Syllabus Spring 2015

Introduction to Relativity and Gravitation

Course description. Relativity and gravitation are a central theme in modern astrophysics and cosmology, in high energy astrophysical processes and the formation of large scale structure. An abundance of relativistic effects are found in, for instance, active galactic nuclei (AGN), black holes and neutron stars, gamma-ray bursts and, possibly, core-collapse supernovae. In this course, we will discuss this theme and explore some of their notable consequences in the observable universe including dark matter and dark energy as indicated by modern observational cosmology.

Professor: Maurice H.P.M. van Putten, Room 614

Coordinates: Room 607, TU and TH 13:30-15:00 hr

Reference material. van Putten, M.H.P.M., 2010 "*Gravitational radiation, Luminous Black Holes and Gamma-Ray Burst Supernovae*" (Cambridge: Cambridge University Press) and lecture notes provided in class.

Contents

I. Superluminal outflows from AGN
II. Introduction to manifolds and tensors
III. Relativity in Minkowski space
IV. Covariant formulation of electromagnetism
V. Shocks in astrophysical fluid dynamics
VI. Relativistic fluid dynamics
VII. Riemann tensor in general relativity
VIII. Non-rotating and rotating Black holes
IX. Gavitational waves and gravitational wave sources
X. Entropy, information and holography in spacetime
XI. Black hole solutions from holography
XII. Friedmann-Robertson-Walker equations of cosmology
XIII. Dark energy and dark matter
XIV. Some open questions

Homework. Provided in class

Grading. Based on class attendance, homework, mid-term and final