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Measurements of compact radio source size and structure of cometary ion tails using interplanetary scintillation at 103 MHz

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The work contained in this thesis was carried out at the Physical Research Laboratory, Ahmedabad and describes observations of Interplanetary Scintillation (IPS), carried out since 1984, using a large 10,000 m^2 dipole array operating to 103 MHz. During the period of research the array underwent an expansion to 20,000 m^2 and the later part of the observations were carried out using the enhanced array.

The thesis begins with three introductory chapters, two of which provide a thorough review of the theory of wave propagation in inhomogeneous media and its use as a means of investigating small-scale irregularities in the solar wind and the interstellar medium, while the third describes the instrumentation. The fourth chapter describes a major sky survey aimed at determining the angular sizes of radio sources from the observed variation of scintillation index as a function of solar elongation (ε). This technique has been used before but these are the first measurements to be made at 103 MHz. Good observations were obtained on 14 sources. After careful calibration and curve-fitting angular diameters were derived and found to be in fair agreement with values obtained elsewhere at other radio frequencies. Evidence was also found for enhanced scattering by the interstellar medium near the galactic plane, again consistent with other work. It was anticipated that the survey would detect a large number of scintillating sources and reasons for the lower sensitivity actually achieved are discussed and identified.

During the survey opportunities became available for investigating the effect of comet tails crossing the lines of sight to compact radio sources and the fifth chapter describes evidence of enhanced scattering caused by plasma turbulence in tail regions. Scale sizes and ion density variations in the plasma tail of comets Halley and Austin 1989c1 were measured and the importance of the geometry of comet tails in making such measurements are discussed.

The thesis gives a comprehensive account of observations of interplanetary scintillation at 103 MHz. Significant new results were obtained, confirming the detection of scattering by interstellar gas and providing original estimates of the physical properties of ion-clouds in comet tails at large distances downstream of the nucleus.