When the Galaxies Collide, Our Solar System Will Go for a Ride

Posted by Guy Pirro on 7/19/2007 9:20 PM

Computer simulations by Cox and Loeb show that big changes are coming in only 2 billion years, when the Milky Way and Andromeda experience their first close pass. A viewer on Earth would see the night sky evolve from today's strip of stars (the Milky Way seen edge-on) to a bright muddled mess as Andromeda approaches and its powerful pull flings stars from their stately orbits. (Image Credit: NASA, James Gitlin)

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The Milky Way and the Andromeda galaxy are approaching each other with a speed of 300,000 miles per hour.

It's not certain whether we're in store for a head-on collision or a simple sideswiping by the two massive galaxies. Astronomers will first need to use powerful new telescopes to precisely measure Andromeda's tangential motion across the sky. (Just as a baseball outfielder estimates whether a ball is heading directly toward him or is going to miss him by determining whether the ball is moving sideways.)

New calculations by theorists T.J. Cox and Avi Loeb of the Harvard-Smithsonian Center for Astrophysics show that the Sun and its planets will be exiled to the outer reaches of the merged Milky Way/Andromeda galaxy.

"You could say that we're being sent to a retirement home in the country," said Cox. "We're living in the suburbs of the Milky Way right now, but we're likely to move much farther out after the coming cosmic smash-up."

Computer simulations by Cox and Loeb show that big changes are coming in only 2 billion years, when the Milky Way and Andromeda experience their first close pass. A viewer on Earth would see the night sky evolve from a strip of stars (the Milky Way seen edge-on) to a muddled mess as Andromeda's powerful pull flings stars from their stately orbits.

At that time, the Sun will still be a hydrogen-burning main-sequence star, although it will have brightened and heated enough to boil the oceans from the Earth.

The two galaxies will swing around each other a couple of times, intermingling their stars as gravitational forces stir them together.

About 5 billion years from now, Andromeda and the Milky Way will have completely combined to form a single, football-shaped elliptical galaxy. The Sun will be an aging star nearing the red giant phase and the end of its lifetime. It and the solar system likely will reside 100,000 light-years from the center of the new galaxy -- 4 times further than the current 25,000 light-year distance.

Any descendants of humans observing the future sky will experience a very different view. The strip of Milky Way will be gone, replaced by a huge bulge of billions of stars. Future scientists may look back on today's research as the first prediction of things to come.

A direct collision would lead to a grand merger between the two behemoths, and the Milky Way would no longer be the pinwheel spiral we are familiar with, but would evolve into a huge elliptical galaxy.

It would happen no sooner than five billion years in the future. By then the Sun may have burned out, and the Earth reduced to a frigid, lifeless cinder. It's impossible to predict if there would be any vestige of humanity colonized among the stars, not to mention extraterrestrial civilizations around to witness this great collision.

The collision will take several billion years to fully run its course, so it will be hard for any one civilization, like ours, to fully understand the vast scale - both in time and space — of the collision.

However, by studying pairs of other colliding galaxies and using computer simulations, astronomers can assemble a series of snapshots of the collision process and get a preview of what might eventually happen to our galaxy.

Here is a scenario of how the Milky Way might change if it were to have a head-on collision with Andromeda.

Today, the Andromeda galaxy appears simply as a spindle-shaped smudge of light in the northern autumn sky. Because it is 2.2 million light-years away — or roughly 20 times the diameter of our Milky Way galaxy - it only appears four times the width of the full moon. As the two galaxies approach each other, Andromeda will grow ever larger in the sky, resembling an eerie glowing sword of light.

When the Andromeda galaxy and our Milky Way galaxy are close enough, huge clumps of cold, giant molecular clouds, each measuring tens to hundreds of light-years across, will be compressed. Like plugging in a string of Christmas light bulbs, these dark knots will light up as millions of stars burst into life. Most of these stars will be in brilliant blue clusters, many of them 100 times brighter than the original globular star clusters already present in the two galaxies.

The disk of dust and stars that for billions of years marked the lanes of our galaxy and the Andromeda galaxy, will also begin to come apart under the gravitational pull of the two galaxies. As Andromeda swings past our galaxy, the sky will grow increasingly jumbled with tattered lanes of dust, gas, and brilliant young stars and star clusters.

So many new stars will be born that the fraction of massive stars that are present will increase dramatically. These stars will begin popping off like a string of firecrackers as they self-destruct as supernovae.

After swinging by our galaxy, Andromeda will take perhaps 100 million years to make a slow and graceful U-turn, before plunging nearly directly into the Milky Way's core. Another, even more spectacular burst of star formation will then occur, with the winds from the supernovae driving most of the remaining gas and dust out of the galaxy. Soon both the old and new stars of the two galaxies will intermingle to form a single elliptical-shaped galaxy.

As the stars gravitationally settle into their new home, through a dynamic process called "violent relaxation", any hint of the Milky Way and Andromeda as majestic spiral galaxies will be gone. The band known as the Milky Way will be gone, but far in the future some astronomers might gaze out onto a starry sky and look all the way into the core of the new elliptical galaxy. They would have no clue that there were once two majestic spiral galaxies, called the Milky Way and Andromeda by a long forgotten civilization.

For more information:

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