Name(s)

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Project Number

S1709

Project Title

Accretion Analysis through Profile Decomposition of T-Tauri Stellar Spectra Using Nonlinear Least Square Minimization

Abstract

Objectives

The accretion shock theory states that Standard T Tauri stars are surrounded by circumstellar disks that gradually accrete onto the stellar surface. Energy is radiated from both the disk and the position where material falls onto the star. The objective of this research is to develop an algorithm for decomposing T-Tauri spectral lines into a Broad Component (BC) and Narrow Component (NC) to support the accretion shock theory. Lines with large widths, BCs, arise in the extended magnetosphere. Narrow lines, NCs, are more likely to be produced in the region of the accretion shock.

Methods

Spectras were obtained from the European Southern Observatory (ESO) Science Portal. The existence of the BC and NC was found through the decomposition of an appropriate spectral line. The 5875.743 Å line, corresponding to strong He I emission, was investigated. Spectral decomposition was carried out via non-linear optimization to fit a function with two Gaussian curves, one for the BC and one for the NC. It is implemented using the AstroPy and SciPy libraries, particularly scipy.optimize.curve_fit, which utilizes the Levenberg Marquardt algorithm.

Results

The NC and BC were modelled using tuples (a1, m1, c1) and (a2, m2, c2) representing Gaussian functions. Accretion shock caused by the free fall of the disk matter was modeled using spectral decomposition into a BC and NC over 170 observations. The approximation error within 0.2% and 5%.

Conclusions

The experimental results support the theory for accretion shock/emission spectra origin. The low value of the approximation error is consistent with the presence of narrow and broad components, corroborating the accretion shock theory. Further research can focus on and evaluate the excess of flux in several T-Tauri stars.

Summary Statement

Developed and implemented a Python algorithm for decomposing a spectral line to support the accretion shock theory through identification the broad and narrow components in the observed spectrum from a T Tauri star.

Help Received

I was directed towards the ESO database and AstroPy library by Citizen Science Initiative, a volunteer group launched by Evergreen Valley College. However, I designed and implemented the data processing software to investigate the spectra on my own, outside of this institution.