# Astronomy 596 NPA
# Nuclear and Particle Astrophysics
# Spring Semester 2019

### Astronomy 134 MWF 1:00–1:50 pm


Instructor: Brian Fields
Astronomy Building Room 216
email: bdfields at illinois.edu
Office Hours: Wed 2–3 pm, or by appointment

Teaching Assistant: Jesse Miller
Astronomy Building Room 234
email: jamillr6 at illinois.edu
Office Hours: Thur 1–2 pm


Course web page URL
http://go.illinois.edu/astr596npa

We are fortunate to participate in the dawn of multimessenger astrophysics–for the first time, we can probe the cosmos with all four fundamental interactions. Going beyond electromagnetic radiation opens new views of the most energetic events in the Universe; these are also the sites cosmic alchemy.

We will apply nuclear and particle physics to trace highlights in the history of cosmic matter from the big bang to the present. The course is targeted to beginning graduate students from Astronomy and from Physics, with no nuclear or particle physics prerequisites. The emphasis will be on physical arguments and quantitative estimates to understand observations.

## 1 Course Requirements

**Grading Scheme**

| Requirement | Weight |
|---|---|
| Preflights | 30% |
| Problem Sets | 60% |
| Final Exam | 10% |

## 2 Problem Sets

I will assign 6 problem sets throughout the course. The relatively high frequency is intended to keep you up-to-date on the material. Problem sets are due in class; late homework will be deducted 25% for every calendar day late.

Science is a collaborative enterprise, and you are encouraged to discuss the class material and the problems with your classmates, the TA, and the instructor. However, you are responsible for your own answers, which you must understand, and must write up *in your own words*.

## 3 Preflights

Class time is best spent when you have already read about the material, so that we can focus on the points that you found difficult and/or interesting. To encourage this reading, and to guide your thinking during the reading, "preflights" will be assigned on weeks when no problem set is due. These will be available on the course `Compass` page. Each one will give the reading assignment for the upcoming week, and will include questions on the reading. These questions will be due, with a hard deadline. Your responses will be graded pass/fail: the point is not that you always understand fully all of the issues, but rather that you be prepared for class, and that I get an idea of what is difficult for you.

## 4 Final Exam

The Final Exam will take the form of a final Problem Set, assigned on the last day of class. and will be due on or before the course exam date, **10:00pm, Monday May 6.** *Late exams will not be accepted!*

## 5 Readings and Resources

Course Texts: The course material is chosen carefully and meant to weave together several forefront topics. Nevertheless, it reflects the instructor's idiosyncratic interests, and no text that I am aware of is a perfect match to what we will discuss.

**B. Pagel** *Nucleosynthesis and the Chemical Evolution of Galaxies*
This text has the most overlap of material, and is written at an accessible level. *Recommended.*

Other useful books include:
Arnett, *Supernovae and Nucleosynthesis*
Clayton, *Principles of Stellar Evolution and Nucleosynthesis*
Gaisser, *Cosmic Rays and Particle Physics*
Klapdor-Kleingrothaus and Zuber, *Particle Astrophysics*
Kolb and Turner, *The Early Universe*
Peacock, *Cosmological Physics*
Peebles, *Principles of Physical Cosmology*
Rolfs and Rodney, *Cauldrons in the Cosmos*

In addition to these texts, research and review articles will occasionally be assigned.

A large body useful material is available online, and will be useful for homework problems and for researching your report. See the `links` page on the course website.

## 6 Schedule

The course website contains the course schedule, along with webpages and notes for each lecture.