Signatures of Type Ia Supernovae in the time-domain and the Near- and Mid-Infrared

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Thermonuclear Supernovae, so called Type Ia SNe, are one of the building blocks of modern cosmology, important of the origin of elements and laboratories for the explosion physics of White Dwarfs stars (WD) in close binary systems. Solving the discrepancy in the Hubble constant Ho between the Microwave background and the empirical SNe Ia-based methods has direct consequences for the BigBang nucleosynthesis and its use for high precision cosmology, early Black Hole formation and testing new physics beyond the high-energy standard model. Is the difference in Ho a calibration issue or do we need a better understanding of SNe Ia? From theory, the empirical SNe Ia relation for cosmology are stable because basic nuclear physics determines the progenitor structure, the explosion physics, average expansion velocities, leading to similar light curve shapes and spectral evolution for a diversity of progenitor systems and explosion scenarios with different masses M but similar M(56Ni)/M(WD) ratios and, thus, different Hubble constants.
In this talk, I will give an overview how recent advances in theoretical modeling, discuss new physical effects commonly neglected and discuss observational constraints in the age of time-domain and multi-wavelength astronomy for progenitor and explosion models which show emerging links and future prospects with ground upcoming ground based, ELT, GMT and space based such as JWST, Euclide and WFIRST instruments.