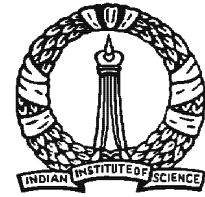**Centre For High Energy Physics**
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14 May, 2014.

To whom it may concern

This is to certify that Animikh Roy has studied under my guidance and completed a project in the month of December 2013, at the Indian Institute of Science, Bangalore.

During the course of his work he first studied the basic ideas behind conformal transformations and the formulation of Penrose Diagrams in Minkowski Space(from The large scale structure of space-time by S.W. HAWKING and G. F. R. ELLIS and Sean Carroll: Lecture Notes on General Relativity). He also studied the various methods of numerical Integration on Mathematica along with other programing techniques necessary to solve basic General Relativity problems using the software. Since Animikh was already familiar with the concepts of spherical gravitational collapse, the Schwarzschild Metric formulation and the Schwarzschild Black-hole. Therefore under my guidance he further studied the Kruskal extension of Schwarzschild Space along with calculations, explanations and the basic Kruskal Coordinate diagrams (from An Introduction to Einsteins General Relativity by James B. Hartle and An Introduction to General Relativity by M.P. Hobson). He implemented the theory of Kruskal coordinates to successfully formulate the Penrose Diagram of a Schwarzschild Black Hole and learnt of its physical significance in a discussion.

In the final part of his project he successfully solved the Innermost-Stable Circular Orbit problem on Mathematica and extended it to find the different types of orbits in Schwarzschild Geometry using specified parameters. For calculations and theory of this problem he has studied the portion from Robert M. Walds General Relativity. I wish him the best.

Sincerely,

Dr. Aninda Sinha,
CHEP, IISc
Bangalore 560012.