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Quantum effects on black holes: evaporation, tunnelling, information leak. Anything observable?

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Black holes are well understood in their classical dynamics or as background geometry for quantum fields. But their quantum gravitational properties remain elusive. These are crucial to understand what happens to the matter falling inside, and to know the holes' long term stability. There are a number of recent results and ideas on this issue, including the firewall theorem, Planck stars, graviton condensate approximations and others. There have also been suggestions for possible observable windows, for instance effects of metric fluctuations outside the horizon, or cosmic rays from by primordial black holes' decay.

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