Probing Stellar Variability in Open Clusters: Insights from Ground-Based Observations

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Open clusters offer excellent laboratories for studying stellar variability across various evolutionary stages. Photometric monitoring of stars in these systems enables the detection of pulsations, rotational modulation, binarity, and other transient phenomena, thereby offering essential insights into stellar structure and evolution. We present results from a variability study of the clusters NGC 2509, NGC 2266, and NGC 2192 using time-series CCD photometry obtained with the 0.61-m optical telescope Vasistha at the IERCOO observatory, ICSP, Kolkata. To complement our ground-based observations, we have incorporated data from the Transiting Exoplanet Survey Satellite (TESS), which significantly improves variability detection. Periodogram analysis reveals the presence of several candidate variable stars, including δ Scuti and W Ursae Majoris (W UMa–type) systems, which are classified based on their positions in the Hertzsprung–Russell diagram, periods, amplitudes, and light curve morphology. These results demonstrate that small and medium-sized telescopes, combined with space surveys, are effective in finding and classifying variable stars within clusters. Continuous monitoring will be essential for refining variability classifications and probing the underlying physical processes with greater accuracy.