Hubble images spawn theory of how spiral galaxies turn into jellyfish before becoming elliptical

January 30 2014, by Bob Yirka

HST images of extreme cases of ram-pressure stripping in galaxy clusters at z > 0:2. From left to right: galaxy C153 in A2125 at z = 0:20 (WFPC2, F606W+F814W, Owen et al. 2006); galaxy 234144–260358 in A2667 at z = 0:23 (ACS, F450W+F606W+F814W, Cortese et al. 2007); galaxy F0083 in A2744 at z = 0:31 (ACS, F435W+F606W+F814W, Owers et al. 2012). Credit: arXiv:1312.6135 [astro-ph.CO]

(Phys.org) —A trio of researchers, two from the University of Hawaii, and one from the University of Dunham in the U.K. has found evidence from the Hubble Space Telescope that suggests jellyfish galaxies come about when spiral galaxies are ripped apart as they move towards dense galaxy clusters. In their paper published in *The Astrophysical Journal Letters*, the team describes how six images of jellyfish captured by Hubble appear to show how spiral galaxies morph into elliptical galaxies.

Prior research has shown that in dense parts of the galaxy, elliptical

galaxies tend to outnumber spiral galaxies—likely due, some have suggested, to some unknown transformation process. In this new effort, the researchers suggest that the mysterious transformation process appears to come about as spiral galaxies encounter the enormous heat present in dense galaxy clusters.

Dense galaxy clusters are thought to come about due to happenstance arrangement of galaxies—those that are close enough to others, draw ever closer to each other due to gravity—as the area of space grows more dense the gasses between the galaxies grows hotter. Anything that approaches the dense area is impacted by the heated gas.

In studying images captured by Hubble, the researchers have witnessed what they believe to be the process by which galaxies evolve in such dense parts of space. They believe that when a spiral galaxy nears a dense galaxy cluster, its colder gases tend to get pulled in to the cluster, causing a stretching of the spiral, and resulting in what is known as a jellyfish galaxy—so named because of its resemblance to the sea creature. Stars from the outer edges of the spiral galaxy are pulled into the cluster, wrecking its signature shape. Over time, the entire spiral galaxy is pulled into the cluster where it melds with other galaxies to form an elliptical galaxy.

The new theory explains both the presence of jellyfish galaxies and so-named orphan stars that don't appear to exist as part of any galaxy—they're actually in transit, the researchers believe, after being pulled from a spiral—eventually they'll wind up as part of an elliptical galaxy.

More information: Jellyfish: Evidence of extreme ram-pressure stripping in massive galaxy clusters, H. Ebeling et al. 2014 *ApJ* 781 L40 DOI: 10.1088/2041-8205/781/2/L40 . On *Arxiv*: arxiv.org/abs/1312.6135

Abstract

Ram-pressure stripping by the gaseous intracluster medium has been proposed as the dominant physical mechanism driving the rapid evolution of galaxies in dense environments. Detailed studies of this process have, however, largely been limited to relatively modest examples affecting only the outermost gas layers of galaxies in nearby and/or low-mass galaxy clusters. We here present results from our search for extreme cases of gas-galaxy interactions in much more massive, X-ray selected clusters at z > 0.3. Using Hubble Space Telescope snapshots in the F606W and F814W passbands, we have discovered dramatic evidence of ram-pressure stripping in which copious amounts of gas are first shock compressed and then removed from galaxies falling into the cluster. Vigorous starbursts triggered by this process across the galaxy-gas interface and in the debris trail cause these galaxies to temporarily become some of the brightest cluster members in the F606W passband, capable of outshining even the Brightest Cluster Galaxy. Based on the spatial distribution and orientation of systems viewed nearly edge-on in our survey, we speculate that infall at large impact parameter gives rise to particularly long-lasting stripping events. Our sample of six spectacular examples identified in clusters from the Massive Cluster Survey, all featuring M F606W 0.2 and facilitates detailed quantitative studies of the most violent galaxy evolution in clusters.

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