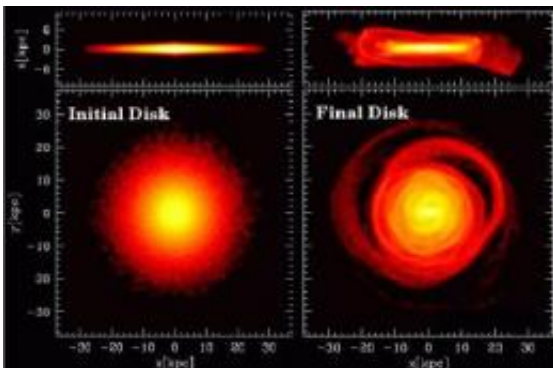


# Is the Milky Way doomed to be destroyed by galactic bombardment? Probably not

August 31 2009, by Pam Frost Gorder



Density maps of disk stars illustrating the global morphological transformation of a galactic disk subject to bombardment by dark matter substructures. Brighter colors indicate regions of higher density of disk stars. The left panel shows the initial disk, while the right panel depicts the final disk after the violent gravitational encounters with the orbiting substructures. The edge-on (upper panels) and face-on (bottom panels) views of the disk are displayed in each frame. Satellite-disk interactions of the kind expected in the currently favored cosmological model produce several distinctive signatures in galactic disks including: long-lived, low-density, ring-like features in the outskirts; conspicuous flares; bars; and faint filamentary structures above the disk plane that resemble tidal streams. These morphological features are similar to those being discovered in the Milky Way, the Andromeda galaxy, and in other spiral galaxies. Credit: Image courtesy of Stelios Kazantzidis, Ohio State University.

(PhysOrg.com) -- As scientists attempt to learn more about how galaxies evolve, an open question has been whether collisions with our dwarf

galactic neighbors will one day tear apart the disk of the Milky Way.

That grisly fate is unlikely, a new study now suggests.

While astronomers know that such collisions have probably occurred in the past, the new computer simulations show that instead of destroying a galaxy, these collisions "puff up" a galactic disk, particularly around the edges, and produce structures called stellar rings.

The finding solves two mysteries: the likely fate of the Milky Way at the hands of its satellite [galaxies](#) -- the most massive of which are the Large and Small Magellanic Clouds -- and the origin of its puffy edges, which astronomers have seen elsewhere in the universe and dubbed "flares."

The mysterious dark matter that makes up most of the universe plays a role, the study found.

Astronomers believe that all galaxies are embedded within massive and extended halos of dark matter, and that most large galaxies lie at the intersections of filaments of dark matter, which form a kind of gigantic web in our universe. Smaller [satellite galaxies](#) flow along strands of the web, and get pulled into orbit around large galaxies such as our Milky Way.

Ohio State University astronomer Stelios Kazantzidis and his colleagues performed detailed [computer simulations](#) of galaxy formation to determine what would happen if a satellite galaxy -- such as the [Large Magellanic Cloud](#) and its associated dark matter -- collided with a spiral galaxy such as our own.

Their conclusion: The satellite galaxy would gradually disintegrate, while its gravity tugged at the larger galaxy's edge, drawing out stars and other material. The result would be a flared galactic disk such as that of the

Milky Way, which starts out narrow at the center and then widens toward the edges.



This image from a supercomputer simulation shows the density of dark matter in our Milky Way galaxy which is known to contain an ancient thin disk of stars. Brightness (blue-to-violet-to-red-to-yellow) corresponds to increasing concentration of dark matter. The bright central region corresponds roughly to the Milky Way's luminous matter of gas and stars and the bright clumps indicate dark-matter satellites orbiting our Milky Way galaxy which are known as "substructure." The simulation predicts that the dark-matter halos of spiral galaxies are lumpy, filled with hundreds of dark matter substructures that pass through the stellar disks of galaxies, leaving their imprint and disturbing them in the process. Credit: Image courtesy of Stelios Kazantzidis, Ohio State University.

The results may ease the mind of anyone who feared that our galactic neighbors and their associated dark matter would eventually destroy our galactic disk -- albeit billions of years from now.

Kazantzidis couldn't offer a 100-percent guarantee, however.

"We can't know for sure what's going to happen to the Milky Way, but

we can say that our findings apply to a broad class of galaxies similar to our own," Kazantzidis said. "Our simulations showed that the satellite galaxy impacts don't destroy spiral galaxies -- they actually drive their evolution, by producing this flared shape and creating stellar rings -- spectacular rings of stars that we've seen in many spiral galaxies in the universe."

He and his colleagues didn't set out solely to determine the fate of our galaxy. In two papers that have appeared in the *Astrophysical Journal*, they report that their simulations offer a new way to test -- and validate -- the current cosmological model of the universe.

According to the model, the universe has contained a certain amount of normal matter and a much larger amount of dark matter, starting with the Big Bang. The exact nature of dark matter is unknown, and scientists are hunting for clues by studying the interplay between dark matter and normal matter.

This is the first time that collisions between spiral galaxies and satellites have been simulated at this level of detail, Kazantzidis said, and the study revealed that galaxies' flared edges and stellar rings are visible signs of these interactions.

Our galaxy measures 100,000 light-years across (one light year equals six trillion miles). Yet we are surrounded by a cloud or "halo" of dark matter that's 10 times bigger -- 1 million light-years across, he explained.

While astronomers envision the dark matter halo as partly diffuse, it contains dense regions that orbit our galaxy in association with satellite galaxies, such as the Magellanic Clouds.

"We know from cosmological simulations of [galaxy formation](#) that these smaller galaxies probably interact with galactic disks very frequently

throughout cosmic history. Since we live in a disk galaxy, it is an important question whether these interactions could destroy the disk," Kazantzidis said. "We saw that galaxies are not destroyed, but the encounters leave behind a wealth of signatures that are consistent with the current cosmological model, and consistent with our observations of galaxies in the universe."

One signature is the flaring of the galaxy's edges, just as the edges of the Milky Way and of other external galaxies are flared.

We consider this flaring to be one of the most important observable consequences of interactions between in-falling satellite galaxies and the galactic disk."

In both articles, the researchers considered the impacts of many different smaller galaxies onto a larger, primary disk galaxy. They calculated the likely number of satellites and the orbital paths of those satellites, and then simulated what would happen during collision, including when the [dark matter](#) interacted gravitationally with the disk of the spiral galaxy.

None of the disk galaxies were torn apart; to the contrary, the primary galaxies gradually disintegrated the in-falling satellites, whose material ultimately became part of the larger galaxy.

The satellites passed through the galactic disk over and over, and on each pass, they would lose some of their mass, a process that would eventually destroy them completely.

Though the primary galaxy survived, it did form flared edges which closely resembled our galaxy's flared appearance today.

"Every [spiral galaxy](#) has a complex formation and evolutionary history,"

Kazantzidis said. "We would hope to understand exactly how the [Milky Way](#) formed and how it will evolve. We may never succeed in knowing its exact history, but we can try to learn as much as we can about it, and other galaxies like it."

Source: The Ohio State University ([news](#) : [web](#))

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