Study of dust in novae environment

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Novae are the only objects in which it has been possible to observe directly all aspects of circumstellar grain formation on a frequent basis. Compared to interstellar dust, novae dust forms within a short time frame of 30 to 100 days after an outburst, allowing them to serve as test beds for understanding the formation and evolution of astrophysical dust. However, dust formation in the hostile environment of novae ejecta has been an open question for many decades. Several attempts have been made to understand the physical and chemical conditions required to dust formation in novae ejecta and its relation with the observable parameters. In this work, we have studied the dust forming nova V1280 Scorpii (2007) with the aim to study the evolution in the physical and chemical parameters. We model the predust and postdust phase optical and near-infrared spectra using the photoionization code CLOUDY, v.17.02, considering a two-component (low-density and high-density regions) model. It is found that a very high hydrogen density ($\sim 10^{13} - 10^{14}$ cm^{-3}) is required for the proper generation of spectra. Dust condensation conditions are achieved at high ejecta density ($\sim 3.16 \times 10^{8}$ cm^{-3}) and low temperature ($\sim$ 2000) K in the outer region of the ejecta at a distance, R $\sim 4.07 \times 10^{15}$ cm away from the central ionising source. A mixture of small (0.005-0.25 μm) amorphous carbon dust grains and large (0.03-3.0μm) astrophysical silicate dust grains are present in the ejecta. Our model also yields very high elemental abundance values as C/H = 13.5-20, N/H = 250, O/H = 27-35, by number, relative to solar values, during the predust phase, which decreases in the postdust phase.

References

Pandey, R., Das, R. K., Shaw, G., et al. 2022, ApJ, 925:187 https://doi.org/10.3847/1538-4357/ac36dc