

COS-GTO: Studies of the HeII Reionization Epoch

Principal Investigator: Dr. James C. Green

Institution: University of Colorado at Boulder

Electronic Mail: jgreen@origins.colorado.edu

Scientific Category: QUASAR ABSORPTION LINES AND IGM

Scientific Keywords: INTERSTELLAR AND INTERGALACTIC MEDIUM, GALAXY FORMATION AND EVOLUTION, LYMAN-ALPHA FOREST CLOUDS, METAL ABSORPTION SYSTEMS

Abstract

Intergalactic Ly-alpha opacity suggests that H I was reionized at $z \sim 6$, while He II reionization was delayed to $z \sim 3$. Both epochs are slightly in disagreement with recent (WMAP-3) inferences from the CMB optical depth, which suggest that IGM reionization occurred at $z = 10.7 (+2.7, -2.3)$ (Spergel et al. 2007). However, these two methods are sensitive to different ranges of ionization (neutral fractions), which allows a partially ionized IGM between $z = 6-10$ produced by early stars and black holes. One of the major contributions of FUSE to cosmological studies was the detection of He II Ly-alpha (Gunn-Peterson) absorption in the spectra of two AGN at redshifts $z = 2.72-2.89$. The He II absorption is quite patchy between redshifts $z = 2.6$ and 3.2 probably because the IGM is clumpy and the reionization process is affected by source fluctuations, spectra, and radiative transfer through the IGM. Observations of the He II absorption can therefore be used as diagnostics of the ionizing sources and radiative transport over large (30-50 Mpc) distances through the IGM. The ionizing radiation field appears to be softer (higher He II/H I) in the galaxy voids. These void regions may be ionized by local soft sources (dwarf starburst galaxies), or the QSO radiation may be softened by escape from AGN cores and transport through denser regions in the cosmic web. With COS, we will observe the brightest He II target, HE2347-4342, a QSO with $z_{\text{em}} = 2.885$. Our goal is to obtain a G130M moderate-resolution ($R = 20,000$) spectrum from 1145-1450Å. Because COS has far greater throughput than either STIS or FUSE, we will be able to resolve and characterize the He II absorption lines. The region shortward of the redshifted He II (Ly-alpha) corresponds to $z = 2.77-2.92$, where He II exhibits patchy transmission and absorption. The ratio of He II/H I (Ly-alpha line) opacities will provide information on the ionizing radiation field (and ionizing sources) at 1 and 4 ryd. We will perform similar He II studies on three other targets, HS1700+6416, PKS1935-692, and Q0302-003.

Investigators:

	Investigator	Institution	Country
PI	Dr. James C. Green	University of Colorado at Boulder	USA/CO
CoI#&	Dr. Cynthia Froning	University of Colorado at Boulder	USA/CO

Number of investigators: 2

Admin CoI: Dr. Cynthia Froning

& Contact CoI: Dr. Cynthia Froning

Target Summary:

Target	RA	Dec	Magnitude
HE2347-4342	23 50 34.2000	-43 26 0.00	V = 16.3 +/- 0.3, F(1300) = 3.0 E - 15
HS1700+6416	17 01 0.6000	+64 12 9.00	V = 16.1 +/- 0.2, F(1100) = 1.00E-15
PKS1935-692	19 40 25.5000	-69 07 57.00	V = 17.3 +/- 0.2, F(1150) = 2.80E-15
Q0302-003	03 04 49.8000	-00 08 13.00	V = 16.38 +/- 0.2, F(1300) = 1.80E-16

Observing Summary:

Target	Config Mode and Spectral Elements	Flags	Orbits
HE2347-4342	COS/FUV Spectroscopic G130M		10 (5x2)
HE2347-4342	COS/FUV Spectroscopic G140L		4
HS1700+6416	COS/FUV Spectroscopic G140L	CVZ	3
PKS1935-692	COS/FUV Spectroscopic G140L	CVZ	4
Q0302-003	COS/FUV Spectroscopic G130M		4
Q0302-003	COS/FUV Spectroscopic G130M		2

Total prime orbits: 27

This is a COS GTO project, no scientific justification is needed.