Evidence for Debris Disk Around the Massive DAZ White Dwarf GD362

M. Kilic, T. von Hippel, D.E. Winget (Univ. of Texas), and S.K. Leggett (UKIRT)

astro-ph 0509188

DA white dwarfs, with hydrogen-rich atmospheres, are the most common type of white dwarfs found in the Galaxy. Due to high surface gravity, gravitational sedimentation is very fast in cool white dwarf atmospheres and even if heavy elements are initially present in the atmosphere, they would sink to the bottom of the photosphere quickly, leaving a pure hydrogen atmosphere behind.

GD362 is the most massive ($1.24M_{\odot}$) and metal- rich DAZ white dwarf ever found. It has a calcium abundance that is a thousand times higher than the DAZ stars with similar effective temperatures. Fig. 1 shows a SpeX spectrum of GD362. Compared to another white dwarf, and excess emission at 2.2-2.5 microns is apparent.

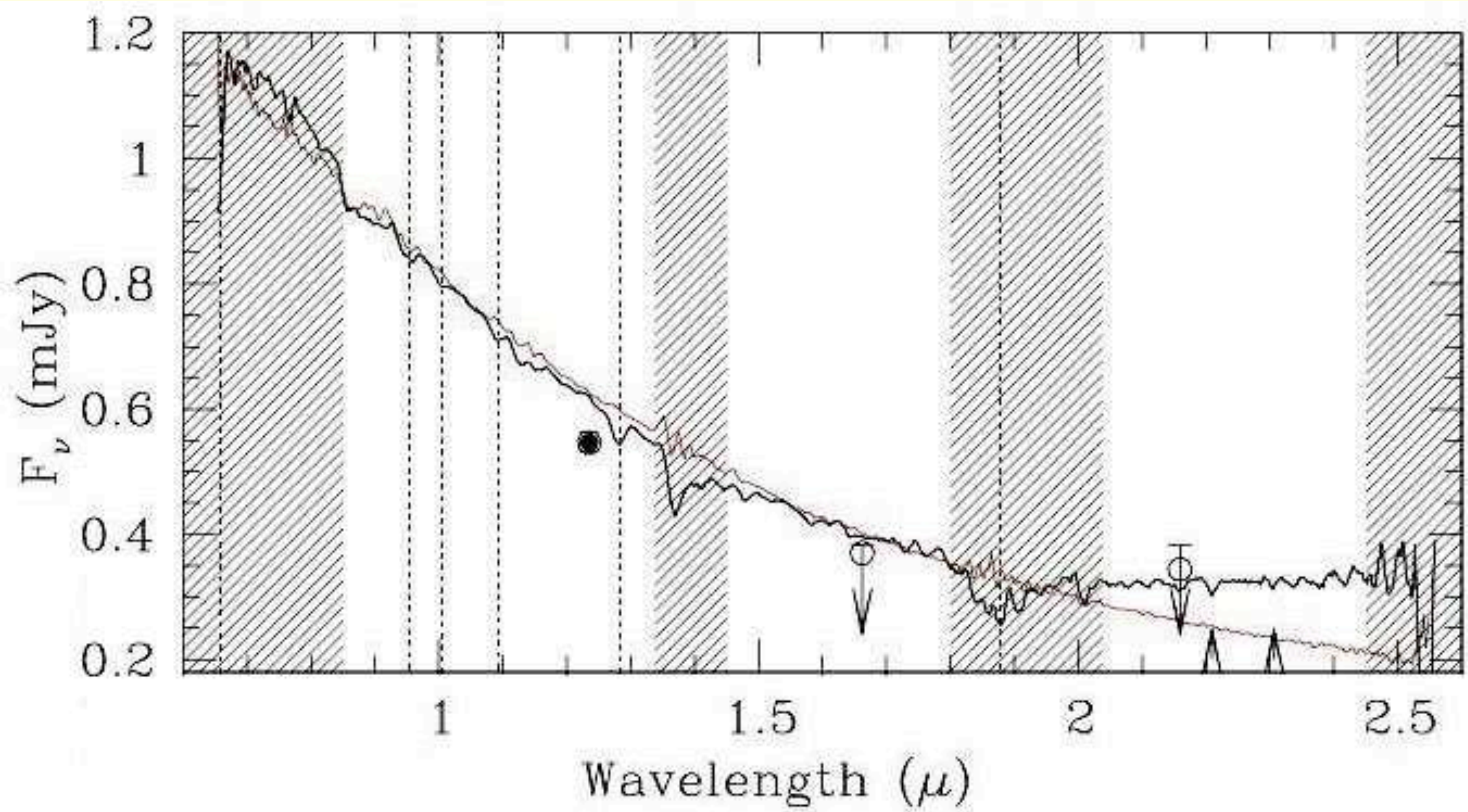

Fig. 1 caption.— Flux calibrated spectra of GD362 (black line) and WD2140+207 (red line). Shaded regions in the top panel suffer from significant telluric features or instrumental efficiency losses. The 2MASS photometry for GD362 (filled circle and downward arrows). The open circles show photometric points for G29-38, the only other white dwarf known to have an infrared excess.

By fitting the spectra it was determined that neither T dwarfs nor any other dwarf stars can explain the excess seen between 2.0 and 2.5 microns. However good fit was obtained with a 700K blackbody (Fig. 2). Therefore, the best explanation for the K-band excess in GD362 is a circumstellar dust disk heated by the white dwarf just as in the case of G29-38. Note that spectroscopic observations of G29-38 with the Spitzer Space Telescope revealed silicate dust around the star, providing support for the idea that these stars have a debris disk.

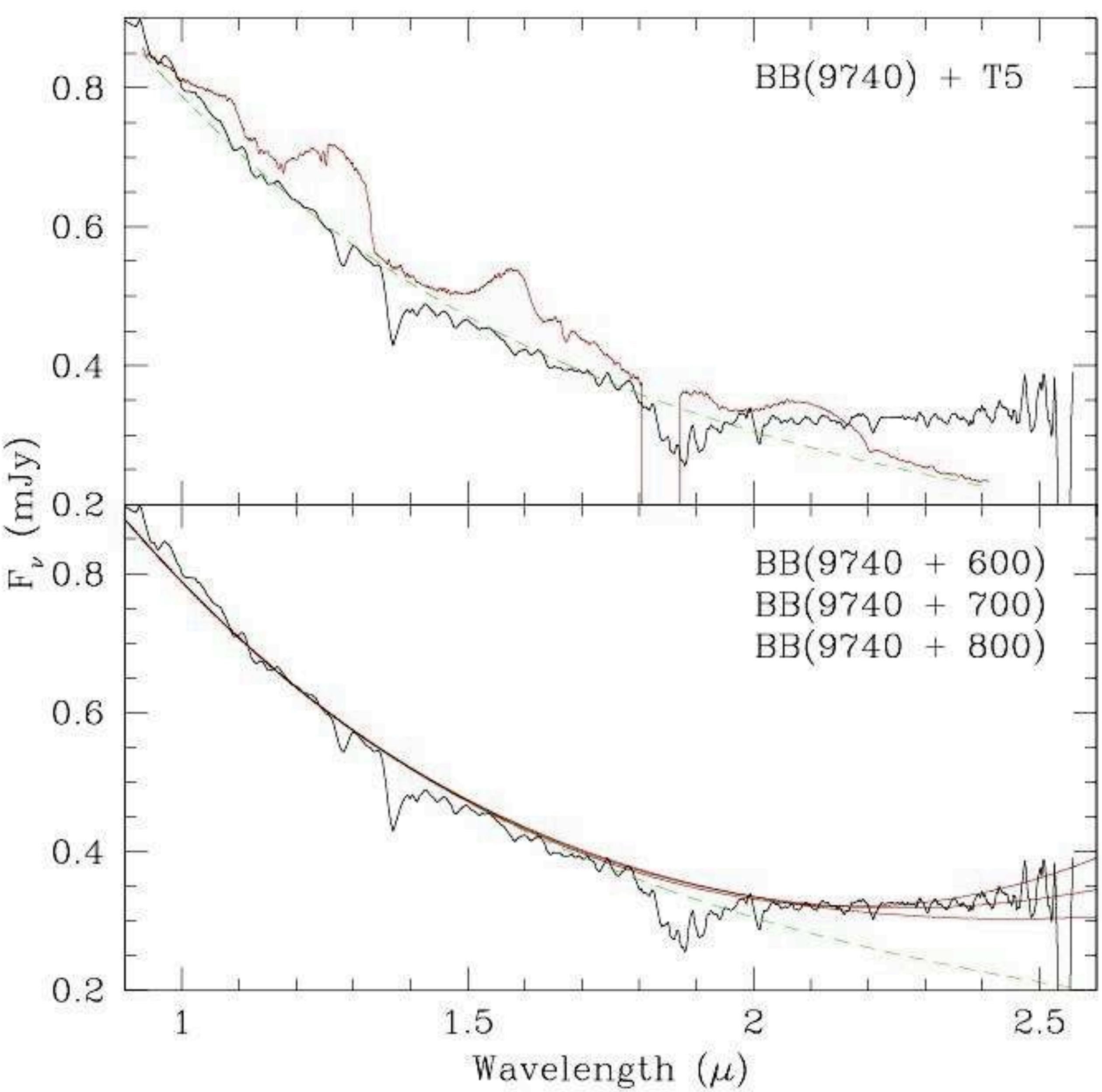

Fig. 2.— GD362 spectrum (black line) and the expected infrared flux from a blackbody at 24 pc (dashed line). Composite blackbody + brown dwarf and blackbody curves are shown as red lines in both panels. This shows the fit is best with a blackbody curve of 700 K.

Summary

The observed metal abundances in GD362 cannot be explained with the interstellar accretion model since GD362 is well within the Local Bubble and away from any high concentration of interstellar matter. Therefore, both G29-38 and GD362 observations favor the model suggested by Zuckerman et al., namely accretion of asteroidal material from a surrounding debris disk.

Was a planet or asteroid-like object tidally disrupted by the white dwarf and ground up into tiny particles that ended up in a debris disk around the star?