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Supermassive black holes formation from fermionic dark matter cores collapse

Press release

Fundamental questions about the origin and growth of supermassive black holes in the earliest stages of the Universe's life, up to about 800 million years after the Big Bang, challenge the scientific community. An international team of ICRANet, in collaboration with researchers from the University of La Plata (Argentina), Universidad Santiago de Cali (Colombia), and Al-Farabi Kazakh University (Kazakhstan), has made a crucial contribution by proposing a new mechanism that explains how these supermassive giants arise and grow so much, so quickly. The novelty was published on May 31, 2023, by the prestigious journal Monthly Notices of the Royal Astronomical Society: (`https://doi.org/10.1093/mnras/stad1380`).

The observations from the central regions of active galaxies, those that are larger and more massive than the Milky Way and have very intense radiation, suggest supermassive black holes are responsible for generating the emission of energy through jets of matter shooting out from the center of these galaxies. However, contrary to the case of black holes of stellar origin that are formed from the death of a star with a mass similar to that of the Sun, there is still a strong debate about what are the origin and main channel of formation of the progenitors (or seeds) of these supermassive giants formed in the early universe.

In the article, the team proposes a new formation mechanism to form supermassive black holes in the early universe, completely different from existing models associated with the gravitational collapse of primordial gas or hypothetical massive stars. The new model shows supermassive black holes originate from the gravitational collapse of dense nuclei of dark matter that arise in the center of the galactic halos at the time of their formation, according to the model of fermionic dark matter halos proposed by the same experts in previous researches.

The relevance of this new result is both observational and theoretical. With respect to observations, it is shown that these seeds or progenitors of black holes formed from dark matter would be born with masses of millions to hundreds of millions of times the mass of the Sun and then, once formed, grow by accretion (or incorporation) of conventional matter up to the values inferred by the observations made by large telescopes.

From the theoretical viewpoint, a new solution to Einstein's General Relativity equations was found for the first time, leading to a distribution of dark matter whose nucleus is on the verge of gravitational collapse towards a massive black hole. This solution implies that the same dark matter that forms the dense nucleus is surrounded by a more diluted halo that explains the galactic rotation curves, all in a realistic and unified picture.

For more details:

On the growth of supermassive black holes formed from the gravitational collapse of fermionic dark matter cores, C. R. Argüelles, K. Boshkayev, A. Krut, G. Nurbakhyt, J. A. Rueda, R. Ruffini, R., J. D. Uribe-Suárez, R. Yunis, Monthly Notices of the Royal Astronomical Society, Volume 523, Issue 2, August 2023, Pages 2209–2218:

Link to the journal's site:
`https://doi.org/10.1093/mnras/stad1380`

Link to the ArXiv:
`https://arxiv.org/abs/2305.02430`

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