DUST SHELL AROUND F AND G MAIN-SEQUENCE STARS

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Abstract. One-hundred and three nearby bright Main-Sequence stars of spectral type F and G have been searched for infrared excess in order to find out 'Vega-like' characteristics. In our sample of bright Main-Sequence F and G stars none of the G-type stars show infrared excess but 4 out of 28 F-type stars are 'Vega-like' and the equilibrium distances of dust shells are within the planet-forming region.

1. Introduction

Recent observations from the Infrared Astronomical Satellite (IRAS) led to the discovery of dust clouds around various stars, e.g., α Lyr, ε Eri, α Psc, β Pic (Aumann *et al.*, 1984; Gillett *et al.*, 1984, 1985). Based on preliminary statistical analysis of IRAS data base, Aumann (1984) indicated a significant fraction of solar neighbourhood stars have cool infrared excess. Walker (1985) using IRAS data showed R CrB stars are surrounded by dust shells having temperatures in the range of 400–900 K. Aumann (1985) suggested that a large fraction of F, G, and K Main-Sequence stars may also be surrounded by dust shells and his search of the IRAS data showed that 12 out of 36 nearby dwarfs and subgiants are 'Vega-like' stars. Odenwald (1986) has searched the *IRAS Point Source Catalogue* for IR excesses in G-type stars. In this paper we have analyzed the IRAS data for F and G nearby bright Main-Sequence stars in order to see whether dust shells are present in these stars?

2. Observational Material and Analysis

For this study we have selected 103 bright F and G Main-Sequence stars from the *Bright Star Catalogue* (Hoffleit, 1964) within 24 parsec from the Sun. Fluxes at 12, 25, 60, and 100 microns for these stars have been taken from the *IRAS Catalogue* (Daniel *et al.*, 1987). To avoid any significant contribution to IRAS fluxes from the background, we have excluded stars having galactic latitude $+10°$ to $-10°$.

Due to the proximity of these stars we have not corrected the fluxes for interstellar reddening.

IRAS data were further corrected for colour correction as given in the *IRAS Explanatory Supplement* (Beichman *et al.*, 1985).

Due to the lack of model atmospheres in IRAS observations range we have subtracted the black-body fluxes from IRAS data in order to estimate the excess in these windows.

For black-body flux estimation we have assumed effective temperature as the black-body temperature which are based on the $(B - V)$ versus T_e relationship (Schmidt-Kaler, 1982). $(B - V)$ values for the stars have been taken from Hirshfeld and Sinnott

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(1982). The radius of the stars for this purpose were estimated using the relationship

$$M_b = 42.26 - 5 \log \frac{R}{R_\odot} - 2 \log T_e ,$$

where M_b is the bolometric magnitude; R, the radius of the star; and T_e, the effective temperature. M_b values were based on trigonometric/spectroscopic parallaxes (Hirshfeld and Sinnot, 1982) and bolometric corrections given by Schmidt-Kaler (1982).

Out of the 103 stars, only 4 stars showed excess at 12, 25, 60, and 100 microns. Due to the high level of sirrus noise at 100 microns (Beichman *et al.*, 1985) we have excluded the 100 micron fluxes from this study. The stars, their flux density and excess, are listed in Table I.

The spectral distribution of the observed excess from the listed stars is shown in Figure 1. The observed excess can be fitted to different black-body spectra with effective

TABLE I

Star HR No. and Sp. type	Flux (Jy) from Daniel *et al.* (1987)			Excess flux in (Jy)		
	12 μm	25 μm	60 μm	12 μm	25 μm	60 μm
v And 458 F8V	3.10	0.70	0.40	0.56	0.11	0.23
10 Tau 1101 F8V	2.90	0.70	0.40	0.27	0.07	0.23
θ Boo 5404 F7V	3.00	0.80	0.40	0.23	0.12	0.30
v Ser 5933 F6V	3.87	0.86	0.40	0.40	0.05	0.20

TABLE II

Star name	Black-body temperature of dust shell (K)	Equilibrium distance of dust shell (AU)	Particle size of dust (μm)	Solid angle fitted to 25 and 60 μm flux (Sr)	Solid angle fitted to 12 μm flux (Sr)
v And	100	11.0	7.6	1.2491(− 14)	1.5057(− 17)
10 Tau	90	13.9	9.5	1.6586(− 14)	1.6820(− 17)
θ Boo	100	12.2	8.5	1.6022(− 14)	1.7148(− 17)
γ Ser	90	25.9	9.5	1.4739(− 14)	2.1038(− 17)

radiating solid angles given in Table II. If we follow Aumann *et al.* (1984) we calculated the equilibrium distance and the particle size of dust, which are given in Table II.

All the assumptions of Aumann *et al.* (1984) have been assumed to be valid in our study also.

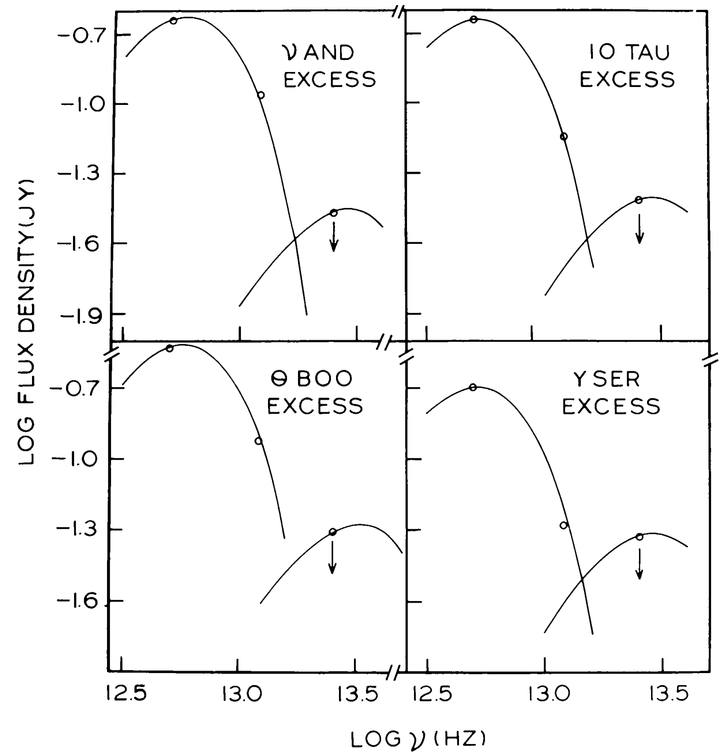

Fig. 1. Dust shell as read F and G Main-Sequence stars.

Figure 1 also illustrates the case for an arbitrarily chosen 500 K black-body fitted to the 12 μm upper limit. The corresponding solid angle of the radiating material is also given.

3. Conclusions

Aumann (1988) found that the presence of cool shells around A, F, and G Main-Sequence stars is the rule. However, Odenwald (1986) finds that 'IR excesses are not a common feature of G-type stars (1%)'. Our study shows that out of 75 G-type Main-Sequence stars which were searched for IR excess none showed IR excess. Twenty-eight F-type Main-Sequence stars were searched for IR excess, only 4 stars showed IR excess. However, the excess is weak. The equilibrium distances of dust shells vary from 11 to 25.9 AU. These distances are within the planet-forming region (Nakano, 1987). One of the stars (γ Ser) in our sample has already been studied by Aumann *et al.* (1984). The derived parameters for γ Ser are slightly different because of the black-body estimation which is subjective.

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