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Putting theory in its place: the relationship between universality arguments and empirical constraints

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In light of the fact that Hawking radiation is practically empirically undetectable, physicists have attempted to establish the effect as universal — as a phenomenon that should appear regardless of the possible details of quantum gravity, whatever those details might be. But, as pointed out in a recent article by Gryb, Palacios, and Thébault [1], these universality arguments for Hawking radiation seem broadly unconvincing compared to the Wilsonian renormalization-group universality arguments for condensed matter physics.

Motivated by their apparent failure, compared with the overwhelming success of universality arguments in so many other contexts, I address the question: in which situations should we expect to be able to construct successful universality arguments? In other words, which situations are *universality-argument-apt*?

I distinguish between two notions of success for a universality argument: strength and relevance. I argue that we should only expect to be able to construct universality arguments that are successful in the sense of being *significantly relevant* to a given domain if (1) we know enough about how that domain's micro-physics is structured, or (2) we are able to empirically test the domain's macro-behaviour, or if we are in both situations at once. These conditions are useful, most obviously, as a clarification of what universality arguments are capable of. But I argue that they are also useful for two less direct reasons: they clarify the status of analogue experimentation, and thereby show us where we stand in our search for empirical confirmation of Hawking radiation.

[1] Gryb, Sean, Patricia Palacios, and Karim P. Y. Thébault. 2020. "On the Universality of Hawking Radiation." *British Journal for the Philosophy of Science*: 1–32.