

Gravitational Geometry and Dynamics Group Seminar

Wed., November 19, 2025, at 11h00.

Room: Sala Sousa Pinto and Teams ID: 352 390 633 854 1

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Black holes with electroweak hair

When the bosonic sector of the electroweak theory is minimally coupled to General Relativity, magnetic Reissner-Nordström black holes become unstable below a critical horizon size. This instability is caused by electroweak condensation – a phenomenon first identified in flat space in the late 1980s, occurring when extremely strong magnetic fields destabilize the usual Higgs vacuum. Around a magnetic black hole, this process breaks the original spherical symmetry of the configuration and produces an "electroweak hair" made of massive W, Z and Higgs fields. We investigate these hairy black holes at the fully nonlinear level, restricting our analysis to the axially symmetric case. We find that the hair features two loops of oppositely directed electric currents that generate a magnetic field with a quadrupolar structure. In the extremal limit, the electroweak gauge symmetry is restored near the horizon. Remarkably, the extremal hairy black holes can reach macroscopic sizes, with horizon radii on the order of a centimeter. Our solutions provide the first example of hairy black holes arising purely within the framework of the Standard Model – with its physical parameter values – and General Relativity.