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Investigating the existence of gravitomagnetic monopole in M87*

When the fuel of a very massive star is spent, it collapses due to its own gravitational pull and eventually becomes a very small region of arbitrarily high matter density, that is a 'Singularity', where the usual laws of physics may break down. If this singularity is hidden within an event horizon, which is an invisible closed surface from which nothing, not even light, can escape, then we call this object a black hole (BH). But if the event horizon does not form, we are left with the tantalizing option of observing a naked singularity (NS). In 2018, we reported the first observational indication of the gravitomagnetic monopole (gravitational analogue of Dirac's magnetic monopole) using the X-ray data from a star GRO J1655-40, which collapsed into the most extreme object in the universe, a Singularity. However, in 2019, the Event Horizon Telescope (EHT) mapped the compact radio source (M87*) of the elliptical galaxy M87 and showed that it is consistent with a Kerr black hole, yet alternatives to this are not ruled out. We examine the possibility for the existence of a gravitomagnetic monopole (n) in M87* by using the results obtained from its first EHT image. Using the EHT observational results, we obtain the allowed parameter space of a Kerr-Taub-NUT metric description for M87. We have found that the observational constraints on the size and circularity of the M87* shadow do not exclude the possibility that M87* can be a naked singularity and contain the gravitomagnetic monopole. Essentially, accurate measurements of both the shadow size and asymmetry could put strong constraints on the Kerr parameter a and n and break the degeneracies between the different metrics (including those between the BHs and NSs).

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