Determining Local Dark Matter Density with LAMOST Data

A recent study conducted by researchers from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) has shed new lights on the mass density of the dark matter in the local volume around the Sun. With carefully selected LAMOST data and a simple analytical Kz force model, they concluded that the volume density of the dark matter around us is $0.018\pm0.005 M.pc^{-3}$, higher than the results of previous measurements from other research groups.

The mysterious dark matter particles are thought not to be involved in electromagnetic interactions and consequently cannot be detected from any form of light. However, astronomers have managed to "see" them by measuring the gravitational force given by these particles. In general, the fraction of the dark matter, which plays a crucial role in the evolution of the universe at all scales, is one of the most fundamental parameters in astrophysics. Nowadays, cosmological observations imply that about 70% of the matter is contributed by dark matter in the whole universe. In a Milky Way-like galaxy, the fraction of the dark matter could be as high as over 90%. However, since dark matter is sparsely distributed in the galactic halo, only a very small portion of the mass nearby the galactic disk is from the dark matter. This makes it even more difficult to accurately measure the density of the dark matter around our Sun.

A precise measurement of local dark matter density is critical in dark matter particle experiments on the Earth. It is also key to understanding how much dark matter actually exists in the Milky Way. Since the famous Dutch astronomer Oort did his first try in 1932, many efforts have been made by astronomers around the world. However, different people have come to different conclusions that are far from any consensus.

A large set of samples with well controlled selection function and a reliable dynamical model are the key to such measurements. The LAMOST survey has observed millions of the stars, allowing for reliable dark matter density measurement with the largest ever dataset. As a first try, XIA Qiran, LIU Chao, MAO Shude and their collaborators from NAOC used data of a few thousands of stars around the north Galactic pole to derive the result. With the latest data release, they are now able to use much more data to remarkably improve their measurement accuracy.

Their work has been published in the *Monthly Notice of the Royal Astronomical Society.*