ASTR-5110: Atomic & Molecular Processes .... Midterm Project, due Oct. 28, 2026

The goal of this project is to enable you to explore a chosen AMP topic in a bit more detail and gain some extra experience with scientific writing (or other forms of communication).

First, I'll ask you to identify a relevant **TOPIC** for your project. It could be something that was introduced only briefly in the lecture notes, or in class, but we didn't have time to go into at a deep level. Maybe we relied on an approximation or assumption, and you're curious to see how this thing *really* works without that approximation. It could also be a brand-new example or application of something that we covered in class—but if that's the case, I hope you're able to uncover something fresh or different about the system in question. You can glean topics from the results of published **journal papers,** but that's not necessary as your initial inspiration.

(If you're feeling extra philosophical, you're also free to veer into the foundations of quantum mechanics, in ways that go beyond the pragmatic *"shut-up-and-calculate"* approach that we often take!)

Next, you can choose between various **FORMATS.** If you think of something that doesn't fall distinctly into any of the following 5 categories, let me know and I'll consider it.

1. Write up two **new homework problems,** with full answer keys, that takes AMP students through your topic and gets to an interesting result. For length guidelines, see my own problems and answer keys.
2. Write **lecture notes** that you could use to teach this material to a new class of AMP students. Aim for a "length" of approximately one 50-minute class, and include a few external pointers (like I do with URL links) for students to follow up on if they want.
3. Write a **short review paper** that describes your topic. This is really similar to option (2) above, but in a more standard paper format; i.e., a brief introduction that motivates the topic, a main body that goes into details, and a conclusion that summarizes what we've learned. You should probably aim for a length of approximately 1,500 to 2,000 words, and include reference citations to document your research.
4. If you're drawing on a journal paper, your writeup can be in the form of a **response;** i.e., either in the form of constructive criticism (i.e., a mock referee's report), or an attempt to reproduce the results yourself (i.e., with some combination of coding, re-deriving equations, downloading data, and making figures), or BOTH!
5. Why not record your description of this topic in the form of a sci-comm **video or podcast?** You don't have to be as fancy as, say, 3Blue1Brown or RadioLab, of course. Just recording yourself on Zoom, talking over a nice powerpoint, can sometimes make for quite engaging content! (cough cough)

If you have only the tiny seed of an idea, please feel free to discuss it with me at any time. I might be able to provide some guidance on where to go with it, or what references/sources could be the most useful.

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Grading Guidelines:

I'll use a 20-point scale for the grading, then later rescale it to be worth 15% of the course grade. There are two equally-weighted categories:

Relevance (10 points): The project clearly & accurately describes a topic or application relevant to this course, which goes beyond the material from the lecture notes and existing homeworks.

Depth (10 points): The amount of submitted material—i.e., some combination of background/ motivation, descriptive text, equations, figures, or code—is sufficient to convey understanding of (and engagement with) the chosen topic.

For each category, 10 points corresponds to meeting the criteria with no significant problems. 8 or 9 points corresponds to generally meeting the criteria, but with minor problem(s) that could have been handled better. 7 points or less corresponds to clearly not meeting some aspect of the criteria.

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For projects like this, I sometimes provide a list of example topics to kick-start your imagination. However, in this case I'll refrain from doing that, since I don't think it's to anyone's benefit if you end up choosing a "least-bad" option from a list. Please feel free to look through the external-URL links in the lecture notes, the table of my favorite spectral lines, and any of the recommended textbooks and online lecture notes from others.
