The Study of Diffuse Warm - Hot Gas using Quasar Absorption Line Spectroscopy

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by

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ABSTRACT

The hydrodynamic simulations of structure formation suggest that nearly 40 % of the baryons at low redshift is outside of galaxies in a warm-hot intergalactic medium with temperature of $T \sim 10^5 - 10^7$ K. Though this is a large reservoir of baryons at low redshift, detecting it observationally has been challenging because of the diffuse nature of this gas ($n_H \sim 10^{-5}$ cm^{-3}). Most of our understanding of this medium has come from studying high ionization intervening absorption lines observed in the spectra of distant quasars. The doublet lines of O VI, Ne VIII and Mg X in the far & extreme UV regions are ions of this kind.

In this thesis, we present the detection and analysis of four instances of warm - hot baryon reservoirs towards three different quasar sightlines using O VI, Ne VIII and broad Lyα absorption features as diagnostics of physical conditions. Using photometric and spectroscopic data from the Sloan Digital Sky Survey (SDSS) database, we also present information on galaxies in the vicinity of each absorber. SDSS shows several galaxies in the vicinity of each of these absorbers. In one instance, the absorber is found to be within the virial radius of a very luminous galaxy and could be tracing gas in the galaxy's extended halo. In the remaining cases, the absorber can have an intergalactic origin or could be associated with the extended circumgalactic region around a sub-L* galaxy below the detection threshold of SDSS.

The thesis also reports the detection of Ne V absorbers for the first time in the high redshift intergalactic medium. The ionization modeling of this absorbers found the origin of Ne V to be ambiguous similar to O VI absorbers. The ion can be produced through photoionisation by the extragalactic UV background radiation, through collisional ionisaion in high temperature plasma, or through photoionization under the influence of local radiation field from quasars.

Broadly, this thesis work demonstrates how Ne VIII and O VI coupled with thermally broadened H I absorption, and Ne V can be useful diagnostics of the

conditions in diffuse gas at $T > 10^5$ K in the intergalactic and circumgalactic space, which harbors more baryons than galaxies at low redshifts.