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RAPID DECLINE OF FG SAGITTAE

FG Sge, the central star of the planetary nebula He 1-5 is a unique variable from both evolutionary and pulsational points of view (see e.g. Herbig & Boyarchuk 1968, Jurcsik & Szabados 1981, Iben 1984, Aikawa 1985). Since the end of the last century it had brightened and cooled to a red supergiant due to helium shell flash. In the 1980's its spectral type did not change any more. However, its classification fell between F6-7 I and K0-2 Ib (Kipper & Kipper 1989, Taranova 1986, Montesinos et al. 1990) as determined from observations in different spectral regions, because of the peculiar behaviour of the star.

While crossing the instability strip, FG Sge started to pulsate in the early sixties. The pulsation period of the variable increased in accordance with the spectral variation: it was about 10-20 days in 1962 and about 100 days in the eighties (Jurcsik & Szabados 1979, 1989). The enrichment of the surface *s*-process elements reported by Langer et al. (1974) strengthens the connection of the observed phenomena with the He shell flash episode of a post-AGB remnant.

In the last decade FG Sge seemed to stop its rapid evolution; no significant changes of its spectroscopic or photometric properties have been reported. All these phenomena fit well the evolutionary calculations of the thermal pulses showing the star moving along a flat loop on the HRD.

The photometric variation of FG Sge has been followed at Konkoly Observatory since 1988 using the 1-meter telescope at Pizskéstető Mountain Station and a $UBV(RI)_c$ thermoelectrically cooled, photon counting photometer. BD+19°4319 and BD+19°4310 were used as comparison stars.

The photometric behaviour of the star showed interesting changes in its pulsational properties in the last years (see Fig. 1). In the 1990 observing season the star developed an extremely long period, large amplitude pulsational cycle and since then only much shorter period, low amplitude oscillations have been detected. Since the end of July 1992 drastic dimming of the star with increasing speed has occurred. Paponšek (1992) reported a sharp decline of the variable on 4 September. FG Sge was as bright as $V=9^m.2$ in August, whereas on 26 September it was already $V=12^m.87$. During this interval the $U-B$, $B-V$ and the $V-R_c$ colour indices became bluer by about $1^m.35$, $0^m.80$, $0^m.16$, respectively, and R_c-I_c reddened slightly. Recent IUE observations (González-Riestra et al. 1992) show similar decline of the UV flux as observed in the optical regions.

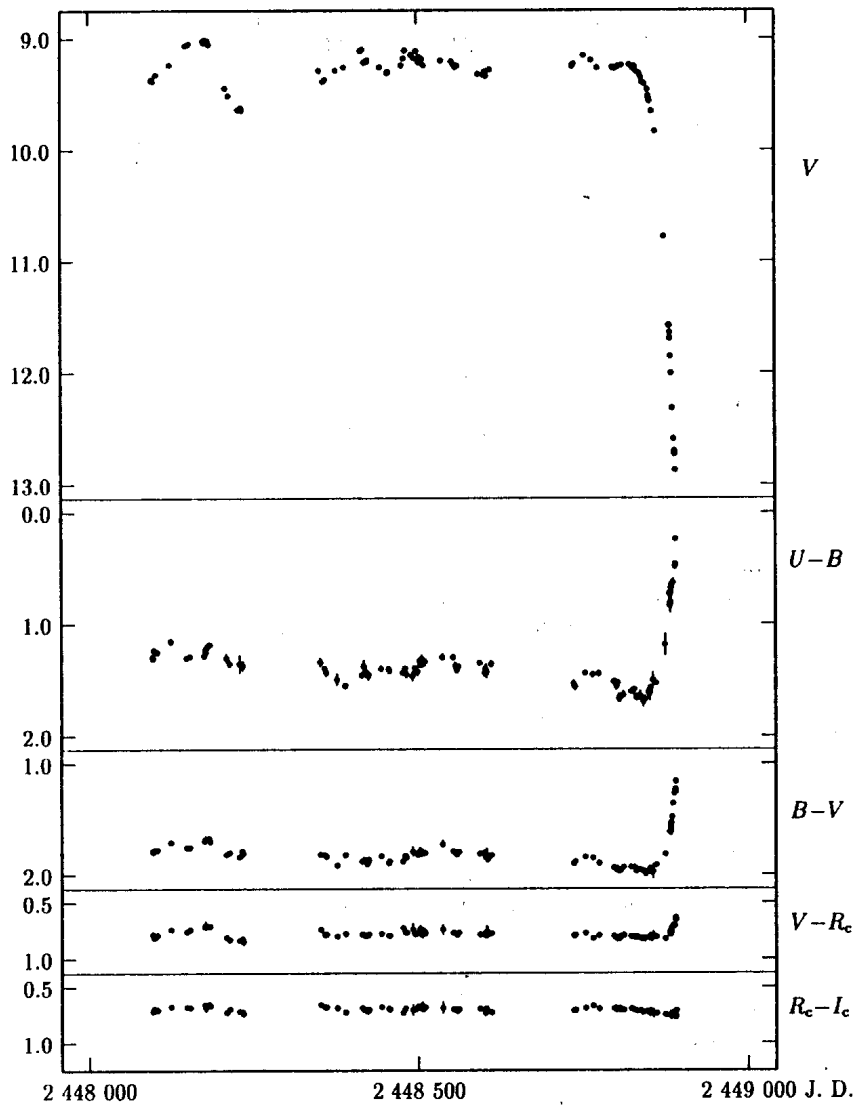


Figure 1. The V light curve and the colour curves of FG Sge in 1990, 1991 and 1992.

The timescale of the decline is several magnitudes shorter than predicted by evolution due to a thermal pulse (e.g. Schönberner 1983). However, pulsation is not included in evolutionary calculations. In the case of the post-AGB thermal flashes where the envelope mass is very small, the influence of the large amplitude pulsation on the evolutionary track of the star could be important. Moreover, the use of the OPAL opacity results in drastic shortening of the post-AGB evolutionary time scale as was shown by Kato and Hachisu (1992).

The pulsational period of FG Sge also shows a 4–5 year modulation superimposed on the steady increase (Jurcsik & Szabados 1989). The maximum phase of this cycle falls to the late eighties (see Fig. 1 in Jurcsik & Szabados 1989) and the observed amplitude and period of the pulsation in 1989–1990 was indeed very large as can be seen in Fig. 1 and Fig. 1 in Arkhipova et al. (1991). The length of the last definite pulsational cycle is longer than 140 days which shows further dilution of the supergiant atmosphere in the past few years, and the fact that subsequently the pulsation nearly disappeared also refers to important changes in the atmosphere. Therefore the possibility that the diluted envelope does not shine any more and we see the hot remnant again seems plausible. The fact that the $U-B$ and $B-V$ colour indices of the variable became significantly bluer while the red colour indices remained nearly constant — the hot remnant hardly radiating in the red region — is in agreement with this picture.

Further theoretical studies of post-AGB thermal pulses are needed to describe the present extraordinary phenomenon observed in FG Sagittae.

The photoelectric observations of FG Sge will be continued. According to the last observation, the star is already as faint as it was at the end of the last century. Knowledge of the full scale of the decline should also be relevant in clearing up the whole evolutionary history of FG Sagittae.

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