VRI LIGHT CURVE ANALYSIS OF SS 433

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1. Introduction

In the light curves of SS 433, in addition to a binary modulation with a period of 13.1 d, there is a precessional one with a period of 162.5 d (Kemp et al. 1986). In the current studies, however, the attention was focused mainly on the light curves during *eclipse* (see, however, e.g., Antokhina, Cherepashchuk 1987). Thus, in this paper we examine light curves during *precession* and compare them with observational ones (Fukue et al. 1997b).

2. Model

The expected light curves were calculated in a similar way as in the previous papers (Fukue et al. 1997a).

We suppose that SS 433 consists of a compact star with mass $M_{\rm x}$ and an early type "normal star" with mass $M_{\rm v}$.

We show the assumptions briefly as follows: i) The compact star is surrounded by a *geometrically thick torus*. ii) The specific angular momentum l of the torus gas can be expressed by a power law of radius r as $l \propto r^{2-q}$, where the torus configuration index q is a constant. iii) The companion star fills its Roche lobe and the surface temperature of the companion is around 17000 K. iv) The SS 433 system has the orbital period (ϕ) is 13.082 d and the precessional period (Φ) is 162.5 d. v) The inclination angle is $i = 78.^{\circ}8$ and the precession angle is $19.^{\circ}8$. vi) When the precession phase Φ is 0.5, the jet/torus is mostly inclined to the observer. Assuming that $i = 78.^{\circ}8$, we obtain the relation between $M_{\rm x}$ and $M_{\rm v}$ as $M_{\rm v}/(1 + M_{\rm x}/M_{\rm v})^2 = 2.12 M_{\odot}$.

The model parameters are thus the binary mass ratio Q ($= M_{\rm v}/M_{\rm x}$), the torus configuration index q (from thin($q = 1.51$) to thick($q = 1.8$)), and the surface temperature $T_{\rm c}$ of the companion.

K. Koyama et al. (eds.), The Hot Universe, 364-365.

3. Results

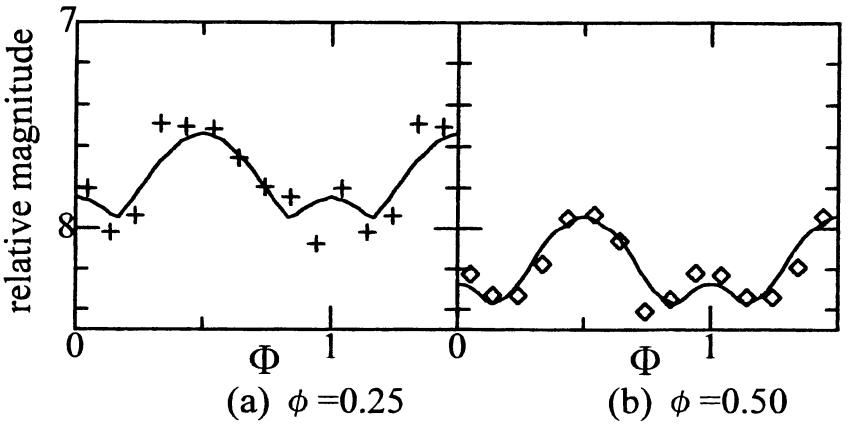

Figure 1. Typical examples of model light curves (best fit). The abscissa is the precession phase Φ, whereas the ordinate is the expected V magnitude. The parameters are: the binary mass ratio Q is 2, the torus configuration index q is 1.52 (the torus is geometrically thin), and the surface temperature T_c of the companion is 17000 K. The orbital phase ϕ is (a) 0.25 and (b) 0.5.

We show the light curves of the best fit parameter. The model for this parameters are well reproduced the observations.

4. Conclusion

We have calculated the precessional light curves under the picture in which SS 433 consists of a geometrically thick torus around a compact star and a companion star filling the Roche lobe.

The extremely geometrically-thick tori are rejected, since the calculated light curves are too flat to explain the observational ones. If this is the case, we should reconsider the model for SS433 jets; instead of the funnel jets we may consider the jet (wind) from a geometrically thin disk (e.g., Tajima, Fukue 1996).

Furthermore, the favarite combination of other parameters is that the binary mass ratio is about 2 (a black hole case) and the surface temperature of the companion is around 17000 K.

Reference

Antokhina É.A., Cherepashchuk A.M. 1987, SvA 31, 295
Fukue J. et al. 1997a, PASJ 49, 93
Fukue J. et al. 1997b, submitted to PASJ
Kemp J.C. et al. 1986, ApJ 305, 805
Tajima Y., Fukue J. 1996, PASJ 48, 529