On the asymptomatic formation of black holes

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The Schwarzschild solution of the Einstein equation has been widely understood to predict the existence of black holes and now most physicists appear to believe that the concept of black hole represents real physical objects. However the Schwarzschild solution gives rise to two problems that have not been properly addressed so far:

1. It is well-known that the Schwarzschild solution contains a singularity and many physicists have doubts that the physical world can contain such a feature.[1]

2. What the Schwarzschild solution clearly tells us is that *black holes will never form for distant observers* (like all of us) since they require *infinite* time for that; black holes require finite time to form only for observers falling together with the collapsing star.

The second problem is perhaps most clearly formulated by Dirac [2]:

> We see that the Schwarzschild solution for empty space can be extended to the region $r < 2m$. But this region cannot communicate with the space for which $r > 2m$. Any signal, even a light signal, would take an infinite time to cross the boundary $r = 2m$, as we can easily check. Thus we cannot have direct observational knowledge of the region $r < 2m$. Such a region is called a black hole, because things may fall into it (taking an infinite time, by our clocks, to do so) but nothing can come out.
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> The question arises whether such a region can actually exist. All we can say definitely is that the Einstein equations allow it. A massive stellar object may collapse to a very small radius and the gravitational forces then become so strong that no known physical forces can hold them in check and prevent further collapse. It would seem that it would have to collapse into a black hole. It would take an infinite time to do so by our clocks, but only a finite time relatively to the collapsing matter itself.

[1] A recent (2023) volume *Regular Black Holes: Towards a New Paradigm of Gravitational Collapse* is devoted to the question of how spacetime singularities can be eliminated [1].

The most probable reason[2] that in recent years physicists have started to talk about black holes as something established and accepted seems to be a result of the almost explicit use of double standards in physics:

- it is assumed that light will *never* leave a black hole because it needs infinite time to do so; in this case "infinite time" is interpreted as "never;"
- black holes are almost unanimously assumed to exist, despite that they also require infinite time to form for distant observers; so "infinite time" in this case inexplicably does not mean "never"!?

Perhaps, to make the use of double standards less transparent,[3] the term "asymptotically" has been sometimes used in the explanation of the formation of black holes for us – black holes do form for us, but "asymptotically"...

Not only doesn't this term "justify" the use of double standards, but its use leads to confusion, because it hides the real problem and, by the same argument (that black holes somehow form "asymptotically"), it implies that, if light asymptotically approaches the event horizon, it will reach it and eventually escape (which is not the accepted understanding). In any case, if black holes do form asymptotically, then, by absolutely the same logic, the event horizon will be as bright as a star.

References

[1] C. Bambi (ed.), *Regular Black Holes: Towards a New Paradigm of Gravitational Collapse* (Springer, Heidelberg 2023)

[2] P. A. M. Dirac, *General theory of relativity* (Princeton University Press, Princeton 1996) pp. 35-36

[2] The existence of super-compact stellar objects does appear to be an experimental fact; however it is a misconception to call those objects black holes as they are understood now – with the two problems discussed here.

[3] I believe making the use of double standards less transparent has not been intentional, but rather following "an inner voice" whispering that there is a contradiction that should be avoided or at least addressed.