Physics 499P: Particle Astrophysics

Spring 2019
TuTh 2:00-3:15 pm, PHY (Toll Building) 1219

Professors: Jordan Goodman and Greg Sullivan

Contact Info:

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TA - Grader

TBD		

Course Description: A contemporary review of the field of Particle Astrophysics

Specific objectives are:

This course aims to learn about:

1. The most energetic non-thermal processes in the Universe;
2. The current observations of cosmic gamma rays and high-energy particles (cosmic rays and neutrinos);
3. Evidence for and efforts to detect cosmic dark matter;
4. The interactions of particles with matter and how these are used to build instruments to detect high-energy particles from astrophysical sources (gamma rays, neutrinos and cosmic rays);
5. The mechanisms by which particles can be accelerated to high energies in astrophysical environments;
6. identify and describe those classes of astrophysical objects that provide such an environment, in particular supernovae and gamma ray bursts, pulsars and supernova remnants, and active galactic nuclei;
7. The remaining open questions and future prospects in the field of particle astrophysics.

Prerequisites

Prerequisite/Co-requisite: PHYS401, PHYS411, or permission of instructor.

Text - Not required, but you may find useful:

*High Energy Astrophysics 3rd edition, Malcolm Longair, Cambridge University Press (*2011) Note: Longair is a radio astronomer, and the emphasis in this text is different from that in the course, so don't be too put off by the level of the mathematics. It is available in paperback or electronically.

The Physics of Neutrinos **–** Vernon Berger, Danny Marfatia & Kerry Whisnant,Princeton University Press (2012), ISBN 978-0-691-12853-5 (hardcover) I think also available in paperback

Course Website

http://elms.umd.edu

We will use ELMS to communicate with the class. All homework assignments will be assigned and submitted through the ELMS course page. You may also contact us directly through our email address listed above.

Assignments:

During the semester you will be given several homework assignments and two projects. For the first project each student will study a specific type detector used in PA experiments or object class (e.g. Silicon strips, CCDs, NaI, Calorimeters, AGN, PWNs etc.) and produce a short report and give a short (5-10 minute) presentation to the class. The second project will involve each student studying a specific experimental technique in PA and giving a longer talk (15-20 minutes) describing the detector, the physics of the measurement technique, the science they study with it and summary of recent results. There will be also a final exam.

Grades

First Project:	20%
Second Project:	30%
Homework:	15 %
Class Participation:	15%
Final Exam:	20%

Notes: We will post .pdf versions of material used in the seminar on the course web site.

Disabilities: If you have a documented disability and wish to discuss accommodations, please contact the professor as soon as possible.

Important Dates:

First Class:	Jan. 29, 2019
Spring Break:	March 18-22, 2019
Last Class:	May 14, 2019
Final Exam:	Monday, May 20, 10:30am-12:30pm

Academic Integrity: The University of Maryland, College Park has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit
http://www.studenthonorcouncil.umd.edu/whatis.html

Tentative Schedule: (Note this may Change and will be updated on ELMS)

Week	Day	Tu Date	Topic
1	Tu/Th	29-Jan	Intro to Particle Astrophysics (Big questions, summary of things we don't cover in detail - Cosmology,Dark Energy, solar neutrinos, etc…)
2	Tu/Th	5-Feb	Cosmic rays, Gamma Rays & Neutrinos
3	Tu/Th	12-Feb	The High Energy Universe
4	Tu/Th	19-Feb	A little Particle Physics
5	Tu/Th	26-Feb	Particle Acceleration
6	Tu/Th	5-Mar	Sources (AGN, GRBs, PWNs, etc…)
7	Tu/Th	12-Mar	Detectors I (Scintillators, Calorimeters, PMTs, etc…)
8	Tu/Th	19-Mar	SPRING BREAK
9	Tu/Th	26-Mar	Gamma Ray Satellites (Fermi, Swift)
10	Tu/Th	2-Apr	Air-Cherenkov Telescopes (VERITAS, HESS, Magic, CTA)
11	Tu/Th	9-Apr	Extended Air Shower detectors (HAWC, Auger)
12	Tu/Th	16-Apr	Neutrino Detectors (IceCube, Antares, Super-k)
13	Tu/Th	23-Apr	Dark Matter
14	Tu/Th	30-Apr	Gravitational Waves
15	Tu/Th	7-May	Student Presentations
16	Tu	14-May	Student Presentations
17	M	20-May	FINAL EXAM 10:30am-12:30pm