LAMOST first data release provides fundamental parameters of nearly 30,000 M dwarfs

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China's Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST). Credit: National Astronomical Observatory of the Chinese Academy of Sciences.

Based on the first data release (DR1) from the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST), astronomers have derived fundamental parameters of nearly 30,000 M-dwarf stars. The research paper presenting the findings was published December 13 on the arXiv pre-print repository.

M dwarfs are the most common stars in our galaxy and excellent targets for exoplanet hunting campaigns. Observations of these stars have the potential of identifying new Earth and super-Earth sized exoplanets using radial velocity measurements or transit photometry technique. Determining fundamental parameters of M dwarfs, such as radius and mass, is therefore crucial to better characterize potential alien worlds orbiting them.

DR1 from the LAMOST optical spectroscopic survey was published in 2015, delivering about 121,000 M dwarf spectra. However, the majority of these objects have not yet been characterized beyond a simple spectral subtype determined from color photometry.

So a team of astronomers led by Brianna Galgano of Fisk University in Nashville, Tennessee, employed a data-driven method for determining physical parameters and chemical abundances of stars from their spectra called "The Cannon." This technique allowed them to obtain basic parameters of almost 30,000 M dwarfs from the LAMOST DR1 dataset.

"We discuss in this work how The Cannon (Ness et al. 2015) can successfully model low resolution, low to moderate signal-to-noise M dwarf spectra, and we use The Cannon model to find the properties of 29,678 previously uncharacterized optical spectra of M dwarfs in the LAMOST DR1 catalog," the astronomers wrote in the paper.

In general, the researchers managed to derive effective temperatures, radii, masses and luminosities for 29,678 M dwarfs with spectral types

from M0 to M6. The radii of these stars are between 0.14 and 0.66 solar radii, while their masses range from 0.1 to 0.71 solar masses. The effective temperatures of the M dwarfs were found to vary from 2,901 to 4,113 K, and their luminosities turned out to be between 0.002 and 0.115 solar luminosities.

The researchers noted that the typical uncertainties for the four derived parameters are 0.065 solar radii, 0.054 solar masses, 110 K, and 0.012 solar luminosities. Although the uncertainties in the data are satisfactory, the astronomers acknowledged that further improvements of the model are possible in order to get more accurate results.

"One particular area for improved accuracy would be to incorporate parameter measurement uncertainties as as an additional weight for the model. The Cannon approach can also be sensitive to outliers, especially if the training set is small. We therefore recommend careful scrutiny and removal of outliers," the authors of the paper explained.

All in all, the astronomers concluded that the model employed by them for DR1 can be used for future LAMOST data releases. This, according to them, would significantly extend the sample of well characterized M dwarfs across the sky using new and exclusively data-based modeling methods.

More information: Fundamental Parameters of ~30,000 M dwarfs in LAMOST DR1 Using Data-driven Spectral Modeling, arXiv:1912.06648 [astro-ph.SR] arxiv.org/abs/1912.06648

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