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Notice for the PhD Viva Voce Examination

Ms Nidhi Sabu (Registration Number: 1942087), PhD scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend her PhD thesis at the public viva-voce examination on Tuesday, 11 February 2025 at 11.30 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029.

Title of the Thesis	:	**Study of Pre-Main Sequence Stars Identified from Lamost Survey**
Discipline	:	**Physics**
External Examiner (Outside Karnataka)	:	**Dr Manash Samal** Associate Professor A & A Division, Physical Research Laboratory Department of Space, Government of India Navrangpura Ahmedabad – 380009 Gujarat
External Examiner (Within Karnataka)	:	**Dr Maheswar Gopinathan** Professor Indian Institute of Astrophysics Koramangala Bengaluru - 560034 Karnataka
Supervisor	:	**Dr Blesson Mathew** Associate Professor Department of Physics and Electronics School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 Karnataka

The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Registrar

Place: Bengaluru
Date: 04 February 2025

ABSTRACT

Understanding pre-main sequence (PMS) stars is crucial for explaining the fundamental processes governing the earliest stages of stellar evolution. Stars are born into protostars through the gravitational collapse of gas and dust-enriched clouds. The gradual dissipation of material in the protostar gives rise to a circumstellar disk, extending into the PMS phase. Young stars in this early phase acquire mass through circumstellar accretion and reach the main sequence stage. The historical context of PMS star classifications identified based on the presence of emission lines, including T Tauri stars and Herbig Ae/Be (HAeBe) stars are now extended to Intermediate-Mass T Tauri Stars (IMTTS) as well. This work is setting the stage for the study of these classifications of PMS stars situated in the Galactic anti-center region, utilizing data from the Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) surveys. Recognizing the literature gap in the collective analysis of PMS stars, the need for a comprehensive examination of mass accretion mechanisms and their dependence on mass is emphasized. The introductory section lays the groundwork by highlighting the significance of the PMS phase in stellar evolution, which also point towards the observable characteristics like emission lines in the spectrum and IR excess in the spectral energy distribution.

Using LAMOST data, initially, we identified 379 PMS samples that are classified into 119 HAeBe and 260 CTTS. Our initial condition included the selection of LAMOST spectra based on the presence of Hα emission line and signal-to-noise ratio greater than 10 in r-band. In the case of HAeBe stars, the selection criteria encompassed O-, B-, A-, and up to F5 spectral type stars exhibiting infrared excess. Conversely, for classical T Tauri stars (CTTS), stars within the spectral range of F5 to M9 were chosen based on the presence of both infrared excess and a minimum Hα equivalent width strength. In this study, we confirm a new set of 44 HAeBe stars and 104 CTTS, increasing the sample of known PMS stars in the Galaxy by 38%. Spectroscopic analysis of HAeBe stars found a correlation between Hα and Fe II emission lines suggests a possible common emitting region. We also explored a technique for the extinction correction of the HAeBe stars using DIB present in the spectrum. Further, using the accretion tracer Hα emission line, the mass accretion rates of HAeBe and CTTS are found to be in the range of $10^{-5} - 10^{-9}$ $M_{\odot}yr^{-1}$ and $10^{-7} - 10^{-10}$ $M_{\odot}yr^{-1}$, respectively. , respectively. We also found the dependency of mass accretion rates with mass for HAeBe and CTTS to follow the power law, $\dot{M}_{acc} \propto M_{*}^{3.12(+0.21,-0.64)}$ and $\dot{M}_{acc} \propto M_{*}^{1.43\pm0.26}$, respectively, in agreement with the literature. However, when we look into the overall trend in the dependency of mass accretion rates with the mass, we found a turnover at 4.62 $M_{\odot}$. It is important to note that this turnover mass is derived specifically for HAeBe stars, likely reflecting a transition in the mass accretion mechanism from magnetospheric accretion to boundary layer accretion within this stellar group. Sources above the turnover mass belong to spectral types B0 – B6/B7, while those below it fall within B6/B8 – G0. Building upon these observations, our investigation delved into the evolutionary predecessors of Herbig stars, namely IMTTS. Out of 164 stars with masses below 4.62 $M_{\odot}$, further refinement based on additional criteria, including spectral type and age, yielded a final set of 36 IMTTS from LAMOST.

Finally, we address the challenges of classifying weak-line T Tauri Stars (WTTS), non-accreting T Tauri stars, resulting in the identification of 48 WTTS and 83 candidate WTTS, through a refined spectroscopic selection process. The conclusions drawn from each chapter contribute significantly to the understanding of PMS stars in the Galactic anti-center region. This study provides refined classification methods and valuable insights, paving the way for future studies and extending the exploration of transitional phases in stellar evolution.

Keywords: *Accretion–Stars: Emission-line–Pre-main sequence stars: Herbig Ae/Be stars, T Tauri stars, Intermediate-mass T Tauri stars–Data: LAMOST survey–Techniques: Spectroscopy, Photometry.*

Publications:

1. **Nidhi, S.**, Mathew, B., Shridharan, B., Arun, R., Anusha, R., & Kartha, S. S. (2023). "Spectroscopic study of Herbig Ae/Be stars in the Galactic anti-centre region from LAMOST DR5". Monthly Notices of the Royal Astronomical Society, 524(4), 5166–5181.
2. **Nidhi, S.**, Mathew, B., Shridharan, B., Bhattacharyya, S., Edwin, D., & Kartha, S. S. (2023). "Estimation of stellar parameters and mass accretion rate of classical T Tauri stars from LAMOST DR6". Journal of Astrophysics and Astronomy, 44(2), 75.