Milky way sidelined in galactic tug of war

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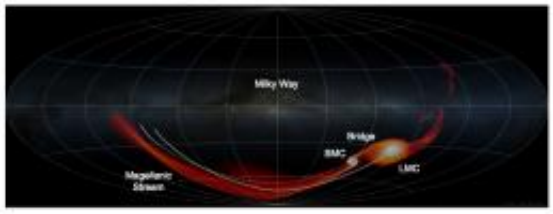

This plot shows the simulated gas distribution of the Magellanic System resulting from the tidal encounter between the Large Magellanic Cloud and Small Magellanic Cloud as they orbit our home Milky Way Galaxy. The entire sky is plotted in galactocentric coordinates of longitude and latitude. The Magellanic Stream is the pronounced tail of material that stretches 150 degrees across the southern sky. The solid line shows the calculated path of the LMC and the dotted line is the path of the SMC. The color range from dark to light shows the density (lower to higher) of the hydrogen gas making up the Magellanic Stream and the Bridge that connects the two dwarf galaxies. Credit: Plot by G. Besla, Milky Way background image by Axel Mellinger (used with permission)

(PhysOrg.com) -- The Magellanic Stream is an arc of hydrogen gas spanning more than 100 degrees of the sky as it trails behind the Milky Way's neighbor galaxies, the Large and Small Magellanic Clouds. Our home galaxy, the Milky Way, has long been thought to be the dominant gravitational force in forming the Stream by pulling gas from the Clouds. A new computer simulation by Gurtina Besla (Harvard-Smithsonian Center for Astrophysics) and her colleagues now shows, however, that the Magellanic Stream resulted from a past close encounter between these dwarf galaxies rather than effects of the Milky

Way.

"The traditional models required the Magellanic Clouds to complete an orbit about the Milky Way in less than 2 billion years in order for the Stream to form," says Besla. Other work by Besla and her colleagues, and measurements from the Hubble Space Telescope by colleague Nitya Kallivaylil, rule out such an orbit, however, suggesting the Magellanic Clouds are new arrivals and not long-time satellites of the Milky Way.

This creates a problem: How can the Stream have formed without a complete orbit about the Milky Way?

To address this, Besla and her team set up a simulation assuming the Clouds were a stable binary system on their first passage about the Milky Way in order to show how the Stream could form without relying on a close encounter with the Milky Way.

The team postulated that the Magellanic Stream and Bridge are similar to bridge and tail structures seen in other interacting galaxies and, importantly, formed before the Clouds were captured by the Milky Way.

"While the Clouds didn't actually collide," says Besla, "they came close enough that the Large Cloud pulled large amounts of hydrogen gas away from the Small Cloud. This tidal interaction gave rise to the Bridge we see between the Clouds, as well as the Stream."

"We believe our model illustrates that dwarf-dwarf galaxy tidal interactions are a powerful mechanism to change the shape of dwarf galaxies without the need for repeated interactions with a massive host galaxy like the Milky Way."

While the Milky Way may not have drawn the Stream material out of the Clouds, the Milky Way's gravity now shapes the orbit of the Clouds

and thereby controls the appearance of the tail.

"We can tell this from the line-of-sight velocities and spatial location of the tail observed in the Stream today," says team member Lars Hernquist of the Center.

More information: The paper describing this work has been accepted for publication in the October 1 issue of the *Astrophysical Journal Letters* and is available online at arxiv.org/abs/1008.2210v1

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