AS 751 Interstellar Medium
Fall 2015
Wednesday 3:30 - 5:00; Friday 2:00 – 3:30
Astronomy Conference Room CAS 502

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Office Hours:
W 11-1:30, F 12:30-2:00 or by appointment

Overview:

AS 751 is an advanced course for post-comp students to lay the foundations for research in astrophysics, especially for studies of the interstellar medium, star formation, and galactic structure. The course builds on AS713, Astronomical Spectroscopy, using quantum mechanics and other physical principles to probe atomic, ionized, and molecular gas. Also features an examination of the properties and compositions of interstellar dust. Building on these principles, the thermal equilibrium of the interstellar medium is explored by examining the dominated heating and cooling processes in a variety of environments. Finally, the course will elaborate on interstellar chemistry and gas dynamical effects in quiescent clouds, star forming regions, and shocked environments.

Grading:

Homework	90 %
attendance/participation	10 %

Late Work:

I do not accept late work except under extraordinary circumstances. Please contact me if you foresee an extraordinary circumstance to make arrangements. Homework is due at the beginning of lecture, every class.

Collaboration:

I encourage collaboration on problem sets and homework assignments, but please do not copy. Discussions about how to solve a problem are fine, but exchanging papers or direct copying of work is unacceptable.

Academic Conduct:

Each of you should adhere to the Graduate School's policies on academic conduct. Do not cheat, plagiarize, or copy another student's work.

Required Textbook:

Draine, *Physics of the Interstellar and Intergalactic Medium, ISBN 978-0-691-12214-4.*

Secondary Textbooks:

Kwok, *Physics and Chemistry of the Interstellar Medium*
Tielens, *The Physics and Chemistry of the Interstellar Medium*
Bodenheimer, *Principles of Star Formation*
Stahler & Pallai, *The Formation of Stars*

Recommended Texts:

Ward-Thompson & Whitworth, *An Introduction to Star Formation*
Osterbrock & Ferland, *Astrophysics of Gaseous Nebulae and Active Galactic Nuclei*
Lequeux, *The Interstellar Medium*
Dopita & Sutherland, *Astrophysics of the Diffuse Universe*
Dyson & Williams, *The Physics of the Interstellar Medium*
Spitzer, *Physical Processes in the Interstellar Medium*

Expectations:

Attendance: I expect each student will attend every lecture presented in this course. Chronic absences (more than 5 lectures) may result in a failing course grade. If you do know you must be absent for professional or personal reasons, please let me know and we will arrange for you to keep up with the work. I also expect, and encourage, questions and participation.

Homework: I expect to issue homework assignments every week. Each homework assignment will be due one week later. I expect every student to complete every homework assignment. Failure to turn in more than 75% of the homework assignments may result in a failing course grade. Homework is due at the beginning of class. I do not accept late homework.

Academic Standards: I expect the homework you turn in to be your work and not the work of fellow classmates. Collaboration is encouraged, but not to the point of direct copying. Students are reminded to adhere to the behavior governed by the Graduate School policies www.bu.edu/academics/grs/policies.

Schedule:

Date	Lecture #	Topic	Homework Due #
2-Sep	1	Course Intro; ISM; **Atomic Gas:** Galactic distribution	
4-Sep	2	Basic atomic gas properties, Spectroscopy	
9-Sep	3	21 cm H I emission, absorption, T_spin, column density	
11-Sep	4	**Ionized Gas:** Photoionization, recombination	1
16-Sep	5	Structure of pure H II regions, Stromgren radius, Temp problem	
18-Sep	6	Structure of impure H II regions, OTS approx., metals, oxygen	2
23-Sep	7	Computing radial distributions of ions, line ratios, detailed balance	
25-Sep	8	Continuum emission, emergent SEDs, radio recom. lines, Balmer dec.	3
30-Sep	9	**Molecular Gas:** excitation, cross section, critical density	
2-Oct	10	Three level systems, temperature and density probes	4
7-Oct	11	Multilevel systems, [O III], rotational spectra	
9-Oct	12	Column density, cloud and core properties	5
14-Oct	13	Vibrational and ro-vibrational spectra, CO fundamental & bandhead	
16-Oct	14	Abundances, more cloud properties	6
21-Oct	15	Photodissociation regions (PDRs) and polycyclic aromatic hydrocarbons (PAHs)	
23-Oct	16	**Dust:** Overview, abundances, depletions	7
28-Oct	17	Extinction, scattering, size distributions, optical properties	
30-Oct	18	Polarization, grain alignment, magnetic fields	8
4-Nov	19	Dust spectral features	
6-Nov	20	Life cycle of dust, formation, evolution, star formation	9
11-Nov	21	**Heating & Cooling:** Overview, gas, dust thermal absorption and emission	
13-Nov	22	H II regions, electron donors, electron thermalization	10
18-Nov	23	Cosmic rays, compositions & energies, interactions, cross sections	
20-Nov	24	Dust grains, PDRs, X-ray heating, fine-structure cooling, multiphase models	11
2-Dec	25	**Chemistry:** CO chemistry, gas-phase reactions, ion-molecule chemistry	
4-Dec	26	Rate equations, grain-surface chemistry, chemical networks, models	12
9-Dec	27	**Dynamics**: Collapse, star-formation, turbulence, winds, outflows, feedback	