

Title of the internship: Standardization of Type Ia Supernovae spectral time series for cosmology

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Summary :

Type Ia supernova have been historically a powerful tool to measure the Universe expansion. Since the pioneering work in 1998 which led to the astounding discovery that the Universe was accelerating and not decelerating as anticipated, all subsequent work have confirmed this major discovery, which was awarded a Nobel Prize in 2011. Yet little is known about the force behind this acceleration, called Dark Energy.

More than 2 decades after the initial discovery, little is known about the nature of the Dark Energy, and Type Ia Supernovae remain one of the promising ways to tackle this enigma. However, their cosmological use supposes that the luminosity emerging from these white dwarf explosions is well understood, or at least offers a simple parametrisation. This is far from the actual complexity of the physics behind this phenomena.

The aim of the M2 internship is to address the issue of supernova standardization, that is how to make them look like ideal objects and deriving proper corrections. The work will make best use of the latest calibration of the spectrophotometric time series from SNFactory, a project led by Saul Perlmutter, one of the 2011 Nobel awardees. The goal is to asses its quality in a first time, before tuning state of the art new supernova empirical model in a second time. A far stretched goal that can lead to a full PhD subject would be then to use modern techniques such as machine learning in order to improve the description of Type Ia supernova light curves. This would be of particular impact to analyze the Rubin Observatory LSST data which will be the next revolutionary dataset in cosmology.

The successful candidate should have an academic knowledge of cosmological models, be proficient with numerical and statistical tools, as well as be fluent in Python programming, including the use of numpy and other scientific librairies. A solid background in astrophysics, machine learning, and/or familiarity with modern coding environment would be a plus.