



Probing Space with Radio and Radar Methods Based on Newly Recognised Symmetries of the Electromagnetic Field

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We describe a method for radio and radar studies of space which exploits the newly recognised symmetry properties - and concomitant conserved quantities - of the electromagnetic field. As an example we demonstrate results obtained by using the photon orbital angular momentum (POAM) and show how this can be used to analyse the spiral spectrum of the vorticity of a turbulent plasma. As another example we show how POAM can be used in astronomy to identify rotating black holes. Hitherto, most of the research on POAM has been carried out at optical, millimetre and microwave frequencies. We show how radio beams at relatively low frequencies can be endowed with POAM by using antennas that can control the azimuthal phase of the received or emitted beam.