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On the complete characterization of the physical observables of radio emissions from arbitrary sources

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Like all forms of electromagnetic radiation, radio emissions of cosmic origin contain a diversity of physical observables that are constants of motion. Each of these observables carry unique information about the physics of the source(s) from which the radiation emanates and the medium through which it propagates. While the electromagnetic observables used in present-day radio and radar studies of space are limited to the energy (radiometry) and the linear momentum (radio astronomy, space radio and radar applications), the angular momentum and the boost momentum of the radiation are typically discarded and thereby important information wasted. We show how all electromagnetic observables can be measured and analysed, yielding information about vorticity and other topological properties as well as turbulence of radio sources and propagation media. Both theoretical predictions and experimental results confirming these predictions will be presented.