Proposed broad area of the phd problem (<u>single supervision</u>):

In the recent past, two very important and pathbreaking experiments were performed related to general theory of relativity. First, the detection of gravitational waves and second, the observation of the shadows of the galactic centers for M87 and Milky Way, by the Event Horizon Telescope. Both these observations are proven to be important to test the theory of general relativity in the strong-field regime and to understand the nature of the astrophysical compact objects. The primary focus of the student will be to learn several important aspects of the physics of compact objects and then try to look for the observational signatures of the existence of an event horizon and observationally distinguish between horizonless ultra-compact objects and black holes. From a more bigger perspective, (s)he has to understand the physics of horizonless ultra-compact objects, particularly the formation, the stability as well as the environmental effects (accretion, plasma, magnetic fields etc.) on such objects.

Proposed broad area of the phd problem (<u>joint supervision with Dr. Sovan Chakraborty</u>):

The missing gravity/mass problem in galaxies requires either dark matter, or modification of gravity (sometimes also called modification of inertia) for explanation. These theoretical possibilities of fundamental importance may be distinguished by the statistical relation between the observed centripetal acceleration of particles in orbital motion and the expected Newtonian acceleration from the observed distribution of baryons in galaxies. The student is supposed to work on the various aspects of the galactic dynamics from the perspective of dark matter as well as modification of gravity. Statistical data analysis as well as machine learning tools will be used mostly towards understanding the said problems.