MONTE-CARLO SED MODELS OF YOUNG STARS WITH ACCRETION DISKS IN TAURUS-AURIGA REGION

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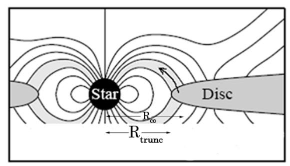
ABSTRACT

Current theory suggests that the accretion disks around T-Tauri stars regulate the angular momentum of these stars by way of the magnetic field lines. These field lines extend from the star into the disk, in effect “locking” the angular velocity of the star to that of the material at the inner edge of the disk (truncation radius). This disk shows up as an IR excess in the spectral energy distribution (SED) emitted by the star and disk. According to theory, the truncation radius is a key parameter in the regulation of the angular momentum evolution of the star.

We are currently using a Monte-Carlo simulation to model the SEDs of a sample of young stars in the Taurus-Auriga region, and comparing these SEDs of these models with flux measurements available for these stars. Specifically, we are testing whether the truncation radii of these stars are consistent with those predicted by theory. We present the results of these stars and explore the implications of the results for theory.

“DISK-LOCKING”: A POSSIBLE SOLUTION TO ANGULAR MOMENTUM REGULATION IN YOUNG STARS

- Magnetic field lines connect the accretion disk to the star.
- The balance between the magnetic field strength and the accretion pressure determine the size of the truncation radius (R_{trunc}).
- The star is forced to co-rotate with disk material at R_{trunc}. → $R_{trunc} \approx R_{co}$
- Thus, R_{trunc} determines the rotation period of the star. For example, larger R_{trunc} produces slower rotation



STUDY OBJECTIVES AND METHOD

Objective

To model the spectral energy distributions (SEDs) of a sample of ten young stars with known rotation periods to determine whether they possess disks with $R_{trunc} \approx R_{co}$ as predicted by theory.

TTSRE (T Tauri Star Radiative Equilibrium)

A program that calculates temperature structure of disk by solving for radiative equilibrium. Produces spectral energy distributions (SEDs) unique to each star.

Models for each star the trajectory and wavelength of photons “emitted” by star, and monitors their interactions with the accretion disk.

RESULTS

In general, we **do not** find $R_{trunc} \approx R_{co}$ as predicted by theory. Only one star, GITau, seems to have a disk where $R_{trunc} \approx R_{co}$. One star (DGTau) has a truncation radius that is smaller than corotation radius. Some of the other stars show $R_{trunc} > R_{co}$ (DFTau, DHTau, GMAur, and IQTau), which implies that the truncation radius is further out than predicted, while the remaining stars have no disk (DITau, IWTau, LkCa14, and LkCa19); there is none or very little infrared excess out to the longest wavelengths currently available.

SEDs:

Top panels: These plots compare the observed SEDs (diamonds) with the SEDs predicted if $R_{trunc} = R_{co}$. Model SEDs have been normalized to the observed I-band flux.

Bottom panels: Residuals between observed fluxes and star+disk SED model (squares), and between observed fluxes and stellar photosphere (X's).