

Astrophysics Seminar

Monday, January 22, 2018

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American Museum of Natural History

The True Ultracool Binary Fraction using Spectral Binaries

Brown dwarfs bridge the gap between stars and giant planets. While the essential mechanisms governing their formation are not well constrained, binary statistics are a direct outcome of the formation process, and thus provide a means to test formation theories. Observational constraints on the brown dwarf binary fraction place it at 10 – 20%, dominated by imaging studies (85% of systems) with the most common separation at 4 AU. This coincides with the resolution limit of state-of-the-art imaging techniques, suggesting that the binary fraction is underestimated. We have developed a separation-independent method to identify and characterize tightly-separated (< 5 AU) binary systems of brown dwarfs as spectral binaries by identifying traces of methane in the spectra of late-M and early-L dwarfs. Imaging follow-up of 17 spectral binaries yielded 3 (18%) resolved systems, corroborating the observed binary fraction, but 5 (29%) known binaries were missed, reinforcing the hypothesis that the short-separation systems are undercounted. In order to find the true binary fraction of brown dwarfs, we have compiled a volume-limited, spectroscopic sample of M7-L5 dwarfs and searched for T dwarf companions. In the 25 pc volume, 4 candidates were found, three of which are already confirmed, leading to a spectral binary fraction of $0.95 \pm 0.50\%$, albeit for a specific combination of spectral types. To extract the true binary fraction and determine the biases of the spectral binary method, we have produced a binary population simulation based on different assumptions of the mass function, age distribution, evolutionary models and mass ratio distribution. Applying the correction fraction resulting from this method to the observed spectral binary fraction yields a true binary fraction of $27 \pm 4\%$, which is roughly within 1σ of the binary fraction obtained from high resolution imaging studies, radial velocity and astrometric monitoring. This method can be extended to identify giant planet companions to young brown dwarfs.



3:30pm in CAS 502. *Refreshments to follow in CAS 500.*

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Next Week

Thursday 2/1

Michael Mendillo
BU CSP