



Part II

ACTIVITY REPORTING FORM ABEL VISTING SCHOLAR PROGRAM

(Deadline for completion: see grant letter)

The progress report should include a brief (one page) activity report prepared by each mathematician supported, listing research in progress, papers published or in preprint form, students and post-doctoral fellows advised and dates spent at the host Institution.

After consideration by CDC, the intention is that this activity report and pictures will be made publicly available on the CDC web site.

1. Name of the Grantee: IBRAR HUSSAIN
2. Country of origin of the Grantee: PAKISTAN
3. Home institution of the Grantee: SCHOOL OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, NATIONAL UNIVERSITY OF SCIENCES AND TECHNOLOGY, ISLAMABAD
4. Name of the institution visited: SCHOOL OF MATHEMATICS, UNIVERSITY OF MINNESOTA
5. Name, position and e-mail address of the host: Peter Olver, Professor, olver@umn.edu
6. Dates of the research visit: 16-07 to 14-08, 2017
 1. **Activity report (at least 400 words)** Listing research in progress, papers published or in preprint form

During my visit to the school of Mathematics, University of Minnesota, USA, I have started a joint research project with Prof. Peter Olver. The title of this project is "Noether and Lie Symmetries of Gowdy Spacetimes and their Physical Interpretation". We have formulated our problem and have started work on its solution. So far we have investigated the Noether and Lie symmetries of some cases with the help of MAPLE. Work is in progress and will be completed soon. In our project we will first study the special case of the Gowdy spacetimes, known as "the polarized case" and then we will look at the general case. Gowdy spacetimes are the cosmological solutions of the Einstein field equations. Therefore, after computing the symmetries and their algebras for these spacetimes we will look at the physical aspects of the new finding. In this direction the work is already started.

During my visit I have delivered a talk in the working seminar series of the school of Mathematics, University of Minnesota. The title of my talk was "Approximate Lie symmetry methods for differential equations in gravity".

2. Students and post-doctoral fellows advised: Nil

3. Including a summary statement (1-2 sentences) of major outcome of research visit:

The Lie symmetry algebra for the polarized case of the Gowdy T^3 symmetric spacetimes is obtained.

4. Planned follow up activities and future implications (2-3 sentences)

The study of the Noether and Lie symmetries of the polarized case of the T^3 symmetric Gowdy spacetimes will be extended to the general case of the Gowdy spacetimes. We will also investigate the Lie and Noether symmetry algebras of the Gowdy spacetimes which are not T^3 symmetric.



Date: 28/08/2017

Signature

Designation: Assistant Professor