Mapping A Distant Protocluster Anchored by A Luminous Quasar in the Epoch of Reionization

Scientific Category:	Supermassive Black Holes and Active Galaxies
Scientific Keywords:	AGN Host Galaxies, Emission Line Galaxies, M-Sigma Relation, Quasars, Supermassive Black Holes
Alternate Category:	Large Scale Structure of the Universe
Instruments:	NIRSPEC, NIRCAM
Proposal Size:	SMALL
Exclusive Access Period:	12 months
Allocation Information (in hours):	
Science Time:	9.8
Coordinated Parallel Time:	5.6
Charged Time:	16.3

Abstract

Theoretical models predict that luminous quasars should act as signposts for protoclusters in the young Universe. However, despite extensive searching, protoclusters traced by quasars have not yet been discovered in the epoch of reionization (EoR). Recent ALMA/JCMT sub-mm observations and Subaru narrow/broad band imaging of a luminous quasar at z=6.63 have finally revealed a spectacular overdensity of [CII] emitters, sub-mm galaxies, and Lyman alpha emitters, suggesting that it is the most distant known protocluster harboring quasar activity, and the first such system discovered in the EoR. An approved HST program will mosaic two 3.6'x3.6' fields, centered at the quasar and a galaxy merging system within this protocluster, respectively. The quasar, with both strong gas outflow as indicated by broad absorption lines and inflow as indicated by multiple metal absorption lines, is hosted by an extended massive merging galaxy. Moreover, the quasar host features an extremely broad [CII] line with a FWHM of 930 km/s, suggesting that this quasar resides in a deep gravitational potential and could be a progenitor of the brightest cluster galaxy (BCG).

We propose NIRSpec MSA observations to identify galaxies physically associated to this protocluster by targeting galaxies selected from HST observations. The MSA observations will allow us to map the 3D structure of the protocluster, measure AGN fraction of protocluster member galaxies, and characterize the physical properties of galaxies in the most dense structure yet known in the EoR. In addition, we will perform NIRSpec IFU observation of the quasar to study the formation of the BCG progenitor.