

Milky Way A Field Of Streams

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A new map of stars in the Milky Way Galaxy reveals a night sky criss-crossed with streams of stars, left behind by smaller satellite galaxies and star clusters ripped apart by the parent galaxy's gravity.

Analyzing five years of data from the second Sloan Digital Sky Survey, which spans nearly one-quarter of the sky, researchers at Cambridge University created the new image of the outer Milky Way by eliminating the redder, nearby stars that otherwise would swamp the view of background structures.

Astronomers Vasily Belokurov and Daniel Zucker found so many trails of stars in their high-contrast image they have named the area the Field of Streams.

Satellite galaxies orbiting the Milky Way are literally ripped apart by the galaxy's tidal forces. Their stars are torn from them in giant streams that trace their orbital paths - just as meteor showers appear when Earth crosses the orbital paths of comets.

Dominating the Field of Streams image is the enormous, arching stream of the Sagittarius dwarf galaxy, which was discovered more than a decade ago. Other researchers previously mapped its long tidal stream in other regions of the sky.

The SDSS-II data have provided a surprise. "The stream appears forked," Belokurov said. "We are seeing different wraps superimposed on the sky, as the stream goes around the galaxy two or three times."

Because of the multiple wraps, the observations provide strong new constraints on the dark matter halo of the Milky Way, said Mike Fellhauer of Cambridge. "The leading theories of dark matter predict that the galaxy's halo should be flattened, like a rugby football, but our simulations only match the forked Sagittarius stream if the inner halo is round, like a soccer ball."

In addition to the Sagittarius arches, the field shows faint trails of stars torn from globular clusters, and other rings, trails, and lumps that appear to be the remains of disrupted dwarf galaxies.

"There are more streams here than in a river delta," Zucker said.

Prominent among these is the Monoceros stream, discovered previously by SDSS-II scientists Heidi Jo Newberg of Rensselaer Polytechnic Institute in Troy, N.Y., and Brian Yanny of the Fermi National Accelerator Laboratory in Batavia, Ill.

The multiple rings of stars are all that remain from a dwarf satellite that was absorbed by the Milky Way long ago. Crossing the Field is an enigmatic, new stream of stars extending over 70 degrees on the sky, whose original source remains unknown.

"Some of these 'murdered' galaxies have been named," said team member Wyn Evans of Cambridge, "but this galactic corpse hasn't been identified yet. We're looking for it right now."

The discoveries reinforce a concept in which galaxies such as the Milky Way are built up from the merging and accretion of smaller galaxies.

"We've known about merging for some time" Yanny said, "but the Field of Streams gives us a striking demonstration of multiple merger events going on the Milky Way galaxy right now. This is happening all over the

Universe, as big galaxies grow by tearing up smaller ones into streams."

The streams also provide new tests of the nature of dark matter itself, said theorist James Bullock of University of California, Irvine, who did not participate in the SDSS-II team.

"The fact that we can see a 'Field of Streams' like this suggests that dark matter particles are very 'cold', or slow moving," Bullock said. "If the dark matter was made up of 'warm,' fast moving particles, we wouldn't expect these thin streams to hang around long enough for us to find them."

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