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Investigating Star-disk Interactions During Late-stage Circumstellar Disk Evolution in the Nearby Pre-MS Stars T Cha and TWA 30

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Abstract

We investigate, via contemporaneous X-ray and optical/IR observations, the nearby, pre-main sequence star/disk systems T Chamaeleontis (T Cha; $D \sim 110$ pc, age 3-5 Myr) and TWA 30A and 30B ($D \sim 40$ pc; age ~ 8 Myr). All three of these systems present opportunities to probe pre-main sequence (pre-MS) star-disk interactions during late-stage circumstellar disk evolution. The classical T Tauri star T Cha is the closest known example of a highly inclined, actively accreting, solar-mass star/disk system; furthermore, T Cha may be orbited by a low-mass companion or massive planet that has cleared an inner hole in its disk. We analyze near-simultaneous Chandra high-resolution X-ray and optical H-alpha spectroscopy observations of T Cha and find a correlation between X-ray and optical extinction resulting from variable photospheric obscuration from a disk warp/clump. We search for signatures of accretion and infer the X-ray absorbing properties of the T Cha circumstellar disk. We also present contemporaneous XMM-Newton X-ray and optical/IR spectroscopic observations of the nearby, actively accreting, very low-mass (mid-M) pre-MS star/disk/jet systems TWA 30A and 30B. Like T Cha, each component of this wide binary is viewed through a nearly edge-on circumstellar disk. We investigate potential X-ray accretion signatures, and compare the levels of magnetic activity in TWA 30A and 30B to those of other nearby, low-mass pre-MS stars near the H-burning limit. Both TWA 30A and 30B display large near-IR variability, suggestive of (respectively) variable obscuration of the stellar photosphere and a possible disk-rim warp. We detect only TWA 30A in X-rays and, similar to the case of T Cha, find a correlation between optical/IR and X-ray extinction associated with variable photospheric obscuration. The proximity and highly-inclined viewing geometries of the TWA 30 pair and T Cha, combined with contemporaneous optical/IR and X-ray observations, afford a unique opportunity to investigate the composition of late-stage circumstellar disks orbiting pre-MS stars.

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