

A LUNAR FAR SIDE RADIO ARRAY AS THE FIRST ASTRONOMICAL OBSERVATORY ON THE MOON: PRECURSOR STUDIES

Y. Takahashi

Astronomy & Astrophysics Group, University of Glasgow (yuki@astro.gla.ac.uk/Fax: +44-141-330-5183)

Setting up an observatory on the Moon could not only give us new views of the universe, but also inspire the billions of people who look at the Moon. The Moon as a site for astronomy has been proposed since at least the mid-1960s when humans began to have access to outer space. The most seriously investigated concept for a Moon-based observatory has always been a very-low-frequency array on the far side for several well-grounded reasons. First, the Lunar far side is recognized as the best site of all for radio astronomy because it is the one location permanently free from the significant artificial and natural interference from Earth. Second, such an observatory will give us a completely new look at the universe by opening up the new frequency window of 50kHz-30MHz, the only part of the electromagnetic spectrum through which the universe has yet to be explored. Third, a simple array of dipole antennas is probably the most technologically feasible observatory to be placed and operated on the Moon. To be able to see astronomy happening from the Moon before we all age another 10 years, we must answer several questions at our earliest opportunities. (1) How far into the far side does the observatory site need to be for the terrestrial interference to be attenuated below the background level? (2) How do the electrical properties of the Lunar surface influence the site selection and the antenna design? In particular, how might the subsurface structures reflect radio waves to affect the observation? (3) How much would the Lunar ionosphere affect the observation? To address these questions now, radio wave propagation around the Moon is simulated using Apollo data for dielectric permittivity and loss tangent of the Lunar surface. The results of the simulations are presented. To ultimately identify the best sites and to specify the observatory design, making the following measurements within the next several years is crucial. (1) The level of terrestrial noise at various far-side locations. (2) Electrical properties of the Lunar surface, including permittivity and conductivity; their variation with depth and radio wave frequency. (3) The electron density profile above the Lunar surface during the day, the night, and the transition in-between. (4) Magnetic fields at candidate sites. (5) Detailed topology at candidate sites. Some ideas are suggested for inexpensive precursor missions in the very near future with significant scientific returns of their own. To realize the dream of observing the universe from the Moon, it is time for an international team to begin seriously proposing these precursor missions.