The Milky Way's merging history: Reconstructing the Cetus stream

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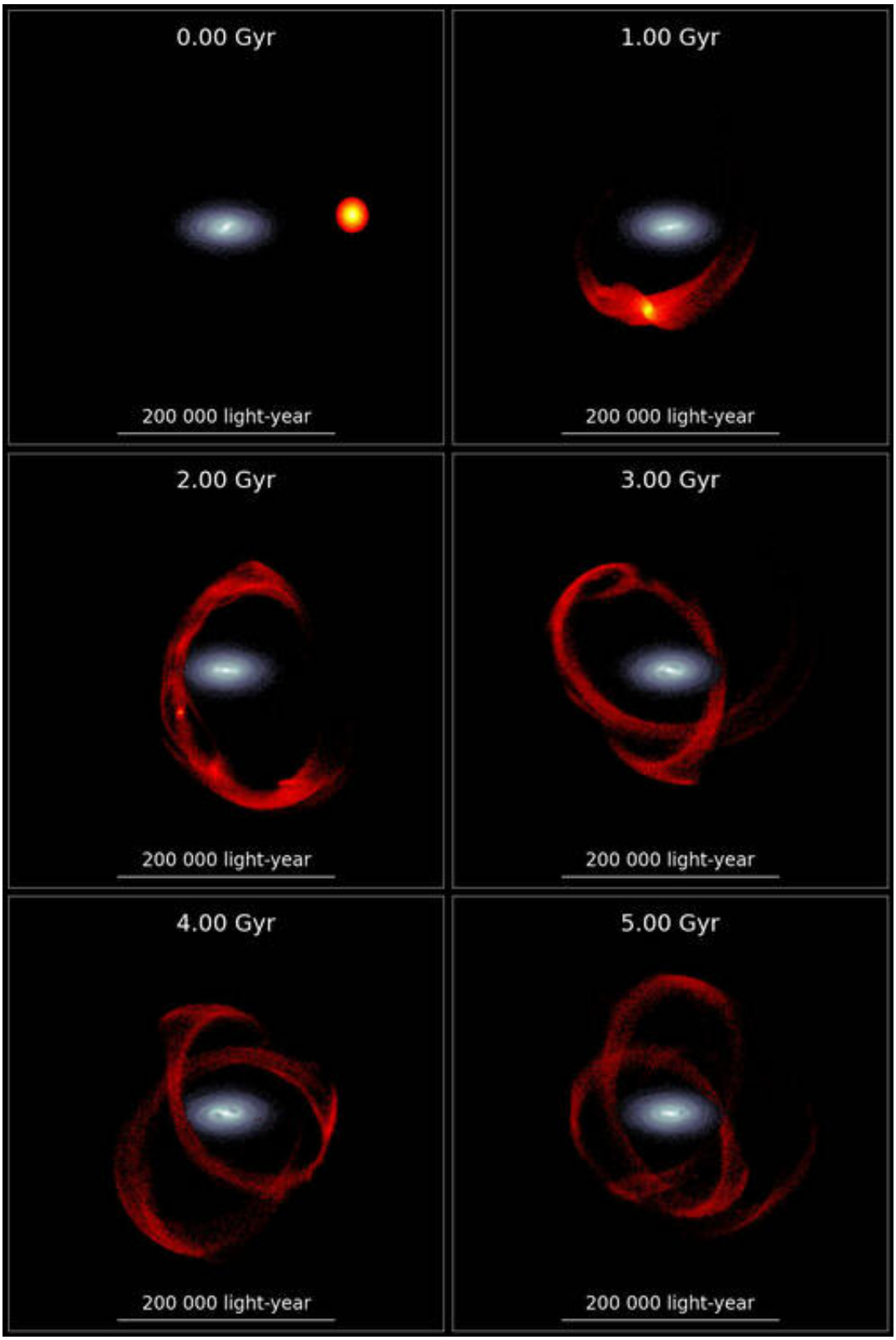

The simulated process of Cetus Stream progenitor merging with the Milky Way. Credit: CHANG Jiang

Around the Milky Way, there are many river-like structures made up of stars. They are called stellar streams. How these stellar streams formed remains unclear.

Researchers led by Prof. Zhao Gang and Dr. Chang Jiang from National Astronomical Observatories of Chinese Academy of Sciences (NAOC) reproduced the formation process of the newly discovered Cetus stream in a computer.

The study was published in The *Astrophysical Journal*.

"Stellar streams are the remnants of dwarf satellite galaxies that are swallowed by the Milky Way, but have not been fully digested," said Dr. Chang, the first author of the study. "The accretion process is not that the Milky Way swallowed the dwarf galaxy in one bite, but it peeled the dwarf galaxy layer by layer from outside to inside by tidal stripping, just like peeling an onion. The stripped stars distributed in their original orbits, and they formed a river-like structure, that is, a stellar stream."

The Milky Way galaxy grows by constantly devouring dwarf satellite galaxies, which is called the galaxy merger. Through the study of the merging history of the Milky Way, we can know how the Milky Way formed and evolved.

In their previous study, the researchers discovered the Cetus stream based on the observational data from the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST, also known as Guoshoujing Telescope) Survey and the Sloan Digital Sky Survey.

Now, they reconstructed the formation history of this stellar stream in the supercomputer through a series of high-resolution dynamics

numerical simulations, and provided a simple portrait of the Cetus Stream progenitor before being swallowed by the Milky Way.

"Our work shows how the Milky Way slowly peeled apart and swallowed a dwarf galaxy with a mass of about 20 million times of the sun over a period of 5 billion years," said Prof. Zhao, the co-corresponding author of the study.

In satellite galaxies, there always remains a core structure composed of relatively dense stars. Some researchers put forward the hypothesis that the globular star cluster NGC 5824 is a core structure associated with the Cetus Stream. But in this work, the researchers overturned this hypothesis through detailed numerical simulations.

"The globular cluster NGC 5824 is not the remnant core structure corresponding to the Cetus stream, because the dynamic feature is not correct," Dr. Chang said. "But we found that there is a strong correlation between the two. NGC 5824 should be a globular cluster in the Cetus stream progenitor galaxy."

The distribution of stellar streams is usually throughout the sky. While LAMOST helped to discover the Cetus stream in the northern sky, the researchers also found the candidate counterpart of the Cetus stream in the southern sky, that is, the Palca stream.

"There are a large number of merging relics in the Milky Way similar to the Cetus stream," said Prof. Zhao. "They compose a treasure house for studying the structure and formation history of the Milky Way, which helps us to better understand how galaxies in the universe have formed and evolved."

More information: Jiang Chang et al. Is NGC 5824 the Core of the Progenitor of the Cetus Stream?, *The Astrophysical Journal* (2020). DOI:

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