

# The peanut at the heart of our galaxy

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This artist's impression shows how the Milky Way galaxy would look seen from almost edge on and from a very different perspective than we get from the Earth. The central bulge shows up as a peanut shaped glowing ball of stars and the spiral arms and their associated dust clouds form a narrow band. Credit: ESO/NASA/JPL-Caltech/M. Kornmesser/R. Hurt

Two groups of astronomers have used data from ESO telescopes to make the best three-dimensional map yet of the central parts of the Milky Way. They have found that the inner regions take on a peanut-like, or X-shaped, appearance from some angles. This odd shape was mapped by using public data from ESO's VISTA survey telescope along with measurements of the motions of hundreds of very faint stars in the

central bulge.

One of the most important and massive parts of the galaxy is the galactic bulge. This huge central cloud of about 10 000 million stars spans thousands of light-years, but its structure and origin were not well understood.

Unfortunately, from our vantage point from within the galactic disc, the view of this central region—at about 27 000 light-years' distance—is heavily obscured by [dense clouds](#) of gas and dust. Astronomers can only obtain a good view of the bulge by observing longer wavelength light, such as [infrared radiation](#), which can penetrate the dust clouds.

Earlier observations from the 2MASS infrared sky survey had already hinted that the bulge had a mysterious X-shaped structure. Now two groups of scientists have used new observations from several of ESO's telescopes to get a much clearer view of the bulge's structure.

The first group, from the Max Planck Institute for Extraterrestrial Physics (MPE) in Garching, Germany, used the VVV near-[infrared survey](#) from the [VISTA](#) telescope at ESO's Paranal Observatory in Chile. This new public survey can pick up stars thirty times fainter than previous bulge surveys. The team identified a total of 22 million stars belonging to a class of [red giants](#) whose well-known properties allow their distances to be calculated.

"The depth of the VISTA star catalogue far exceeds previous work and we can detect the entire population of these stars in all but the most highly obscured regions," explains Christopher Wegg (MPE), who is lead author of the first study. "From this star distribution we can then make a three-dimensional map of the [galactic bulge](#). This is the first time that such a map has been made without assuming a model for the bulge's shape."

"We find that the inner region of our Galaxy has the shape of a peanut in its shell from the side, and of a highly elongated bar from above", adds Ortwin Gerhard, the coauthor of the first paper and leader of the Dynamics Group at MPE. "It is the first time that we can see this clearly in our own Milky Way, and simulations in our group and by others show that this shape is characteristic of a barred galaxy that started out as a pure disc of stars."

The second international team, led by Chilean PhD student Sergio Vásquez (Pontificia Universidad Católica de Chile, Santiago, Chile and ESO, Santiago, Chile) took a different approach to pin down the structure of the bulge. By comparing images taken eleven years apart with the MPG/ESO 2.2-metre telescope they could measure the tiny shifts due to the motions of the bulge stars across the sky. These were combined with measurements of the motions of the same stars towards or away from the Earth to map out the motions of more than 400 stars in three dimensions.

"This is the first time that a large number of velocities in three dimensions for individual stars from both sides of the bulge been obtained," concludes Vásquez. "The stars we have observed seem to be streaming along the arms of the X-shaped bulge as their orbits take them up and down and out of the plane of the Milky Way. It all fits very well with predictions from state-of-the-art models!"

The astronomers think that the Milky Way was originally a pure disc of [stars](#) which formed a flat bar billions of years ago. The inner part of this then buckled to form the three-dimensional peanut shape seen in the new observations.

**More information:** This research was presented in papers entitled "Mapping the three-dimensional density of the Galactic bulge with VVV red clump stars" by C. Wegg et al., to appear in the *Monthly Notices of*

*the Royal Astronomical Society, and "3D kinematics through the X-shaped Milky Way bulge", by S. Vásquez et al., which has been recently published in the journal *Astronomy & Astrophysics*.*

Provided by ESO

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