

# Hard Ionizing Photons at High Redshift --- A New Method for Measuring the QSO Continuum Shape

Principal Investigator: Dr. Jack A. Baldwin

Institution: Michigan State University

Electronic Mail: baldwin@pa.msu.edu

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## Abstract

We wish to test and calibrate a new method for measuring the far-UV continuum shapes of AGN. Knowledge of this continuum shape bears on several key questions about the high-redshift universe: What is the shape and intensity of the ionizing background radiation for the IGM, as a function of lookback time? How and at what rate do massive black holes grow at the centers of galaxy halos? How do the chemical abundances in the central regions of massive proto-galaxies evolve with lookback time at redshifts  $z > 6$ ? A well-established way to measure the far- to near-UV continuum shape of AGN is to compare the intensities of high- and low-ionization emission lines from the gas that is photoionized by that radiation. The highest ionization gas is expected to be in a hard-to-observe hot phase, emitted by gas at nearly a million degrees. There are to date only a few detections of this gas, using x-ray telescopes to measure the L-alpha equivalent emission line from ions such as O VII, Ne IX and Mg XI. Such measurements are only possible for the brightest nearby AGN. We show here that these same ions are expected to also emit other lines in the rest-UV with about the same strength. For high-redshift QSOs, these will be redshifted into the optical region, where they can be studied using the large collecting area of ground-based telescopes. The strengths of these lines will then tie down the far-UV continuum shape of high-redshift AGN. But the method needs to be tested and calibrated by searching for these lines in the observed-UV spectra of the same nearby AGN for which the L-alpha equivalent lines have been detected at x-ray wavelengths. This is only possible using archival HST spectra, as we propose to do here.

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**Investigators:**

	Investigator	Institution	Country
PI	Dr. Jack A. Baldwin	Michigan State University	USA/MI
CoI	Dr. Gary J. Ferland	University of Kentucky	USA/KY

Number of investigators: 2