# Creating a Classification System for Semi-Relativistic Outflows in the Form of Broad Absorption Systems of Active Galactic Nuclei

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## Abstract

The purpose of this project is to find a relationship between broad absorption systems (>2000 km/sec wide), a rare set of lines with 500 km/sec< v < 2000 km/sec, and the more common narrow absorption lines (<500 km/sec) using spectra of quasi-stellar objects (QSO) obtained from the Sloan Digital Sky Survey Data Release 5 (SDSS DR5). Quasars are extremely bright and distant active galactic nuclei, much brighter than the integrated starlight of the galaxy that hosts the QSO, by virtue of gravitational energy released as photons as material falls from the inner part of the host galaxy onto the central black hole. Most of the light is from a compact region surrounding the central supermassive black hole of a galaxy. QSO spectra show the emission features of the light of the QSO,

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as well as absorption or emission from objects through which the light may pass on as it travels through the Universe to the Earth. Intervening systems produce narrow absorption lines (<500 km/sec) at a red shift far from the QSO; they are thought to be the result of intergalactic clouds along the line of sight, from other galaxies. Associated systems produce narrow absorption at a red shift close to that of the QSOs; they likely result from either interstellar matter in the host galaxy, far from the nucleus, or from bits of gas ejected from the central part of the host galaxy. Extreme cases of these systems are referred to as broad absorption line systems. These systems contain broad absorption lines (BALs) at a red shift very close to that of the QSO; they probably result from matter being ejected from the QSO's associated black hole. The high velocity matter is represented by deep absorption troughs of ionized materials (particularly $C^{+3}$, from 2000-30,000 km/s). These types of broad absorption line systems make up about 15% of all quasars. A complete catalog of identified broad absorption systems can be found in Gibson et. al (2008)[7]. A small subset of broad absorption systems called miniBALs occur in only approximately 0.3% of all QSOs. It is believed that miniBALs are short lived aspects of BALs, hence their infrequent nature. The purpose of this project is to test this hypothesis. We will present a morphological classification of absorption line systems. We hope to find a new classification system with a connection between systems containing miniBALs, the high velocity BALs and the narrow absorption line associated gas.

[7] Gibson, Robert R.; Linhua, Jiang; Brandt, W.N.; Hall, Patrick B.; Shen, Yue; Wu, Jianfeng; Anderson, Scott F.; Schneider, Donald P.; Berk, Daniel Vanden; Gallagher, S.C.; Fan Xiaohui; York, Donald G; 2008, ApJ