

# A DIRECT MEASUREMENT OF THE INTERGALACTIC MEDIUM OPACITY TO H I IONIZING PHOTONS

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4:00 P.M. NSH 118  
(Refreshments at 3:30 P.M. NSH 202)

We present a new method to directly measure the opacity from H I Lyman limit (LL) absorption  $\kappa_{LL}$  along quasar sight lines by the intergalactic medium (IGM). The approach analyzes the average ("stacked") spectrum of an ensemble of quasars at a common redshift to infer the mean free path  $\lambda_{912}$  mfp to ionizing radiation. We apply this technique to 1800 quasars at  $z = 3.50-4.34$  drawn from the Sloan Digital Sky Survey (SDSS), giving the most precise measurements on  $\kappa_{LL}$  at any redshift. From  $z = 3.6$  to 4.3, the opacity increases steadily as expected and is well parameterized by  $\lambda_{912} \text{ mfp} = \lambda_0 - b \lambda(z - 3.6)$  with  $\lambda_0 = (48.4 \pm 2.1) h^{-1} 72 \text{ Mpc}$  and  $b = (38.0 \pm 5.3) h^{-1} 72 \text{ Mpc}$  (proper distance). The relatively high  $\lambda_{912}$  mfp values indicate that the incidence of systems which dominate  $\kappa_{LL}$  evolves less strongly at  $z > 3$  than that of the Ly $\alpha$  forest. We infer a mean free path three times higher than some previous estimates, a result which has important implications for the photoionization rate derived from the emissivity of star-forming galaxies and quasars. Finally, our analysis reveals a previously unreported, systematic bias in the SDSS quasar sample related to the survey's color targeting criteria. This bias potentially affects all  $z \sim 3$  IGM studies using the SDSS database.

Colloquium

All interested  
persons are  
cordially  
invited to  
attend.