Electromagnetic scattering from Reissner-Nordström black holes

Luís Carlos Bassalo Crispino, Ednilton Santos de Oliveira
Universidade Federal do Pará, Brasil
Sam R. Dolan
University of Sheffield, United Kingdomm
Atsushi Higuchi
University of York, United Kingdom

The Reissner-Nordström geometry is a solution of Einstein equations that represents the spacetime around static electrically charged black holes. These solutions are very important mainly because they offer the possibility of studying extreme black hole configurations in spherically symmetric geometries. Charged black holes also present new phenomena when compared to Schwarzschild black holes (static uncharged black holes). As an example, we can mention the interconversion between electromagnetic and gravitational radiation. In this talk it is presented the study of electromagnetic scattering properties of Reissner-Nordström black holes. Low-frequency and numerical results are shown. Basically because of the parallel-transport of polarization vector along light rays, in the Schwarzschild spacetime, the back-scattered flux of electromagnetic radiation is exactly zero. In Reissner-Nordström spacetimes, however, there is nonzero scattered flux of electromagnetic radiation in the backward direction. This outcome has two causes: First, because of the background electrostatic field, part of the incident modes suffers a helicity-reversing scattering. Second, because of the interconversion between spin 1 and 2 fields, part of the incident electromagnetic wave is converted into gravitational radiation. Hence, for charged black holes there is a non-zero electromagnetic flux in the backward direction, which, in principle, can be identified as a bright spot in the electromagnetic wave detector. This spot is brightest in the case of extreme Reissner-Nordström black holes. However, differently from the spot present in the scattering of scalar waves by static black holes – the glory effect –, the bright spot in the case of electromagnetic scattering from Reissner-Nordström black holes gets less bright for higher frequencies.