AI for Transient Detection with Rubin

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A Tidal Disruption Event (TDE) is a transient astrophysical phenomenon that occurs when a star passes within the tidal radius of a Supermassive Black Hole (SMBH) and is torn apart by its tidal gravitational force [1][2], creating a luminous flare as some of the debris is accreted onto the black hole. The luminous flare observed from a TDE follows a characteristic nature where the luminosity rises over weeks to months and then fades slowly over months to years [3], which helps us distinguish it from Active Galactic Nuclei (AGN) and supernovae. TDEs provide us a unique opportunity to learn about quiescent supermassive black holes and study the formation of accretion disks, SMBH demographics, and astrophysical jet launching [1][3].

Current optical surveys like the Zwicky Transient Facility (ZTF) at Palomar Observatory detect roughly 10 TDEs per year [4]; however, the ZTF TDE program is incomplete beyond a magnitude of 19.1 due to limitations of available spectrographs [1][5]. The Legacy Survey of Space and Time (LSST) with the Vera C. Rubin Observatory, a 10-year long survey of the dynamic Universe in six optical bands [4][6], will image to a magnitude of 24.4 in the r band [4], accessing a volume of the universe thousands of times larger than ZTF can reach. While mapping tens of billions of stars and galaxies [6][7], it is expected to observe more than 3,000 TDEs per year [4], which makes expensive spectroscopic classification of every candidate infeasible, while photometric classification shows prominent potential [1].

Our project focuses on developing a nuclear transient filter adapted for the survey data collected through Rubin and identifying TDEs using it by evaluating different survey-independent high-level physical features such as light curve shape, rise and fade time, and color evolution. The results of our work will be an enriched dataset populated with TDEs carefully identified using different astrophysical features extracted from Rubin data, to support the study of SMBH demographics.

References

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