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Interpretation of the light curve of gamma-ray emission from the 2021 outburst of the recurrent nova RS Ophiuchi

Nova outbursts take place in binary star systems comprising a white dwarf and either a low-mass Sun-like star (classical novae) or, a red giant. GeV gamma-ray emission has been detected from a dozen classical novae and from one nova in a symbiotic system (V407 Cyg) by Fermi-LAT. For classical novae, gamma-ray emission is generally thought to be related to internal shocks formed as fast outflow collides with the slow outflow. However, for V407 Cyg, the origin of the gamma-ray emission has been debated, as both an internal shock and an external shock resulting from the collision between the nova ejecta and the ambient wind of the giant companion, and were suggested to explain the gamma-ray data. Recently, bright GeV and TeV gamma-ray emission has been detected from a nova in symbiotic system, RS Ophiuchi, during its 2021 outburst, which shows a remarkably smooth power-law decay in time up to about one month after the outburst. We show that this temporal decay behavior can be interpreted as arising from an adiabatic external shock expanding in the red giant wind. In this interpretation, the gamma rays are produced by shock-accelerated protons interacting with the dense wind through the hadronic process. We also derive the scaling relations for the decay slopes for both adiabatic and radiative nova shocks in the self-similar deceleration phase.

Summary

Primary author: Mr ZHENG, Jianhe (NanJing University)