

UNIVERSITY OF CALGARY  
DEPARTMENT OF PHYSICS and ASTRONOMY  
COURSE OUTLINE

1. **ASPH 621, High-energy Astrophysics and Cosmology**

Lecture Sections:

**L01:** MoWeFr, 14:00-14:50, SS 117, **Dr. J. M. Stil**, SB 519, 220-8015, stil@ras.ucalgary.ca, Office Hours: Thursday 14:00-16:00

This course uses blackboard: <http://blackboard.ucalgary.ca>

Department of Physics and Astronomy Office: SB 605, 220-5385, office@phas.ucalgary.ca

2. **PREREQUISITES:** ASPH 503

3. **GRADING:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Assignments (5)	25%
Report	20%
Midterm test	20% (Monday, 28 February 2011, in class)
Final Examination	35% (To be scheduled by the Registrar)

**A Passing grade for the final is required to get a passing grade for the course. All exams are cumulative.**

**Differences with ASPH 509: ASPH 621 must submit a 15-20 page report (12pt double-spaced) on a pre-approved subject in high-energy astrophysics or cosmology. In addition, the exams will include an ASPH 621 component.**

Each piece of work (assignments, midterm presentation, and final exam) submitted by the student will be assigned a percentage grade. Missed course components are assigned a 0% grade, unless a valid reason is presented. The student's average percentage score for the various components listed above will be combined with the indicated weights to produce an overall percentage for the course, which will be used to determine the course letter grade, bearing in mind that a maximum D+ grade will result if the student does not pass the final exam. The conversion between course percentage and letter grade is given on page 2 of this document. The assignments are graded individually, and the averaged with equal weight to calculate the total assignment grade. Students are required to submit a 15-20 page report on a pre-approved subject in the field of high-energy astrophysics or cosmology. The report will be graded on the content, clarity of explaining key concepts at the senior undergraduate level, and discussion of relevant literature.

4. **Missed Components of Term Work.** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in section 3.6: <http://www.ucalgary.ca/pubs/calendar/current/sc-3-6.html>. It is the student's responsibility to familiarize himself/herself with these regulations. See also <http://www.ucalgary.ca/pubs/calendar/current/e-3.html>.

5. There are no out-of-class time activities scheduled for ASPH 621

**REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY.** If you have a clash with this out-of-class-time-activity, please inform your instructor as soon as possible so that alternative arrangements may be made for you.

6. **TEXTBOOK:** "*High Energy Astrophysics*", Fulvio Melia, Princeton University Press, ISBN: 978-0-691-14029-2

7. **EXAMINATION POLICY:**

**Use of books is not allowed on the exams.** Use of a calculator is allowed and recommended.

Students are encouraged to read the Calendar, Section G, on Examinations:

<http://www.ucalgary.ca/pubs/calendar/current/g.html>

8. Purchase of the text book is required.

9. Grading of the exams and assignments is based on clarity, completeness and conciseness of the answer provided. Minor spelling mistakes or grammar errors will not affect the grading. See **also** <http://www.ucalgary.ca/pubs/calendar/current/e-2.html>.

10. There are no "human studies" components to this course. See **also** <http://www.ucalgary.ca/pubs/calendar/current/e-5.html>.

Department Approval \_\_\_\_\_ Date \_\_\_\_\_

Associate Dean's Approval for  
out of regular class-time activity: \_\_\_\_\_ Date: \_\_\_\_\_

## 11. OTHER IMPORTANT INFORMATION FOR STUDENTS:

- (a) **ACADEMIC MISCONDUCT** (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under K. Student Misconduct (<http://www.ucalgary.ca/pubs/calendar/current/k.html>) to inform yourself of definitions, processes and penalties
- (b) **ASSEMBLY POINTS in case of emergency during class time.** Be sure to **FAMILIARIZE YOURSELF** with the information at <http://www.ucalgary.ca/emergencyplan/assemblypoints>.
- (c) **ACADEMIC ACCOMMODATION POLICY.** Students with documentable disabilities are referred to the following links:  
Calendar entry on students with disabilities: <http://www.ucalgary.ca/pubs/calendar/current/b-1.html>  
Disability Resource Centre: <http://www.ucalgary.ca/drc/>
- (d) **SAFEWALK:** Campus Security will escort individuals day or night (<http://www.ucalgary.ca/security/safewalk/>). Call **220-5333** for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.
- (e) **FREEDOM OF INFORMATION AND PRIVACY:** This course will be conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, **students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page.** For more information see also <http://www.ucalgary.ca/secretariat/privacy>.
- (f) **STUDENT UNION INFORMATION:** VP Academic **Phone:** 220-3911 **Email:** [suvpaca@ucalgary.ca](mailto:suvpaca@ucalgary.ca).  
SU Faculty Rep. **Phone:** 220-3913 **Email:** [sciencerep@su.ucalgary.ca](mailto:sciencerep@su.ucalgary.ca) Website <http://www.su.ucalgary.ca/home/contact.html>.  
Student Ombudsman: <http://www.su.ucalgary.ca/services/student-services/student-rights.html>
- (i) **INTERNET and ELECTRONIC COMMUNICATION DEVICE Information.** You can assume that in all classes that you attend, **your cell phone should be turned off.** Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

## Grading scheme

Your Course Letter Grade for ASPH 621 will be based on the weighted average percentages of the various course components (assignments, midterm exam, report, and final exam) using the weighting scheme on the first page of this course outline. The conversion from weighted average percentage to course letter grade is (minimum average scores required to obtain a letter grade):

90%	A+	75%	B+	60%	C+	47%	D+
85%	A	70%	B	55%	C	45%	D
80%	A-	65%	B-	50%	C-	<45%	F

YOU MUST PASS THE FINAL EXAM TO GET A LETTER GRADE C- OR HIGHER FOR THE COURSE

## DETAILED COURSE SYLLABUS

We will discuss detection techniques for imaging and spectroscopy of X-rays and  $\gamma$ -rays, and of cosmic rays, and introduce the high-energy sky by discussing various all-sky surveys. The basic high-energy emission mechanisms are discussed (bremsstrahlung, synchrotron emission, X-ray spectral lines and nuclear transitions in  $\gamma$ -rays). If necessary, an introduction to special relativity is given (Lorentz transformation, time dilation, Minkovski diagrams), and also an introduction to general relativity. Compact objects (white dwarfs, neutron stars and varieties, and black holes are introduced. Supernova remnants (shell-like and pulsar wind nebulae) are discussed, and used to introduce X-ray spectroscopy. Diffuse sources of X-ray emission (clusters) and  $\gamma$ -ray emission (the Galactic interstellar medium) are discussed. Accretion processes (Bondi accretion, Shakura-Sunyaev disk) are discussed, and applied to X-ray binaries and active galactic nuclei. Pulsars (P-P-dot diagram) and other transient sources are discussed. If time permits, we will discuss cosmological subjects with emphasis on cosmic nucleosynthesis.

## Appendices