Rotating black holes in the cubic Galileon theory

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The gravitational wave detection GW170817 and its electromagnetic counterpart GRB170817A set uptight constraints on the speed of gravitational waves [1]. As a result, only restricted families of many modified theories of gravity turned to be explicitly compatible with these constraints [2].

Soon, the observations of the instrument GRAVITY [3] and the worldwide network Event Horizon Telescope [4] may further rule out various classes of modified theories of gravity: both of them are currently focused on the close neighbourhood of *Sgr A**, the central supermassive black hole of the Milky Way, and should thus provide new tests of gravity, in the strong-field regime.

Within this context, the cubic Galileon theory is of particular interest: it is a scalar-tensor theory compatible with the observed speed of gravitational waves. Moreover, it is known to admit static black holes different from Schwarzschild's solution[5], thus circumventing a former no-hair theorem [6]. This indicates that the black hole solutions of this theory may significantly deviate from general relativity in cases as massive as *Sgr A**.

Following these results, we present the first numerical solutions of rotating black holes in the cubic Galileon theory and subsequent results which should have astrophysical relevance in regards of the observations from GRAVITY and the EHT.

References

[1] B. P. Abbott *et al.* Gravitational Waves and Gamma-Rays from a Binary Neutron Star Merger: GW170817 and GRB 170817a. *Astrophys. J.*, 848, L13, 2017.

[2] J. M. Ezquiaga and M. Zumalacárregui. Dark Energy after GW170817: dead ends and the road ahead. *Physical Review Letters*, 119(25), 2017.

[3] R. Abuter *et al.* First light for gravity: Phase referencing optical interferometry for the very large telescope interferometer. *Astronomy & Astrophysics*, 602, 2017.

[4] S. Doeleman *et al.* Imaging an event horizon: submm-vlbi of a super massive black hole. *ASTRO2010 Decadal Review Panels*, 2009.

[5] E. Babichev, C. Charmousis, A. Lehébel, and T. Moskalets. Black holes in a cubic Galileon universe. *Journal of Cosmology and Astroparticle Physics*, 2016(09).

[6] L. Hui and A. Nicolis. No-hair theorem for the galileon. *Physical Review Letters*, 110(24), 2013.