DISSERTATION ABSTRACT

The Low Ionization Gaseous Content in Intermediate Redshift Galaxies

CHRISTOPHER W. CHURCHILL

Thesis work conducted at: University of California, Santa Cruz
Current Address: Pennsylvania State University
Astronomy and Astrophysics
525 Davey Lab
University Park, PA 16802
Electronic Mail: cwc@astro.psu.edu
Ph.D. dissertation directed by: Steven S. Vogt
Ph.D. degree awarded: 1997

The kinematic, chemical, and ionization conditions and spatial distributions of low ionization gas associated with early epoch ($0.3 \leq z \leq 1.7$) galaxies have been studied using high resolution (6.6 km s^{-1}) absorption line spectra. The absorption profiles for a total of 48 MgII selected systems were obtained from 25 quasar (QSO) spectra observed with the HIRES spectrograph on the Keck I telescope. In addition to the MgII $\lambda\lambda 2976, 2803$ doublet, the MgI $\lambda 2853$ transition and multiple transitions of FeII were also studied. In some cases, MnII and CaII were observed. The absorption profiles were objectively searched for weak absorbing "subsystems" in line–of–sight velocity space. For each overall system, and their multiple subsystems, absorption properties were measured directly from the flux values in the spectra. Additionally, the absorption profiles were modeled by Voigt Profile (VP) decomposition using an algorithm written for this work. Extensive simulations of the VP decomposition were performed in order to establish confidence levels on inferences based upon VP profile fits.

Main results include:
(1) "High velocity" subsystems ($v \geq 40$ km s^{-1}) are characterized by equivalent widths less than 0.1 Å and velocity widths less than 10 km s^{-1}. There is no turnover in these subsystem equivalent widths down to 0.005 Å. Thus, no lower limit on the size and column density of the clouds has been found to this observed sensitivity.
(2) The individual cloud temperatures are $T \sim 30,000$ K and they are relatively quiescent in that they are consistent with having a zero non–thermal broadening component.
(3) The maximum likelihood power–law slope of the column density distributions for MgII, FeII, and MgI were measured to be -1.58, -1.65, and -2.22. Within uncertainties, the FeII slope is consistent with that of MgII.
(4) For the column densities, there is a strong anti–correlation between $\log N(\mathrm{MgI}) - \log N(\mathrm{MgII})$ and $N(\mathrm{MgII})$. Based upon photoionization modeling, VP components with $N(\mathrm{MgI}) - \log N(\mathrm{MgII}) \geq -1.6$ are suggestive of "shielded" clouds, or "softened" ionizing radiation fields.
(5) For a subsample of 15 systems, the number of absorbing clouds does not follow a functional relation with projected galactocentric distance, suggesting that the gas clouds are *not* distributed isothermally within galactic halos, for example.
(6) From the distribution of absorption strengths, velocity widths, and velocity dispersions, it can be inferred that, for the majority of the galaxies, the absorbing gas spatial distribution is a single, dominant absorbing "complex" around which smaller clouds are clustered.
(7) The cloud–cloud clustering function (TPCF) is best modeled as a two–component Gaussian with narrow dispersion $\sigma_1 = 30$ km s^{-1} and broad dispersion $\sigma_2 = 150$ km s^{-1}.
(8) Spatial/kinematic models were designed and their absorption properties analyzed using the same techniques applied to the data. The model most consistent with the data is that in which the absorbing clouds are in an extended disk with a surrounding diffuse infalling halo. The halo clouds are optically thin in HI and the dispersion in the disk is small, $\sigma_{\mathrm{disk}} \sim 15$ km s^{-1}.