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Measuring Dark Energy with the Supernova Legacy Survey

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The Supernova Legacy Survey was brought about in response to the discovery, at the close of the last millennium, that the expansion of the universe is accelerating. The implied dark energy driving this acceleration is completely unknown at this point and poses a significant challenge to the standard model of physics. Dark energy theories abound and include a vitiation of Einstein's "biggest blunder": the Cosmological Constant, quintessence theories which model dark energy as a scalar field, and radical models that require new physics. The implications for fundamental physics that a confirmation of any of these theories would bring are far-reaching and demand a measurement of the universal expansion at an unprecedented accuracy in order to select between these theories. The Supernova Legacy Survey is a five year, multi-observatory project that is on track to characterize 700 Type Ia supernovae, the 'standard candles' that provided the original measurement of the acceleration. Already the most successful high-redshift supernova study in history after only 18 months of operation, the survey will not only measure dark energy at a higher statistical significance by increasing the number of measurements by an order of magnitude over previous studies, but will also offer improved control of systematic effects by repeated observing of 4 one-square-degree areas of the sky and by using the largest telescopes in the world to acquire the spectra of the distant suprenovae. The resulting measurement of the equation of state of the universe has the potential to eliminate broad categories of dark energy theories. The survey database characterizing this large sample of Type Ia supernovae will provide the cornerstone for third generation surveys already being designed and due to take the stage in the middle of the next decade.