Rebuttal to the Adam's Narkiewicz article "Black holes do not exist"

Bartosz Marszałek

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Abstract

In the article author presents his unconventional approach to the interpretation of collapsing matter model. From his description it can be understood that event horizon which forms in such models represents a physical boundary of the spacetime. When a particle reaches it, its worldline ends and proper time stops. He also presents a proof that spacetime describing black hole formation is inconsistent. From these premises he draws a conclusion that black holes cannot exist because they cannot be formed. Instead, he proposes that those massive astrophysical objects should be named brown holes because they are actually in state of permanent collapse. In this rebuttal I will refer to the presented arguments, show where author is right, and point mistakes.

1 Correct conclusions

To set my point of view I will start from referring what the author describes correctly. First of all, I would like to disagree with the Gemini's opinion so the fact that author has a Phd in Economics not in Physics means that the paper is less valuable. Science is a beautiful field of study because it is not important who says something as long as it is logically consistent and empirically verified (or possible to be verified).

1.1 Schwarzschild and Kerr metrics do not describe astrophysical black holes

Author is right that neither Schwarzschild nor Kerr metrics describe astrophysical black holes. Both metrics are stationary so they describe curved spacetimes which do not change under transformation $t \to t + \lambda$. If they would like to be considered as models of a BH (black hole), without any constraints, they would describe an eternal BH, which exists from infinite past, to infinite future. The announced metrics are also vacuum solutions to Einstein Field Equations (EFE) so they do not take into account that the objects which we observe as BHs were previously giant stars. The metric which will fully describe an astrophysical BH should contain in its structure a phase of star, a gravitational collapse, and a remnant BH. What author does not raise is that there are also some exact dynamical solutions to EFE. They are much more complicated so not as popular as stationary solutions but they are well known to specialists. Those solutions are (considered in the article) Oppenheimer-Snyder collapse and Vaida collapse.

1.2 Distant observer will never detect that something reached an event horizon

Particles falling into a BH are from the outside perspective in the state of permanent collapse and they never reach an event horizon. This "perspective" is considered as the family of space-like submanifolds $\{\tau = \text{const.}\}$, where τ is proper time of the observer. When the observer $\mathcal{O}$ is far away from the BH ($r >> 2m$), proper time is approaching the coordinate time $\tau \approx t$ in Schwarzschild coordinates. In this situation the coordinate $r \to 2m$ of the in-falling particles corresponds to $t \to \infty$. The observer will have to wait infinite amount of time to agree that in his space of simultaneity the particle has reached an event horizon. $\mathcal{O}$ will also notice that the light emitted by the particles will be more and more redshifted and finally he will not be able to detect it.

1.3 Brown holes may be indistinguishable from black holes

Brown holes which as mentioned are in the state of permanent collapse may behave in observations similarly to BHs or even exactly the same. In spherically symmetric case, the spacetime around a brown hole has to be a Schwarzschild spacetime due to the Birkhoff's theorem. For the rotating case it may not be the same as Kerr spacetime so it could behave differently in observations.

1.4 Idealized mathematical model can lead to unphysical solutions

In context of paragraph "A note on coordinate transformations" it is true that mathematics gives us sometimes solutions that are unphysical for some reason. It is e.g. the case with part of Schwarzschild metric (visible in Kruskal-Szekeres coordinates) consisting of a white hole and a second asymptotically flat universe which are remnants of eternity and are not being restored in simulations of symmetric gravitational collapse. We have to be really careful when rejecting solutions because equations usually "know" more than their authors. The author tells "If someone introduces a coordinate transformation to discuss points that are not in M_{OS}, then [...] one has to carefully argue why such an extension is warranted." Physically more suitable would be the opposition: One has to argue why not to take into account the extension (which is in fact part of a solution, just not visible in the previously chosen coordinates) if it is mathematically correct.

2 Mistakes

In the article appears an overinterpretation of the mathematical description of the gravitational collapse. The author also refers to apparent paradox which is based on logical error. Finally, author introduces his arbitrary postulate in order to solve those apparent paradoxes. But eventually the most contentious part is a more philosophical than scientific question: what we treat as reality?

2.1 Definition

To anchor the argumentation, I will refer to the definitions of a black hole given by NASA and ESA:
"A black hole is an astronomical object with a gravitational pull so strong that nothing, not even light, can escape it. A black hole's "surface," called its event horizon, defines the boundary where the velocity needed to escape exceeds the speed of light, which is the speed limit of the cosmos. Matter and radiation fall in, but they can't get out." - NASA [https://www.nasa.gov/universe/what-are-black-holes/]
"A black hole is an extremely dense object whose gravity is so strong that nothing, not even light, can escape it." - ESA [https://www.esa.int/Science_Exploration/Space_Science/Black_holes]
If an object in the state of permanent collapse also has the property that even light can not leave it (as it is mentioned at the end of the article, author calls it interior horizon), it will technically be a black hole. Event horizon and singularity are not the defining features but appear in their description.

2.2 Physical reality

I will start with the question what does it mean for something to be real? Or to take the same point of view as the author: What does it mean for a black hole to exist? As I mentioned before it is a rather philosophical question from the field of ontology and philosophy of science so I will refer to it shortly, just because it is not the purpose of this polemic. The main purpose of physics is constructing mathematical model of physical reality. Within the model we perform calculations and predict values of some observables. Then one can perform experiments and check if the observations correspond to the predictions. If so, it is said that model correctly describes the physical reality. Here appears a fatal issue: the implication does not work this way. From incorrect model it is still possible to derive correct predictions "by accident". To make sure that the model is correct it is important to perform as many observations from different approaches as possible. If we do not encounter any mismatch, we make certain that the model correctly describes the physical reality. On the other hand one mismatch forces us to modify the model or even abandon it. In the context of black holes, theory predicted possibility of their existence and the observations confirmed their properties. The process of their creation is still under research but the simplest theoretical models have been discovered and the numerical simulations confirmed their properties. It is true that physical reality may be more complicated than an idealized

model but in this case the correlation between predictions and observations are astonishing. That is why we can say that black holes are real objects. We can argue if these objects are in the state of permanent collapse from our perspective or are fully formed but if they are empirically indistinguishable we can treat them as being the same.

Full description should contain creation of the star, its evolution, supernova explosion and collapse into a black hole but this aim has not yet been reached. The black hole considered as a final stage can be approximately described by Kerr metric but we have to be aware of its constraints. What we call "a black hole" is the region of spacetime, not only the space. If we would consider it as the region of space, its existence will depend on the observer. But in GR we should think about existence in spacetime - for some observer there appears a region of space from which nothing, not even light can escape: the fully formed black hole.

2.3 Infalling particle

In the text author considers the example of a particle falling into a brown hole. He describes this scenario as being identical to the case of Schwarzschild BH as long as the particle exists above[1] the event horizon. It is in agreement with the Birkhoff's theorem: if the spacetime around brown hole is spherically symmetric it has to be described by the Schwarzschild metric. But after crossing the event horizon the description is different. In the black hole case, the particle will continue its travel and finally reach the singularity (in the Schwarzschild case the singularity is in fact a moment in time not the point in space). In the brown hole case it will end its journey at the surface $\{r = 2m\}$ (in Schwarzschild coordinates). The author says that the time of the particle will stop. He argues it with comparison to the Big Bang, when the causal curves can reach the Big Bang singularity in finite affine parameter (for particles - in finite proper time). If the time can begin somewhere it can also end somewhere. There appear the following misconceptions:

- The General Relativity as every physical theory has limited scope of application. Newton theory of gravity is limited to weak, slowly varying gravitational potential. The General Relativity has broader scope of application but still finite. It cannot be used to describe the neighbourhood of the spacetime singularity. When the causal curve touches a singularity, GR cannot describe what is happening here, so it is said that we cannot continue the curve. It can happen in finite affine parameter, which for massive particle is interpreted as proper time. If so, it is non-formally said that time stops here. To be precise we should say that we do not know what happens to the particle in the neighbourhood of the singularity, maybe the proper time here makes no sense, because GR does not work here.

- The situation in which continuation of time makes no sense without touching any singularity is possible only when the particle would touch the spacetime boundary. It is not mathematically forbidden for such boundaries to exist. In the gravitational collapse such boundary appears but "in the past". Solutions restore asymptotically only the part of Schwarzschild metric containing one asymptotically flat Universe and the black hole (region I and II on Penrose diagram) but the regions with the second asymptotically flat Universe and the white hole (region III and IV) are not being restored. It suggests that these not-restored regions are artefacts of eternity and do not reflect the physical reality. It creates boundary at $\{r = 2m, t = -\infty\}$. If one argues that also the region II should be crossed out, one should justify why to do it.

- The horizon in Oppenheimer-Snyder model grows during the collapse. If the region below the horizon does not belong to the manifold, what happened to the particles which were reached by the growing horizon? Did they disappear from the spacetime? In what way then the horizon can still grow and finally reach the surface? Here appears a paradox of this approach. It would not be a consequence of singular curvature because the spacetime is smooth at the horizon so it cannot be solved by saying that GR does not holds here.

[1] I will use words *above* and *below* the event horizon while referring to the region of spacetime which in Schwarzschild coordinates corresponds to $\{r > 2m\}$ and $\{r < 2m\}$ respectively.

2.4 Paradoxes

The author tells that black holes create disjoint regions in spacetime. I will now refer to this scenario in details. First of all, we cannot describe whole spacetime by one metric. We have to split it into a matter part and vacuum part which have to be smoothly connected to hold differentiability assumption. In the region above the star's surface spacetime is described by Schwarzschild metric. Inside the star a metric depends on the distribution of mass. The author correctly describes events from A to C. Observer $\mathcal{O}_1$ starts from some event A in the region inside the star, then fly to event B where he is waiting for the event horizon to form. The particles are accumulating below him and the event horizon is approaching him from the centre of the star. He has to burn more and more fuel to stay at the same coordinate distance from the centre. The horizon finally touches him at event C. Then, author says:
"Thus, from event C, we should be able to draw a (mostly lightlike) curve to event D".
Yes we can draw it but it will not represent a worldline of the $\mathcal{O}_1$. He can at most send light signal in exactly radial direction to event D, but the lightlike curve cannot be described by proper time. Then author says:
"As the final step, we can draw a curve of positive proper distance from event D to some event E located far outside the fully-formed black hole"
The curve of positive proper distance still does not represent any observer's worldline. It may represent a superluminal observer but there will appear a causality violation. A subluminal observer cannot become superluminal so it cannot be the observer $\mathcal{O}_1$. The superluminal observer (say $\hat{\mathcal{O}}_1$) will be going back in time from the subluminal perspective. Imagine the observer $\mathcal{O}_2$ who will start from event A and will not touch the event horizon. The observer $\hat{\mathcal{O}}_1$ can meet $\mathcal{O}_2$, and tell him about things that will happen in his future: formation of the black hole. But the observer $\mathcal{O}_1$ cannot transfer into a $\hat{\mathcal{O}}_1$ because he would need infinite amount of energy to reach the speed of light and even more to exceed it.

If we would like to consider only abstract curves on the manifold it can be best visualised on the Penrose diagram. Those diagrams represent 2-dimensional manifold, compactified to a finite region, with the preservation of the lightcone structure. Every point on the diagram represents a 2-sphere. For Oppenheimer-Snyder collapse, the Penrose diagram is drawn in Figure [1]. One can write any closed curve on the below image. One of them will correspond to the curve A-B-C-D-E-A from the article.

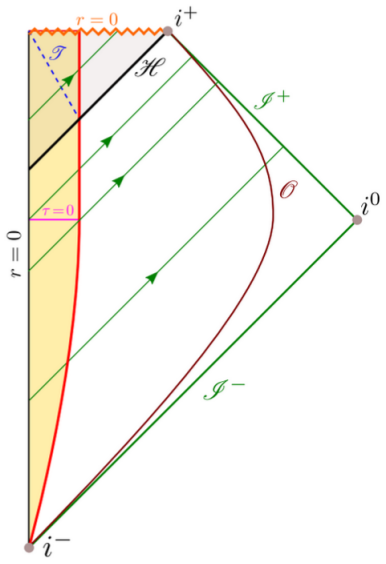


Figure 1: Carter-Penrose Diagram of Oppenheimer–Snyder spacetime. Diagram represents a causal structure of compactified spacetime. The shaded region is the stars interior. $\mathcal{H}$ is an event horizon. Curve $\mathcal{O}$ represents a worldline of distant remote observer. The outgoing green lines represent null-geodesics outgoing from the centre of the star. [Gou26]

To summarize: there are no disjoint region of spacetime in the sense presented by the author.

Observer $\mathcal{O}_1$ starting from A can reach event C but will be unable to reach neither event D nor E. Curve $D-E$ represents the worldline of a superluminal observer. The event horizon formation appeared in his past but from subluminal perspective this event may be reached only in the future.

3 Collapse

The whole argumentation is built on the observation that originally in Oppenheimer-Snyder paper [OS39] they end up with the metric above the horizon. Then it is said that extending it to the part below the horizon is not needed and unnecessary. But one can start from horizon-penetrating coordinates at the very beginning and perform whole calculations. Then one will end up with the whole metric, without need of extending anything. Here the argument that we do not have to take the part below the horizon into account is unjustified. The whole procedure could be found in the lecture notes [Gou26]. In the Penrose-Carter diagram [1] we can also see that the remote distance observer will never detect the fully formed horizon since the lightlike geodesics go along the horizon. But he can observe the gravitational collapse and the changes in the star surface's shape and luminosity. Theoretically, lightlike curves can reach him always along his worldline but practically he will be unable to detect them. On the other hand, it would require a continuously shining source. In physical world the light is emitted in packages - photons - emitted when the electron changes its energy. This process is really rapid but still not continuous. This implies that there will always be the very last photon which can reach the observer. This is visualised in figure [2]. For the remote distance observer after some time the compact object which is in fact dynamical will appear as stationary (in this case even static) and any deviation will be below measurement error. This makes it indistinguishable empirically from the eternal one.

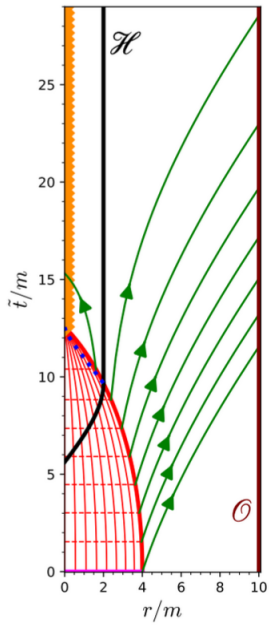


Figure 2: Radial lightlike curves outgoing from the surface of a collapsing star. r is an areal radius and $\tilde{t}$ is the Eddington-Finkelstein time coordinate. Curve $\mathcal{H}$ depicts an event horizon and curve $\mathcal{O}$ represents a worldline of a distance remote observer. The green curves are lightlike geodesics outgoing radially from the star surface. [Gou26]

4 Summary

From the philosophical point of view if the objects called brown holes are empirically indistinguishable from black holes, they can be treated as being the same objects. Physically we can construct a model

of collapsing matter which forms a black hole and the observations confirm its external properties. Formation of the horizon does not lead to the paradox mentioned in the article. Extending manifold below the horizon allows to avoid the paradox of falling out of spacetime.

References

[Gou26] Eric Gourgoulhon. Geometry and physics of black holes (lecture notes), 2026. Last accessed 27 March 2026.

[OS39] J. R. Oppenheimer and H. Snyder. On continued gravitational contraction. *Physical Review*, 56:455–459, 9 1939.