Microscopic Processes in X-ray Modulated Star Formation

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The formation of low-mass stars is accompanied by flows that originate or terminate on very small spatial scales, of the order of an AU or less. Future spectroscopic imaging missions from space and from ground have the potential to aide our understanding of the basic mechanisms involved in star formation that are associated with these flows. Their physical conditions vary widely, ranging from relatively cool accretion disks to warm and turbulent jets, both exposed to high levels of X-rays during flares which occur on the time scale of several days. I will review the challenges of modeling the physical properties and deducing the diagnostic signatures of these complex, multi-component systems, with special emphasis on the reactions that determine their ionization, chemical, and thermal structure. In one set of problems, I will use the recent work of Shang *et al.*, (ApJ, 564, 853, 2002) on the heating and ionization of the X-wind model, and show for example how accurate symmetric charge-exchange cross sections lead to a new understanding of the role of ambipolar diffusion in winds and jets. I will also discuss how our ability to model the most important diagnostic optical lines for analyzing the jets from young stellar objects are still hampered by the lack of low-energy cross sections for the charge-exchange of hydrogens ions and heavy elements. Some problems of protoplanetary disk chemistry will also be discussed.