
Physics 650

Aeronomy and Auroral Physics 3 Credits

Instructor – Dr. Mark Conde



http://www.esa.int/var/esa/storage/images/esa_multimedia/images/2014/07/artist_s_view_of_atv-5_reentry/14605700-2-eng-GB/Artist_s_view_of_ATV-5_reentry.jpg

Overview

Description

This will be a graduate level introduction into the physics of Earth's upper atmosphere, and the auroral phenomena that occur within it. Topics to be covered will include:

- Basic properties of the upper atmosphere, and how it differs from layers below
- Radiative transfer in the upper atmosphere
- Kinetic theory
- Fluid dynamical description
- Waves and tides
- The ionosphere
- Space weather influences
- Survey of auroral phenomena
- Solar, interplanetary, and magnetospheric origins of the aurora
- Optics and spectroscopy of the aurora
- Auroral forecasting
- Tools and techniques for studying aeronomy and the aurora
- Aeronomy and auroral physics on other planets
- Recent research topics

The course will be mostly focused on giving students a practical working understanding of these topics, rather than developing detailed high-level theoretical descriptions.

Course goals and student learning outcomes

Upon completion of this course students will:

- Understand the nature of Earth's upper atmosphere, ionosphere, and aurora
- Understand the societal relevance of these topics
- Be familiar with the tools and techniques used to study them
- Be aware of recent research directions in these fields

My goal as an instructor is to provide every student with maximum possible opportunity for success. This means that I try to be as flexible as possible with the course requirements, to avoid creating needless hurdles. Nevertheless, some penalties for missed or late work are necessary; my policies in this regard are outlined in subsequent sections.

Instructor information

Instructor: Dr. Mark Conde
Email: mgconde@alaska.edu
Office locations: Reichardt room 110 and Elvey room 706F.
Office Phone: 474-7741
Office hours: TBD, but likely 9:00 AM – 11:15 AM Tuesday and Thursday. I will be in Room 110 of the Reichardt building at these times.

Target schedule

Week	Dates	Topics	Comments
1	Aug 28 - Sep 01	Class introduction, Basic properties	
2	Sep 04 - Sep 08	Hydrostatics	
3	Sep 11 - Sep 15	Radiative transfer	HW 1 Assigned; Project proposals due
4	Sep 18 - Sep 22	Introduction to the Aurora	
5	Sep 25 - Sep 29	Solar activity	HW 2 Assigned
6	Oct 02 - Oct 06	Solar wind	
7	Oct 09 - Oct 13	Kinetic theory	HW 3 Assigned
8	Oct 16 - Oct 20	The ionosphere	
9	Oct 23 - Oct 27	Fluid dynamics	HW 4 Assigned
10	Oct 30 - Nov 03	Fluid dynamics	Mid Term Exam
11	Nov 06 - Nov 10	Upper atmospheric "weather"	HW 5 Assigned
12	Nov 13 - Nov 17	Atmospheric waves	
13	Nov 20 - Nov 24	Thanksgiving week, Tides	HW 6 Assigned
14	Nov 27 - Dec 01	Auroral morphology	
15	Dec 04 - Dec 08	Tools and Techniques	Project is due
16	Dec 11 - Dec 15	Finals week	
17	Dec 18 - Dec 22	Grades posted by Dec 23	

Note that this is a just a guess; I do not yet know exactly how long each topic will take.

Course components and instructional methods

Instructional materials

Material for this course will be prepared electronically and will be available *over the web via the "Blackboard"*¹ system at <https://classes.alaska.edu>. Material to be posted this way includes:

- Course syllabus (this document)
- Lecture notes (see comments below)
- Homework problem sets
- Supplementary handouts
- Online student grades

Note that I will not be distributing homework or exam solutions to the web. These will instead be posted in the glass cabinets in the physics departmental area of the Reichardt building.

Lectures

I will be presenting lectures mostly using a computer, although I will supplement this with additional informal diagrams etc drawn on the blackboard. I intend to post printable versions of the electronic lecture notes online ahead of time.

¹ All students should have access to Blackboard. Please let me know if you have difficulties with this.

Lectures are currently scheduled for 2:00 pm – 3:30 pm on Tuesdays and Thursdays in room 204 of the Reichardt building. This is an unattractive time for me because I have a 1.5 hour long Astronomy class shortly before this, and because the Thursday class clashes with Departmental Meeting times. We will discuss options for rescheduling during the first lecture. (The first lecture will be held at the scheduled time.)

Once skies get dark enough, we will likely spend some time each lecture discussing auroral activity over the preceding night(s), and trying to predict what might happen over the next day or two.

Homework

Homework will be assigned every second week during the Thursday lecture, and will be due at the Thursday lecture two weeks later. Turn in your homework by handing it to me at the lecture. You may work with others on the homework problems, but you are prohibited from simply copying other's work. Homework will count significantly toward your final grade, as well as provide me with feedback regarding your understanding of the material.

Please realize that even if you submit a correct solution to a problem, I may not recognize it as correct if it's poorly presented. To maximize your chance of scoring well, your homework must:

- Be neatly laid out
- Be largely free from crossing out and over-writing
- Use grammatically correct English and be well enough written that the grader can understand what you're trying to say

Project

The reason I'm only assigning Homework every second week is to allow you time to work on a student project. This can be either an essay on a topic of current relevance, or else a review of a recent and substantial scientific paper on Aeronomy or the aurora. It is up to you to propose a topic or Journal article of interest to you that will become the basis for your project. You will need to discuss your proposal with me and, by the end of our third week (Sep 15) we should have agreed upon a project topic for you. Projects should be roughly 10 -15 pages of single-spaced text, plus figures. Journal-standard referencing is required.

Exams

There will be one 90-minute mid-term exam during the semester and one two-hour final exam. The preliminary dates for these are

- Mid-term: Week of Oct 30 – Nov 03, exact date TBD
- Final: 1-3 p.m., Thursday, December 14.

No textbooks or printed material will be allowed in the exams, but you may bring in any amount of your own original (not photocopied) handwritten notes. You should also bring a calculator.

Course policies

Grading

The course grade will consist of the following components

- Homework: 30%
- Project 25%
- Mid-term exam: 20%
- Final exam: 25%

I will post all grades online, using the UAF's "Blackboard" system (<http://classes.alaska.edu>). All registered students have access to this system for checking their grades. Please do *check that we have posted all your grades correctly*, and let me know if you think there is an error. Also, please retain all work that we return after grading, in case an error does appear. Returned graded work is proof of your scores.

Final grades will be returned as letter grades with plus/minus modifiers. These will be derived from your overall percentage grade. The approximate conversions for each letter grade will be as follows. A: $\geq 90\%$; B: 75% to 90%; C: 60% to 75%; D: 50% to 60%; F: $< 50\%$. Plus/minus modifiers will subdivide each main grade into three equally spaced sub-levels.

Attendance

UAF policy² states that "you are expected to adhere to the class attendance policies set by your instructors." In general, I expect at least 90% attendance from all students. In this small class absences will not go unnoticed.

Class participation

There is no requirement for you to participate actively in class by asking questions or joining discussions, and there is no grade component based on this. Nevertheless, you are of course free to ask questions at any time during the lectures. Because we have a large amount of material to cover, I may defer answering lengthy or numerous questions until after class.

²See <http://www.uaf.edu/catalog/current/academics/regs2.html#Attendance>

Missed or late work

Problem sets will generally not be accepted after the due date, without evidence of illness or genuine emergency. Students having documented clashes with other UAF commitments may pre-arrange alternate homework submission deadlines with me. All decisions regarding late homework or alternate deadlines will be at the discretion of the instructor.

Student conduct and academic honesty

It is the responsibility for each student to be informed about the policies for student conduct and safety at the University of Alaska. You are encouraged to read these policies at <http://www.uaf.edu/usa/student-resources/conduct/#condu>. It should go without saying that students are expected to do their own original work for all assignments. Any deviation from this may be considered academic misconduct and may result in a failing grade and referral to university authorities for possible disciplinary action.

Student responsibilities

It is the responsibility of all students to be aware of the various requirements of the class. This includes knowing what work is required, when the deadlines are, and how this work should be turned in. These requirements are clearly outlined in the syllabus, and multiple reminders will be given in class. Lack of awareness of a requirement will not be regarded as an acceptable rationale for failing to meet it.

The department takes great care to ensure that all submitted work is graded fairly and that the resulting scores are correctly credited to the students who submitted the work. Nevertheless, scores occasionally do get entered incorrectly or missed altogether. **It is the responsibility of students to check their scores in Blackboard frequently**, and to notify the instructor and/or TA immediately any discrepancy is noted. As discussed earlier, students are also responsible for keeping all graded work returned to them, as evidence of the grade received, should any disparity arise later.

Course requirements and materials

Prerequisites

Enrolment in a Natural Sciences graduate degree program.

Textbooks

Required: None

Recommended: Aeronomy, by Banks & Kockarts; Aurora, by Vallance-Jones

Both of these are out of print. But you can likely find them in the library or online.

Calculators

You will need access to a calculator to complete some of the homework problems. Calculators will also be permitted during exams. Remember that it is much more important to present the correct reasoning for solving a problem than it is to arrive at the correct numerical value. Please, explain your reasoning when presenting solutions to homework and exam problems. I will award partial points for correct reasoning, if presented, even if the final answer is incorrect or incomplete.

Support Services

Complaints and concerns

You are always welcome to discuss your concerns with me. However, if you have a concern that you feel cannot be resolved by discussion with me, you may wish to contact the Physics Department chair, Dr. Wackerbauer. The University also has an Academic Advising Center on the 5th floor of the Gruening building, open Monday to Friday, 8 am to 5 pm and contactable via phone at 907-474-6396. The advising center can help with all student matters, from study tips to help with understanding the University's formal mechanisms for academic appeals. (See also <http://www.uaf.edu/advising/>)

Student Health and Counseling Center

The University provides health and counseling services through its Student Health and Counseling Center, which is located at 612 N. Chandalar Drive, on the 2nd floor of the Whitaker Building (the same building as Fire and Police, across from the bus turn around.) Their web site is at <http://www.uaf.edu/chc/>. The center will see students on an appointment basis. The number to call for an appointment is 474-7043. It is best to do so at 8:00 AM in the morning, because they are scheduled daily on a first come first serve basis.

Disabled students

Disability services are provided free of charge, and are available to any student who qualifies as a person with a disability. Student seeking special accommodations for a disability must first discuss their needs with Disability Services. Call 474-5655 to schedule an appointment.

UAF Disability Services is located in the Whitaker Building, room 208. Extensive support is available, as described at <http://www.uaf.edu/disability/>