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THE EXTENDED DUST EMISSION AROUND THE NOVA GK PERSEI

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Abstract. We have applied maximum entropy reconstruction methods to the IRAS observations of the nova GK Persei to examine the spatial distribution of the far-IR emission. We have discovered discrete regions of emission in a co-linear structure extending to 17 arcmin on either side of the binary system, supporting a stellar origin for the structure. We postulate that the evolved secondary is the progenitor of the circumbinary envelope.

The classical nova GK Per is one of the more unusual cataclysmic binaries: it has the longest known orbital period for a CV (1.997 days), and it contains a white dwarf with an evolved K0–2 sub-giant secondary. Most remarkably, it exhibits an extended region of far-IR emission, shown in the co-added maps of the IRAS Sky Survey Atlas. The IRAS data contain information at higher resolution than presented in the co-added maps of the IRAS Sky Survey Atlas. The higher intrinsic resolution and the multi-scan observing strategy allow image construction with a resolution approaching the diffraction limit of the telescope, which is 1 arcmin at 60 μm and 1.7 arcmins at 100 μm (Bontekoe *et al.* 1991). The 100 μm maximum entropy reconstruction shown in Figure 1 was obtained with the HIRAS software package developed at SRON Groningen (Bontekoe, Koper & Kester 1994).

The maximum entropy reconstructions show that the emission at both 60 and 100 μm is resolved into several discrete emission regions that form an almost linear feature extending ~ 17 arcmins to the SE and NW of GK Per, which is located in a saddle at the centre of this feature (Dougherty *et al.* 1994). The discrete regions are evident in both bands on each side of the nova, with their positions being remarkably symmetric about GK Per. The highly symmetric distribution of the emission features about the position of GK Per is very unlikely in the context of superimposed interstellar cirrus, and strongly supports a stellar origin for the far-IR emitting matter around GK Per. In addition, observations of ^{12}CO line emission within 2 arcmins of

Fig. 1. The maximum entropy reconstruction of the $100\mu\text{m}$ IRAS data. The cross denotes the position of the CV.

GK Per support a stellar origin for the molecular gas (Scott *et al.* 1994).

Bode *et al.* (1987) propose that the emission is from the remnant of a PN. However, there are a number of issues that require addressing in this model, in particular the age of the envelope. The secondary is of low mass ($\sim 0.5 M_{\odot}$) and has evolved to a sub-giant. This evolutionary state gives a minimum age of the binary at $\sim$ a few 10^{10} years. The $1 M_{\odot}$ WD primary had a main sequence progenitor of $6-7 M_{\odot}$ (Weidemann 1992), which would have evolved through the AGB to a WD in $\sim 10^8$ years. Since the dynamical age of the IR emitting envelope is $\leq 10^6$ years (Dougherty *et al.* 1994), the stellar envelope that formed the AGB star associated with WD could not have been the source of the circumbinary envelope. We conclude that the secondary is the source of the material in the recently ejected extended envelope.

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