Quasi-thermal noise, plasma wave, and radio measurements for an Interstellar Probe Mission

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A well-designed radio and plasma wave instrument on Interstellar Probe will measure a variety of key phenomena in the outer heliosphere and interstellar medium, namely few-kHz radio emissions from beyond the heliopause, quasi-thermal noise emissions - hence plasma density and temperature, plasma waves associated local kinetics and beams, and potentially dust impacts on the spacecraft. Radio emission signatures have been observed as solar transients interact with the local interstellar medium and can give remote measurements of the interaction between the heliosphere and local interstellar medium. The quasi-thermal noise spectrum is a highly accurate way to measure total density, electron pressure, and potentially bulk flow speed in the interstellar medium. Nonthermal plasma waves are indication of electron beams and kinetic plasma distributions and can give key diagnostics of shocks, current sheets, and other discontinuities. And of course, plasma wave measurements have proved to be a simple, robust measure of dust statistics with a relatively large count rate. All of these science goals can be met with a simple radio and plasma wave instrument, provided that proper consideration is given to sensor design and geometry and spacecraft integration is considered a priori. We describe the science and instrument trades and resource estimates associated with such an instrument.