Abstract

Type Ia Supernovae (SNe Ia) are celestial bodies of transient luminosity resulting from the explosion of stars. They are nowadays at the heart of observational cosmology analysis because of their regularity in their released luminosity, which allows different surveys and telescopes to measure their distance and thus the expansion rate of the Universe.

However, the detailed nature of SNe Ia remains uncertain, and these studies rely on empirical laws and in particular on the distinction into two populations of SNe Ia which would have different properties. As the statistics of the surveys increase, the question of astrophysical systematic uncertainties arises, including the evolution of SNe Ia populations.

In this perspective, we implement attempts to improve our knowledge of the physics of SNe Ia through the study of correlations between their properties and their environment. We have shown the existence of a bias related to the global mass of the host galaxy of a SN, and highlighted the exitence of age-based subpopulations that could be more relevant as a tracer of the difference in properties observed in SNe.

Our thesis builds on this hypothesis and the link established by previous studies between SNe stretch and age. In this thesis, we study the redshift dependence of the light curve stretch from a `SALT2` fit of SNe Ia, which is a purely intrinsic property of SNe, to probe its potential drift with redshift. We model different dependencies and give the results of our analysis: we will see that the astrophysical drift of SNe Ia properties is strongly favored and that the underlying distribution models of constant stretches with redshift are excluded as good representations of the data with respect to our reference model.

The impact of this modeling on the determination of cosmological parameters has been studied through numerical simulations, and indicate a bias of up to 4% in the value of the dark energy state parameter, w, if these correlations are not taken into account.