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SPECTROSCOPIC OBSERVATIONS OF FIVE F SUPERGIANT STARS

We observed 5 F-supergiant stars, HD161796, 89 Her, IRAS 18095+2704, AFGL 2343 and HD 187885, with the high-dispersion coude spectrograph ( $=5 \text{ \AA mm}^{-1}$ ) of 74-inch telescope at the Okayama Astrophysical Observatory in August 1990. Our purpose was to detect H $\alpha$  profiles implying mass losing phenomena. Sample objects are IRAS point sources, and occasionally show CO and/or OH radio molecular emission-lines (Likkell et al. 1987, Likkell 1989). We obtained several interesting observational results as the following:

- (1) IRAS 18095+2704 and HD 187885 showed inverse P Cyg type profiles while 89 Her has a normal P Cyg type H $\alpha$  line with a rather wide absorption component. The result on 89 Her seems to be quite identical to that of Luck et al. (1990).
- (2) AFGL 2343 had a complicated H $\alpha$  absorption-line profile consisting of several violet-shifted components.
- (3) In addition to H $\alpha$ , we could identify a couple of absorption-lines as FeI, FeII and CI which have suggested different radial velocities within our accuracy of velocity measurements,  $\pm 6 \text{ km s}^{-1}$ .

The features of line profiles are likely evidence for the mass losing process of these four stars.

It seems that a lot of F-supergiants show optical variability mentioned already on several samples. HD 161796 and 89 Her are well-known semi-regular variable stars, and the variability of IRAS 18095+2704 is also detected (Hrivnak et al., 1988). Optical variability often gives us important information on stellar masses and absolute magnitudes. It may be supposed that these stars would be less massive and of high luminosity, since the study of hydrodynamic models for the F-supergiants brighter than classical cepheids show that the variability will be irregular when the mass of models is less than a limit (Nakata, 1987; Aikawa, 1988; also Aikawa 1990). Thus the stars in our sample seem to be post AGB stars.

On the other hand, it is invoked that Sasselov (1984) proposed that some F-type semi-regular variable stars be classified as the UU Her stars, including HD 161796, 89 Her together with UU Her. Among them UU Her is not

an IRAS point source, and found as a double-mode oscillator (Zsoldos and Jurcsik, 1989). The point-source IR radiation is evidence for mass-loss from the star. Both the lack of such an evidence and the success to decompose optical observations into two definite periods suggest us that UU Her is a massive star not a post-AGB star. Concerning HD 161796, we may imagine that the star stops mass ejection recently, and has sufficient circumstellar material supplied by past ejection.

It will be also interesting if we compare the complicated features of spectral lines with the optical variability. Photometric and spectroscopic monitoring of these stars will be useful in order to secure intrinsic characteristics of them.

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