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Characterization of Dark Energy: precision measurements of the recent expansion history with the Zwicky Transient Facility (ZTF-II)

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Title: Characterization of Dark Energy: precision measurements of the recent expansion history with the Zwicky Transient Facility (ZTF-II)

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Team : Cosmologie et Énergie Noire; groupe LSST/ZTF II

Description :

Constraining the luminosity distance-versus-redshift relation using type Ia supernovae (SNe Ia) is one of the most sensitive probes of the nature of Dark Energy, through the measurement of its equation of state w = p/Á. Over the last 15 years, large surveys (SNLS, SDSS, DES, PanSTARRS) have produced high-quality SNIa samples in the redshift range 0.05 < z < 0.8 and published the best constrains on w. The Hubble diagram is still notoriously under-constrained at high-z (z>0.8), and low-z (z<0.1), precisely in the redshift range where the sensitivity to w is the highest. Our project is to populate the low-z part of the Hubble diagram with a sample of about 8000 nearby, cosmology-grade, SNe Ia discovered and followed-up by the Zwicky Transient Facility (ZTF).

The ZTF collaboration operates a 47 deg^2 camera (600 Mpixels), mounted on the 1.22-m Oschin Schmidt telescope, at the Palomar Observatory. This unique facility is able to scan 3750 square degrees per hour and is used to conduct a high-cadence photometric survey of the entire northern sky. ZTF also operates two dedicated integral field spectrographs to secure the spectroscopic identification of all the transients discovered in the photometric survey, up to magnitude 19. This design allows us to produce low-z SN sample, of unprecedented size and follow-up quality, complete up to z around 0.1.

The ZTF-II french participation group is working on assembling a supernova photometry pipeline, which is at the core of the cosmology analysis. To reach our science goal, we need to produce SN flux measurements accurate at the per-mil level, and this on the entire sky. The student will work specifically on the SN photometry pipeline, based on the â€œscene modelingâ€• approach. First, s/he will focus on producing a fast scene modeling algorithm, exploiting the potential of the GPU farm available at the IN2P3 computing center. S/he will also characterize and control the bias of the SN flux estimates. In a second phase, s/he will intercalibrate the ZTF sample with the statistics available at higher redshifts and derive constraints on a (potentially variable) Dark Energy equation of state.

Location: LPNHE, Paris

Collaborators: Lyon, Stockholm, Berlin, Los Angeles (Caltech)

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