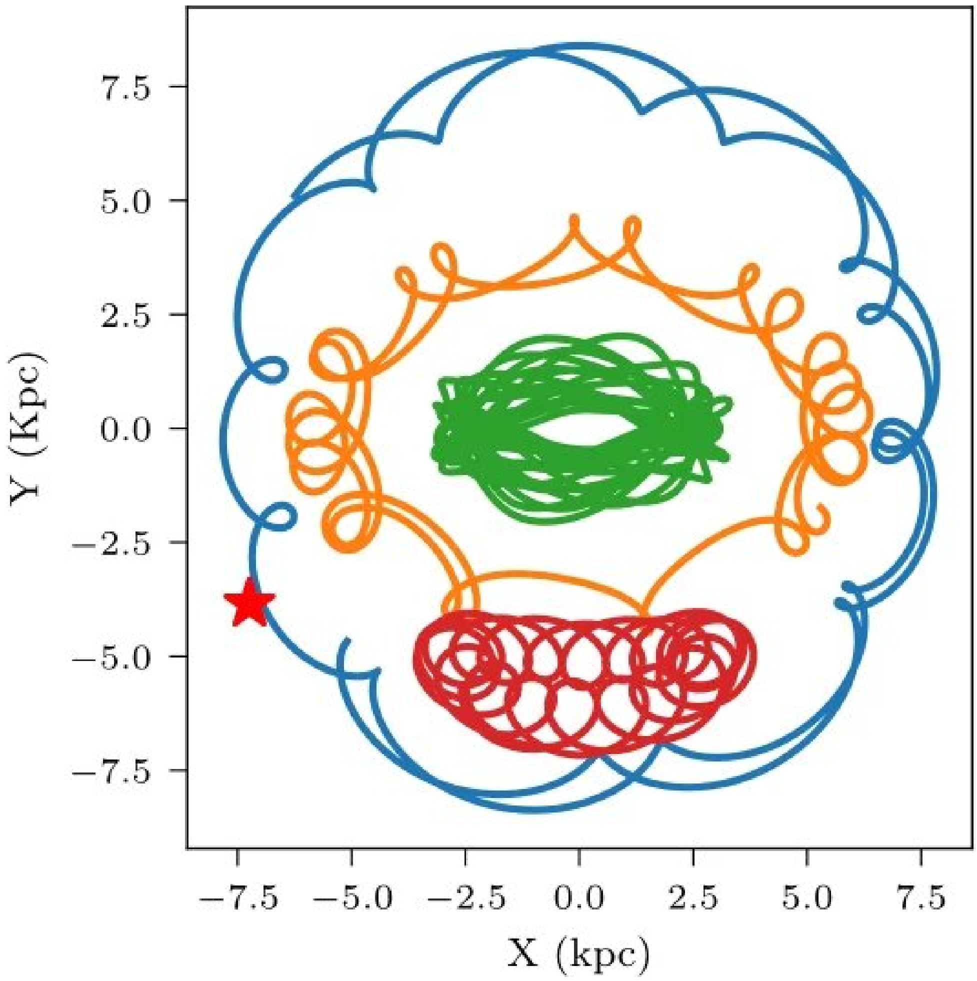
The Milky Way's middle-aged inner ring

April 5 2022

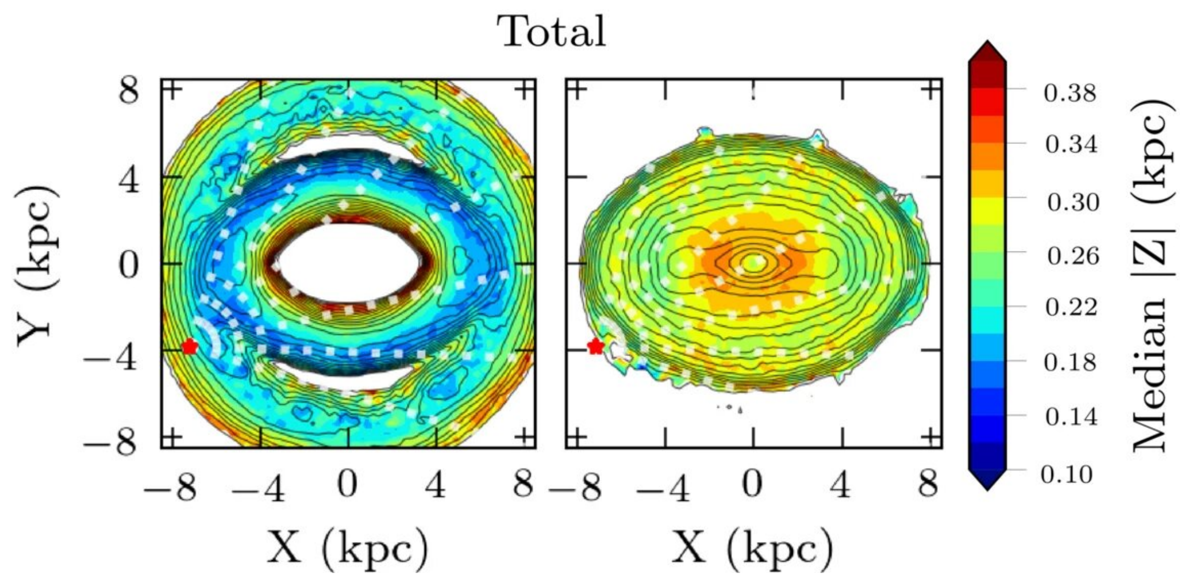


A selection of example orbits of the more than 30 000 APOGEE stars evolved in a state-of-the-art model for the gravitational potential of Milky Way. The red star shows the position of the sun. Credit: MPE

Using a combination of observed stars and a realistic model of the Milky Way, scientists at the Max Planck Institute for Extraterrestrial Physics have found a new structure in our home galaxy. Just outside the galactic bar, they found an inner ring of metal rich stars, which are younger than the stars in the bar. The ages of the ring stars can be used to estimate that the bar must have formed at least 7 billion years ago. The existence of this ring makes it likely that star formation from inflowing gas played an important role at these early epochs.

Understanding the global structure of our own galaxy is complicated by the fact that we are situated close to one of its spiral arms in the disk plane. In many directions, stars are obscured by dense clouds of gas and dust. This is especially true towards the center of the Milky Way, making the inner Milky Way's structure particularly elusive. Nevertheless, over the past decade, scientists at the Max Planck Institute for Extraterrestrial Physics (MPE) have been able to combine data from various observation campaigns with sophisticated computer simulations to create a state-of-the-art model of the inner Milky Way: a slow bar with a peanut-shaped bulge.

Recent surveys have produced a wealth of new data for the inner Milky Way. APOGEE is a large-scale, stellar spectroscopic survey conducted at near-infrared wavelengths. As opposed to optical light, infrared light can more easily pierce though dust, allowing APOGEE to detect stars situated in the dusty regions of the Milky Way, such as the disk and bulge, and determine not only their element abundances but also their positions, line-of-sight velocities, and approximate ages. In addition, the ambitious Gaia mission is charting about one billion stars, providing positional and proper motion measurements. Together both surveys provide all the necessary observational ingredients to determine orbits of stars in the inner regions of the Milky Way. All that is needed is a realistic Milky Way potential to integrate the stars in. This is obtained from the inner Milky Way model created by MPE scientists.



In these two images, the stars are separated by the eccentricity of their orbits, with

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