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A new look at energy extraction from charged black holes via particle collisions

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Near-horizon, high-energy test particle collisions should be the ideal ingredient for collisional Penrose process. Thus, the observation by Bañados, Silk and West that particles coming from rest at infinity may collide with arbitrarily high centre-of-mass energy near the horizon of a maximally spinning black hole gained a lot of attention. Unfortunately, the energy that can be extracted through such an event turned out to be subject to an unconditional upper bound. On the other hand, such a bound does not exist for an analogous effect in the vicinity of a maximally charged black hole, which is however much less realistic. We remedied this impossible dilemma by combining the two variants and showing that the upper bound is absent whenever both the black hole and the ejected particle are charged, regardless of how small the black hole charge might be [PhysRevD.105.024014]. Nevertheless, this result was still limited to extremal black holes, and thus we generalise the analysis to subextremal cases. In the present talk, we focus on the simplified case of Reissner-Nordström spacetime. We found that with deviation from extremality, the possibility of significant energy extraction remains, whereas the possibility to produce new particles with arbitrarily high mass is severely hindered. This indicates that collisional Penrose process can in principle be responsible for production of powerful cosmic rays, but is unlikely to serve as a probe of new particle physics.

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