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Pseudo-Newtonian Simulations With Reissner–Nordström Naked Singularity

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We present a new pseudo-Newtonian potential for the gravity around a Reissner–Nordström naked singularity and perform numerical simulations of matter encircling such object. Simulations with our potential reproduce exactly the radial dependence of the Keplerian orbital frequency, with the orbital angular velocity vanishing at the zero gravity radius and showing a maximum at 4/3 of that radius. The accretion stops at a certain distance away from the singularity, where the material is accumulating in a toroidal structure close to the zero-gravity sphere. Such rotating ring could be observed by the methods developed in Event Horizon Telescope collaboration. Our simulations show that some features of naked singularity could be probed in simulations with the pseudo-Newtonian potential, which are less numerically demanding than simulations in general relativity.

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