Short Description of GR course at IPMFall-Winter Semester 2015

Lecturer:*M.M. Sheikh-Jabbari*

Relativity, special and general, has been the corner stone of developments in physics in the last century. Relativity on top of the other things, provides a different measurement theory for all observables, that they should be Lorentz invariant or invariant under general coordinate transformations and in this way provides the dictionary to translate measurements of various observers. Based on this general idea and framework, the equivalence principle arises, which is then formulated into the theory of Einstein gravity.

In this course we will start with a description of characteristics and special feature of gravity and how general relativity indeed completes the program Einstein started in special relativity. It is hence assumed that the students are familiar with special relativity. As the preparation to Einstein GR we need some mathematical tools, that is differential and manifold geometries and, tensor and forms calculus. We assume some familiarity with these mathematical frameworks. In the course, after discussing gravitational effects in a given gravity field, we introduce Einstein's equations, through which gravitational field are promoted to dynamical field. We then discuss the structure of Einstein's equations and construct and study some solutions of this theory, including standard Schwarzchild and Reissner-Nordstrom black holes, (weak) gravitational waves and Kerr and Kerr-Neuman geometries.

The main text of the course will be the book by
N. Straumann,
General Relativity, 2nd edition
By Springer, 2013.

Notes:

1. I expect the students to cover the mathematics needed. Part III of the book is a good source for this issue.
2. My intention is to cover sections 1,2,3,4,5, half of 7 and 8.
3. The course will have tutorial sessions, once per week. The time will be fixed later.
4. The classes will be on **Sunday and Tuesday morning 10-12 am** in *Farmanieh Bldg classroom A*. The course will start from **Mehr 12th**.

Interested students are all kindly asked to contact Ms Pileroudi, niloufar@theory.ipm.ac.ir, providing their name, institution (or affiliation) and level (Masters or PhD). For non-IPM students there is the possibility of formally registering for the course as a "guest student". For the latter please arrange the formal details with Ms Pileroudi.