Dark Energy Project Report

Motivation

In the early 20th century, Edwin Hubble and other astronomers observed that galaxies were moving away from the milky way. More distant galaxies moved away faster than nearer galaxies.

The acceleration expansion of the universe is said to be due to the presence of dark energy. The exact nature of dark energy is still unknown. However, proving the accelerating expansion of the universe, supports the claim of the existence of dark matter.

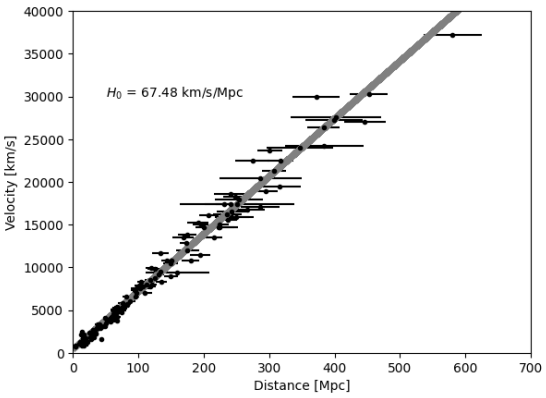
Methods

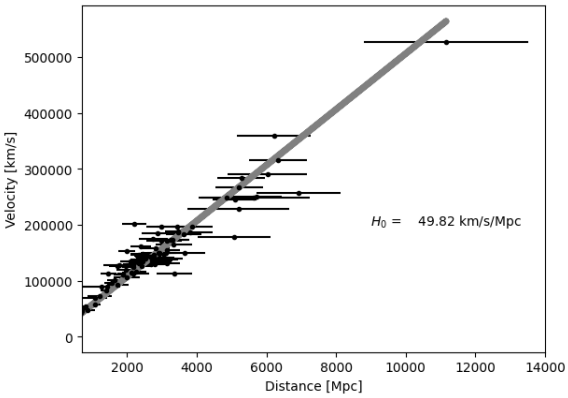
The Hubble constant is determined through observations and measurements of the rate of expansion of the universe. The value of the Hubble constant can be calculated using Hubble's law, which relates the recessional velocity of distant objects to their distance. The basic form of Hubble's law is $v = H_o \times D$, where v is the recessional velocity of the object, H_o is the Hubble constant, and D is the distance to the object. The units are often expressed in kilometers per second per megaparsec (km/s/Mpc).

In this project, we observed the brightness and redshift of Type Ia supernovae in distant galaxies. This provided us with a way to estimate their distance and velocity. By applying Hubble's law to the supernovae data, we estimated the Hubble constant. We first imported data from the 'Tonry_2003.vot' file, which is a file that contains data about type 1A supernovae explosions, and analyzed the data from 0 to 700 Mpc by plotting the data. We then applied Hubble's law to the data in the plot and found the Hubble constant.

We then analyzed the data from 700Mpc to 14000Mpc by following the same steps.

Results





After analyzing the graphs, we find that the calculated Hubble constant from the data about supernovae from 0 to 700 Mpc is 67.48 km/s/Mpc and the Hubble constant that we get from the data from 700 Mpc to 14000 Mpc is 49.82 km/s/Mpc. This clearly indicates an increasing hubble constant. Since the Hubble constant is increasing over time, this indicates that the expansion of the universe is accelerating.

Conclusion

Dark energy is an unknown form of energy that is thought to be responsible for the observed acceleration of the expansion of the universe. Observations of distant Type Ia supernovae suggested that the expansion of the universe is accelerating. Since dark energy is postulated to be responsible for the observed accelerated expansion by exerting a repulsive gravitational force. The results of this project support the existence of dark energy.

References

1. HUBBLESITE. *Measuring the universe's expansion rate*. NASA. https://hubblesite.org/mission-and-telescope/hubble-30th-anniversary/hubbles-exciting-universe/measuring-the-universes-expansion-rate#:~:text=In%201929%2C%20Edwin%20Hubble%20provided,expanding%20uniformly%20in%20all%20directions.
2. Uchicago News. *The Hubble constant, explained*. Universe of Chicago. https://news.uchicago.edu/explainer/hubble-constant-explained