N93-26771

THE REIONIZATION OF THE UNIVERSE: THE FEEDBACK OF GALAXY FORMATION ON THE INTERGALACTIC MEDIUM

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I.

We have calculated in detail the thermal and ionization evolution of a uniform intergalactic medium (IGM) composed of H and He, undergoing "reionization," including the mean effect of gas clumps embedded in a smoothly distributed ambient gas. We have solved the rate equations for ionization and recombination, together with the equations of energy conservation, including the effects of cosmological expansion, radiative and Compton cooling, and the diffuse flux emitted by the gas, and radiative transfer. We have included the contribution to the continuum opacity of the universe due to the observed quasar absorption line clouds (QALC's). We have considered a variety of sources of photoionization, including quasars and primeval galaxies, as well as the possibility that hydrodynamical processes deposit thermal energy in the IGM. We shall describe applications of these calculations including the evolution of Ly α forest clouds.

II.

A self-consistent treatment of the thermal and ionization history of the intergalactic medium (IGM) must take account of the growth of structure in the universe, since the mean density of the IGM corresponds primarily to the time-varying *uncollapsed* fraction of the baryon-electron component of the matter, and the collapsed fraction, in turn, can have a "feedback" effect on this uncollapsed fraction by releasing ionizing radiation and thermal energy and by contributing to the opacity of the universe. We have begun to study this coupled evolution of the IGM and the emerging structure with a special focus on the reionization of the IGM, which is believed to have been completed by some redshift $z \gtrsim 4$, as inferred from the absence of the Gunn-Peterson effect in the spectra of high z quasars. We will describe the results and implications of detailed, numerical calculations of the thermal and ionization balance and radiative transfer in a uniform IGM of H and He, including the mean effect of an evolving distribution of gas clumps embedded in a smoothly distributed ambient gas.