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On the assumptions leading to the information loss paradox

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The information loss paradox is usually stated as an incompatibility between general relativity and quantum mechanics. However, the assumptions leading to the problem are often overlooked and, in fact, a careful inspection of the main hypothesises suggests a radical reformulation of the problem. Indeed, I will present a thought experiment that shows the existence of an incompatibility between (i) the validity of the laws of general relativity to describe infalling matter far from the Planckian regime, and (ii) the so-called central dogma which states that as seen from an outside observer a black hole behaves like a quantum system whose number of degrees of freedom is proportional to the horizon area. We critically revise the standard arguments in support of the central dogma, and argue that they cannot hold true unless some new physics is invoked even before reaching Planck scales. This leads to the counterintuitive result that the information loss problem, in its current formulation, is not necessarily related to any loss of information or lack of unitarity. Semiclassical general relativity and quantum mechanics can be perfectly compatible before reaching the final stage of the black hole evaporation where, instead, a consistent theory of quantum gravity is needed to make any prediction.

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