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THE SPECTRUM OF FG SAGITTAE IN 1995

The temporal behaviour of the remarkable variable star FG Sge has received much attention in the recent years due to its unusual activity after its sudden fading in 1992 (Papoušek, 1992). We have routinely obtained some spectra of FG Sge every year, trying to detect possible changes in its spectrum. All our spectra from 1992 and onwards were obtained with the echelle spectrograph "Lynx" of the 6 m telescope of the Special Astrophysical Observatory (Panchuk et al., 1993). These spectra cover the spectral region $\lambda\lambda 5000 \div 7200$.

In the spectra obtained in 1992 just few weeks before the dimming started, we identified C_2 Swan bands clearly indicating that FG Sge has become a carbon star (Kipper & Kipper, 1993). Iijima & Strafella (1993) have found C_2 bands in low resolution spectra taken much earlier, in 1981. In our spectra obtained in 1994 the C_2 bands were still present and in NaI D doublet a P Cygni–type emission has appeared. This allowed us to estimate some parameters of the expanding shell around FG Sge (Kipper et al., 1995). The intensities of emission components of the doublet changed in 1994 on the time scale of weeks. There were no low–excitation heavy–element lines in emission, which, however, were visible in the spectra obtained near the deep minimum in 1992 by Smith et al. (1995).

In 1995 FG Sge changed in brightness in a quite sporadic manner from $V \sim 10.5$ to $V \sim 13.0$ according to the data by Hungarian Astronomical Association–Variable Star Section. During the spectral observations on 9/10 and 10/11 August FG Sge was very faint (HAA-VSS data: $V \approx 12.5 \div 13.0$, according to Variable Stars Observers' League of Japan: $V \approx 13.3$) and therefore erroneously the visual companion $8''$ apart from FG Sge was actually observed. This is probably the first high resolution spectrum of the companion ever obtained. The spectrum turned out to correspond to a quite normal giant with the spectral type around K0. For more detailed classification some blue classification spectra should be obtained. Adopting CI= +1.50 (Herbig & Boyarchuk, 1968) one could estimate with this spectral type (K0III) the distance of the companion (3.3 kpc) close or larger to that of FG Sge. The radial velocity of the companion is -34 km s^{-1} (that of FG Sge itself is 38 km s^{-1}). The emission lines of [OI], [NII], and H_α originated in the planetary nebula He 1–5, surrounding FG Sge, are clearly visible in the spectrum of the companion.

The spectrum of FG Sge itself was obtained on 12/13 December when the star was relatively bright ($V \approx 10.5$). From February 1996 a new very steep fading of FG Sge started again (Mattei, 1996). There are no drastic changes in the absorption spectrum compared with the spectra obtained in 1992 and 1994. The C_2 Swan bands are still present and the C/O abundance ratio is around 3.2. This value corresponds to the case when the solar O abundance and the effective temperature of 5500 K are assumed for modelling and spectrum synthesis. Like a year before the only emission lines are the P Cygni–type emission components of NaI D lines.

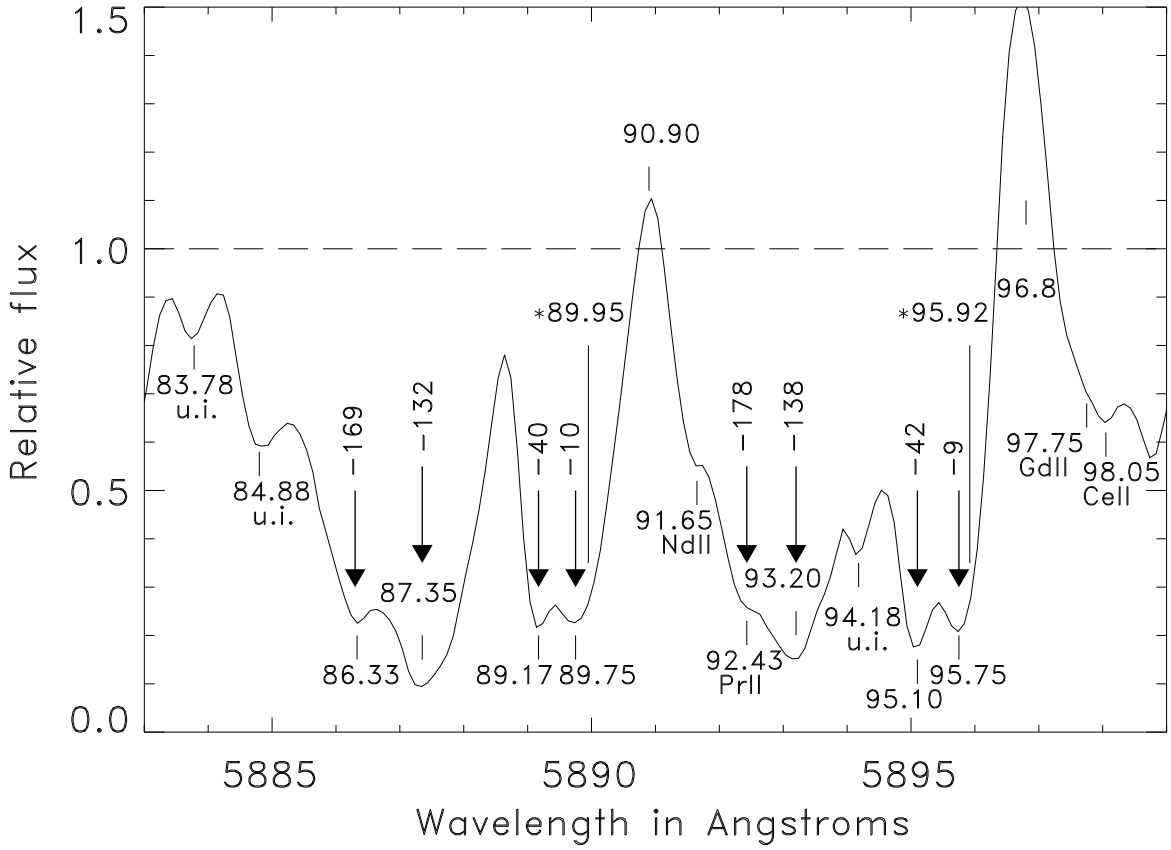

Figure 1. The NaI D lines in the spectrum of FG Sge obtained on 12/13 Dec. 1995. The positions of zero-velocity photospheric lines are indicated by asterisks. Some of the lines from the earlier line–lists (Kipper & Kipper, 1993; Wallerstein, 1990) are indicated with their identifications or noted as unidentified (u.i.). The relative radial velocities of components are indicated with arrows

As in 1994 the most drastic changes appeared in the profiles of NaI D doublet shown in Figure 1. The wavelength scale in this Figure takes into account the mean radial velocity $V_{\rm rad} = 38$ km s^{-1} found for the spectral region $\lambda\lambda 5800 \div 5920$. The continuum level was estimated for the same region. We expect the error in $V_{\rm rad}$ to be less than 3 km s^{-1}. The sharp components at nearly -41 km s^{-1} were also observed in 1981, 1992, and 1994 and correspond most probably to the interstellar gas. In the spectrum of the companion these lines are not fully resolved, causing only some extra absorption in the red wings of the doublet. These components have the $V_{\rm rad}$ relative to the Sun about -3 km s^{-1}. According to Langer et al. (1974) there is an interstellar cloud in the line of sight with $V_{\rm rad} = -6$ km s^{-1}. Taking into account the possible errors in radial velocities it is obvious that the IS lines correspond to that cloud.

The absorption components at -10 km s^{-1} could correspond to expanding higher levels of the photosphere, but the apparent blueward shift could well be the result of the blending with the emission part of the profile.

The circumstellar absorption components at –135 and –173 km s^{-1} correspond to the shells ejected at different times. The complicated structure of the doublet does not allow the quantitative analysis we performed for 1994 spectrum.

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