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Spitzer-IRAC Photometry of M, L, and T Dwarfs


Abstract

In the first year of Spitzer science operations, we have carried out a program to acquire photometry for some 80 late-M, L, and T dwarfs using the Infrared Array Camera (IRAC). We find it is the T dwarfs which stand out in IRAC colors and provide the most insight into the nature of brown dwarf atmospheres. For the T dwarfs we find that for \([5.8] \text{ versus } ([5.8]-[8.0])\) the IRAC data are not monotonic in either magnitude or color, giving the clearest indication yet that that the T dwarfs are not a one parameter family in \(T_{\text{eff}}\). Since metallicity does not vary enough in the solar neighborhood to act as the second parameter, the most likely candidate then is gravity, which in turn translates to mass. To quantify the spread in mass, we have compared the IRAC photometry with previous theoretical models (e.g. Burrows et al. 1997) as well as new spectrum and atmosphere calculations performed by one of us for this project. Among objects with similar spectral type, the range of mass suggested by our sample is about an order of magnitude (\(~70\) MJ to \(~15\) MJ), with the less massive objects making up the younger members of the sample. We also find the 4.5 micron fluxes to be lower than expected, from which we infer a stronger CO fundamental band at \(~4.67\) micron. This suggests that equilibrium CH4/CO chemistry underestimates the abundance of CO in T dwarf atmospheres, confirming a conclusion reached by Golimowski et al. (2004) using M-band observations from the ground. Finally, we find support for the notion that oxygen abundances in the solar neighborhood are lower than previously assumed.

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