In-situ observations of Langmuir waves in radio emission source regions are critical to understanding the microphysics governing emission at the plasma frequency and its harmonic. In particular, high-cadence three-dimensional observations of Langmuir wave modulation and polarization from the STEREO spacecraft can help distinguish among proposed emission mechanisms and illuminate wave interaction with small scale turbulent density fluctuations in type III and III burst source regions and the terrestrial foreshock.

In this context, we describe, observationally and theoretically, Langmuir waves localized as eigenmodes of solar wind density cavities. We conclude that under a range of plasma conditions they can grow to higher amplitudes than non-localized Langmuir waves in a turbulently fluctuating solar wind. Radiating as antennas, Langmuir eigenmodes can therefore contribute strongly to plasma frequency and harmonic radiation radio emission.

We also discuss recent observations showing that Langmuir wave polarization is organized by the speed of the driving electron beam. Interpreting these observations as evidence of the z-mode character of small wave number Langmuir waves, we evaluate whether proposed methods of shifting Langmuir waves to small wave number are consistent with observations and discuss the implications for plasma frequency and harmonic radiation.