The Radio Quiet Environment Above the Lunar Farside and its Application to 21-cm Experiments. Neil Bassett[1], Jack O. Burns[1], David Rapetti[1,2], and Keith Tauscher[1], [1]Center for Astrophysics and Space Astronomy, University of Colorado Boulder, [2]NASA Ames Research Center

Astronomical observations at low radio frequencies made from the ground are distorted by both ionospheric effects and human generated radio frequency interference (RFI). In order to mitigate these contaminating effects, observations must be made from above Earth's atmosphere and radio signals from Earth must be blocked. The region behind the lunar farside provides a unique radio quiet zone that is ideal for performing low frequency astronomical measurements.

Although the Moon is able to block most radio emission from Earth, a small amount will be diffracted by the spherical geometry of the Moon, creating a 'quiet cone' behind the farside. The amount of diffraction, and thus the level of attenuation of radio signals from Earth, is a function of frequency. We utilize a two-dimensional Finite Difference Time Domain (FDTD) numerical technique to simulate the behavior of low frequency radio waves and their interaction with the Moon. The simulations were performed using Meep, an open-source software package for implementing the FDTD method for electrodynamical modeling.

We find that the power of radio interference signals from Earth is significantly diminished behind the farside. As expected, the amount of diffraction is less, and thus the amount of attenuation is greater, at higher frequencies.

The Dark Ages Polarimeter PathfindER (DAPPER) mission is designed to probe the highly redshifted 21-cm signal of neutral hydrogen from the radio quiet environment in orbit above the lunar farside. DAPPER will collect science data while in the cone defined by 80 dB suppression of RFI from Earth. Our simulations show that there is sufficient suppression of RFI while in orbit above the farside to collect the data necessary to separate the 21-cm spectrum from the much brighter foregrounds.

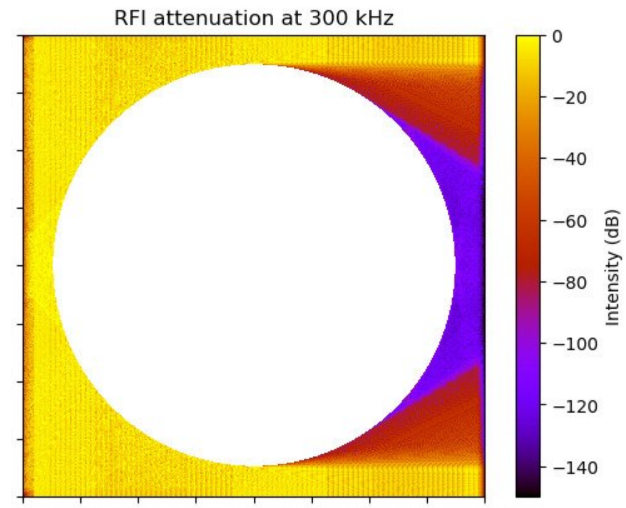

Figure 1: A 2D FDTD simulation of the diffraction of a 300 kHz plane wave around the Moon. The Moon is assumed to be a perfect conductor.

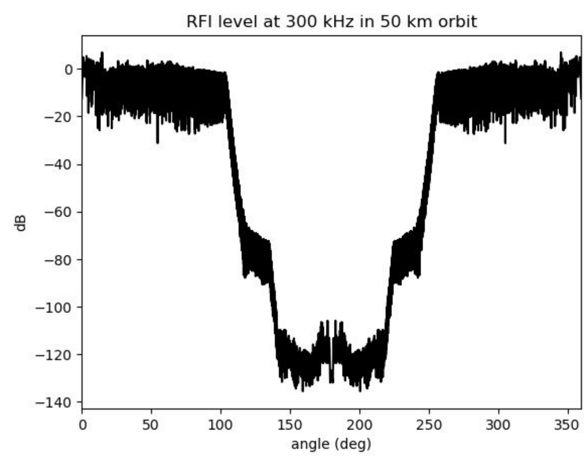

Figure 2: Amount of RFI suppression at 300 kHz during a circular orbit 50 km above the surface of the Moon. Calculations were performed using the same FDTD simulation as Figure 1.