Low-mass Stars

The stars that we study here are lighter than our Sun. We discovered a wide pair of low-mass dwarf stars (Phan-Bao et al. 2007). Follow-up spectroscopic observations confirmed a spectral type of M0 (0.5 solar mass) for the primary (hereafter ASIAAa) and L0 (0.1 solar mass) for the secondary (hereafter ASIAAb). The projected separation between ASIAAa and ASIAAb is large, about 400 astronomical units (AU). The presence of Balmer line emission in ASIAAa indicates that the star is magnetically active. The wide binary provides us opportunities to test atmospheric theoretical models since the components are expected to have the same age and metallicity.
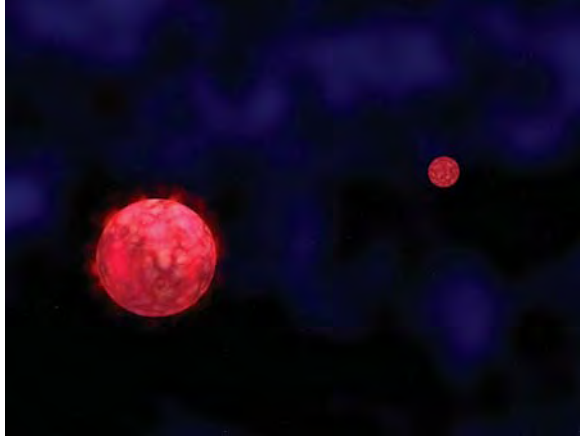

Figure 14. The wide binary: ASIAAa and ASIAAb (Credit ASIAA/Artwork by Change Tsai).

The ejection models of brown dwarf (very low mass, below 0.08 solar mass) formation predict that the binary brown dwarf systems that do exist must be close (separations $\leqq$ 10 AU). We (Phan-Bao et al. 2005) discovered a wide very low-mass binary system, LP 714-37AB, consisting of two very low-mass ($\leqq$ 0.3 solar mass) dwarf stars with a projected separation of 33 AU (Figure 15, left panel). The existence of wide binaries is therefore at first sight inconsistent with the ejection model, suggesting that at least some very low-mass stars and brown dwarfs form through another process. A caveat, however, is that some apparent binaries might be unresolved triple or higher order multiple systems, whose additional components could boost the binding energy of the systems enough to allow them to survive ejection. Our follow-up adaptive optics observations of one such system, LP 714-37AB, did resolve the secondary into a tighter pair (Figure 15, right panel, Phan-Bao et al. 2006). The system LP 714-37 therefore demonstrates that some wide apparent very low-mass binaries are actually higher order multiple systems and no longer contradict the ejection scenario for brown dwarf formation.
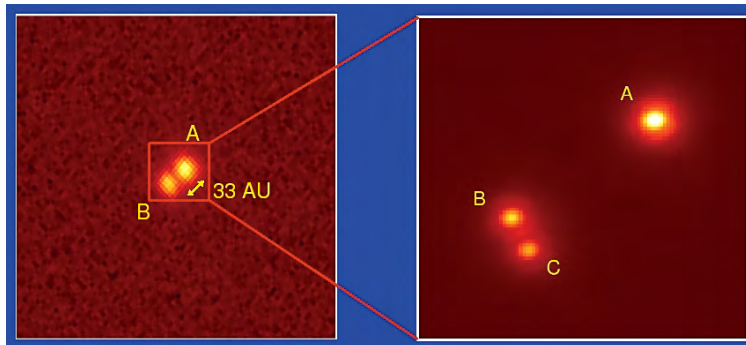

Figure 15. LP 714-37: A wide pair of ultracool dwarfs actually is a triple.