Stellar fountain of youth with turbulent formation history in the center of our galaxy

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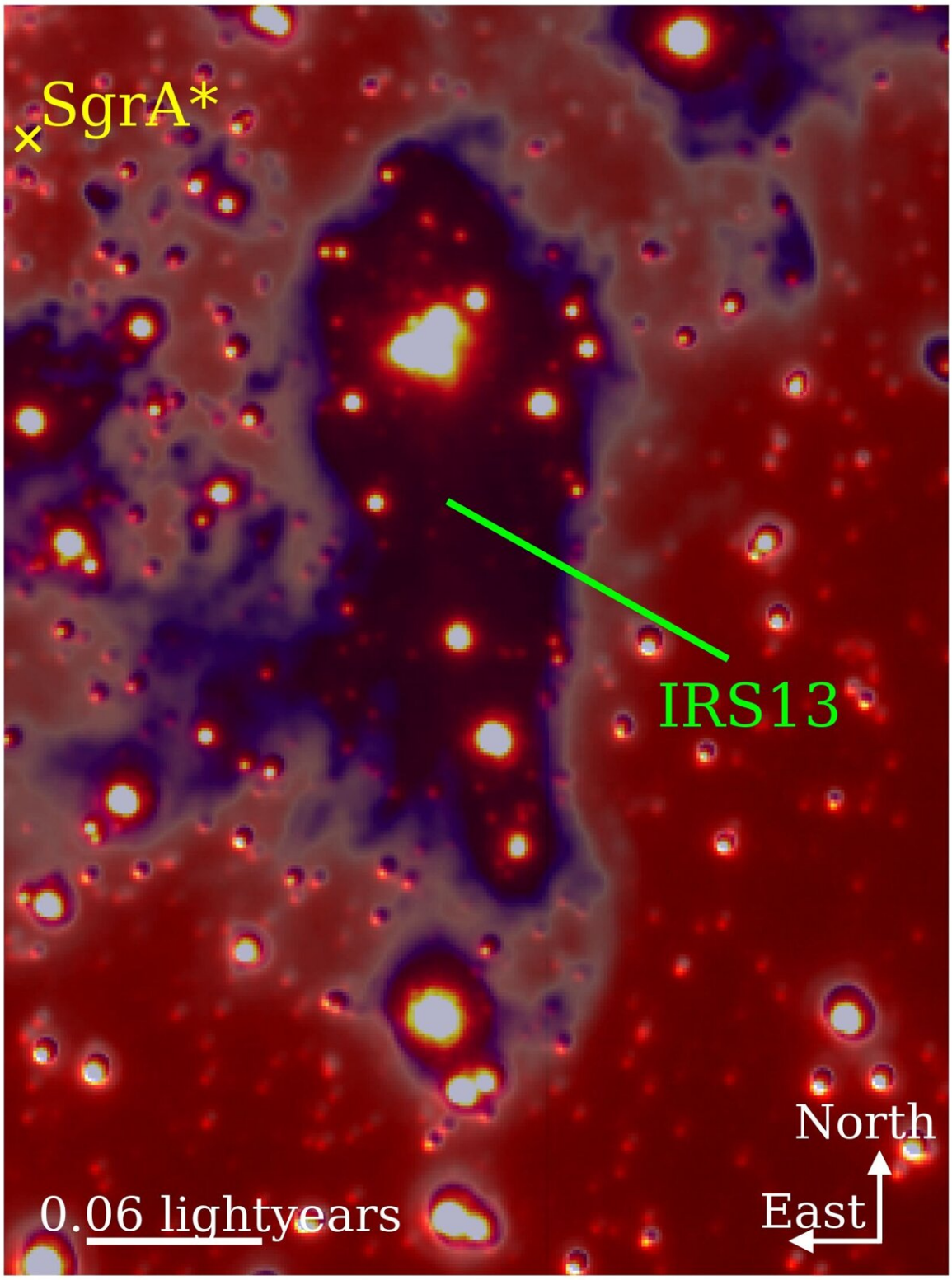
SgrA*
IRS13
0.06 lightyears
North
East

A multi-wavelength view of the surroundings of the supermassive black hole SgrA* (yellow X). Red are the stars, blue the dust. Many of the young stars in the star cluster IRS13 are obscured by the dust or blended in by the bright stars. Credit: Florian Peißker / University of Cologne

An international team led by Dr. Florian Peißker at the University of Cologne's Institute of Astrophysics has analyzed in detail a young star cluster in the immediate vicinity of the super massive black hole Sagittarius A* (Sgr A*) in the center of our galaxy and showed that it is significantly younger than expected.

This cluster, known as IRS13, was discovered more than twenty years ago, but only now has it been possible to determine the cluster members in detail by combining a wide variety of data taken with various telescopes over a period of several decades. The stars are a few 100,000 years old and therefore extraordinarily young for stellar conditions. By comparison, our sun is about 5 billion years old.

Due to the high-energy radiation as well as the tidal forces of the galaxy, it should in fact not be possible for such a large number of young stars to be in the direct vicinity of the super massive black hole. The study is published as "The Evaporating Massive Embedded Stellar Cluster IRS 13 Close to Sgr A*. I. Detection of a Rich Population of Dusty Objects in the IRS13 Cluster" in *The Astrophysical Journal*.

For the first time, the James Webb Space Telescope (JWST) was used to record a spectrum free of atmospheric interference from the Galactic Center. A prism on board the telescope was developed at the Institute of Astrophysics in the working group led by Professor Dr. Andreas Eckart, a co-author of the publication. The present spectrum shows that there is water ice in the Galactic Center. This water ice, which is often found in

the dusty disks around very young stellar objects, is another independent indicator of the young age of some stars near the black hole.

In addition to the unexpected detection of young stars and water ice by the JWST, the researchers led by Dr. Peißker have also found that IRS13 has a turbulent history of formation behind it. The study results suggest that IRS13 migrated toward the super massive black hole through friction with the interstellar medium, collisions with other star clusters, or internal processes. From a certain distance, the cluster was then "captured" by the gravitation of the black hole.

In this process, a bow shock may have formed at the top of the cluster from the dust surrounding the cluster, similar to the tip of a ship in the water. The associated increase in dust density then stimulated further star formation. This is an explanation why these young stars are above all in the top or front of the cluster.

"The analysis of IRS13 and the accompanying interpretation of the cluster is the first attempt to unravel a decade-old mystery about the unexpectedly young stars in the Galactic Center," according to Dr. Peißker. "In addition to IRS13, there is a star cluster, the so-called S-cluster, which is even closer to the black hole and also consists of young stars. They are also significantly younger than would be possible according to accepted theories."

The findings on IRS13 provide the opportunity in further research to establish a connection between the direct vicinity of the black hole and regions several light years away. Dr. Michal Zajaček, second author of the study and scientist at Masaryk University in Brno (Czech Republic), added, "The star cluster IRS13 seems to be the key to unraveling the origin of the dense star population at the center of our galaxy.

"We have gathered extensive evidence that very young stars within the

range of the super massive black hole may have formed in star clusters such as IRS13. This is also the first time we have been able to identify star populations of different ages—hot main sequence stars and young emerging stars—in the cluster so close to the center of the Milky Way."

More information: Florian Peißker et al, The Evaporating Massive Embedded Stellar Cluster IRS 13 Close to Sgr A*. I. Detection of a Rich Population of Dusty Objects in the IRS 13 Cluster, *The Astrophysical Journal* (2023). DOI: 10.3847/1538-4357/acf6b5

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