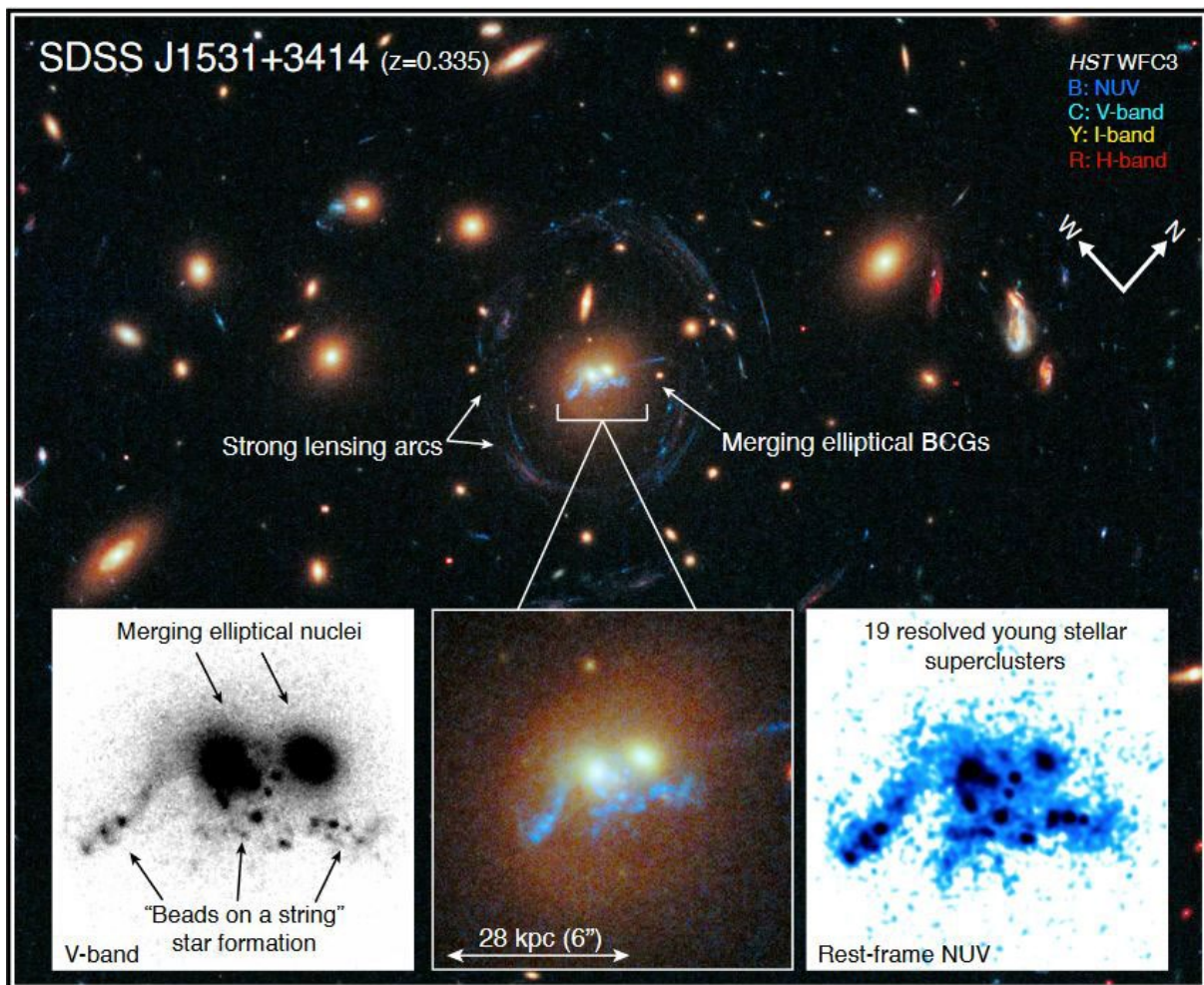


Black Hole Fashions Stellar Beads on a String

An international team of astronomers has discovered one of the most powerful eruptions from a black hole ever recorded. This mega-explosion billions of years ago may help explain the formation of a striking pattern of star clusters around two massive galaxies, resembling ‘beads on a string.’

This discovery was made in the system known as SDSS J1531+3414 (SDSS J1531 for short), which is located 3.8 billion light-years from Earth. Several telescopes were used for this study, including Chandra for the X-rays, and the Low Frequency Array (LOFAR), for the radio.

SDSS J1531 is a massive galaxy cluster containing hundreds of individual galaxies and huge reservoirs of hot gas and dark matter. In the heart of SDSS J1531, two of the cluster’s largest galaxies are colliding with each other. Surrounding these merging giants is a set of 19 large clusters of stars, called superclusters, arranged in an ‘S’ formation that resembles beads on a string (cf Figure).



These observations are evidence for an ancient, titanic eruption in SDSS 1531, and provide a vital clue. The eruption likely occurred when the supermassive black hole in the center of one of the large galaxies produced an extremely powerful jet. As the jet moved through space, it pushed the surrounding hot gas away from the black hole, creating a gigantic cavity.

The evidence for a cavity comes from “wings” of bright X-ray emission, seen with Chandra, tracing dense gas near the center of SDSS J1531. These wings are the edge of the cavity, and surround less dense gas inside the cavity. LOFAR shows radio waves from the remains of the jet’s energetic particles filling in the giant cavity. Together, these data provide compelling evidence of an ancient, massive explosion.

The astronomers also discovered cold and warm gas located near the opening of the cavity, detected with the Atacama Large Millimeter and submillimeter Array (ALMA) and the Gemini North Telescope, respectively. They argue that some of the hot gas pushed away from the black hole eventually cooled to form the cold and warm gas shown. The team thinks tidal effects from the two merging galaxies compressed the gas along curved paths, leading to the star clusters forming in the “beads on a string” pattern.

Reference: Omoruyi, O., Tremblay, G.R., Combes, F. et al: "Beads on a String" Star Formation Tied to one of the most Powerful AGN Outbursts Observed in a Cool Core Galaxy Cluster, ApJ in press, <https://arxiv.org/abs/2312.06762>