ASTRO 504: COURSE SYLLABUS

Prof. Arif Babul
Wednesdays, 12-3pm

Welcome to ASTR 504.

Normally this graduate course has between 2 and 5 students. The number varies from year to year. Over the years, I have experimented with a number of different approaches and over the past 7 years, settled on a scheme that seems to work well. Here's how it works — and how the grades will be assigned. I will spend a fair amount of time during our first class going through this. If you have suggestions for improvement, I am happy to mull it over and make the appropriate adjustments.

Before I go into details, let me re-iterate some of the information I have already sent. This email is going to 5 potential students. If you know of others who will be joining, please forward this email to them.

VENUE AND TIME
The class will be held on **Wednesdays from 12pm to 3pm.**
(This is different from the time listed in the timetable. 12-3 was the original time and for a couple of years, the start time was shifted to 11:30am because the colloquia were moved to start 3pm)

The class will be conducted in mix-mode: in-person (70%) as well as via zoom (30%).

In-person classes will be held in **ELL 038,** the conference room in the basement. Tomorrow's class is in-person.

When we meet on zoom, please use the following link:

Topic: ASTR 504 weekly Wednesday class
Zoom: https://uvic.zoom.us/j/86886663085?pwd=eVgyelZLK0RwSUxhaGI5aW9ZWFhiUT09

COURSE STYLE
Given that this is a small class, I will use the informal "discussion seminar" style format. Over the the semester, I will send you a series of papers to read and assign readings (typically of order 25 pages to start with). The expectation is that **everyone will read the assigned pages and think about the content.** As you read, you are expected to **make notes:** comments stemming from previous experience with the material, questions about things that are not unclear issues, and questions that push beyond the readings.

Each week, we will have a volunteer who will lead the discussion for an hour (or when a natural break point is reached, like the end of section) and hand off to the next person, and then the next. The lead will review the content of the readings orally. Do not use powerpoint or key or anything other formal presentation software. Also, everyone (including the lead) will **INTERRUPT** with their comments/questions. I will do so too. I expect that in the beginning, I may be doing more of this than you but I expect that after we finish the first paper, your contributions will become comparable.

Comments like "this wasn't mentioned here but I thought it was an important/interesting related issue…" is very welcome. Essentially, I would like you to active think about the material as you are reading and come prepared with questions and comments that will enriched the discussion. Also, while reading the assigned pages (see below), do make notes of the detailed notes of key ideas and draw attention explicitly to these in your overview. If there are concepts you are not familiar with, do take some time to look up these up and come prepared to explain. Also jot down any questions that come up.

This exercise is all about reading and learning about the current state of affairs in Galaxy Formation modeling, about the terminology used, concepts that inform the topic, successes and failures, etc. I expect you to have questions and by asking and discussing, we will get to learn more about the topic than is covered in the Review papers. I have also found that this is a very useful way to teach how to think as you read.

THE COURSE GRADE WILL BE A DIRECT REFLECTION OF HOW WELL YOU TAKE UP THIS CHALLENGE.

In addition to our weekly discussions, members of this class are expected to attend all colloquia and seminars that address "extra-galactic" topics. The first of these is tomorrow: Martin Bureau's colloquium.

After the first two/three weeks, I will also expect you to ask questions at these seminars and collloquia. This is to promote active listening and engagement, and to encourage you to being using your new knowledge on galaxy formation.

FORMAL REFERENCE BOOK + READING LIST

Previously, I used the following book as a basis for readings and classroom discussions:
Galaxy Formation and Evolution by Houjun Mo, Frank van den Bosch , Simon White.
The book offers a fairly thorough coverage of subject - usually in gory detail. As a result, it is difficult to separate out the key concepts and ideas. Most students in the past have tended to not see the "forest for the trees". I recommend this book as a reference. If you are going to work on galaxy formation or need a source to read up on some specific issue, this is as good a starting point as any.

From 2015 onward, I started using recent reviews (published in Annual Reviews, Modern Physics, etc.) for readings and discussion. These, I have found, are written more clearly, tend to focus less on details (in the first instance, at least) and more on concepts, which I think is more important for an introductory course. In addition, this approach gives me more flexibility so I can add and remove reviews depending on topics that are becoming more/less important.

I have listed some of the reviews that we have worked through previously. The Benson paper is the first one and you can grab it from ArXiv. We will start with it:

- Andrew Benson, Galaxy Formation Theory -- 55 pages (arXiv:1006.5394)

The rest are only for your reference. I will send you an updated list in due course. I have a bunch of reviews and I need to look them over and decide which will be most useful. And if you have a topic you are especially interested in that falls under the category of "galaxy formation theory", I am happy to consider it.

- Somerville and Dave, Physical Models of Galaxy Formation in a Cosmological Framework (arXiv:1412.2712) — 67 pages
- Oppenheimer et al., Simulating Groups and the IntraGroup Medium: The Surprisingly Complex and Rich Middle Ground Between Clusters and Galaxies (https://arxiv.org/abs/2106.13257) — 61 pages
- Reality and Myths of AGN Feedback (https://arxiv.org/pdf/1802.10304.pdf) — 3 pages

  Naab & Ostrikier 2017
  paper: http://www.annualreviews.org/doi/abs/10.1146/annurev-astro-081913-040019 — 50 pages
- Raffaella Morganti 2017 paper. The Many Routes to AGN Feedback - 10 pages (observational overview)
- Harrison et al. 2018 paper AGN outflows and feedback twenty years on (https://www.nature.com/articles/s41550-018-0403-6) — 6 pages

On the average, this course has entailed about 200 pages of readings over the semester. **This is less than 25% of the reading pages assigned from the reference book.** This means less reading per week, which I hope gives you more time to think about what you have read. In fact, the readings will get less onerous with time because some of the topics are repeated from one reading to the next. This is not a bad thing. It is useful to see the same topic covered from different perspectives. And even straight repetition is good...it highlights what the community considers to be among the more important issues.

CLASS SESSIONS

I anticipate approximately 11 class days over the course of the semester and allowing for a couple of "absent" days, that leaves us with ~9 days. We will need 1-2 days during the exam period for the presentations. So, I propose that we read and discuss about 25-30 pages per session.

For Wednesday (Jan 18th), let's focus on the first 25 pages of Benson's paper. 25 pages is not an onerous reading assignment but do take the time to think about the material.

The class discussion leads should think of this as an informal presentation. You will speak informally using your notes. I don't want you to prepare any powerpoint slides but you are welcome to use the blackboard. Also, as you speak, I will add additional information, and I am happy to discuss related topics further if you wish. I also encourage you to ask questions about the subject and your readings, which I will try my best to answer.

GRADING

45% of your final mark will come from both the degree of engagement and quality of your contributions. This includes your level of preparedness, how well you summarise and

highlight, questions you pose and effort that goes into answering my questions and generally generating discussion.

At seminars or we colloquia on relevant topics, I'd like to see you draw on your readings - and improving understanding of the subject - to ask the speakers interesting and even challenging questions. To encourage you,

15% of your final mark will come from the quality of questions you pose during the seminars/colloquia. Make sure you raise your hand up!

FINAL PROJECT/PRESENTATION

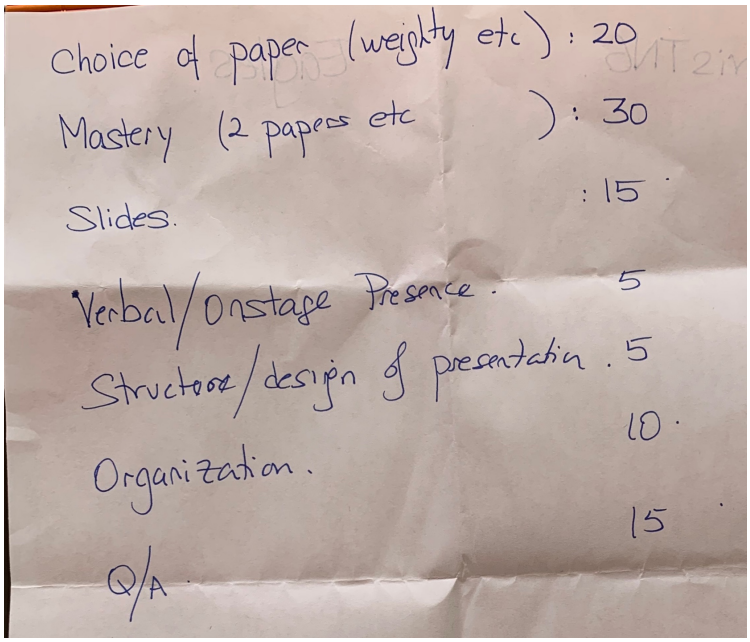
In previous years, I have asked the students to do an actual research project. These have ranged from working with Galacticus, a semi-analytic code that Andrew Benson developed, to working with outputs from numerical simulations. I have several simulation boxes.

If you are interested in doing this, I can look into this option to see if it is possible.

The default option is to pick and discuss a recent arXiv paper on a relevant topic. This usually means owning the paper. I will discuss what this means at our first meeting but it basically will involve reading more than one paper.

40% of your final mark will come from this "final project" component. During the exam week, you will give a formal - with powerpoint - presentation (35-40 minutes) and submit a report written in ApJ paper style.

The grading rubric for the presentations is as follows:



I have covered everything I can think of. Let me know if I have left anything out — we can discuss it tomorrow.