

Galaxy clusters caught in a first kiss

June 24 2019



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For the first time, astronomers have found two giant clusters of galaxies that are just about to collide. This observation can be seen as a missing 'piece of the puzzle' in our understanding of the formation of structure in the universe, since large-scale structures—such as galaxies and clusters of galaxies—are thought to grow by collisions and mergers. The result was published in *Nature Astronomy*.

Clusters of galaxies are the largest known bound objects and consist of hundreds of [galaxies](#) that each contain hundreds of billions of stars. Ever

since the Big Bang, these objects have been growing by colliding and merging with each other. Due to their large size, with diameters of a few million light years, these collisions can take about a billion years to complete. After the dust has settled, the two colliding clusters will have merged into one bigger cluster.

Because the merging process takes much longer than a human lifetime, we only see snapshots of the various stages of these collisions. The challenge is to find colliding clusters that are just at the stage of first touching each other. In theory, this stage has a relatively short duration and is therefore hard to find. It is like finding a raindrop that just touches the water surface in a photograph of a pond during a rain shower. Obviously, such a picture would show a lot of falling droplets and ripples on the water surface, but only few droplets in the process of merging with the pond. Similarly, astronomers found a lot of single clusters and merged clusters with outgoing ripples indicating a past collision, but until now no two clusters that are just about to touch each other.

An international team of astronomers have now announced the discovery of two clusters on the verge of colliding. This enabled astronomers to test their [computer simulations](#), which show that in the first moments a shock wave is created in between the clusters and travels out perpendicular to the merging axis. "These clusters show the first clear evidence for this type of merger shock," says first author Liyi Gu from RIKEN national science institute in Japan and SRON Netherlands Institute for Space Research. "The shock created a hot belt region of 100-million-degree gas between the clusters, which is expected to extend up to, or even go beyond the boundary of the giant clusters. Therefore the observed shock has a huge impact on the evolution of galaxy clusters and large scale structures."

Astronomers are planning to collect more 'snapshots' to ultimately build

up a continuous model describing the evolution of [cluster](#) mergers. SRON-researcher Hiroki Akamatsu: "More merger clusters like this one will be found by eROSITA, an X-ray all-sky survey mission that will be launched this year. Two other upcoming X-ray missions, XRISM and Athena, will help us understand the role of these colossal merger shocks in the structure formation history."

Liyi Gu and his collaborators studied the colliding pair during an observation campaign, carried out with three X-ray satellites (ESA's XMM-Newton satellite, the NASA's Chandra satellite, and JAXA's Suzaku satellite) and two [radio telescopes](#) (the Low-Frequency Array, a European project led by the Netherlands, and the Giant Metrewave Radio Telescope operated by National Centre for Radio Astrophysics of India).

More information: Observations of a pre-merger shock in colliding clusters of galaxies, *Nature Astronomy* (2019). [DOI: 10.1038/s41550-019-0798-8](#) , www.nature.com/articles/s41550-019-0798-8

Provided by RIKEN

Citation: Galaxy clusters caught in a first kiss (2019, June 24) retrieved 21 September 2024 from <https://phys.org/news/2019-06-galaxy-clusters-caught.html>

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