

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

gcoe-biep@scphys.kyoto-u.ac.jp , gcoe-office@scphys.kyoto-u.ac.jp

(2011/01/19)_____

Invited Student

Name	Ali Akbar Abolhasani
University and Country	Sharif University of Technology and IPM, Iran
Grade	PhD student
Phone and FAX	+98 (21) 22 28 06 92
e-mail address	abolhasani-AT-ipm.ir
URL	
Name and Position of Ph.D. advisor	Hassan Firouzjahi, Department of Physics, IPM.
e-mail address of Ph.D. advisor	firouz-AT-ipm.ir

Responsible Researcher in Kyoto University

Name	Misao Sasaki
Group and Faculty	Astrophysics and Cosmology
Position	Professor
e-mail address	misao-AT-yukawa.kyoto-u.ac.jp
Phone and FAX	+81-75-753-7043 (office), +81-75-753-7058 (secretary) +81-75-753-7071 (Fax)

Research Project

Title	Cosmological Perturbation Theory and non-Gaussianities
Duration	Oct. 25, 2010 – Jan. 21, 2011

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.

First of all I would like to thank Prof. Misao Sasaki and Kyoto University for giving me the opportunity to participate In GCOE BIEP program.

My field of research is early universe cosmology, focusing on cosmic inflation, cosmological perturbation theory and non-Gaussianities. These are active fields of researches and Prof. Sasaki is a leader of these fields.

The aim of my visit was to strengthen my studies of cosmological perturbations and non-Gaussianities. In my previous works in Iran we studied models of hybrid and double inflation. After these works, Prof. Sasaki, my supervisor at YITP, suggested that I continue my investigations on this model, searching for possible large non-Gaussianities. I started the work by doing some numerical analysis based on my previous codes. The initial attempts were not successful

but fortunately after some fruitful discussions we found a new model of double inflation with very interesting results. After many constructive discussions with Prof. Sasaki I obtained a better view of the model with the right way of performing the analysis. Indeed Prof. Sasaki's advices were crucial for these developments. In collaboration with my advisor in Iran, we are finishing this project. Hopefully the paper based on this research will appear in next few weeks.

I hope I can continue my collaboration with Prof. Sasaki and his group in future. I would like to mention that working under the supervision of Prof. Sasaki was a unique opportunity for me to improve my knowledge of cosmological perturbation theory, inflation and many related topics.

The motivation and abstract of my research in Kyoto are as follow:

The primordial non-Gaussianities provide valuable information beyond the curvature perturbations power spectrum. This information can be used to discriminate among different scenarios of inflation. Recently, this has led to vast investigations on primordial non-Gaussianities. Current data are consistent with negligible non-Gaussianities but ongoing and future observations, such as PLANCK, can measure non-Gaussianities to higher precisions. Detecting a non-zero value of non-Gaussianity will have profound implications for inflation model building. For example simple single field scenarios of inflation will be ruled out if appreciable amount of non-Gaussianity is detected.

In this work we consider a model of double inflation with the range of parameters that has not been investigated. Namely, we consider a model in which the initial vacuum-dominated inflation is destabilized by a tachyonic field. This is similar to the water-fall in hybrid inflation except that the tachyonic mass is at the same order of magnitude as H , the Hubble expansion rate during inflation. In this case, both the quantum fluctuations and the self-interaction of the tachyonic field play important roles at the second stage of inflation. We compute the curvature perturbation power spectrum and the non-Gaussian parameter f_{NL} . We find that the spectrum is blue on large scales, peaked at the scale of the tachyonic transition, and red on small scales. Furthermore, f_{NL} can be large enough to be detected for reasonable range of parameters.

During my visit I also received the referee report for one of my earlier work submitted to the journal. Fortunately Prof. Sasaki has published a paper on the same topic. This was a good opportunity for me to have useful discussions with him on this topic. His advices were very helpful for us and we have employed his comments to clarify some issues in our previous work.

In principle, exchange programs can provide good opportunities for students of Kyoto university to make use of experiences of foreign students. I think this program can also encourage them and provide them with wide scientific relations. Specifically, in my case, I had vast discussions with the students both on scientific issues and cultural issues. I tried to make good relations with all student, asking them about their works and in some cases following their progress and encouraging them. Also I had very good discussions with one of the students about his thesis and I helped him with writing his thesis.

During our stay in Kyoto, me and my wife have visited many beautiful temples, shrines, museums. We also enjoyed the fantastic natural sceneries of Kyoto. We also tried to find out more about Japanese culture and traditions by both direct observations and constructive discussions with other students. I am highly impressed by many nice aspects of Japan's culture such as the sense of social cooperations and collaborations which I think are among the most important factors of Japanese culture.

Finally, I would like to thank again all people who helped me during my stay here, specially Prof. Sasaki, my roommates and the students of cosmology group. Also I would like to thank YITP staff who tried to prepare a comfortable and fruitful stay for me here specially Ms. Kuniko Tsurahara for all her considerations, kind helps and useful information.