Introduction to General Relativity I: Fall/Spring 2019-2020

M- W- F 10:00 --10:50, 105 Allen Hall

Instructor: Dan Boyanovsky, 208 Allen Hall. ph: (412)-624-9037, e-mail: boyan@pitt.edu
Office Hours: W- F, 4:15 pm to 5:00 pm in 208 Allen : if you cannot make these office hours call me or send me e-mail requesting an appt. (give me a few choices).

Gravity at last: the equivalence of inertial and gravitational mass, the equivalence principle: gravitational redshift and light bending, tidal forces, gravity as geometry. GPS: SR + GR in action. Weak field limit. The geometry of space-time outside a non-rotating spherical star: the Schwarschild metric: consequences, Killing vectors and conservation laws, the gravitational redshift. Particle orbits: advance in the perihelion of Mercury, light bending, radar echo. PPN and solar system tests of GR. Gravitational lensing: thin lenses, microlensing and Machos, macrolensing and Dark Matter. Tidal forces and geodesic deviation, the geodetic effect, Lense-Thirring (frame dragging) and Gravity Probe B-experiment.
The march towards Einstein’s field equations: geometry first, a taste of Riemannian geometry, absolute and covariant derivatives, curvature and the curvature tensor.


Books: I recommend the following outstanding books: I) Modern General Relativity, Mike Guidry, II) General Relativity, an Introduction for Physicists by M. P. Hobson, G. Efstathiou, A. N. Lasenby, III) Gravity an introduction to Einstein’s General Relativity by J. Hartle. Other excellent books are: An introduction to GR: spacetime and geometry by S. Carroll, although this book is more geometric-oriented. S. Weinberg’s Cosmology and Gravitation is a classic and highly recommended. I will borrow material from many
different books. Book I) is more up to date in cosmology and astrophysical applications, II,III) are more pedagogical and a true jewel, the ideal book is a combo of I+II+III +Weinberg, but it does not exist (yet!).

**Format of the course:** One homework problem set (4-5 problems) per week, one take home midterm and a take home final. The final grade is the average of HM+mid+final.