Physics 5392
Relativity II
Spring 2007

Location and times: CB1.122 Tue/Thu 5:30 – 6:45 pm
Instructor: Wolfgang Rindler; e-mail: rindler@utdallas.edu
Office and Office Hours: FO2.716A Tue/Thu 4:15-5:15pm
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Text: W. Rindler, Relativity: Special, General, and Cosmological, 2nd ed.,Oxford UP 2006
Homework: Much emphasis is placed on regular problem solving. Work is always due the Thursday after the week when it was set. Each problem is graded A, B, or C.
Collaborations, with due acknowledgement, are encouraged.
Exams: Midterm Quiz and Final.
Grade: A weighted average of homework, midterm, and final. The midterm grade is not averaged in if it is less than the final.
Prerequisites: Physics 5391 (Relativity I) or instructor's consent.

Syllabus:

This course aims to introduce students to the main ideas of general relativity and relativistic cosmology. It usually covers Chapters 8 through 18 of the text book, with various omissions, depending on class needs.

Ch.8. Curved spaces and the basic ideas of general relativity: curved surfaces, curved spaces of higher dimensions, Riemannian spaces, plan for general relativity.

Ch9. Static and stationary spacetimes: the coordinate lattice, synchronization of clocks, first standard form of the metric, Newtonian support for the geodesic law of motion, symmetries and the geometric characterization of static and stationary spacetimes, canonical metric and relativistic potentials, the uniformly rotating lattice in Minkowski spqace.

Ch.10. Geodesics, curvature tensor and vacuum field equations: tensors for general relativity, geodesics, geodesic coordinates, covariant and absolute differentiation, the Riemann curvature tensor, Einstein's vacuum field equations.

Ch. 11. The Schwarzschild metric: derivation of the metric, properties of the metric, the geometry of the Schwarzschild lattice, contributions of the spatial curvature to post-Newtonian effects, coordinates and measurements, the gravitational frequency shift, isotropic metric and Shapiro time delay, particle orbits in Schwarzschild space, the precession of Mercury's orbit, photon orbits, deflection of light by a spherical mass, gravitational lenses, de Sitter precession via rotating coordinates.

Ch.12. Black holes and Kruskal space: Schwarzschild black holes, potential energy: a general-relativistic 'proof' of E=mc^2, the extendibility of Schwarzschild space, the uniformly accelerated lattice, Kruskal space, black-hole thermodynamics and related topics.

Ch.13. An exact plane gravitational wave (usually omitted).

Ch.14. The full field equations; de Sitter space: the laws of physics in curved spacetime, at last, the full field equations, the cosmological constant, modified Schwarzschild space, de Sitter space, anti-de Sitter space.

Ch.15. LInearized general relativity: the basic equations, gravitational waves, the TT gauge, some physics of plane waves, generation and detection of gravitational waves, the electromagnetic analogy in linearized general relativity.

Ch.16. Cosmological spacetimes: the basic facts, beginning to construct the model, Milne's universe, the Friedman-Robertson-Walker metric, Robertson and Walker's theorem.

Ch.17. Light propagation in FRW universes: representation of FRW universes by subuniverses, the cosmological frequency shift, cosmological horizons, the apparent horizon, observables.

Ch.18. Dynamics of FRW universes: applying the field equations, what the field equations tell us, the Friedman models, once again, comparison with observation, inflation, the anthropic principle.