# AS781 – Planetary Atmospheres (Section A1) - Spring 2016

**Class Hours:** Tuesday and Thursday; 2:00 pm - 3:30 pm, Room CAS 502.
**Class Dates:** Tuesday 19 January 2016 - Thursday 28 April 2016.

Your instructor is Professor Paul Withers. I have mailboxes in CAS 506 and CAS 514.

| Person | Office | Email | Phone | Office Hours |
|---|---|---|---|---|
| Withers | CAS 604 | withers@bu.edu | 617 353 1531 | Drop in or by appointment |

**Course Description**
Planetary and cometary atmospheres; atmospheric vertical mixing; radiative processes; catalytic ozone destruction; aurorae and airglow; planetary ionospheres; energy budgets. Planetary evolution: solar nebula, outgassing, water loss on Venus and Mars, escape of light gases, greenhouse effect, isotope fractionation, impact theory

We will interpret this description loosely. Very loosely. This course will cover four themes related to planetary atmospheres: vertical structure, dynamics, chemistry, and radiative transfer, (about three weeks will be devoted to each of these themes). It will focus on the physical and chemical principles required to understand the current states of the fluid atmospheres found in our solar system.

**Resources**
(Recommended) An introduction to planetary atmospheres; Agustin Sanchez-Lavega; CRC Press, 2011, about $60-$70, ISBN-13: 978-1420067323
(Suggested) Exoplanet atmospheres: Physical processes; Sara Seager; Princeton University Press, 2010; about $25-$30, ISBN-13: 978-0691146454

There is no perfect book for this course and neither of the above textbooks is required. I will post sections from these books and many other resources online, so you will not need to purchase any book for this course. This course has a Blackboard site.

| Assignments | Possible Due Date |
|---|---|
| JITT questions – 20% | Weekly |
| Homeworks – 20% | Sporadic, probably four of them |
| Plan for a research project – 5% | Mid-semester |
| Report on a research project – 40% | Late in the semester |
| Abstracts of other research projects – 10% | End of the semester |
| TBD – 5% | |

Just In Time Teaching (JITT)" is a technique in which students do some reading in advance of a class, then answer a few short questions online before class. The professor uses the submitted answers to work out what to focus on in class. There will be plenty of reading assigned to you in this course and JITT questions give me a way to encourage you to (A) do this reading and (B) think about what you've read. They also make our usage of class time responsive to your concerns. About half of our classes will be lectures with accompanying readings and JITT questions. Rather than deriving a lot of algebraic results in our limited class time, the details of them will be in the reading material. In class, we will focus on the most important and/or most confusing aspects of the material.

Most of the other classes will be hands-on computational activities related to planetary atmospheres. If you took AS 803 with me, you will see some similarities here. Hopefully these classes will occur in room 502 using IDL-equipped laptops. The backup plan is room 606. I prefer that you learn a few topics deeply than many topics superficially. That requires you to spend time doing things, rather than falling asleep while I read a textbook to you. Homework assignments will evolve naturally out of these exercises, probably one assignment for each of the four main themes of the course. For grading them, I will make an appointment to visit you at your computer, where you will show me your code, run a few examples, and convince me that you understand both the scientific concepts being simulated and the code in front of us. I will discuss in class the extent to which collaborating with other students is permissible and the extent to which it is not.

You will complete a project related to planetary atmospheres this semester. This does not have to involve original research, but you do have to actively do some research. Think of it as an opportunity to explore in detail some aspect of planetary atmospheres. I recommend a simple general idea that you are confident has room for exploration, rather than a narrow question that might prove insurmountable within the constraints of a semester project. Start by deciding what you want to have learned at the completion of the project, and then define the project to achieve that. You can reproduce a known result if you wish. This can be a theoretical, modeling, observational, or data analysis activity. Your report should be prepared using a LaTeX template suitable for your eventual dissertation, although it must not approach dissertation length.

At the end of the semester, I will share the project reports with the entire class. You will then read them and prepare a short abstract for each of them. The abstracts should follow the ideals of the "Nature summary paragraph", which will be provided to you. The point of this activity is to train you to communicate effectively in a world in which most of your colleagues won't read your full papers. They will just look at the abstract.

A fraction of the final grade is reserved for unanticipated activities that are encountered during the semester. If nothing suitable is encountered, these points will be neglected.

**Other matters**

You are expected to attend scheduled class sessions. To the extent possible, let me know in advance of any unavoidable absences. As post-comps students, many of you may have travel commitments related to your research, such as conference presentations. Let me know about these in advance so that suitable arrangements can be made. This may lead to some students having a different due date for assignments than others. If you feel disadvantaged by this, see me. Assignments will have 15% of the maximum possible score deducted for each day they are overdue.

I have not scheduled fixed office hours for this small class of post-comps graduate students. Drop by my office or make an appointment if you'd like to talk. I expect you to be comfortable approaching faculty by this stage of your education.

All students are expected to know and follow the GRS Academic Conduct Code. If you have any problems with the class that I cannot resolve, see these senior individuals.
**Astronomy Department Chair:** Professor Al Marscher, CAS 418, 617-353-5029, marscher@bu.edu
**Associate Dean of the Graduate School:** Professor Jeffrey Hughes, CAS 401, 617-353-2471, hughes@bu.edu

**Planned Schedule** This is the plan, but it is subject to change.

| Date | Number | Description |
|---|---|---|
| Tuesday 19 January | 01 | Introduction to atmospheres |
| Thursday 21 January | 02 | Vertical structure |
| Tuesday 26 January | 03 | |
| Thursday 28 January | 04 | |
| Tuesday 02 February | 05 | |
| Thursday 04 February | 06 | Dynamics |
| Tuesday 09 February | 07 | |
| Thursday 11 February | 08 | |
| Tuesday 16 February | | NO CLASS, Academic Monday |
| Thursday 18 February | 09 | |
| Tuesday 23 February | 10 | |
| Thursday 25 February | 11 | |
| Tuesday 01 March | 12 | Chemistry |
| Thursday 03 March | 13 | |
| Tuesday 08 March | | NO CLASS, Spring Break |
| Thursday 10 March | | NO CLASS, Spring Break |
| Tuesday 15 March | 14 | |
| Thursday 17 March | 15 | |
| Tuesday 22 March | 16 | |
| Thursday 24 March | 17 | |
| Tuesday 29 March | 18 | Radiative transfer |
| Thursday 31 March | 19 | |
| Tuesday 05 April | 20 | |
| Thursday 07 April | 21 | |
| Tuesday 12 April | 22 | |
| Thursday 14 April | 23 | |
| Tuesday 19 April | 24 | Margin |
| Thursday 21 April | 25 | |
| Tuesday 26 April | 26 | |
| Thursday 28 April | 27 | |