Contribution ID: **6** Type: **Presentation**

Exploring Demographic Drift: A Redshift Dependent Two-Population Model of Type Ia Supernovae and Its Implications for Dark Energy

Friday, 31 March 2023 13:20 (20 minutes)

Type Ia supernovae have played a significant role in measuring the acceleration of the Universe's expansion and the existence of dark energy. However, understanding the nature of the supernovae and the impact of population, originating from two distinct progenitor channels (single- and double-degenerate), changes over cosmic time is crucial to accurately measuring these phenomena. In this talk, we present a novel Bayesian hierarchical two-population model of Type Ia supernovae which enables us to measure the properties of the two populations, redshift evolution of their relative fractions and thus investigate the impact of these elements on the precision and accuracy of constraints on the dark energy equation of state.

Our model builds on earlier work by accounting for the varying fraction of two distinct Type Ia supernova populations over cosmic time. By modeling the redshift dependence of the two populations, we can estimate their respective fractions at different epochs and explore the impact of these changes on our measurement of dark energy.

We apply our model to both simulations and to observational data from Pantheon+. We show that observational data has signatures of redshift-dependent fractions of the supernova populations and discuss these results in the framework of basic expectations related to the star formation history. We find that this demographic drift has important implications for measuring the properties of dark energy, as it affects the derived distance and spectral properties of Type Ia supernovae.

Finally, we discuss the implications of our results for future observations and the study of dark energy. Our model provides a framework for incorporating demographic drift into the two population model of Type Ia SNe, which could lead to more accurate measurements of the properties of dark energy. We also highlight the importance of continued observational efforts to constrain the properties of Type Ia supernovae and their progenitor scenarios.

In conclusion, our Bayesian two-population model of Type Ia supernovae provides a powerful tool for exploring the demographic drift of these populations and its implications for measuring dark energy. By accounting for the changing fraction of the two populations over cosmic time, we can improve our understanding of the nature of Type Ia supernovae and their use as cosmological probes. We hope that our results will motivate further observational and theoretical studies of these important astrophysical phenomena.

Field of study

Astrophysics

Supervisor

Radek Wojtak

Primary author: HJORTLUND, Jacob Osman (DARK, NBI, University of Copenhagen)

Session Classification: Oral presentation