Galaxy's Neighboring Spiral Arm Is Closer Than Thought (Forwarded)

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Galaxy's Neighboring Spiral Arm Is Closer Than Thought

Cambridge, MA −− The Perseus spiral arm, the nearest spiral arm in the

Milky Way outside the Sun's orbit, lies only half as far from Earth as some previous studies had suggested. An international team of astronomers measured a highly accurate distance to the Perseus arm for the first time using a globe−spanning system of radio dishes known as the Very Long Baseline Array (VLBA), which offers the sharpest vision of any telescope in existence. Additional VLBA measurements will help astronomers to determine the true structure of the Milky Way.

"We know less about the structure of our own galaxy than we do about many nearby galaxies like Andromeda," said Smithsonian astronomer and team leader Mark Reid (Harvard−Smithsonian Center for Astrophysics). "We literally can't see the forest for the trees because we are embedded inside our own galaxy, and interstellar dust blocks our view."

The team's results were published in the December 8, 2005 online issue of Science Express and will appear in print in the January 6, 2006 issue of Science. Reid also will speak about the findings on January 9 at the 207th meeting of the American Astronomical Society in Washington, DC.

Previous estimates of the distance to the Perseus arm varied by a factor of two. Studies based on the motions of stars yielded a distance of more than 14,000 light−years, while observations comparing the apparent brightness of massive, young stars with estimates of their intrinsic brightness yielded a distance of only about 7,200 light−years. The new VLBA measurements confirm with an accuracy of 2 percent that the Perseus spiral arm is located about 6,400 light−years from the Earth.

"Our neighbors are closer than we thought," stated first author Ye Xu (Shanghai Astronomical Observatory).

Obtaining accurate distances in astronomy is a difficult challenge. The most reliable method for measuring astronomical distances is called trigonometric parallax, a technique similar to the triangulation used by land surveyors. A trigonometric parallax is determined by observing the change in position of a star relative to a very distant, essentially fixed object like a quasar, as the Earth moves in its orbit around the Sun. Just as a finger held at arm's length appears to shift against the far wall when viewed with one eye or the other, a nearby object will appear to shift position relative to a more distant one. Mathematical calculations then yield the distance to the closer object. The parallax method is powerful but requires exceptional accuracy.

"I have spent more than a decade developing the calibration techniques we needed to obtain this result," said Reid.

The team achieved an accuracy of 10 micro−arcseconds, which is a factor of 100 better than previous methods. That resolution is equivalent to looking from the Earth to a person standing on the Moon's surface and telling whether that person is holding a flashlight in their right or left hand. The VLBA is the only telescope able to provide such high resolution.

Reid and his colleagues used the VLBA to examine the region near a newly formed star in the Perseus arm called W3OH. They gathered radiation from bright, compact radio sources known as methanol masers. (Masers amplify, or strengthen, radio−wave emission the same way that lasers amplify light emission. Masers can form naturally in outer space.)

With a distance in hand, the team was able to determine the motion of W3OH in three−dimensional space. They found that W3OH is orbiting the galactic center more slowly than the galaxy spins, and is "falling" toward the center of the Milky Way. Such peculiar motions can be studied to determine the distribution of mass in the Milky Way.

The team has been awarded additional VLBA observing time to measure other regions of the galaxy. Over time, such studies will help map the spiral structure of the Milky Way and determine the distribution of unseen dark matter believed to surround it.

The VLBA is part of the National Radio Astronomy Observatory (NRAO), a research facility of the National Science Foundation (NSF). Dedicated in 1993, the VLBA consists of 10, 25−meter−diameter dish antennas spread from Hawaii to St. Croix in the Caribbean. The antennas all work together as a single telescopic system roughly the size of the Earth. The NRAO is operated for the NSF under a cooperative agreement by Associated Universities, Inc.

Headquartered in Cambridge, Mass., the Harvard−Smithsonian Center for Astrophysics (CfA) is a joint collaboration between the Smithsonian Astrophysical Observatory and the Harvard College Observatory. CfA scientists, organized into six research divisions, study the origin, evolution and ultimate fate of the universe.
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