

Polarization Observations of RV Tauri Stars at the Dodaira Station of the National Astronomical Observatory in Japan

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Abstract. We made multicolor linear polarimetric observations of RV Tauri stars using the 91-cm reflector at the Dodaira Station of the National Astronomical Observatory in Japan. We report the main results for 17 RV Tauri stars obtained until now.

1. Introduction

The RV Tauri stars are semiregular variables whose light curves are characterized by alternate deep and shallow minima. On the basis of light curves the RV Tauri stars are divided into 2 subgroups, RVa and RVb. The RVa group is characterized by a relatively regular light curve, while the RVb group is characterized by a rather irregular light curve, especially by a superposition of a long-term brightness variation (RVb phenomenon). The RVb phenomenon is explained in two ways. One explanation interprets it as a result of binarity, while the other one interprets as a phenomenon caused by an outer layer of a single star. On the basis of spectroscopic characteristics in an optical region the RV Tauri stars are divided into 3 subgroups, group A, group B, and group C. The group A generally shows strong TiO bands near light minima, while group B shows strong CH and CN bands. The group C shows all the characteristics of the group B except that the carbon features are weak.

The group A is further divided into 2 subgroups, group A₁ and A₂. The group A₁ shows TiO bands near light minima, while the group A₂ does not show TiO bands.

The RV Tauri stars show strong excess infrared radiation, which indicates that they are embedded in circumstellar dust envelopes. The RV Tauri stars are generally regarded as post-asymptotic giant branch (post-AGB) stars which left

the AGB recently. Their circumstellar dust envelopes are thought to be formed as a result of mass loss at the final stage of the AGB phase.

2. Observations and Results

The observations were made between 1993 October 23 and 1998 October 29 with the multichannel polarimeter which measures linear polarization at 8 colors (0.36, 0.42, 0.455, 0.53, 0.64, 0.69, 0.76, and 0.88 μm).

The following results have been obtained:

1) Out of 17 stars, only one star, SS Gem, has been confirmed to show no time variations of polarization, which means that most RV Tauri stars may have intrinsic polarization. This result seems reasonable, because RV Tauri stars have circumstellar dust envelopes.

2) SU Gem, U Mon, and RV Tau show conspicuous time variations. All of these stars belong to the RVb group. These stars show long-term periodic time variations of polarization with nearly the period of the long-term brightness variation. This suggests that the long-term variations of polarization are caused by the same mechanism that causes the RVb phenomenon. A simple binary explanation has difficulty accounting for the long-term variations of polarization.

For example, the trajectory of time variation of polarization in QU plane is nearly circular (where Q and U are the normalized Stokes parameters), while it should be nearly linear when we observe edge-on. Furthermore, the polarization should vary with one half of the period of revolution when it is observed from edge-on, which is contrary to the observation.

3) The percentage of polarimetric time-variation depends on the subclasses. The RVb group has a higher ratio (83%) than that of the RVa group (50%). Furthermore, the group A_1 has a higher ratio (80%) than that of the A_2 group (67%).

4) The B group has a tendency for the observed p values (where p is the degree of linear polarization) to reach a minimum at an intermediate wavelength, which may indicate that the group B has more than two circumstellar dust envelopes.