SETI from the Lunar South Pole

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1 SETI and its Challenges

The Search for Extraterrestrial Intelligence (SETI) refers to astronomical observation campaigns which look for *technosignatures* - electromagnetic radiation produced by technology, and not by natural sources. If technosignatures were discovered whose origin was non-human, such a detection would provide strong evidence for life having also emerged elsewhere in the Universe. Technosignature searches, when conducted with telescopes located on the Earth's surface, face a number of challenges including (1) the Earth's ionosphere blocks low frequency radio waves, limiting the range of frequencies that can be searched and (2) when terrestrial radio frequency interference (RFI) is detected in high volume in SETI observations, it becomes challenging to attribute any particular signal to extraterrestrial intelligence. Despite being constructed in remote, radio-quiet regions, terrestrial radio telescopes are still exposed to RFI from artificial satellites around the Earth, the number of which is expected to increase massively in the next decades. While SETI astronomers have developed observing strategies and specialized software for approaching this challenge, a more radical solution could be to avoid of the problem entirely by conducting observations from a region of space with minimal exposure to terrestrial RFI.

2 SETI from the Moon

Much previous work has identified the Moon as a prime platform for doing astronomy. Notably, the Moon would make an ideal platform for low-frequency cosmology due to its location above the Earth's ionosphere [1]. But it could also be a revolutionary platform for SETI [2, 3, 4]. Being above the ionosphere, observing from the Moon would open up previously unexplored frequencies for technosignature searches. But a critical advantage for SETI is that the body of the Moon can act as a shield against terrestrial RFI. The Moon's capacity to block such RFI has been established both by computer simulations of radio wave diffraction around the Moon [5] and by direct measurements from lunar orbit made by NASA's RAE-B spacecraft [6]. Accordingly, proposals for lunar SETI generally suggest that a telescope be placed on the lunar farside, ideally in a crater. The craters Saha [3, 7], Tsiolkovsky [8, 5], and Daedalus [9, 10] have been chosen in past lunar radio-astronomy proposals.

3 SETI from the Lunar South Pole

While the center of the lunar farside would be perhaps the most radio-quiet location from which to conduct SETI observations, certain locations near Moon's South Pole would also be favorable for SETI. In particular, the surface at the farside of Malapert Mountain, whose summit lies in selenographic coordinates at 86°S, 0°E (and thus is plausibly accessible by the Artemis III mission), could be an ideal site [11, 12]. The reason for this is that the mountain, rising 5km above the surface, would significantly shield a telescope or array placed beyond it from terrestrial RFI. Simulations of radio wave diffraction around the mountain from [5] show that RFI would likely be attenuated by 5 orders of magnitude (see Figure 1). From the lunar South Pole, and protected by Malapert Mountain, a set of 3-5 broadband (DC-10 GHz) radiometers could be deployed to sample the RFI environment and to conduct a pathfinder survey that would effectively probe regions of the spectrum that are incredibly difficult to observe from the Earth's surface due to copious anthropogenic interference.

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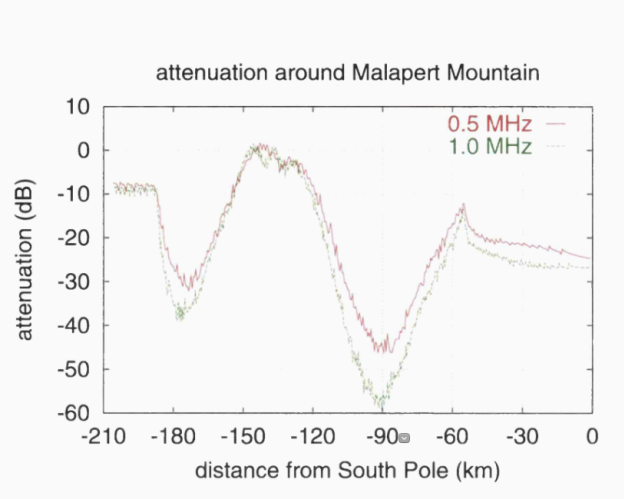

Figure 1: Simulations show that terrestrial radio waves, even at very low frequencies, would be attenuated by 5 orders of magnitude in the region directly beyond Malapert Mountain. Taken from [5].

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