Mapping Quasar Light Echos in Three Dimensions with Lya Forest Tomography

Joe Hennawi*[1]

[1]Physics Department [Santa Barbara] – United States

Abstract

Bright quasars are powerful sources of ionizing radiation and have profound impact on the Intergalactic Medium. In particular, they create 'proximity regions' in their surroundings, areas with enhanced ionization and therefore reduced Lyman alpha absorption. Studies of the IGM in the vicinity of quasars can therefore deliver important information about key quasar properties. My studies of the HeII transverse proximity effect have already delivered joint constraints on quasar age and obscuration. However, expanding the so far limited HeII sample is hampered by the lack of future space-based UV telescopes. I will therefore present a novel method focused on the HI proximity effect that will deliver three-dimensional maps of quasar light echos based on 'Lyman alpha forest tomography'. This technique was recently pioneered by the CLAMATO collaboration. Using faint galaxies as background sources offers a sufficiently high sightline density to interpolate between sightlines and derive a 3D map of the Lyman alpha forest on Mpc scales. While this method was initially intended to map the large scale density structure, it is equally well suited to three-dimensionally map the proximity regions of hyperluminous quasars. Such observations will allow clear statements about the emission geometry (beaming/obscuration and orientation) as well as the emission history (lifetime, variability, flickering) of individual quasars. This connects AGN physics on parsec scales to the large scale structure. On small scales, our study will allow to e.g. test AGN unification models and the proclaimed torus geometry of the obscuring dust. On larger scales, it will give key insights into AGN triggering and activity cycles, the growth of SMBHs, AGN feedback processes, the possible impact of variable quasar emission on the ionization state of metals in the CGM and the topology of helium reionization.

*Speaker

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