Handedness of photons and gravitational wave polarization.

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I will show that the electric-magnetic classical symmetry of Maxwell theory breaks down by quantum fluctuations in spacetimes admitting gravitational radiation that propagates to future null infinity with an excess of one polarization mode. Typical scenarios where this gravitational asymmetry occurs include mergers of binary black holes and stellar gravitational collapse. The classical electric-magnetic symmetry is associated to the conservation of the net number between right- and left-handed photons. It will be argued then that potential implications of this quantum effect are expected in the astrophysics of black holes through combined measurements of photon and gravitational wave polarizations, and this may be useful to test the geometry in the vicinity of black holes.

(1) *Electromagnetic duality anomaly in curved spacetimes*, I. Agullo, A. del Rio, J. Navarro-Salas, Phys. Rev. Lett 118, 111301 (2017).

(2) *Gravity and handedness of photons*, I. Agullo, A. del Rio, J. Navarro-Salas, Int. J. Mod. Phys. D, Vol. 26 (2017) 1742001. [First award in the 2017 GRF essay competition]

(3) *Classical and quantum aspects of electric-magnetic duality rotations in curved spacetimes*, I. Agullo, A. del Rio, J. Navarro-Salas, Phys. Rev. D98 125001 (2018).

(4) *On the electric-magnetic duality symmetry: quantum anomaly, optical helicity, and particle creation*, I. Agullo, A. del Rio, J. Navarro-Salas. Symmetry 2018, 10(12), 763.