Gravitational asymptotic freedom and matter filling of black holes

Michael A. Ivanov
Physics Dept.,
Belarus State University of Informatics and Radioelectronics,
6 P. Brovka Street, BY 220027, Minsk, Republic of Belarus.
E-mail: michai@mail.by.

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Abstract

The property of asymptotic freedom of the model of low-energy quantum gravity by the author leads to the unexpected consequence: if a black hole arises due to a collapse of a matter with some characteristic mass of particles, its full mass should be restricted from the bottom. For usual baryonic matter, this limit of mass is of the order $10^7 M_\odot$.

The accepted mechanism of gravity in the model [1] leads to the consequence that a black hole should have an essentially bigger gravitational mass than an inertial one (approximately of 1000 times). There are the two variants: a) the equivalence principle is valid, then black holes cannot exist in the nature (in this case, super massive compact objects at centers of galaxies should have another nature); b) the equivalence principle is not valid for black holes which exist in the nature. In the second case, black holes should aim to the dynamical center of a galaxy with a huge acceleration due to the difference of gravitational and inertial masses. The objects known as black holes correspond to this scenario.

Additionally, the property of asymptotic freedom of this model [2] leads to the unexpected consequence: if a black hole arises due to a collapse of a matter with some characteristic mass of particles, its full mass should be restricted from the bottom [3]. For example, in a case of collapsing usual baryonic matter one may accept that a particle mass is equal to the proton mass m_p. Big deviations from general relativity should take place by the minimum radius of the object: $r_{min} \sim < \sigma >^{1/2} N^{1/3}$, where $< \sigma >$ is an average cross-section of an interaction of a particle with a graviton, N is a full number of particles. We can compute the ratio r_g/r_{min}, where $r_g = 2Gm/c^2$ is a gravitational radius of the object:

$$r_g/r_{min} \sim (m/m_0)^{2/3},$$

where $m_0 = m_p(< \sigma >^{1/2} /r_{gp})^{3/2}$, and r_{gp} is a formally introduced gravitational radius of proton. The rough estimate for m_0 is: $m_0 \sim 10^7 M_\odot$. It is necessary to have $r_g/r_{min} > 1$, or $m/m_0 > 1$.

For another mass of particles of collapsing object, it is easy to re-calculate this bottom limit of the mass; because $m_0 \sim m_p^{1/4}$, we shall have by some new mass of particles $m' : m_0(m') = m_0(m_p)(m'/m_p)^{1/4}$.

References

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