Absolute colors and phase coefficients of trans-Neptunian objects

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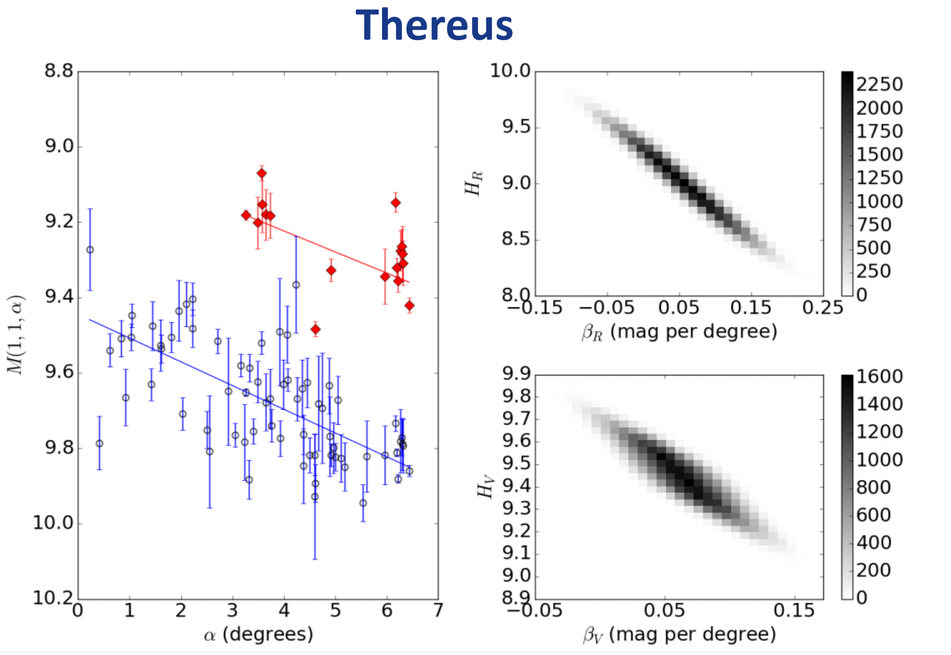
Trans-Neptunian Objects

- **What are they?**
  - Trans-Neptunian Objects (TNOs) are small, distant objects in our Solar System
  - Their relatively small size and massive distance from Earth makes them difficult to observe
  - TNOs are remnants of the protoplanetary disk
    - ~4.6 billion years ago, all the planets in the Solar System formed from a leftover disk of matter known as the protoplanetary disk
- **Why study TNOs?**
  - Understanding the physical characteristics of TNOs is essential to understanding the evolution of the Solar System
  - There are ~2,300 known TNOs, but only a few have been studied extensively.
  - Determining the colors of TNOs sheds light on their composition

Image Credit: NASA – New Horizons

Thereus



This is a phase curve of 32532 Thereus – a centaur that orbits at a Blue points correspond to the violet filter (V), red points correspond to the red filter (R), and the solid lines show the preferred solution as calculated by astronomers. H represents the absolute magnitude.

Methodology

- **Photometry**
  - Astronomers use photometry to determine physical characteristics of TNOs
  - This involves measuring the apparent magnitudes and colors of TNOs
    - Apparent magnitude is a measure of how bright an object in space appears from Earth
  - Knowing the apparent magnitude and the distance from Earth allows astronomers to calculate the absolute magnitude of a TNO
  - Astronomers can then view TNOs through special filters to measure absolute color
    - These filters only allow certain wavelengths of light to enter a telescope – this allows astronomers to measure magnitudes in specific wavelengths of light (i.e. color)
- **Phase Coefficients (α)**
  - The phase coefficient is a measure of the angle between the Earth and the Sun as measured from the TNO
  - This is used as a proxy of the distance to the TNO from Earth