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Probing Substellar-Mass Objects with Updated ATMO Atmospheric Models

Tuesday, December 16, 2025 12:10 PM (20 minutes)

We present a new generation of ATMO2020 atmosphere models which is appropriate for application to studies low mass stars, brown dwarfs and rogue planetary-mass objects. The models compute temperature–pressure profiles and emergent spectra for atmospheres in both radiative–convective equilibrium and non-equilibrium chemistry, covering effective temperatures and surface gravities within the ranges 200 ≤ Teff ≤ 3000 K and 2.5 ≤ logg ≤ 5.5. We extend the metallicity grid from -1.0 to +0.5 and incorporate additional opacities, including MgO and SiO. Thereby, these models broaden the diversity of available model atmospheres, particularly at sub-solar metallicities.

We compare synthetic spectra from these models to 178 spectroscopically confirmed ultracool dwarfs (M7–T7) from Domínguez-Tagle et al. (2025), and demonstrate that ATMO robustly constrains effective temperatures, surface gravities, and atmospheric compositions. These models provide a critical physical bridge between observed spectra and the underlying dynamical and chemical processes shaping ultracool dwarfs objects, enhancing our understanding of these objects.

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