

TERM PAPER REQUIREMENTS

A vital skill for any scientist is the ability to explain one's self clearly to other scientists. The purpose of the term paper is twofold: 1) to learn in depth about a topic of interest to you, and, 2) to practice technical writing. This assignment can be both enjoyable and educational if you approach it with curiosity and desire for knowledge.

Choice of Topic. You may write a paper with a focus on either an astrophysical theory or astronomical observations. If you choose to write a theoretical paper, you should briefly describe the observations that motivate the theory, then describe the theory, and conclude with discussion of how well the theory does at explaining observations. If you choose a focus on observations, describe the purpose for making the observations, then describe the observations in detail, and conclude with interpretation of the observations. The interpretation will require brief discussion of theoretical ideas for context. You have considerable leeway in the choice of topic. Nobel-prize winning discoveries are obvious choices. Choose something you can explain in 8–10 pages. Since your paper is fairly short, it should be highly focused. You may not choose a topic that we have covered in detail in class. Each student's topic must be unique, though two or more students may report on separate aspects of the same problem. See *Suggested Topics for Term Papers* for ideas.

You must choose your topic *and have it approved* by **April 4**. Topics will be approved in the order they are submitted for approval, so sign up for the hot topics early! If you do not obtain approval by April 4, I will assign you a topic, and you might not want that. If your approved topic is not working out, for whatever reason, a new topic can be negotiated after April 4.

Standards of Composition. As with any technical composition, your term paper must have an introduction, a main body, and a concluding section. In the introduction, provide clear motivation for the subject you are about to discuss. Provide historical and intellectual context, but note that your paper should be a science paper, *not* a history paper. In the main body, develop the subject in detail. In the concluding section, to which you should devote about one page, summarize the main results you have presented, what they mean, and their relevance in the big picture. This section should not be excerpts from the main body, but should logically tie the content of the paper together.

Your paper should be at the level at which material has been presented in class, or higher. Assume that the reader of your paper, namely, your instructor, is familiar with the basics of the topic of your paper and so don't waste space on fundamentals. If your paper has an observational focus, do not describe the details of how the observation were made, but do discuss how the data were analyzed.

Your paper must have a complete bibliography at the end in which you reference the key work you are discussing in your paper. Since scientific progress is cumulative, it is standard practice to use or restate another person's ideas or results in your paper *with the appropriate citation*. To neglect the citation is known as *plagiarism*. Citations should be to the *original* work, which is published in a scientific journal, or sometimes, a book.

Reference Materials: The entire astrophysical literature is available on-line at Harvard Astrophysics Data System (ADS), a searchable database available at:

http://adsabs.harvard.edu/abstract_service.html

Most articles in journals to which MSU has a subscription will be available in pdf form through the ADS if you use a computer on campus. Many articles will be available off campus as well. If you still cannot get the article, see if there is an “X” option for the article you have found (there usually is); clicking that will take you directly to the Cornell Preprint Archive where you can get a pre-publication or post-publication version of the paper. Technical articles are difficult to read for the uninitiated, and are often difficult for experienced researchers. Reading technical articles is a skill. Give it a try, and don’t become discouraged if you don’t understand everything or even very much. Try to get the gist of the papers you read.

A good place to begin your research is with a textbook, such as Carroll & Ostlie. If you use a result from a textbook, cite the book. Usually a textbook will cite the original work, which you can find on the ADS. Read the original work and cite it in your paper. If you download an electronic figure from the web, make sure that you cite the website.

Wikipedia. Wikipedia can be useful for getting background knowledge, but keep in mind that Wikipedia is essentially a blog site. Many things on Wikipedia are just wrong, and so this resource should not be used as an objective reference for anything. Wikipedia can be useful for finding original references, which you should read and cite. **Do not cite Wikipedia in the bibliography itself.**

Your paper should closely resemble a typical paper in the astrophysics literature; see *Example of a Technical Paper* on the class website. In general:

- Avoid philosophy, subjective statements, or colorful language. A technical paper should be clear, dry, and concise.
- Avoid long historical discussion. *Brief* discussion of past work, properly cited, is appropriate for establishing context.
- Avoid direct quotations of individuals or verbatim excerpts from other sources. Quotations are almost never needed in a technical paper.
- Avoid trivia or technical detail not related to the topic.

Your paper should be written in complete sentences, with well-formed paragraphs, good grammar, correct spelling and logical organization. If figures and equations will help the exposition, by all means use them, but keep the focus on the physics. Avoid spending too much time on formatting, but make sure your paper is readable. The papers must be in typeset, hard-copy form. No hand-written papers, please. Limit the text of your paper, including figures but excluding the bibliography, to 10 pages in a font size that is easy to read (at least 11 point).

An Example. Suppose you were writing a paper on the Chandrasekhar Mass Limit, the *theoretical* maximum mass for a white dwarf. (We will discuss this in class, so this is not fair game as a topic!). First, you might look in Carroll and Ostlie. You will find a nice discussion of the topic on pp. 559-572; much of this material you might want to include, *in your own words*, in the main body of your paper. The text mentions that the mass limit was determined by S. Chandrasekhar in 1931. If you then do an ADS search with “Chandrasekar” in the author field and look for papers published in 1931, you will find a paper entitled, “The Maximum Mass of Ideal White Dwarfs” (1931; *Astrophysical Journal*, 74, 81). This is the original paper by Chandrasekhar and should be

cited in your paper. This paper builds on the author's earlier work, which should also be cited. Chandrasekhar's papers contain considerable detail on how he actually calculated the mass limit. (The discussion in Carroll & Ostlie provides only an estimate). This extra level of detail would be appropriate for the main body of your paper.

In the introduction, you could discuss why knowledge of mass limits on stars is interesting. (Mass limits are related to stellar structure, composition, and quantum mechanical effects in the case of white dwarfs). In the conclusions of your paper, you could discuss the observational evidence for a mass limit on white dwarfs, with appropriate references, and compare mass measurements with Chandrasekhar's prediction. Are there any white dwarfs with masses well in excess of Chandrasekhar's prediction? If so, is this a serious problem?

You might find that the topic you are writing about is covered in sufficient detail in a good textbook. This is fine; just make sure that you write a proper technical paper rather than a book report, and cite both the text and the original reference(s) on your topic.

The Draft. A draft of your term paper, which is due on **April 18**, should represent your best attempt to complete the assignment. Papers in the scientific literature are *peer-reviewed*. Hence, your draft will undergo *preliminary review*, in which the scope, physics, background information, references, organization, composition, etc. will be graded. You will receive a provisional grade and a "referee's report" by April 25, **summarizing what you need to do to earn a perfect score** on the final version that is due one week later. If your draft is very rough, the referee's report will not help you much since you will be starting nearly from scratch in preparing the final manuscript. Submit a draft that is as close to final form as possible, so that only minor modifications will be needed in preparation of the final manuscript. Without an April 18th draft, there will be no preliminary review. Note that the two-week period from April 4 to April 18 is not really very much time to prepare a good paper, so I strongly encourage you to select a topic, get it approved, and get to work on your paper well before April 4.

Final Manuscript. The final version of your term paper is due at **5 pm on May 2**. The grade assigned to the final manuscript will supersede the grade assigned to the April 13th draft. If you do not turn in a final manuscript, the grade you receive for your paper will be that given to the draft.