

Notes on the Notes

These lecture notes have been distilled from hand-written notes compiled while teaching Astronomy 871, Physics of the Interstellar Medium, during 4 quarters between 1993 and 1999, and recently revived for teaching it again during Autumn Quarter 2008. Ast871 is a graduate core course required of all students in the graduate Astronomy program at the Ohio State University. Please don't let the fancy typesetting fool you, this is not a draft textbook, and it is never meant to become a textbook. These are just my notes, nicely typed up, in a (semi-)coherent narrative form. They are designed as a distillation of a number of sources, and in places may even be inadvertent (or forgotten) word-for-word transcriptions of particularly clear explanations. A number of people have asked for copies over the years, and I decided that the exercise of typing them in would help me to organize them, trim them down, and otherwise fix up years of smudged hand-written copies that were getting ragged at the edges.

I must pay some serious debts up front, lest people think this is entirely original work (it is not, and does not pretend to be completely original – they're *notes*). While preparing to teach this course for the first time in Spring Quarter 1993 I fell back on two invaluable resources.

The first were my own notes from when I took “Low Density Astrophysics” from the late Donald Osterbrock at UC Santa Cruz during Winter Quarter 1994. Don was my teacher, Ph.D. advisor, and research mentor during my years at UCSC, and it is to him I owe my abiding interest in what happens to low-density gas when you heat it up. If the chapter on HII region seems somewhat long compared to the others (50-odd pages of text compared to an average of ~30 for the others), it is due in part to my immersion in the topic at an impressionable age. I have, however, striven to strip the topic down to the most essential physics, which is so rich for UV, optical and IR emission lines that I could not cut out any more without personal pain. As time goes it is being brought more into balance.

My second vital resource was a copy of lecture notes written by Prof. Harriet Dinerstein for her ISM course at the University of Texas at Austin. Harriet's ISM course was legendary among the graduate students there, but I arrived in the off year for the course cycle. During my year as a McDonald Fellow at UT Austin, I enjoyed many opportunities to interact with Harriet, her students, and other UT faculty, broadening my interests in near-IR and millimeter molecular astrophysics. Harriet's notes are monumental, and strongly influenced the creation of these notes, even to the choice and ordering of topics, especially in areas where my own experience was sorely lacking. For sections on dust and molecules, Xander Tielens' recent book has been a major and lucid resource, and for this year I am using incremental revisions of these notes as a catalyst for diving into Bruce Draine's outstanding new ISM/IGM book (which book may become the text for the course the next go-round).

I wish to acknowledge numerous valuable conversations with Kris Sellgren at OSU who has kept me informed (and honest) on the subject of dust, and with Joseph Shields at Ohio University on many aspects of ionized gas physics. Mark Everett (1997 OSU Ph.D.) taught me a great deal about near-IR emission lines of H₂ during his dissertation research, and my other student Nancy Joanne Lame (1995 OSU Ph.D.) helped me work through the material on nebular diagnostics in her PNe research. Bruce Balick at UW used these notes in his class and provided excellent feedback. I have also had the benefit of some excellent notes from the ISM course taught at UC Berkeley by James Graham and Chris McKee (they used some of my notes, I used some of theirs). And lastly I thank the numerous graduate students who have waded through this material with me, and corrected many errors and helped to work out many explanations. Any errors herein, however, are entirely my own fault.