Black holes and impostors

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The large majority of the scientific community accepts black holes as real and important players in the (astro) physical Universe. But this idea had a very difficult birth. For the first half of their century old history, black holes – as mathematical solutions of General Relativity – were not properly understood and considered by most experts as a mathematical curiosity without astrophysical reality. The black hole hypothesis came to be accepted slowly and largely by virtue of the *astrophysical data*, which could not be explained by any other viable theoretical alternative.

The black hole *hypothesis* has, however, far reaching theoretical consequences. As Penrose showed (and for which he was awarded half of the 2020 Nobel Physics prize), black holes in General Relativity and with reasonable matter/energy imply the existence of singularities in their interior, hence the doom of General Relativity itself. Additionally, the marriage of black holes with quantum mechanics has led to the famous information paradox, questioning what happens to information when it forms a black hole and the black hole evaporates due to quantum effects.

These challenges led to a lingering suggestion in the scientific literature that the astrophysical objects regarded as black holes may be something different. For instance some sort of dark matter star which, albeit dark, needs not trap light, the defining property of black holes. This work, published as Editors Suggestion in Physical Review Letters, provides evidence that any such theoretical *black hole impostor* that could imitate some key observable properties of a black hole, and that has a plausible formation mechanism, is unstable and therefore unviable as a contender to explain astrophysical observations.

The key point is that the instability afflicting black hole foils is triggered by the very same property that seems mandatory in order for the impostor to *appear* a black hole – its ability to curve the paths of light into close orbits called light rings.

Even though the imitation game is not closed, this work hammers another nail on the coffin of black hole impostors, thus corroborating the need to accept the physical reality of the mysterious celestial bodies we dub black holes.

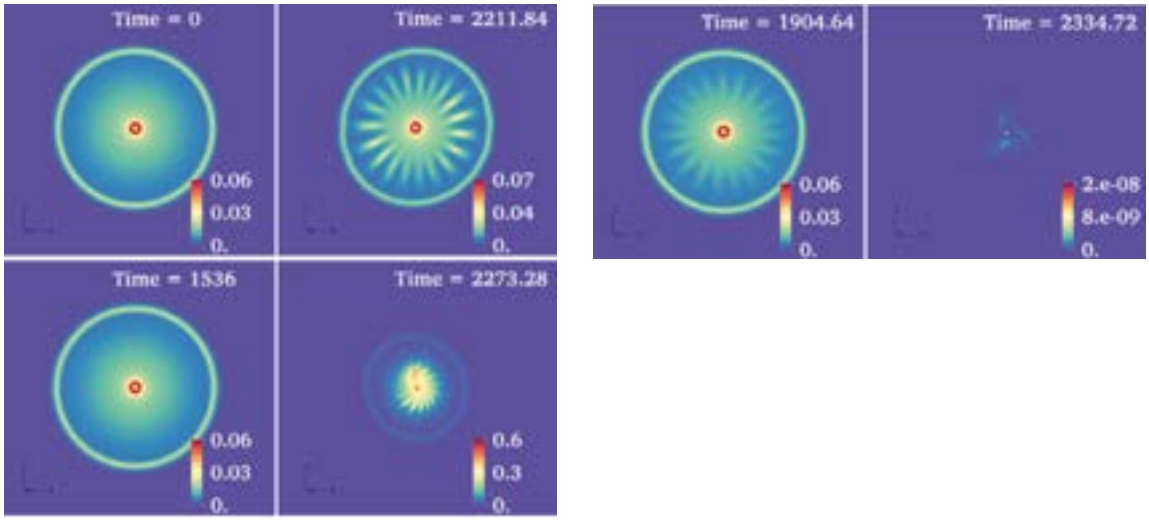

FIGURE 1
Numerical evolution of a black hole impostor showing that it decays... into a black hole!