IONIZATION FRONTS IN ASTROPHYSICS AND THE LABORATORY

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The phenomena referred to in astrophysics as "ionization fronts" involvethe progressive photoionization of a medium, in which only radiative recombination and shock wave generation also eventually come to play a role. The analysis of such systems dates back to Stromgren in 1939. Related phenomena are not easily produced in the laboratory, but in the last 20 years we have seen a sequence of papers having "ionization front" in their titles and reporting laboratory experiments. In this presentation, we discuss the similarities and differences between the laboratory experiments and astrophysical ionization fronts.

The laboratory experiments are potentially far more complex than the astrophysical cases. In order to have a large enough photon flux that the front propagates measurable distances on the timescale of the source, the temperature of the source must be large compared to the ionization energies of lower ionization states. As a result, the initial energy of the electrons produced by photoionization is quite large. Hydrogen is probably not feasible to use because of its small photoionization cross section, and so further electron-impact ionization may become important, as may dielectronic and three-body recombination at the high densities present in laboratory systems. Wherever photoionization stalls, electron heat transport may carry the ionization further forward.

We present models evaluating these various effects, discuss the observed behavior in existing experiments, and discuss the potential for a laboratory experiment that is truly well scaled to the astrophysical case.

This work is funded by the U.S. Department of Energy, through the NNSA Stockpile Stewardship Academic Alliances program, via grant number DE-NA0001840.