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UNVEILING THE COSMIC DARK AGES: INTEGRATING SCIENCE MODELING AND SYSTEMS DEVELOPMENT FOR THE LUNAR CRATER RADIO TELESCOPE ON THE FAR SIDE OF THE MOON

Abstract

The Cosmic Dark Ages constitute the period of the Universe, starting immediately after the decoupling of CMB photons from matter, and ending with the formation of the first stars and galaxies. The electromagnetic radiation emitted by neutral hydrogen at the rest wavelength of 21 cm is the only mechanism for us to investigate this crucial phase in the evolution of the Universe and answer fundamental questions about the validity of the standard cosmological model, dark matter physics, and inflation. Due to cosmological redshift, this signal is now only observable at frequencies that cannot be accessed from the surface of the Earth due to ionospheric absorption and reflection. With the Lunar Crater Radio Telescope (LCRT), we aim at carrying out unprecedented measurements of the sky-averaged redshifted signal spectrum in the 4.7-47 MHz band, by deploying a 350m-diameter parabolic reflector mesh inside a lunar crater on the far side of the Moon and suspending a receiver at its focus. This work discusses the feasibility of the LCRT science goals through the development of a science model, with emphasis on post-processing techniques to extract the Dark Ages signal from the galactic foreground dominating the expected raw data. This model can be used to vary critical instrument and mission parameters to understand their effect on the quality of the retrieved signal.
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