Cosmological numerical simulations of X-ray heating during the Universe's "Dark Ages": Predictions for observations with a lunar farside radio telescope

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Abstract. Due to its tenuous ionosphere and shielding from terrestrial radio interference, the lunar farside is a unique platform for astrophysical research of the very early universe. In particular, future measurements of the highly redshifted 21cm line of neutral hydrogen will contain a wealth of information about the universe's first stars, galaxies, and black holes. In the last decade, it has been shown that early X-rays are likely the dominant source of heating during the cosmic "Dark Ages" and early Reionization epochs, a time less than one billion years after the Big Bang when the universe began its transition from being mostly neutral to almost entirely ionized. These X-rays, produced in large part by accretion onto the first black holes, propagate deeply into the intergalactic medium (IGM) and are expected to drive the global 21cm signal into emission. However, the expected amplitude and observed frequency of this signal are highly uncertain since these parameters depend sensitively on the formation and growth histories of the first black holes. Using new high mass resolution cosmological simulations with radiative transfer, we are exploring the effects of an early X-ray background from accreting black holes on the 21cm signal. Through detailed tomography of the 21cm line, future observations will place constraints on the accretion history of super-massive black holes and their impact on the IGM.