Effect of Distributed Mass in Black Hole Interiors on Plunging Particles

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Abstract. Earlier work on the mass distribution in black hole interiors[1] left the question of what happens to a plunging particle unanswered. This issue is resolved here.

Introduction

An earlier paper[1] showed that contrary to long-held belief in a singularity, the mass of a black hole is distributed throughout the space interior to the event horizon. Essential to this conclusion was the understanding that a particle plunging toward the event horizon will, to a far-off observer, appear to slow down to a standstill as it approaches the event horizon and will never cross it.

To a hapless observer accompanying the particle, they will reach and cross the event horizon in finite time and will then proceed to the central singularity, again in finite time. The outcome of falling inside the event horizon might be different with mass distributed throughout the interior as was shown, but it is inconceivable that the conclusion that the particle reaches the event horizon could be any different as the Schwarzschild solution is exact and equivalent in both representations, outside the event horizon.

It would seem that there is a certain incompatibility between these two different viewpoints in that the same particle is hovering close to the event horizon and yet has reached it. This incompatibility would also seem to exist in a more extreme way with the existing accepted theory; the particle is hovering close to the event horizon and yet crushed into the central singularity.

Time course

Time is the essential difference between the two viewpoints. To a far-off observer, time for the particle slows to a standstill as it approaches the event horizon. Its' clock has stopped ticking and the finite time taken to reach the event horizon is never reached[2].

However, there is more to this. Light emanating from the particle appears red shifted to the far-off observer, and with expected reciprocity, light from the far-off observer appears blue shifted to the observer accompanying the particle; in fact it has been said, that such an observer would see the end of the Universe before completing his journey. But before then, the black hole will have evaporated away due to Hawking radiation[3]. The observer will see the black hole disappear below his feet has he falls towards it.

We would, however, expect the particle to be spread out by tidal forces into a collapsing spherical shell, eventually creating a new outer event horizon. This layer would then be the first mass to be released by Hawking radiation on a last in first out basis; again without reaching the original event horizon.

Conclusion

There is no conflict between the two views.

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[1] D. Proffitt, “Mass distribution in black hole interiors,” *viXra:1201.0107*, pp. 1-3.

[2] J. A. W. E F Taylor, *Exploring Black Holes - Introduction to General Relativity*. Addison Wesley Longman Inc., 2000.

[3] S. W. Hawking, “Particle creation by black holes,” *Communications In Mathematical Physics*, vol. 43, no. 3, pp. 199-220, Aug. 1975.