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Spitzer mid-IR spectroscopy of Wolf-Rayet stars: the frequent detection of circumstellar dust

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Abstract. We report recent observations with the *Spitzer Space Telescope* of the Wolf-Rayet stars WR 102ka and WR 102c, located in the vicinity of the Galactic Center. We used the short-high module of the IRS to obtain high quality mid-IR spectra. In this range from $10-20\mu$m, the spectra of both stars are dominated by dust emission, partly of circumstellar origin. Dust has not been detected before around WN types stars.

Recent observations with *Spitzer* reveal a rich stellar emission line spectrum in the mid-infrared of Wolf-Rayet stars (see Morris, Crowther, & Houck 2004). We observed two WN-type stars, WR 102ka and WR 102c, in the metal enriched Galactic Center with the short-high module (SH) of the IRS instrument. The data were compared with model calculations from our non-LTE stellar atmosphere (PoWR) code. In contrast to other WN stars, the mid-IR spectra of these two objects show a huge excess above the stellar model spectrum (Fig. 1). Their flux distribution corresponds roughly to a blackbody temperature of about $100 - 200$ K.

The spectrum of WR 102ka (WN 10) shows prominent forbidden nebula emission lines and a PAH feature at 11.2 μm (Fig. 2, top). The intensity distribution along *Spitzer*'s spectrograph slit indicates that 80% of the flux is due to a spatially extended source, while 20% is concentrated in an unresolved point source. An LBV-type nebula around WR 102ka was already suggested by Clark, Lariono & Arkharov (2005) on the basis of mid-IR imaging with the MSX satellite. Our data confirm the presence of dust around WR 102ka. The existence of PAHs in the vicinity of a WN star is enigmatic.

The mid-IR excess of WR 102c (WN 6) is even stronger. Several prominent forbidden nebula lines are present, but the PAH feature is missing (Fig. 2, bottom). The spatial distribution indicates a high extended background contributing 2/3 of the observed mid-IR flux. The remaining 1/3 can be attributed to WR 102c as an unresolved point source smaller than $5''$, suggesting the presence of warm, dusty circumstellar material.

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References

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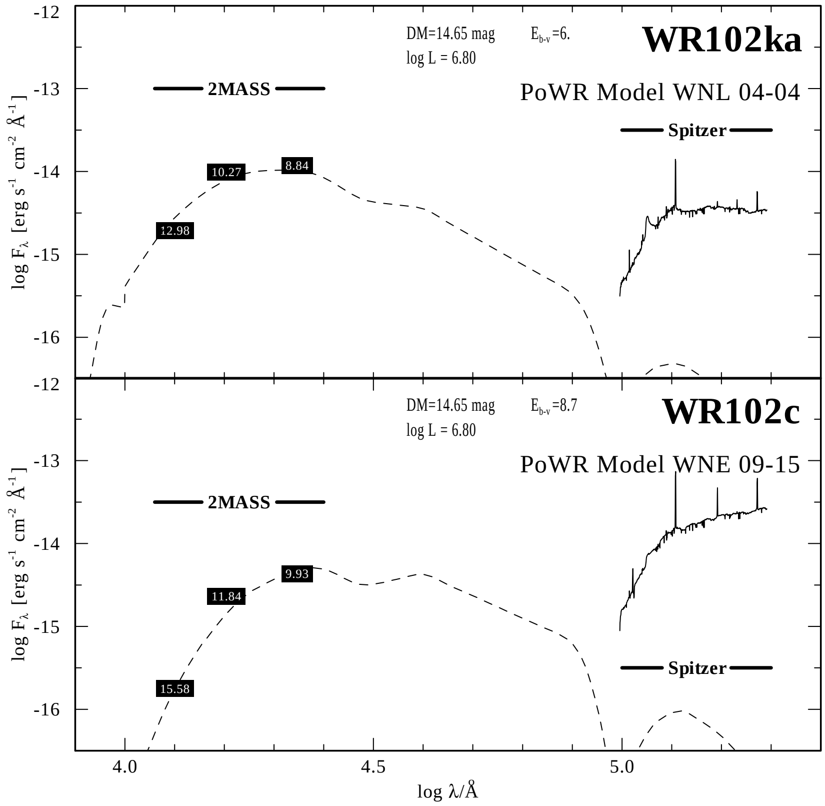

Figure 1. Spectral energy distribution of different PoWR models (dashed line) with our *Spitzer* observations (solid line) and 2MASS photometry marks (boxes). The mid-IR flux is clearly not of stellar origin.

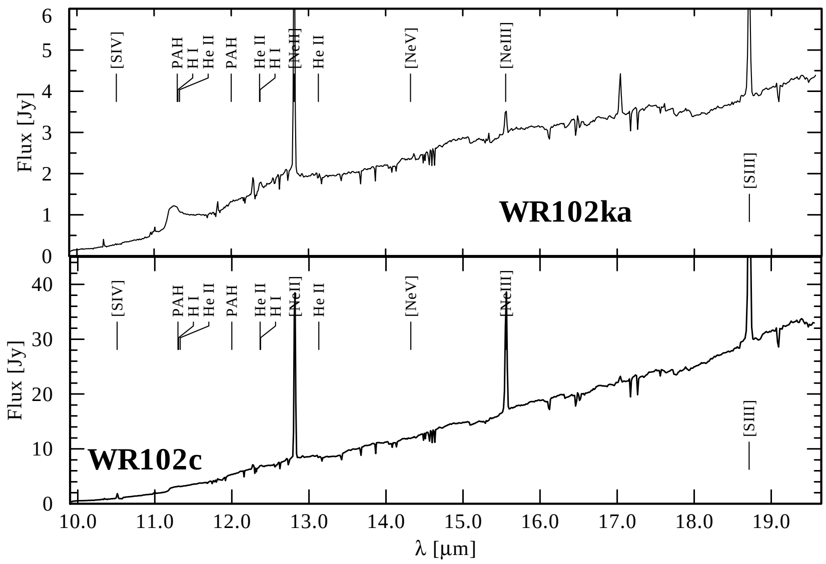

Figure 2. *Spitzer* mid-infrared spectra for WR 102ka (top) and WR 102c (bottom) including some line identifications.