The Interstellar Medium

AST 393 **Fall 2014**

Instructor: Neal Evans
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Office Hours: M 4:00-5:00
W 9-10
Required Texts: *Physics of the Interstellar and Intergalactic Medium* by Bruce Draine (D)

Exams and Grading: There will be homework, three exams and one comprehensive final. Class discussion and questions are appreciated and will be rewarded with credit. We may have in-class exercises to apply ideas. The homework is important in providing a basis for understanding the tests. The course grade will be determined according to the following plan:

Top two exam scores	20% each
Final exam	20%
Homework	30%
Class Participation	10%

Goals of the Class: The primary goal of the class is to help students develop an understanding of the physical processes at work in the interstellar medium; this goal provides the organizing framework for the course. A secondary goal is to introduce students to the different components of the interstellar medium, which span an enormous range of conditions. The role of the interstellar medium in forming stars and the return of matter and energy from stars to the interstellar medium will also be covered, time permitting. In addition to the connections to stars, the ISM is connected through disks around forming stars to the origin of planetary systems and life. The larger scale issues of star formation in galaxies as a whole and in the early Universe will be discussed briefly. The material covered in the course on Radiative Processes will be reviewed very briefly. Students who have not had that course will be paired with those who have taken the course to provide help as needed. Students will need Rybicki and Lightman's book and my notes on quantum processes (the notes will be supplied).

Course Outline

I. (2 classes) Observational Overview (D1, D21)
The different components of the ISM and where they are

II. (2-4 classes depending on need)
Review of Radiative Processes (as needed) (D2-D7, D9-D11, D17)
Radiative Transfer, atomic and molecular processes

III. (1 class) Radiation Fields (D12, D40)

IV. (2 classes) Ionization and recombination (D13-14, D16)

V. (2 classes) Chemistry (D31, D33)
Basic processes that determine abundances

VI. (2 classes) Excitation (D17, D19, D20)
Radiative and collisional excitation, pumping, masers
Observations of Excitation and their interpretation

VII. (2 classes) Energetics (D27, D30, D24, D34)
Heating and cooling of gas and dust
Radiative equilibrium
Application to different components of ISM

VIII. (2 classes) Dynamics (D35, D36)
Virial Theorem, thermal and turbulent velocities, shocks, waves

IX. (2 classes) Star Formation (D32, D41)
Collapse theory and observations, Disks and outflows
Massive star formation

X. (2 classes) Aftermath of Star Formation (D15, D37, D38, D39)
HII regions, Winds, Planetary Nebulae, Supernova remnants

XI. (2 classes) ISM on a Galactic Scale (D30.4, D39.4, other refs)
2, 3, many phase models, galactic haloes, fountains, supershells
Distribution of phases in Galaxy, other galaxies

XII. (2 classes) Star Formation on a Galactic Scale (D42.4-D42.5, other refs)
Star Formation in Milky Way, nearby galaxies