Highlights of Spanish Astrophysics XII, Proceedings of the XVI Scientific Meeting of the Spanish Astronomical Society held on July 15 - 19, 2024, in Granada, Spain. M. Manteiga, F. González Galindo, A. Labiano Ortega, M. Martínez González, N. Rea, M. Romero Gómez, A. Ulla Miguel, G. Yepes, C. Rodríguez López, A. Gómez García and C. Dafonte (eds.), 2025

Stellar characterization of very late-type M dwarfs

E. Marfil[1,2], D. Montes[1], A. Schweitzer[2], and J. A. Caballero[3]

[1] Departamento de Física de la Tierra y Astrofísica & IPARCOS-UCM (Instituto de Física de Partículas y del Cosmos de la UCM), Facultad de Ciencias Físicas, Universidad Complutense de Madrid, Spain
[2] Hamburg Observatory, University of Hamburg, Germany
[3] Centro de Astrobiología (CAB, CSIC-INTA), Spain

Abstract

Accurate parameter determinations (effective temperature, surface gravity, and metallicity) from stellar spectra in very cool M dwarfs (M7.0 V and beyond) still prove extremely elusive, mostly due to the absence of useful line indicators used in early M dwarfs (e.g. Fe I, Ti I lines) and the impact of stronger molecular absorption bands (TiO, VO) that severely disrupt their spectra. Additionally, the presence of more intense magnetic fields and violent activity phenomena make such determinations even more challenging. However, these accurate parameter determinations are still essential to better characterize the exoplanetary systems (i.e. habitability zone and the constraints on exoplanetary mass, radius, and composition) discovered around very cool M dwarfs: for instance, the M8.0 V exoplanet host star TRAPPIST-1 or the M7.0 V host Teegarden's Star.

In this contribution, we aim to expand the methodology used by Marfil et al. (2021), based on spectral synthesis, to characterize the coolest M dwarfs observed with CARMENES. To do so, we delve into the selection of the most reliable spectral indicators for stellar parameter determinations in a collection of very high-resolution ($R = 90,000$), high signal-to-noise spectra in the optical and near-infrared wavelength regions ($520 - 1710\,\mathrm{nm}$). With this goal in mind, we employed a new grid of atmospheric models called NewEra (Hauschildt et al. in prep.), which introduces significant improvements to previous grids (e.g. PHOENIX-ACES, BT-Settl, MARCS), such as updated molecular line lists. To validate such analysis, we compared the results obtained with the analysis done by Marfil et al. (2021) for the CARMENES M-dwarf GTO sample up to M7.0 V.

My poster in zenodo.org can be found here