Spectroscopic study of the quiescent stages in between the 2006 and 2021 outbursts of RS Ophiuchi

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Abstract

This paper presents a comprehensive spectroscopic analysis of the quiescent stage of the recurrent nova RS Ophiuchi between its 2006 and 2021 outbursts. The spectra shows prominent low ionization emission features, including hydrogen, helium, iron emissions, and TiO absorption features. The H α and H β lines showed double-peaked emission profiles, indicating that both originate from the accretion disc. The central peaks of the H α and H β emission profiles exhibited subtle shifts towards the blue or red side, attributed to orbital motion and fluctuations in the accretion rate. Using the double-peak features observed in the H α and H β lines, we have estimated the accretion disc size to be RAD = 3.10 ± 0.04 × 10^12 cm. The CLOUDY photoionization code is employed to model the quiescent phase spectra, allowing us to study the evolution of various physical parameters such as temperature, luminosity, hydrogen density, elemental abundances, accreted mass, and accretion rate. The central ionizing sources exhibit temperatures in the range of 1.05 − 1.80 × 10^4 K and luminosities between 0.10 − 7.94 × 10^30 erg s^−1. The mean accretion rate, calculated from the model, is ∼ 1.25 × 10^−8 M ⊙ yr^−1. The model results reveal that the accretion rate rose substantially in the later phase. The accreted mass in the 16 months, preceding the 2021 outburst exceeds 47% of the critical mass, and more than 88% of the critical mass was accreted in the last three years.