

Substellar Objects in nearby Young Clusters (SONYC). IV. A Census of Very Low Mass Objects in NGC 1333

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SONYC (Substellar Objects in Nearby Young Clusters) is a program to investigate the frequency and properties of young substellar objects with masses down to a few times that of Jupiter [1]. Here we present a census of very low mass objects in the ~ 1 Myr old cluster NGC 1333. We analyze nearinfrared spectra taken with Fiber Multi-Object Spectrograph/ Subaru for 100 candidates from our deep, widefield survey and find 10 new likely brown dwarfs with spectral types of M6 or later. Among them, there are three with later than M9 and one with early L spectral type, corresponding to masses of 0.006 to $0.02 M_{\odot}$, so far the lowest mass objects identified in this cluster.

The combination of survey depth, spatial coverage, and extensive spectroscopic follow-up makes NGC 1333 one of the most comprehensively surveyed clusters for substellar objects. In total, there are now 51 objects with spectral type M5 or later and/or effective temperature of 3200 K or cooler identified in NGC 1333; 30–40 of them are likely to be substellar. NGC 1333 harbors about half as many brown dwarfs as stars, which is significantly more than in other well-studied star-forming regions (Fig. 1), thus raising the possibility of environmental differences in the formation of substellar objects. The brown dwarfs in NGC 1333 are spatially strongly clustered within a radius of less than 1 pc (Fig. 2), mirroring the distribution of the stars. The disk fraction in the substellar regime is 66%, lower than for the total population (83%) but comparable to the brown dwarf disk fraction in other 2–3 Myr old regions [2].

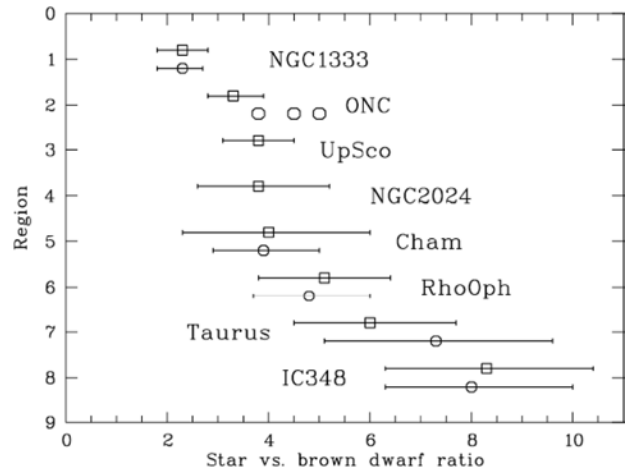


Figure 1: Star vs. brown dwarf ratios for various starforming regions. Squares are values with $0.08\text{--}1.0 M_{\odot}$ as stellar and $0.03\text{--}0.08 M_{\odot}$ as brown dwarfs, while circles are $0.08\text{--}10 M_{\odot}$ as stellar and $0.02\text{--}0.08 M_{\odot}$ as brown dwarfs.

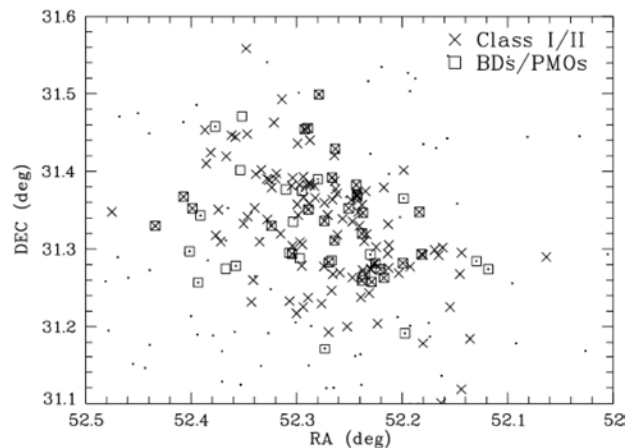


Figure 2: Spatial distribution of NGC 1333 members. Crosses are all 137 objects with Spitzer excess and squares are all confirmed brown dwarfs. Objects with spectroscopy for which we can exclude that they are substellar members are shown with dots.

References

- [1] Tamura, M., et al.: 1998, *Science*, **282**, 1095.
- [2] Scholz, A., et al.: 2012, *ApJ*, **744**, 6.