Proposal for Microcredit course of 12-14 lectures in Autumn 2019-20

Title of course: Classical Black Holes

Host/ Venue: CTS, IIT Kharagpur

Purpose:

This course is intended for advanced Masters (both Integrated and Lateral-entry) and PhD students aspiring towards a deeper understanding of black hole theory beyond what they may have been exposed to in earlier courses. The purpose is to acquant them with fundamental issues that one encounters in classical black hole physics, and efforts made over the years to overcome them. Many of the topics to be discussed are active areas of research, and exposure to them is expected to aid students already working on research areas, as well as younger students who are strongly motivated towards research in black hole theory.

Outline of topics:

1. Preliminaries : Why study black holes ?

2. Examples: Spherically symmetric and axisymmetric event and Cauchy horizons.

3. Uniqueness theorem on Kerr type black holes (no detailed proofs).

4. Laws of mechanics for event, isolated and dynamical horizons entropy.

5. Radiant black holes : Hawking radiation and information loss puzzle.

6. Energy extraction: Penrose process, Superradiance and Blandford-Znajek effect.

7. Acoustic Black Holes : prospects for observation of Hawking radiation of phonons, super-resonance and Lense-Thirring precession

References:

1. General Relativity by N. Straumann.

2. General Relativity by R. M. Wald.

3. A Relativists Toolkit by E. Poisson.

4. Quantum Field Theory in Curved Space by L. Parker.

NOTE: This course was offered in Autumn 2018-19 as TS66001. It ran successfully with 17 registered students.