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Innermost part of accretion disks around black holes

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Einstein's general relativity makes fundamental predictions about the latest, strong-field, stages of accretion, when matter plunges from the accretion disk into the black hole. They include

- location of the plunge-in region,
- efficiency of the black hole accretion,
- nature of torques in the plunge-in region,
- extracting energy from the black hole.

The 1977 Blandford & Znajek prediction that energy may be extracted from a rotating black hole by an electromagnetic version of the Penrose process was convincingly proven in recent super-computer simulations of the "arrested" accretion of magnetized matter by Tchekhovskoy, McKinney and Narayan*.
Another version of the Penrose process, involving energetic particle collisions near the horizon, has been discussed by Piran and collaborators already in the 1970. These classic works (and their recent follow-up, also by Piran and collaborators) proved that this process can neither extract a significant amount of energy from the black hole nor accelerate particles to large energies.
* Ramesh Narayan's lecture describes these simulations.