A Radio Scream at Cosmic Dawn: Modeling the impact of Radio-Loud Black Holes in the 21 cm signal

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Today, very little is known about the progenitors of the super-massive black holes that we observe within our Universe's first billion years and whether they might have produced appreciable radio emission. While inverse Compton scattering of the higher energy Cosmic microwave background is expected to drain energy from the electrons responsible for synchrotron radio emission at high redshifts, an extremely radio loud active galactic nucleus (AGN) was recently discovered at z~6 (Banados+ 2018) while radio loudness fraction has been observed to be roughly constant beyond z~5 (Banados+ 2015), exceeding previous expectations. In addition, several mysterious features in the radio monopole might be explained by a population of high-redshift radio loud black holes. These include claimed detections of an excess radio background by the ARCADE-2 experiment (Fixsen+2011) and an anomalously deep cosmic dawn absorption feature by the EDGEs experiment (Bowman+2018).

I will discuss our efforts to better understand whether upcoming observations of 21cm from HI might help us constrain radio emission from the first black-holes using semi-analytic model for the impact of radio-emission from accreting black holes on the 21cm signal. Exploring the dependence on black-hole seed properties such as accretion rates, halo masses, obscuration, and radio-loudness, we find that a population of Compton thick black holes growing rapidly in ancient atomic cooling halos are capable of producing a radio background consistent with observations by ARCADE-2 and others and an absorption feature similar to what is observed by EDGEs. We also find that such black-holes would produce a population of ~tens of micro-jansky sources at 1.4 GHz that will be detectable with the Square Kilometer Array.