Title:	Observational constraints on dark energy parameters
Authors:	Sangwan, A. (/jspui/browse?type=author&value=Sangwan%2C+A.)
Keywords:	Physics Hubble’s Law Dark Energy Cosmological constant Einstein’s Field Equation
Issue Date:	1-Oct-2019
Publisher:	IISERM

Abstract:	Our universe is undergoing an accelerated expansion as confirmed by various observa- tions. The acceleration is caused by a component of universe with large negative pressure called dark energy which contributes to almost three-quarters the total energy of the uni- verse. The nature of dark energy is still a mystery for cosmologists. A large number of models have been proposed to explain dark energy. The models include the cosmological constant which is favoured by large number of observations and this is also the most elegant explanation of dark energy. Theoretically, this model suffers from the fine tuning problems. To circumvent this problem, many other models were proposed and have been studied in order to understand dark energy. These models include barotropic fluid model, scalar field models etc. The condition for acceleration is that the equation of state parameter, must be $w = P/\rho \leq -1/3$. The equation of state parameter can be a constant or a function of time. The equation of state can be that of a barotropic fluid and within this description, the equation of state parameter can be a unison of time. Alternatively, scalar fields naturally have a negative equation of state parameter with the condition that the kinetic energy is subdominant to the potential energy. The potential dominated scalar field, requires a fine tuning of its own; the amplitude and the shape of the potential needs to be fine tuned. In my Ph.D., we have studied fluid models of dark energy, and canonical scalar field models. To study these models, we first solve the cosmological equations for the models mentioned above and determine their respective parameters using different datasets. We focus mainly on the low redshift data constraints, namely Supernova type Ia data, Baryon Acoustic Oscillation data and direct measurements of Hubble parameter dataset. We consider four different scenarios; a constant equation of state parameter of dark energy, and three different paramatization's of dark energy equation of state parameter, i.e., with a variable equation of state parameter. The case with a constant equation of state consists of two parameters (equation of state of dark energy, and matter density parameter) description of dark energy, and is called wCDM model. We then consider three different parametric forms. At lower redshifts, all the parameterisations are equiv- alent but at higher redshifts they show different behaviour in the evolution of equation of state parameters. The dark energy parameters are then constrained using different observations. Another viable description of dark energy is given by scalar fields in which equation of state for the field changes as the field evolves. Different types of scalar fields which have been introduced in extensive literature. We stududied the quintessence field, which is a minimally coupled canonical scalar field. The value of the equation of state paramter depends upon the functional form of the potential and the kinetic energy of the field. The scalar fields, in general, have been categorised into two broad classes depending upon the evolution of equation of state parameter; ”freezing” and ”thawing” scalar fields. We study two thawing class potentials and two freezing potentials. Using the same three different observations as before we provide constraints on the sclar field parameters. We also combined the first two approaches and study the form of potentials which are consistent with different parameterisations used in first problem. We reconstruct the quintessence and phantom scalar field potentials and study the evolution of the scalar field as a function of scale factor. Using the same three observations mentioned earlier, we provide constrains on the reconstructed potential and field parameters.