Study hints at the existence of the closest black holes to Earth in the Hyades star cluster

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Credit: Jose Mtanous

A paper published in the journal *Monthly Notices of the Royal Astronomical Society* hints at the existence of several black holes in the

Hyades cluster—the closest open cluster to our solar system—which would make them the closest black holes to Earth ever detected.

The study results from a collaboration between a group of scientists led by Stefano Torniamenti, from the University of Padua (Italy), with the significant participation of with Mark Gieles, ICREA professor at the Faculty of Physics, the Institute of Cosmos Sciences of the University of Barcelona (ICCUB) and the Institute of Space Studies of Catalonia (IEEC), and Friedrich Anders (ICCUB-IEEC).

Specifically, the finding took place during a research stay of the expert Stefano Torniamenti at the ICCUB, one of the research units that make up the IEEC.

Black holes in the Hyades star cluster?

Since their discovery, black holes have been one of the most mysterious and fascinating phenomena in the universe and have become the object of study for researchers all over the world. This is particularly true for small black holes because they have been observed during the detection of gravitational waves. Since the detection of the first gravitational waves in 2015, experts have observed many events that correspond to mergers of low-mass black hole pairs.

For the published study, the team of astrophysicists used simulations that track the motion and evolution of all the stars in the Hyades—located at a distance from the sun of about 45 parsecs or 150 light-years—to reproduce their current state.

Open clusters are loosely bound groups of hundreds of stars that share certain properties such as age and chemical characteristics. The simulation results were compared with the actual positions and velocities of the stars in the Hyades, which are now known precisely from

observations made by the European Space Agency's (ESA) Gaia satellite.

"Our simulations can only simultaneously match the mass and size of the Hyades if some black holes are present at the center of the cluster today (or until recently)," says Stefano Torniamenti, postdoctoral researcher at the University of Padua and first author of the paper.

The observed properties of the Hyades are best reproduced by simulations with two or three black holes at present, although simulations where all the black holes have been ejected (less than 150 million years ago, roughly the last quarter of the cluster's age) can still give a good match, because the evolution of the cluster could not erase the traces of its previous black hole population.

The new results indicate that the Hyades-born black holes are still inside the cluster, or very close to the cluster. This makes them the closest black holes to the sun, much closer than the previous candidate (namely the black hole Gaia BH1, which is 480 parsecs from the sun).

In recent years, the breakthrough of the Gaia space telescope has made it possible for the first time to study the position and velocity of open cluster stars in detail and to identify individual stars with confidence.

"This observation helps us understand how the presence of black holes affects the evolution of star clusters and how star clusters in turn contribute to gravitational wave sources," says Mark Gieles, a member of the UB Department of Quantum Physics and Astrophysics and host of the first author in Barcelona. "These results also give us insight into how these mysterious objects are distributed across the galaxy."

More information: S Torniamenti et al, Stellar-mass black holes in the Hyades star cluster?, *Monthly Notices of the Royal Astronomical Society* (2023). DOI: 10.1093/mnras/stad1925

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