INTRODUCTION

The theory of final evolutionary stages for red giants and supergiants receives observational confirmation slowly and with difficulty. Visible photometry proved to be ineffective, because the lines of normal colors could not be constructed (strong absorption in circumstellar shells is a hindrance). The situation improved significantly as a result of the IRAS mission, when it became possible to associate IR characteristics of the shells with the presumed evolutionary status of the corresponding objects and to construct evolutionary models for gas–dust shells [1]. A subsequent, more oriented search for evolutionary changes of the chemical composition in the stellar atmospheres of objects at the protoplanetary-nebula stage shows that the chemical composition of a sample of protoplanetary-nebula candidates is highly nonuniform, and its peculiarities are associated with a set of characteristics of both IR and optical spectra [2, 3].

There are many examples when different classification criteria yield conflicting results. The object IRAS 20004+2955, identified with the variable star V1027 Cyg (HD 333385, BD+29 3865), serves as an example. Its very red color index $(B-V) = 2.34$ is apparently attributable to substantial interstellar reddening of this object, located close to the Galactic plane. The IR color indices are similar to those of IRAS 18095+2704, which is believed to be a typical protoplanetary nebula, but its chemical abundance [4] is not in close agreement with that expected for this evolutionary stage.

OBSERVATIONS AND ANALYSIS OF SPECTRA

Our spectrograms of V1027 Cyg were obtained with the PFES [9] and NES [10] echelle spectrographs of the
6-m Special Astrophysical Observatory telescope. Information about the spectrgrams is presented in Table 1. The spectrgrams were reduced by using the MIDAS [11] and DECH20 [12] packages.

**DETERMINING THE MODEL PARAMETERS AND CHEMICAL COMPOSITION**

The spectral type of the object under study was considered by several authors and was estimated to range from G7 Ia to K2–4 I. The spread in estimates can be explained primarily by the star’s variability. Roman [13], Keenan and McNeil [14], and Winfrey et al. [15] found the spectral type to be K0 Ia, G7 Ia, and K2–4 I, respectively. The spectra obtained at different epochs with the same spectrophotograph were classified as late G [7] and K2 Ib [8].

Using spectra with 1.5 Å resolution, Hrivnak et al. [16] estimated the spectral type to be G7 Iab. When modeling the IR spectrum, these authors ran into the difficulty of describing optical and near-IR fluxes using a single value of the extinction. According to Hrivnak et al. [16], this may imply that the star’s effective temperature is below 5000 K assumed in the model.

Using a calibration relationship between the equivalent width of the oxygen infrared triplet and the absolute luminosity [17], we estimated $M_V \approx -7$. Based on equivalent widths of the barium 5853, 6141 Å lines, we estimated $M_V$ by extrapolating the calibration from [18] to be in the range $-7$ to $-8$. Taking into account uncertainty in the object’s mass and large errors of the above calibrations in the luminosity range under consideration, we gave up determining the surface gravity from the luminosity.

Because of the ambiguous relationship between light and color variations [8] and because of the large reddening, we also gave up determining the effective temperature from photometric data. We estimated the effective temperature ($T_{\text{eff}} = 5000$ K) by comparing observed and theoretical H\textalpha profiles. In this case, the profile is described best at the surface gravity log $g = 1$, but it should be borne in mind that the H\textalpha profile is only slightly sensitive to log $g$ in this temperature range. The assumed $T_{\text{eff}}$ is confirmed by the lack of correlation between the Fe I abundance and the lower-level potential of the Fe I lines used for its determination. The conditions of ionization equilibrium for iron and vanadium (two Fe II lines and one V II line were measured in the spectrum) give a lower value, log $g = 0.7$. The set of $T_{\text{eff}}$ and log $g$ corresponds to the spectral type G5 Ib. We determined the microturbulent velocity ($6.7$ km s$^{-1}$) from the condition that there was no correlation between the equivalent widths $W$ of Fe I lines and the number density of iron atoms calculated from the corresponding lines.

We estimated the uncertainty in the effective temperature, gravity, and microturbulent velocity to be 100 K, 0.3 dex, and 0.3 km s$^{-1}$, respectively.

We determined the chemical composition by using the spectra taken with the 6-m telescope on August 14, 1996 (JD 2450309). Photometric measurements are available for this date: $V = 8.88, B-V = 2.28$, and $U-B = 2.26$ [8]. The star was on the descending branch of its light curve, where the absorption spectra of semiregular variables are generally not distorted by emission. Since our spectra exhibit no clear peculiarities, we could use the intensity ratio of the Ba II 6497 Å and H\textalpha lines for the classification ($I_{6497}/I_{6563} < 1$, typical of normal supergiants). We estimated the spectral type to be G5 Ia–G7 Iab. The figure shows the corresponding portion of the spectrum. The only peculiarity of the spectrum is the line broadening, which exceeds significantly the instrumental-profile widths of the spectrophotographs used. By comparing the observed and theoretical spectra, we estimated the broadening (35 km s$^{-1}$), in agreement with the value from [6]. Although microturbulence is most likely responsible for the broadening, we formally estimated the projected rotational velocity from the Fe I 4476 Å line to be $V \sin i = 40$ km s$^{-1}$. For

![A portion of the V1027 Cyg spectrum near the Ba II and H\textalpha lines (JD 2450309)](image_url)