

# The Gunn-Peterson Trough from the First Stars in the Universe

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The observational non-detection of the Gunn-Peterson troughs from the high redshift objects including the  $z=5.8$  quasar found from the Sloan Digital Sky Survey pushes the era of the reionization of our Universe much earlier than has been previously expected. The Gunn-Peterson trough will be formed during the passage of photons around Ly alpha through the partially or completely neutral intergalactic space with  $z_2 < z < z_1$ , where the reionization starts at  $z_1$  and ends at  $z_2$  with  $5.8 < z_2 < z_1$ . However, many previous theoretical approaches to the construction of the Gunn-Peterson profile were made with approximate expressions of the scattering cross section that often deviate significantly in far off-resonance regions. In this study, we adopt the exact Kramers-Heisenberg formula that is faithful to the atomic physics and compute the Gunn-Peterson troughs assuming standard cosmological models with our choices of  $z_1$  and  $z_2$ .