

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	课程名称 Course Title	广义相对论:从黑洞到宇宙学 General Relativity: from Black Holes to Cosmology				
2.	授课院系 Originating Department	物理系 Department of Physics				
3.	课程编号 Course Code	PHY439				
4.	课程学分 Credit Value	3				
5.	课程类别 Course Type	Major Selective Course				
6.	授课学期 Semester	Spring				
7.	授课语言 Teaching Language	English				
8.	授课教师、所属学系、联系方式 (如属团队授课, 请列明其他授课教师) Instructor(s), Affiliation & Contact (For team teaching, please list all instructors)	Leonardo Modesto, Department of Physics				
9.	实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact	待公布 To be announced				
10.	选课人数限额(可不填) Maximum Enrolment (Optional)					
11.	授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other (Please specify)	总学时 Total
	学时数 Credit Hours	48				48

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	线性代数 A Linear Algebra A (MA107A) 分析力学 Analytical Mechanics (PHY205-15)
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	Advanced quantum field theory
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 N/A

教学大纲及教学日历 SYLLABUS

15. 教学目标 **Course Objectives**

This is a course for students interesting in relativistic astrophysics from the solar system scale to cosmological scale. From a mathematical standpoint they will learn more about linear algebra, tensor calculus, differential geometry, and classical mechanics. From the physical standpoint they will learn the modern geometrical understanding of gravity as curvature of the space-time. In modern physics General Relativity is not anymore a speculative research topic, but a well-tested theory with implications in the everyday life as shown by the application to the "Global Position System" and the very recent discovery of the gravitational waves. Indeed, the latter discovery opens new possibilities of employment for the new generations of experimental as long as theoretical physicists. Moreover, the physics of gravitational waves is only one of the numerous job possibilities offered in astrophysics and cosmology, in public and private institutions, in China and abroad, for which a background in general relativity is needed.

16. 预达学习成果 **Learning Outcomes**

By the end of this course, students will be able to understand the following topics:

- black hole physics,
- cosmology,
- gravitational collapse,
- gravitational waves,
- Einstein gravitational equations.

17. 课程内容及教学日历 (如授课语言以英文为主, 则课程内容介绍可以用英文; 如团队教学或模块教学, 教学日历须注明主讲人)

Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

- 1) Special Relativity in a nutshell. 4 学时
- 2) Short review of linear algebra. 4 学时
- 3) Geodesic principle. 4 学时
- 4) Spherically symmetric Schwarzschild Black Hole. 4 学时
- 5) Rotating Kerr Black Hole and other black hole solutions. 4 学时
- 6) Cosmological spacetimes. 4 学时
- 7) Gravitational collapse. 4 学时
- 8) Tensor calculus and differential geometry. 4 学时
- 9) Einstein Equations. 4 学时
- 10) Einstein-Hilbert Action. 4 学时
- 11) Gravitational waves. 4 学时
- 12) Goedel Universe, wormholes, and time machines. 4 学时

18. 教材及其它参考资料 Textbook and Supplementary Readings

James B. Hartle, GRAVITY, an introduction to Einstein's General Relativity (Addison Wesley).

L. D. Landau and E. M. Lifshitz, The Classical Theory of Fields, Volume 2 (Chapters:1, 2, and 10).

Ray d'Inverno, Introducing Einstein's Relativity.

Other master books:

Charles W. Misner, Kip S. Thorne, and John Archibald, GRAVITATION.

Stephen Hawking and George Ellis, The Large Scale Structure of Space-Time.

课程评估 ASSESSMENT

19. 评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10%		
课堂表现 Class Performance		10%		
小测验 Quiz				
课程项目 Projects				
平时作业 Assignments		20%		

期中考试
Mid-Term Test
 期末考试
Final Exam
 期末报告
Final Presentation
 其它（可根据需要
 改写以上评估方
 式）
Others (The above may be modified as necessary)

	60%		

20. 记分方式 **GRADING SYSTEM**

- A. 十三级等级制 **Letter Grading**
 B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority

物理系教学指导委员会
 Education Instruction Committee of Physics department

