ASTRONOMICAL AND IONOSPHERIC IMAGING

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Radio astronomy was discovered at 20 MHz, and radio astronomers are increasingly looking to observations in the HF and VHF bands as a means of elucidating various astronomical phenomena. High dynamic range, high angular resolution imaging in these bands requires exquisite *differential* compensation of the phase fluctuations induced by the ionosphere; a nominal goal is to maintain uncompensated ionospheric phase fluctuations below a level of 0.1 radian, equivalent to an electron column density of 1 mTECU. Simultaneously, ionospheric scientists are looking to probe the ionosphere at higher spatial and temporal resolutions in order to understand aspects of ionospheric plasma physics, the solar terrestrial relation, and effects on technology systems. We review a series of 74 MHz observations made with the Very Large Array, including a series of joint optical-radio observations utilizing an all-sky optical camera during the summer of 2003. The VLA observations can be used to probe the ionosphere at the milli-TEC unit level, on spatial scales up to roughly 50 km and on time scales as short as 10 s, while the optical camera, combined with additional off-site sensors, was used to identify the dominant, summer nighttime ionospheric phenomena. We find a wide variety of phenomena, even in the mid-latitude location of the VLA. Key to these findings is the identification of specific ionospheric phenomena using the off-site support sensors. We close with a discussion of future VLA campaigns and plans for a larger astronomical/imaging instrument, the Long Wavelength Array (LWA). The latter will be able to probe ionospheric density fluctuations on scales ranging from a few kilometers to potentially as large as 400 km.

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