

Black Hole Escape Velocity - a Case Study in the Decay of Physics and Astronomy

By

Stephen J. Crothers

7th August 2015

steve@plasmareources.com

FOREWORD

Cosmologists always claim that their black holes, mathematical fabrications entire, have an escape velocity. They even have an equation for it and by using this equation they assert that the 'escape velocity' at their black hole 'event horizon' is the speed of light. This event horizon, they say, is at the 'Schwarzschild radius' of their black hole; and they have an equation for that too. On the other hand, the cosmologists also always assert that nothing can even leave the event horizon of their black holes. Light, they say, hovers forever at their event horizon as it tries to leave or escape the clutches of a black hole. Thus, according to the cosmologists, their black holes have and do not have an escape velocity simultaneously at the same place. However, nothing can in fact have and not have an escape velocity simultaneously at the same place. This schizophrenic character of the black hole is sufficient to completely invalidate it. But there is more. Escape velocity is a two body relation – one body escapes from another body. The black hole is, by its supposed mathematical construction, a one mass universe. Consequently the very concept of escape velocity does not even apply. Obviously, no cosmologist understands the meaning of escape velocity.

1. Escape Velocity

Velocity is a vector – it has magnitude and a direction. Speed however is a scalar; it has magnitude but no direction. For example, the speed 60 km/hr has no direction, but the speed 60 km/hr due north has direction. The former is a scalar, the latter a vector. Although velocity is a vector whereas speed is a scalar, the cosmologists use the terms interchangeably when talking of their black holes. Throw a ball straight up into the air. It leaves your hand with a speed and it travels in the radial direction, along an imaginary line through the ball and the centre of the Earth. For simplicity, dear reader, you and I will consider only speed in the radial direction and so speak of escape speed and escape velocity in this context.

The ball thrown upward into the air reaches some height and then falls back

down. Thrown with a greater speed it goes higher before it falls back down. If thrown hard enough, that is, with a sufficiently high speed, it will go up and never fall back. The minimum speed which permits the ball to never fall back is called the escape speed, at the place the ball left; in this case the surface of Earth.

Escape speed and escape velocity do not mean that nothing can leave, only that a body will not escape from some other body unless it leaves at or greater than the escape speed. If it cannot even leave it certainly has no chance of escape and therefore the notion of escape speed (or escape velocity) has no meaning. After all, if a body cannot even leave there is no escape speed.

2. Black Hole Escape Velocity

According to the cosmologists their black holes all have an escape velocity (or escape speed).

“black hole A region of spacetime from which the escape velocity exceeds the velocity of light.” [1]

“black hole A massive object so dense that no light or any other radiation can escape from it; its escape velocity exceeds the speed of light.” [2]

“A black hole is characterized by the presence of a region in space-time from which no trajectories can be found that escape to infinity while keeping a velocity smaller than that of light.” [3]

“A black hole is, ah, a massive object, and it’s something which is so massive that light can’t even escape. ... some objects are so massive that the escape speed is basically the speed of light and therefore not even light escapes. ... so black holes themselves are, are basically inert, massive and nothing escapes.” [4]

According to references [1] and [2] the black hole ‘escape velocity’ exceeds that of light. According to reference [3] the ‘escape velocity’ of a black hole is at least the ‘velocity’ of light. Reference [4] asserts that the escape speed of a black hole is the speed of light, yet light cannot escape. Now light travels at the speed of light (does it not?), and so if the escape speed of the black hole is the speed of light, then, by the very definition of escape speed, light must escape! Cosmologists do not think so. They have a very confused notion of what constitutes an escape speed. Indeed, not only do they tell us that their black holes have an escape velocity and that the escape speed is greater than or equal to that of light, they also tell us that nothing whatsoever can even leave or emerge from their black holes, let alone fail to escape. Light itself hovers forever at the black hole event horizon as it tries to leave, or to escape. Furthermore, they tell us that things can only go into a black hole and nothing can come out –

the black hole event horizon is a ‘one-way membrane’, a place of no exit.

“I had already discussed with Roger Penrose the idea of defining a black hole as a set of events from which it is not possible to escape to a large distance. It means that the boundary of the black hole, the event horizon, is formed by rays of light that just fail to get away from the black hole. Instead, they stay forever hovering on the edge of the black hole.” [5]

“The problem we now consider is that of the gravitational collapse of a body to a volume so small that a trapped surface forms around it; as we have stated, from such a surface no light can emerge.” [6]

“Einstein predicts that nothing, not even light, can be successfully launched outward from the horizon ... and that light launched outward EXACTLY at the horizon will never increase its radial position by so much as a millimeter.” [7]

“It is clear from this picture that the surface $r = 2m$ is a one-way membrane, letting future-directed timelike and null curves cross only from the outside (region I) to the inside (region II).” [8]

“Things can go into the horizon (from $r > 2M$ to $r < 2M$), but they cannot get out; once inside, all causal trajectories (timelike or null) take us inexorably into the classical singularity at $r = 0$ The defining property of black holes is their event horizon. Rather than a true surface, black holes have a ‘one-way membrane’ through which stuff can go in but cannot come out.” [9]

“In the exceptional case of a ∂_v photon parametrizing the positive v axis, $r = 2M$, though it is racing ‘outward’ at the speed of light the pull of the black hole holds it hovering at rest.” [10]

“Thus we cannot have direct observational knowledge of the region $r < 2m$. Such a region is called a black hole, because things can fall into it (taking an infinite time, by our clocks, to do so) but nothing can come out.” [11]

“The most obvious asymmetry is that the surface $r = 2m$ acts as a one-way membrane, letting future-directed timelike and null curves cross only from the outside ($r > 2m$) to the inside ($r < 2m$).” [12]

“It turned out that, at least in principle, a space traveller could go all the way in such a ‘thing’ but never return. Not even light could emerge out of the central region of these solutions. It was John Archibald Wheeler who dubbed these strange objects ‘black holes’”. [3]

So the cosmologists, as cited above in profusion, assert on the one hand that their black holes have an escape velocity, and that the escape speed is greater than or equal to that of light, yet on the other hand they also assert that nothing can even leave or emerge from the event horizon or from below their event horizon. As explained in Section 1 above, if nothing can even leave then there is no escape velocity. For a body to have an escape velocity, other bodies must be present and at least be able to leave it. Thus, according to the cosmologists their black holes have and do not have an escape velocity simultaneously at the same place. Alas, nothing can have and not have an escape velocity simultaneously at the same place. The schizophrenic black hole is therefore a fallacy.

3. The Black Hole Escape Speed Equation

Despite the impossible escape velocity duality possessed by the black hole, the cosmologists even provide us with an

equation for black hole escape speed. What equation is that you ask? Well, first they give us an equation for the ‘radius’ of their black hole event horizon, their so-called ‘Schwarzschild radius’ r_s . Here it is,

$$r_s = \frac{2Gm}{c^2}$$

From this they solve for c , thus,

$$c = \sqrt{\frac{2Gm}{r_s}}$$

This they say is the escape speed of their black hole event horizon, the speed of light c , but from which light can’t escape! However, this equation is immediately recognised as the Newtonian equation for escape speed, in which the escape speed is set to c , the speed of light. More often than not, the cosmologists rescale by setting $G = 1$ and $c = 1$, so that their black hole escape speed equation becomes,

$$1 = \sqrt{\frac{2m}{r_s}}$$

and so their ‘Schwarzschild radius’ is,

$$r_s = 2m$$

as appears in the above quotations from references [8 – 12].

4. How Many Bodies?

Although the Newtonian expression for escape speed contains only one term for mass (m), it is an implicit two-body relation: one body leaves or escapes from another body. Indeed, to derive it in the first place requires two masses according to Newton’s equation for the attractive force of gravity between two masses, M and m , given by,

$$F = G \frac{Mm}{r^2}$$

But all alleged black hole equations pertain to a universe that by supposed mathematical construction contains only one mass, the black hole itself [13, 14]. Consequently, Newton's expression for escape speed cannot rightly appear in what is alleged to be a solution for a universe that contains only one mass. Moreover, gravity is a force in Newton's theory, but it is not a force in Einstein's theory, because in the latter gravity is spacetime curvature [13, 14], and so surreptitiously using Newton's gravitational force equation for the black hole is a big no-no. The insinuation of the Newtonian equation for escape speed into the black hole equations is spurious.

5. The Lesson Learned

Cosmologists do not even understand the meaning of escape velocity, since they unwittingly adorn their black holes with the schizophrenic properties of escape velocity and no escape velocity simultaneously at the same place, which is in fact quite impossible, no matter what they plead and despite them having equations. The black hole and its escape velocity are nonsense, illustrating once again that the word of an Authority is no guarantee that the word makes sense. The black hole is another symptom of the decline in physics and astronomy over the past century or more.

Note: This article is the fourth in a series [15 - 17].

REFERENCES

[1] Dictionary of Geophysics, Astrophysics, and Astronomy, Matzner, R. A., Ed., CRC Press LLC, Boca Raton, LA, 2001, <http://www.deu.edu.tr/userweb/emre.timur/dosyalar/Dictionary%20of%20Geophysics,%20Astrophysics%20and%20Astronomy.pdf>

[2] Collins Encyclopædia of the Universe, Harper Collins Publishers, London, 2001

[3] 't Hooft, G., Introduction to The Theory of Black Holes, online lecture notes, 5 February 2009, <http://www.phys.uu.nl/~thoof/>

[4] Bland-Hawthorn, J., ABC television interview with news reporter Jeremy Hernandez, 24 Sept. 2013, http://www.physics.usyd.edu.au/~jbh/share/Movies/Joss_ABC24_13.mp4

[5] Hawking, S. W., The Theory of Everything, The Origin and Fate of the Universe, New Millennium Press, Beverly Hills, CA, 2002

[6] Chandrasekhar, S., The increasing role of general relativity in astronomy, *The Observatory*, 92, 168, 1972

[7] Taylor E. F. and Wheeler J. A., Exploring Black Holes — Introduction to General Relativity, Addison Wesley Longman, 2000 (in draft).

[8] d'Inverno, R., Introducing Einstein's Relativity, Oxford University Press, 1992

[9] Hughes, S. A., Trust but verify: The case for astrophysical black holes, Department of Physics and MIT Kavli Institute, 77 Massachusetts Avenue, Cambridge, MA 02139, SLAC Summer Institute 2005

[10] O'Neill, B., Semi-Riemannian Geometry With Applications to Relativity, Academic Press, 1983

[11] Dirac, P.A.M., General Theory of Relativity, Princeton Landmarks in Physics Series, Princeton University Press, Princeton, NJ, 1996

[12] Hawking, S. W. and Ellis, G. F. R., The Large Scale Structure of Space-Time, Cambridge University Press, Cambridge, 1973

[13] Crothers, S. J., General Relativity: In Acknowledgement Of Professor Gerardus 't Hooft, Nobel Laureate, 4 August, 2014, <http://vixra.org/pdf/1409.0072v6.pdf>

[14] Crothers, S. J. "Black Hole and Big Bang: A Simplified Refutation", <http://vixra.org/pdf/1306.0024v2.pdf>

[15] Crothers, S. J., A Few Things You Need to Know to Tell if a Nobel Laureate is Talking Nonsense, 10 July 2015, <http://vixra.org/pdf/1507.0067v2.pdf>

[16] Crothers, S. J., A Nobel Laureate Talking Nonsense: Brian Schmidt, a Case Study, 16 July, 2015, <http://vixra.org/pdf/1507.0130v1.pdf>

[17] Crothers, S. J., A Few Things You Need to Know to Tell if a Mathematical Physicist is Talking Nonsense: the Black Hole - a Case Study, 29 July, 2015, <http://vixra.org/pdf/1508.0007v1.pdf>