RevMexAA (Serie de Conferencias), **29**, 177–177 (2007)

PHYSICAL PROPERTIES OF ABSORBERS IN HIGH REDSHIFT QUASARS

L. E. Simon,[1] F. W. Hamann,[1] and M. Pettini[2]

Recent studies based on quasar emission lines suggest that quasar environments are typicaly metal rich, with metallicities near or above the solar value at even the highest observed redshifts. Due to the large uncertainties inherent in emission line abundance analysis, we employ another technique, absorption line analysis, to corroborate the evidence gleaned so far in order to better constrain the detected metallicities. We are also interested in the physical nature of these absorbers, their relationship to quasar outflows, and their role in quasar-host galaxy evolution.

We present results on the basic physical properties of the absorbing material in the quasar vicinity, including location, ionization and density, which are fundamental for interpreting the derived abundances. The data suggest that most absorbers that are near the quasar source in redshift are also physically near. The structure of these absorbers appears to be clumpy, with dense, low ionization cores and diffuse high ionization envelopes. The data also suggest from this first analysis that the absorbers can be quite far from the source. Locations based on determined densities and plausible ionization paremeters range from 60 to 825 kpc away from the quasar source. These distances are too large for the lines to be intrinsic (part of the quasar), requiring an alternate explaination.

An analysis of the Covering Fraction, a measurement of the percentage of the source covered by the absorber, supports a high proportion of intrinsic systems close to the quasar emission redshift with 80% of all systems measured exhibiting partial coverage. Of the six quasars studied, at least five contain at least one intrinsic system based on the partial coverage analysis. The covering fraction appears to vary with velocity and with different elements, suggesting non-uniform cloud shapes, densities and composition.

We also search for intrinsic lines using variability studies. We compare these data to previous low resolution observations using equivalent width measurements, and find that 62% of all lines with multiple epochs of data show significant variability. The variations are on timescales of years which is consistent with variability measured in quasar source emission. The results from the variability study are consistent with the partial coverage analysis.

Further analysis includes gas kinematics and densities. The low ionization species have narrower profiles on average (10-50 km s^{-1}) while the high ionization species have on average broader profiles (50-150 km s^{-1}), and both are found in single systems, further supporting the clumpy cloud model. Electron densities of the gas, derived from low ionization excited state absorption lines, range from < 1 cm^{-3} to 37 cm^{-3}.

With a better understanding of this absorbing gas, we can constrain the global workings of quasars, in particular how they drive and interact with the outflows. Future work will include deriving these abundances for the outflows, which will be used to constrain the age of this early star formation.

[1]Department of Astronomy, University of Florida, 211 Bryant Space Science Center, P.O. Box 11205, Gainesville, Florida, 32611-2055, USA (lsimon@astro.ufl.edu).

[2]Institute of Astronomy, University of Cambridge, Madingley Road, Cambridge, CB3 OHA, United Kingdom.

REFERENCES

Folts, C. B., Weymann, R. J., Peterson, B. M., Sun, L., Malkan, M. A., & Chaffee, F. H., Jr. 1986, ApJ, 307, 504

Hamann, F. W., Barlow, T. A., Foltz, C. B., & Weymann, R. J. 2001, ApJ, 550, 142

Hamann, F. W., Barlow, T. A., Junkkarinen, V. T., & Burbidge, E. M. 1997, ApJ, 478, 80

Hamann, F. W., Dietrich, M., Sabra, B. M., & Warner, C. in Carnegie Observatories Astrophys. Ser. 4, Origin and Evolution of the Elements, ed. A. McWilliam & M. Rauch (Cambrige: Cambridge Univ. Press), 440

Hamann, F. W., & Ferland, G. J. 1999, ARA&A, 37, 487

Hamann, F. W., & Sabra, B. M. 2004, in ASP Conf. Ser. 311, AGN Physics with the Sloan Digital Sky Survey, ed. G. T. Richards & P. B. Hall (San Francisco: ASP), 203

Sargent, W. L. W., Steidel, C. C., & Boksenberg, A. 1989, ApJS, 69, 703

Steidel, C. C. 1990, ApJS, 72, 1

Storrie-Lombardi, L. J., McMahon, R. G., Irwin, M. J., & Hazard, C. 1996, ApJ, 468 121

Tripp, T. M., Lu, L., & Savage, B. D. 1996, ApJS, 102, 239