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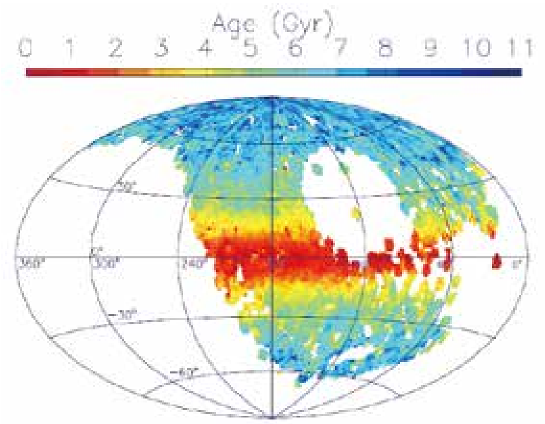
Basic Science

# Revealing Ages and Masses of a Million Stars

Researchers from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), Peking University (PKU) and Beijing Normal University (BNU) have obtained robust age and mass estimates for a million main-sequence stars observed in the Galactic Spectroscopic Surveys of the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST). They used stellar parameters from the LAMOST Data Release 4 value-added catalog, which contains stellar atmospheric parameters, absolute magnitudes, surface gravity, metallicity, abundance, extinction, distance and kinematics for over four million stars, and the age estimates for nearly half of the sample stars were as low as 20–30% uncertainties.

Age is a major parameter in determining the evolutionary state of a star. Obtaining reliable age for a large numbers of stars is the key to characterizing stellar populations as well as revealing the assemblage and evolution history of the Galaxy. However, deriving stellar age is extremely difficult because there is no "clock" in the universe to record the accurate age of a star. Unlike other parameters (like mass and chemical composition), it is almost impossible to directly derive a star's age with observables or via fundamental physic laws. Scientists have to rely on stellar evolutionary models — usually by comparing stellar parameters deduced from observables with model predictions. While this requires accurate and precise parameters such as effective temperature, metallicity, surface gravity and luminosity, the method is only applicable to limited types of stars whose observables are sensitive enough. Due to these difficulties, the ages of a large sample of Galactic field stars are still unknown.

With the LAMOST turnoff and subgiant (MSTO-SG) star sample, researchers found that the stars distribute along two sequences in both the age — [Fe/H] and age — [α/Fe] spaces. It implies that the chemical enrichment history of the Galactic disk may have experienced different processes. One process may correspond to the formation of the thick disk, which started to form at a very early epoch and almost quenched 8 Gyr ago. The other may correspond to the formation of the thin disk, which started to form around 8-10 Gyr ago and is still growing. The data also revealed a flaring phenomenon of the outer disk in stellar age distribution — young stars tend to reach larger heights above the disk mid-plane at the outer disk, which is expected to provide strong constraints on the disk formation scenarios.



Distribution of median stellar ages in Galactic coordinate system (*l*, *b*). The data are divided into patches of 1.5°×1.5° to draw the map.

Their paper was published in the *Astrophysical Journal Supplement* (Xiang et al. 2017, *ApJS*, 232, 2). The first author XIANG Maosheng is a LAMOST Fellow and his research was funded by the Astronomical Mega-Science Center under the Chinese Academy of Sciences. Their work was also supported by the National Key Basic Research Program of China and the National Natural Science Foundation of China.