TRANSFORMATIVE ASTROPHYSICS FROM THE FARSIDE OF THE MOON. Jack. O. Burns[1] on behalf of the DAPPER and FARSIDE teams, [1]Center for Astrophysics and Space Astronomy, University of Colorado Boulder, Boulder, CO, jack.burns@colorado.edu.

Introduction: The farside of the Moon is a pristine, quiet platform to conduct low radio frequency observations of the early Universe's Dark Ages, as well as space weather and magnetospheres associated with habitable exoplanets. In this talk, NASA-funded concept studies will be described for DAPPER and FARSIDE. DAPPER observations (17-38 MHz), using a single cross-dipole antenna, will measure the global 21-cm spectrum to the level required to distinguish the standard cosmological model from those of additional cooling models possibly produced by exotic physics such as dark matter interactions. FARSIDE consists of 128 dipole antennas deployed across a 10 km area by a rover. FARSIDE would enable monitoring of the nearest stellar systems for the radio signatures of coronal mass ejections and energetic particle events, and would also detect the magnetospheres of the nearest candidate habitable exoplanets.

DAPPER: The *Dark Ages Polarimeter PathfindER* is designed to precisely measure the two absorption troughs in the redshifted global 21-cm spectrum (Figure 1). To accomplish these goals, DAPPER will observe the hydrogen cosmology spectrum over the redshift range $83 \geq z \geq 12$ to an rms thermal noise level of ≈20 mK. These requirements are met by a relatively simple cross-dipole antenna + spectropolarimeter placed in a low lunar orbit (50×100 km), with data taken when the spacecraft is in the radio shadow above the farside of the Moon. The instrument components have high TRL heritage from previous space missions and ground-based prototypes.

FARSIDE: The *Farside Array for Radio Science Investigations of the Dark ages and Exoplanets* would place a low radio frequency interferometric array on the farside of the Moon. A NASA-funded design study, performed in collaboration with JPL, focused on the instrumentation, deployment rover, and lander/base station, delivered an architecture broadly consistent with the requirements for a Probe mission. This architecture consists of 128 dipole antennas deployed across a 10 km area by a rover, and tethered to a base station for central processing, power, and data transmission to the Lunar Gateway. FARSIDE would provide the capability to image the entire sky each minute in 1400 channels spanning frequencies from 100 kHz to 40 MHz, extending down two orders of magnitude below bands accessible to ground-based radio astronomy. The lunar farside can simultaneously provide isolation from terrestrial radio frequency interference, auroral kilometric radiation, and plasma noise from the solar wind. It is thus the only location within the inner solar system from which sky noise limited observations can be carried out at sub-MHz frequencies. This would enable near-continuous monitoring of the closest stellar systems in the search for the radio signatures of coronal mass ejections and energetic particle events, and would also detect the magnetospheres for the nearest candidate habitable exoplanets.

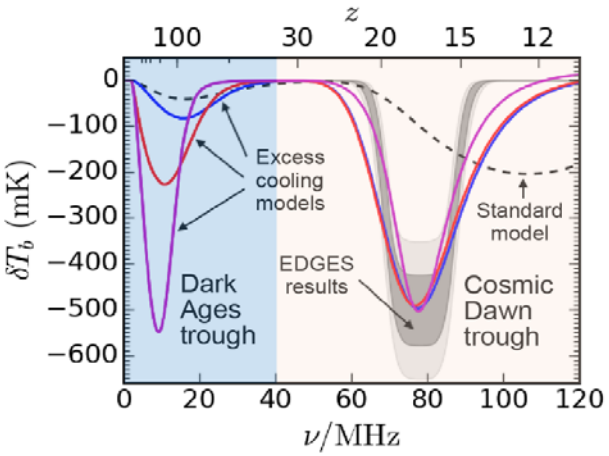

Figure 1. The global 21-cm spectrum (δT_b is brightness temperature) provides a key test of standard cosmology and possible exotic physics produced by interactions with dark matter. The black dashed curve is a prediction using standard cosmology with adiabatic hydrogen gas cooling and star formation similar to that in the Milky Way. The color curves are parametric models with added gas cooling. The grey curves are 1- and 2- σ uncertainties from EDGES ground-based observations.

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