Course objectives: This is the 1-hour optional companion course for ASTR/PHYS 109. It is designed to give more of a hands-on understanding of the concepts surrounding the Big Bang and Black Holes in an effort to de-mystify them for the non-scientist. The emphasis will be on the interpretation of data with minimal data analysis techniques. The mathematics used will be straightforward and use only basic high-school algebra. The primary goal is for students to gain insight into the process of gathering and interpreting evidence for use in the field of Cosmology and to do so in a way that is communicable to a lay audience.

Co-requisites: Concurrent registration in ASTR/PHYS 109 is required unless that course has been taken in a previous semester. Exceptions are rarely granted and must be done with the written consent of the instructor immediately.

Instructor: Prof. David Toback
Office/Phone: Mitchell Institute (MIST), Room M425
Email: toback@tamu.edu
Course website: http://people.physics.tamu.edu/toback/119

Textbook: "Big Bang, Black Holes, No Math: Lab Manual" (Toback) is required and “Big Bang, Black Holes, No Math” (Toback) is recommended. EBook format is also available online. See bigbang.physics.tamu.edu for more details. If you cannot find it at the book store, there is a copy on Reserve at the Library or you can order it directly at bigbang.physics.tamu.edu.

Course Work and Grading: This class will meet two hours per week with an average of one hour per week outside of class. The bulk of the grade for this course is in the lab report component. A premium will be placed on the ability to understand, interpret and convey the data in a way that provides evidence for our understanding of cosmology and the physical universe to the lay reader. By percentage, the grade is based on:

- Lab Reports (including assigned Rough Drafts): 90%
- Attendance/pre-class and in-class quizzes and Activities: 10%

Note that you cannot pass the course unless you complete all the labs, and all the components of the labs (including the rough draft and final report). In addition, all labs must have a passing grade.

The course schedule can be found at http://people.physics.tamu.edu/toback/119/LabClassSchedule.pdf

Description of the report writing instruction
Each writing assignment will be discussed both in class and in outside help sessions with the teaching assistant. During these times, the topics will be discussed and effective methods of conveying the information will be illuminated. Each student will be encouraged to submit as many drafts as necessary to produce an excellent final draft paper. Feedback, written and in rubric form, will be provided with each iteration designed to help polish the documents into a clear, concise and readable form. The instructor and TA will be available to discuss papers during the drafting process. Resubmissions will be encouraged and the final draft as well as the quality of iterations will be taken into account in the grade for each paper.
Since there often confusion about what you can and cannot use from the lab manual in your report, or from working with partners, more details can be found at http://people.physics.tamu.edu/toback/109/WritingAssignments/plagiarism.shtml

<table>
<thead>
<tr>
<th>Assignment Name</th>
<th>Short Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>This lab will focus on the process, expectations, and necessary software for the semester's labs and recitations.</td>
</tr>
<tr>
<td>Lab 0 - Boot Camp</td>
<td>This lab is designed to introduce the student into understanding the software and process involved with labs for this class.</td>
</tr>
<tr>
<td>Lab 1 - What is the Sun Made Of?</td>
<td>This lab uses an experiment to allow students to find the spectral lines of known elements and use them to compare with the spectral lines from light we see coming from the Sun to determine what the Sun is made of.</td>
</tr>
<tr>
<td>Lab 2 - How Do the Galaxies Move?</td>
<td>Building on Lab 1, this lab combines the idea of spectral lines with Doppler shifts to observe the relations between a star's brightness, speed, distance, luminosity, and Doppler shift in order to discover the relationship between the distances and speeds of galaxies.</td>
</tr>
<tr>
<td>Lab 3 - What if the Sun became a Black Hole?</td>
<td>This lab will explore the implications of our Sun becoming a black hole. It combines knowledge of escape velocity and properties of a black hole to test the scenario of our Sun becoming a black hole.</td>
</tr>
<tr>
<td>Lab 4 - What's the Evidence for Dark Matter?</td>
<td>This lab will use a module to simulate what we expect versus what we observe in the rotation of objects in our solar system and in galaxies.</td>
</tr>
</tbody>
</table>
Checklist for the first day of lab:
- Take the attendance quiz
- Download the data from the lab website
- Make the histograms indicated by the TA
- Work through all the tips and tricks in Appendix A
- If you finish early, you should start working through the Boot Camp lab

Checklist for Boot Camp:
- **Day 1**
  - Take the attendance quiz
  - Download the data from the lab website
  - Make the histograms and tables indicated in the lab
  - Analyze the data as indicated in the lab manual
  - Make the histograms and tables indicated in the lab
  - If you finish early, you should start working through the Boot Camp lab

Checklist for Each day of the regular labs:
- **Day 1 (Data taking day)**
  - Take the attendance quiz
  - Download the data from the lab website
  - Make the histograms and tables indicated in the lab
  - Analyze the data as indicated in the lab manual
  - Make the histograms and tables indicated in the lab
  - If you finish early, you should start writing up your lab report
- **Day 2 (Work day)**
  - Take the attendance quiz
  - Finish analyzing any data if needed, and make or remake any figures or tables needed.
  - Work in editor-author pairs with your partner
  - If you finish early, you should finish your lab report and make sure it is excellent (and you will get an A). If you finish that early, turn it in for feedback by TA.
- **Day 3 (Evaluation day)**
  - Have rough draft submitted before class
  - Finish analyzing any data if needed, and make or remake any figures or tables needed
  - Work in the same editor-author pair as you did on Day 2
  - Submit your editor-author pair assignment by the end of class to eCampus and point the TA to it (this will be instead of your regular attendance quiz)
  - Note: The only reason you should be finishing early is if you have completed revising your final assignment and it is excellent (and you will get an A). We expect you will alert your TA for feedback to confirm it is excellent before leaving
**ADA Policy**
The American's with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Disability Services in Cain Hall B118, call 845-1637, or e-mail disability@tamu.edu. Additional information is available at http://disability.tamu.edu.

**Honor Code**

**50-Word Summary:**
This companion course is designed teach about the collection, interpretation and explanation of data used as evidence in our understanding of the Big Bang and Black Holes. It is designed to be for non-scientists to understand and appreciate.