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Thermal Properties of Spiral Structures in the Accretion Disk of UU Aquarii from Multicolor Eclipse Observations

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The mechanisms responsible for angular momentum transport in accretion disks remain poorly understood. Hydrodynamic simulations predict that tidal interactions can generate spiral density waves and shocks, potentially contributing to angular momentum transport, but observational evidence for these structures and their physical properties remains limited.

We previously reported an analysis of multi-band eclipse observations of the cataclysmic variable UU Aquarii based on data obtained in 2024. In this work, we extend that study by incorporating new simultaneous V- and J-band eclipse observations obtained in 2025, allowing us to investigate possible temporal variations in the thermal properties of spiral structures within the accretion disk.

To interpret the observations, we construct a three-dimensional accretion disk model including non-axisymmetric spiral features with non-uniform temperature distributions and compare synthetic eclipse light curves with the observed data. In both observing epochs, the eclipse profiles exhibit systematic deviations from a standard axisymmetric disk model, particularly an early and gradual ingress in the J band, indicating the presence of non-axisymmetric structures in the disk.

Our modeling indicates that the thermal properties of the spiral structures differ between the two epochs. The 2024 data are consistent with spiral temperatures comparable to, or slightly lower than, those of the surrounding disk, whereas the 2025 observations require spiral structures approximately twice as hot as the ambient disk. Nevertheless, the inferred temperature enhancements are insufficient to support a strong shock-heating scenario. We also find evidence for an additional emission region outside the disk. These results suggest that the observed spiral structures in UU~Aqr are more consistent with tidally induced distortions than with strong shock-heated features.