved.

Besides my main work on ghosts I have also performed some exploratory work on non-Gaussianity with Dr. F. Arroja. We were looking numerically at the effect of shape on the four-point function. This work is very much in its embryonic stages and we will continue this after I return to Cambridge.

If I had not been concentrating on work so much I would have enjoyed spending more time learning Japanese. Doubtless this would have been helpful for my stay as I would have been able to make myself better understood, particularly in situations outside of the institute. As far as I know the GCOE program doesn't provide financial support for Japanese classes. This would be a nice addition.