Hawking Radiation by Neutron Stars

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Abstract

There is a critical issue against Hawking Radiation: the "Trans-Planckian problem", dwelling on the fact that the laws of gravitation are unknown at short distances [Adam D. Helfer, "Do black holes radiate?", Rep. Progr. Phys. 66 (6), 943–1008 (2003)]. In this short note, I demonstrate to have no Hawking Radiation from the static neutron star and the collapsing star (latter gradually becomes a Black Hole), therefore, one has no Information Loss Paradox [Sabine Hossenfelder (2020) "The Black Hole Information Loss Problem is Unsolved. And Unsolvable", https://youtu.be/mqLM3JYUByM].

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I. MY CONTRIBUTION

It is not a secret that the vacuum [influenced by gravity] can produce particles not only in the presence of Black Holes [1].

Steven Hawking tells us [2] that while the star collapse, there is particle production (The "Hawking Radiation"). This happens before the appearance of the event horizon; otherwise, the collapse has been finished. The metric of spacetime in the vacuum outside the collapsing star coincides with the vacuum metric around a static neutron star. Both metrics are static and stationary (time-independent).

The particle production, if it would happen inside the collapsing star (i.e., not outside in the vacuum) is modifying the spectrum of the Hawking Radiation, because the radiation goes through the star layers. However, in Hawking's paper entitled "Particle Creation by Black Holes" the formula for the temperature does not include the parameters of matter; only the mass of the collapsing star, which is the only parameter of the vacuum metric around the star. Therefore, one can conclude that a static neutron star can also be a source for Hawking Radiation.

I remember from Quantum Field Theory that a stationary field cannot produce new particles out of the vacuum. Thus, there should be a fatal mistake in Hawking's paper. Indeed, you can find a critical issue against Hawking's paper, the "Trans-Planckian problem" [3]: since the laws of physics at short distances are unknown, some find Hawking's original calculation unconvincing. [3]

Dr. Unruh, the famous discoverer of the Unruh Effect, has written in the abstract of Ref. [5] that "We present a simple model for stellar collapse and evaluate the quantum mechanical stress-energy tensor to argue that quantum effects do not play an important role for the collapse of astrophysical objects."

But his paper and the papers of other researches have one common disadvantage: they are highly mathematical, as the mathematical tools presented are supposed to debunk the flaws (in Ref. [2]). In contrast to this, my present note is completely logical and rigorously scientific, however without any mathematical expressions.

II. SOLUTION TO INFORMATION LOSS PARADOX

Having no Hawking Radiation, we have no Information Loss. The Information Loss in Black Holes is the most severe problem in physics, as mentioned by Dr. Sabine Hossenfelder [4] in her reply to Ref. [6]. The latter paper is showing the absence of the Information Loss in Black Holes, which is the independent evidence for my note to be correct.

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[1] Leonard Parker, "Particle creation and particle number in an expanding universe", J. Phys. A: Math. Theor. 45, 374023 (2012), arXiv:1205.5616 [astro-ph.CO].

[2] S. W. Hawking, "Black hole explosions?", Nature 248 (5443), 30–31 (1974); S. W. Hawking, "Particle Creation by Black Holes", Comm. Math. Phys. 43, 199–220 (1975).

[3] Adam D. Helfer, "Do black holes radiate?", Rep. Progr. Phys. 66 (6), 943–1008 (2003), arXiv:gr-qc/0304042; V. A. Belinski, "On the existence of black hole evaporation yet again", Phys. Lett. A 354, 249–257 (2006), arXiv:gr-qc/0607137; Robert Brout, Serge Massar, Renaud Parentani, Philippe Spindel, "Hawking radiation without trans-Planckian frequencies", Phys. Rev. D 52 (8), 4559–4568 (1995), arXiv:hep-th/9506121

[4] Sabine Hossenfelder (2020) "The Black Hole Information Loss Problem is Unsolved. And Unsolvable", https://youtu.be/mqLM3JYUByM

[5] Bruno Arderucio-Costa, William G. Unruh, "Model for Quantum Effects in Stellar Collapse", Phys. Rev. D 97, 024005 (2018), arXiv:1709.00115 [gr-qc]

[6] "The Most Famous Paradox in Physics Nears Its End" physics-astronomy.com, it is the commentary about: Donald Marolf, Henry Maxfield, "Observations of Hawking radiation: the Page curve and baby universes", arXiv:2010.06602 [hep-th] (2020).