The origin of the s-star cluster at the galactic center

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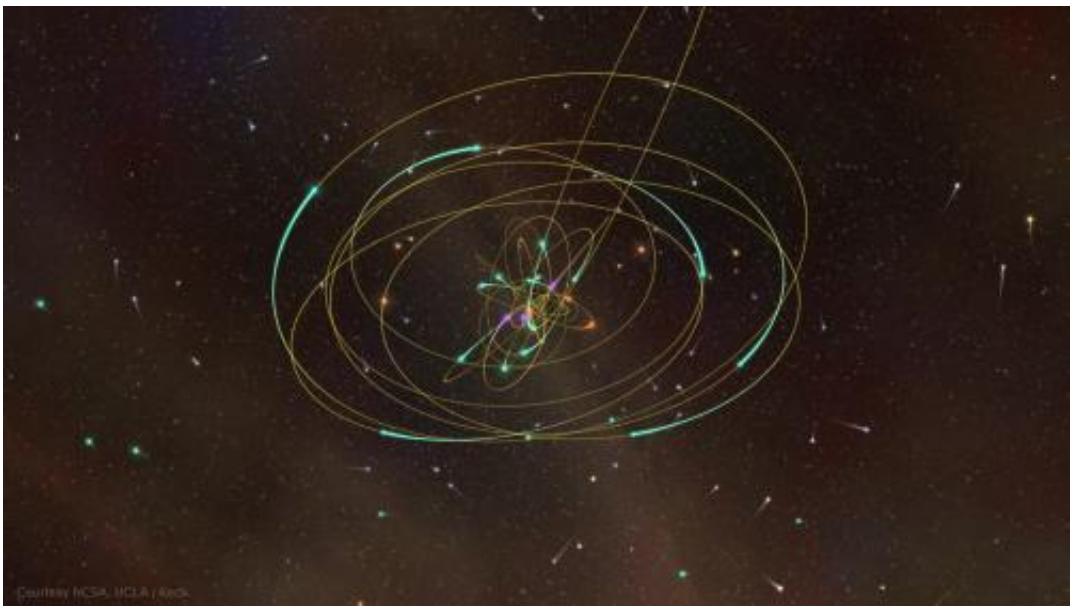

(Phys.org) —Scientists Fabio Antonini, of the Canadian Institute for Theoretical Astrophysics, and David Merritt, of the Rochester Institute of Technology, have developed a new theory that explains the orbits of the massive young stars that closely orbit the black hole at the center of the Milky Way.

The discovery of these stars called "S-stars" provided an unprecedented opportunity for studying the black hole at the galactic center itself, but it

also raised new questions: how were massive young stars orbiting in a region too violent for them to have formed there? They could not have formed where they are observed because of the strong gravity of the supermassive black hole, implying that they had to have migrated from further out. When theoreticians produced models explaining the migration of the S-stars toward the center the observed orbits didn't match the models. Why were the orbits observed different from what was predicted?

Dr. Antonini is offering the best answers to date for this puzzle in his Thursday afternoon talk at the annual meeting of the Canadian Astronomical Society (CASCA). In "The Origin of the S-star Cluster at the Galactic Center," Antonini is presenting a unified theory for the origin and dynamics of the S-stars.

Explaining how these stars managed to get so close in only tens of millions of years since they formed has been a challenge. "Theories exist for how migration from larger distances has occurred, but have up until now been unable to convincingly explain why the S-stars orbit the galactic center the way they do," Antonini said. "As main-sequence stars, the S-stars cannot be older than about 100 million years, yet their orbital distribution appears to be 'relaxed', contrary to the predictions of models for their origin." Antonini and Merritt's model suggests that the S-stars formed farther out from the galactic center, migrated within their lifetime to the region where they are observed and subsequently attained the observed orbital shapes by interacting gravitationally with other stars near the central black hole.

Antonini's and Merritt's research builds on new insights on how stellar orbits at the galactic center evolve due to the joint influence of gravitational interactions with other stars and relativistic effects due to the supermassive black hole.

"Theoretical modeling of S-star orbits is a means to constrain their origin, to probe the dynamical mechanisms of the region near the galactic center and," says Merritt, "indirectly to learn about the density and number of unseen objects in this region."

Supermassive black holes are believed to inhabit the center of most, if not all, massive galaxies. How they form and grow is intimately connected to the formation of the galaxies they inhabit. The black hole in the center of our own galaxy, named Sgr A* (pronounced Sagittarius A-star), is the closest and most extensively studied example. By tracking the orbits of the S-stars over the past several years, astronomers have been able to conclusively show that the object they orbit is indeed a supermassive black hole.

Provided by Canadian Astronomical Society

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