



Department of Physics
PH 4630, Particle Astrophysics, spring 2011

Instructor:	Amir Shahmoradi
Office Location:	Fisher B008
Email:	ashahmor@mtu.edu
Office Hours:	2:00-2:30 pm, MWF, <i>Other times may be arranged by appointment.</i>
Class Days/Time:	1:00 – 2:00 pm, MWF
Classroom:	Fisher Hall 0126
Prerequisites:	PH 2400, MA 3520 or MA 3521 or MA 3530 or MA 3560
Course Web Page:	http://www.phy.mtu.edu/~ashahmor/teaching/ph4630/
Grader / TA:	Nathan Kelley-Hoskins (nkelley@mtu.edu)

Course Description

Introduction to the twin fields of elementary particle physics and high energy astrophysics. Topics include an overview of particles and interactions, the expanding universe, conservation laws, dark matter and dark energy, large scale structure, and cosmic particles.

Required Texts/Readings

Textbook

Particle Astrophysics, Donald H. Perkins, Oxford University Press, USA, 2nd edition

Other Readings

- Introduction To Elementary Particles, David Griffiths, Wiley-VCH; 2nd edition
- Introduction To Modern Cosmology, Andrew Liddle, Wiley; 2nd edition
- Cosmic Rays and Particle Physics, Thomas K. Gaisser, Cambridge University Press

Grading Scheme

- PreFlights (24%)
Class time is best spent when you have already read about the material, so that we can focus on the points that you found difficult and/or interesting. To encourage this reading, and to guide your thinking during the reading, “pre-flights” will be assigned for every upcoming lecture. These will be available online via the course page. Each one will give the reading assignment for the upcoming lecture, and will include questions on the reading. These questions will be due, with a hard deadline at the beginning of every class. Your responses will be graded pass/fail: the point is not that you always understand fully

all of the issues, but rather that you be prepared for class, and that I get an idea of what is difficult for you.

- **Biweekly Homework (14%)**
There will be assigned 7 problem sets throughout the course. The high frequency is intended to keep you up-to-date on the material. Problem sets are due in class; late homework will be deducted 25% for every calendar day late, unless there is a reasonable excuse for the late submission of HW. Science is a collaborative enterprise, and you are encouraged to discuss the class material and the problems with your classmates and the instructor. However, you are responsible for your own answers, which you should understand and write up in your own words. All problem sets will have equal weight of 2% in the final grade.
- **Biweekly quizzes (32%)**
There will be 7 biweekly quizzes that will be taken on alternative Fridays. The questions on each quiz will be exclusively from the topics discussed in class since the last quiz.
- **Final Exam (30%)**
The final exam includes all the topics discussed in class. However, the exam questions will be exclusively from the PreFlight and HW assignments, as well as the biweekly quizzes.

COURSE SCHEDULE

Lecture material may vary, but due dates are fixed. See course webpage for updates.

Lecture	Date	Topic	Assignment Due
0	Monday, January 10, 2011	Introduction: Particle Physics, Cosmology, Particle Astrophysics	---
1	Wednesday, January 12, 2011	Particle Physics 1: The Elementary Particles & their interactions	PreFlight 1
2	Friday, January 14, 2011	Particle Physics 2: The Elementary Particles & their interactions	PreFlight 2
---	Monday, January 17, 2011	No Class Meeting: Birthday of Martin Luther King, Jr.	---
3	Wednesday, January 19, 2011	Particle Physics 3: The Elementary Particles & their interactions	PreFlight 3
---	Friday, January 21, 2011	Quiz # 1	Problem Set 1
4	Monday, January 24, 2011	Particle Physics 4: The Special & The General Theories of Relativity	PreFlight 4
5	Wednesday, January 26, 2011	Particle Physics 5: The Special & The General Theories of Relativity	PreFlight 5
6	Friday, January 28, 2011	Particle Physics 6: The Special & The General Theories of Relativity	PreFlight 6
7	Monday, January 31, 2011	Particle Physics 7: The Standard Model of Particle Physics	PreFlight 7
8	Wednesday, February 02, 2011	Particle Physics 8: The Standard Model of Particle Physics	PreFlight 8

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9	Monday, February 07, 2011	Particle Physics 9: The Standard Model of Particle Physics	PreFlight 9
10	Wednesday, February 09, 2011	Particle Physics 10: Beyond The Standard Model	PreFlight 10
---	Friday, February 11, 2011	No Class Meeting: Winter Carnival Recess	---
11	Monday, February 14, 2011	Cosmology 1: The Expanding Universe	PreFlight 11
12	Wednesday, February 16, 2011	Cosmology 2: The Expanding Universe	PreFlight 12
---	Friday, February 18, 2011	Quiz # 3	Problem Set 3
13	Monday, February 21, 2011	Cosmology 3: The Expanding Universe	PreFlight 13
14	Wednesday, February 23, 2011	Cosmology 4: Nucleosynthesis & Baryogenesis	PreFlight 14
15	Friday, February 25, 2011	Cosmology 5: Dark Matter & Dark Energy	PreFlight 15
16	Monday, February 28, 2011	Cosmology 6: Dark Matter & Dark Energy	PreFlight 16
17	Wednesday, March 02, 2011	Cosmology 7: Dark Matter & Dark Energy	PreFlight 17
---	Friday, March 04, 2011	Quiz # 4	Problem Set 4
---	Monday, March 07, 2011	No Class Meeting: Spring Break	---
---	Wednesday, March 09, 2011	No Class Meeting: Spring Break	---
---	Friday, March 11, 2011	No Class Meeting: Spring Break	---
18	Monday, March 14, 2011	Free Discussion	PreFlight 18
19	Wednesday, March 16, 2011	Cosmology 8: The Large Scale Structure of The Universe	PreFlight 19
20	Friday, March 18, 2011	Cosmology 9: The Large Scale Structure of The Universe	PreFlight 20
21	Monday, March 21, 2011	Cosmology 10: The Large Scale Structure of The Universe	PreFlight 21
22	Wednesday, March 23, 2011	Cosmology 11: The Large Scale Structure of The Universe	PreFlight 22
---	Friday, March 25, 2011	Quiz # 5	Problem Set 5
23	Monday, March 28, 2011	Particle Astrophysics 1: Cosmic Particles	PreFlight 23
24	Wednesday, March 30, 2011	Particle Astrophysics 2: Cosmic Particles	PreFlight 24
25	Friday, April 01, 2011	Particle Astrophysics 3: Cosmic Particles	PreFlight 25
26	Monday, April 04, 2011	Particle Astrophysics 4: Cosmic Particles	PreFlight 26
27	Wednesday, April 06, 2011	Particle Astrophysics 5: Cosmic Particles	PreFlight 27
---	Friday, April 08, 2011	Quiz # 6	Problem Set 6
28	Monday, April 11, 2011	Particle Astrophysics 6: Stellar Astrophysics	PreFlight 28
29	Wednesday, April 13, 2011	Particle Astrophysics 7: Stellar Astrophysics	PreFlight 29
30	Friday, April 15, 2011	Particle Astrophysics 8: Stellar Astrophysics	PreFlight 30
31	Monday, April 18, 2011	Particle Astrophysics 9: Stellar Astrophysics	PreFlight 31
32	Wednesday, April 20, 2011	Free Discussion	PreFlight 32
---	Friday, April 22, 2011	Quiz # 7	Problem Set 7