A CCD SEARCH FOR FAINT HIGH-LATITUDE CARBON STARS: DWARFS AMONG THE GIANTS

PAUL J. GREEN, BRUCE MARGON, SCOTT F. ANDERSON, and PETER M. GARNAVICH
University of Washington
KEM COOK
Lawrence Livermore National Laboratory
and
D. JACK MACCONNELL
Computer Sciences Corp., Astronomy Programs

ABSTRACT. We are acquiring a large-area sample of faint, high-latitude carbon star candidates for the study of halo dynamics by using an intermediate-band color system with CCDs in efficient survey modes. Except for one odd dwarf carbon (C) star, G77–61, it has long been assumed that these faint C stars are distant giants. However, we recently demonstrated that three more faint C stars are high proper motion objects, and therefore dwarfs. Now we are completing a proper motion survey of known faint high-latitude C stars to search for additional C dwarfs. The CCD and proper motion surveys together will place significant limits on the space density of C stars, be they dwarfs or giants.

Carbon stars are readily recognizable from their strong C_2 and CN absorption bands. A sample of faint high-latitude C giants would provide an excellent dynamical tracer of the outer halo, especially since other tracers (*e.g.,* K giants, RR Lyr stars, and globular clusters) yield poorly reconciled estimates of halo dynamical parameters. Several dozen faint high-latitude C stars have been detected from R=12 to 16 on low-dispersion objective prism plates of Sanduleak and Pesch (1988, ApJS, 66, 387). In a complementary survey at Kitt Peak, we have used the 0.9m telescope and CCDs to image 55 deg^2 of sky to V$\approx$ 18. This limit corresponds to a heliocentric distance about 40 kpc for the faintest objects thought to be typical of halo Pop I carbon stars. The photometric technique we use has been shown (Cook and Aaronson 1989, AJ, 97, 923) to efficiently distinguish C stars from other late-type stars by using intermediate-band filters, one ("77") centered on a region of TiO absorption at λ7750, and the other ("81") at λ8100 on a CN absorption band.

To date the only known flaw in the otherwise promising technique of employing faint C stars as outer halo tracers has been the puzzling existence of one dwarf C star: G77–61 (Dearborn *et al.* 1986, ApJ, 300, 314) has V= 13.9 along with a high proper motion, and thus is of main sequence luminosity. Recently, however, Green *et al.* (1991, ApJ Letters, 380, L31) recognized three more such dwarf C stars, at estimated distances of 170, 100, and 400 pc, respectively. Together with radial velocities (Bothun *et al.* 1991, AJ, 101, 2220), these distances imply space motions consistent with halo kinematics for all four dwarf C stars known to date. These distances also suggest space densities high enough that *C stars may be dwarfs more often than giants.*

Using the HST Guide Star Catalog and a digitization of the original Palomar Observatory Sky Survey, we are measuring proper motions for all faint high-latitude C stars of which we are aware. We will use spectroscopy of the resulting C dwarfs to estimate their metallicities, binarity, and possibly the source of their high carbon abundances. Carbon dwarfs of similar magnitude to G77-61 are detected in our CCD survey to about 300 pc. Although our spectroscopic followup is not complete at this writing, very low surface densities are already indicated. Considerable care will clearly be needed in future studies to determine which faint C stars are in fact distant objects. JHK colors for four presently known C dwarfs are consistent with the colors of other late-type field dwarfs, and so are likely to provide a convenient luminosity discriminant.

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