
# ELECTROMAGNETIC & PROCA FIELDS ON ROTATING BLACK HOLES

**Samuel Richard Dolan**[1]

[1]*The University of Sheffield - Western Bank Sheffield, S10 2TN, United Kingdom.*

In 1974, Cohen & Kegeles showed that the vector potential A for an electromagnetic field on any 4D spacetime admitting a shear-free geodesic null direction l can be derived from a Hertz potential built from a (scalar) Debye potential that satisfies second-order (Teukolsky) ODEs in the frequency domain. In 2017, Frolov and coworkers showed that A for the Proca (massive spin-1) field on Kerr-AdS-NUT spacetimes could also be derived from a scalar potential that satisfies separable ODEs. The former approaches yields A in radiation gauge (A.l = 0) whereas the latter yields A in Lorentz gauge (div A = 0). In this talk I will review and attempt to unify both formalisms for the 4D Kerr spacetime. In the massless (EM) limit, I will present new results for (i) the gauge transformation that links the vector potentials in radiation and Lorentz gauges, and (ii) the Hertz potential for the Lorentz gauge. I will then describe how the approach of Frolov et al. has led to an improved understanding of the superradiant instability of the Proca field on Kerr spacetime.