Monster in the Early Universe: Unveiling the Nature of a Dust Reddened Quasar Hosting a Ten-Billion Solar Mass Black Hole at z=7.1

Scientific Category:	Supermassive Black Holes and Active Galaxies
Scientific Keywords:	AGN Host Galaxies, Quasars, Supermassive Black Holes
Instruments:	NIRSPEC, MIRI
Proposal Size:	SMALL
Exclusive Access Period:	12 months
Allocation Information (in hours):	
Science Time:	2.2
Charged Time:	5.5

Abstract

The discovery of z>7 quasars hosting billion solar mass supermassive black holes (SMBHs) places the strongest constraints on the formation of the earliest SMBHs in the universe. These quasars are also signposts of the assembly of the early massive galaxies during the epoch of reionization. Is there an upper limit on BH masses and the rate of their growth in the early universe? Recently, a luminous quasar at z=7.1 has been discovered to host a SMBH with at least 10 billion solar masses. It also shows evidence of strong dust reddening based on ground-based spectroscopy. Its rest-frame UV continuum shape is highly unusual, suggestive of extinction due to supernova produced dust. However, the total extinction is completely unconstrained with ground-based data, therefore the SMBH mass is only a lower limit. We propose to carry out JWST observations to obtain its rest-frame optical spectrum and broad-band SED in the near-infrared. The first goal is to accurately measure its BH mass based on its H-beta line and bolometric luminosity fully corrected for extinction, in order to confirm the first detection of a BH with mass exceeding 10 billion solar masses in the early universe. The same data will be used to characterize the nature of dust extinction and test whether supernova dust can explain its continuum shape. The modest JWST program proposed here will unveil the nature of this remarkable quasar at the epoch of reionization, and provide new insight in the growth of the most massive BHs in the early universe and their connections to galaxy formation.