Astronomy Live! Summer Workshop Analysis Projects

The goal of these projects is for you to become familiar with the data reduction process, reduce data on an object, produce a picture of that object, learn more information about that type of object, or perform a simple numerical or computational analysis. During the last week of the workshop, you will give a 5-10 minute presentation on your research showing your results. Here are the project overviews:

Dark Matter
We've found that galaxies rotate faster than they should. If we take all the light from a galaxy, and convert it into a mass value, this mass value does not explain away how fast the galaxies are actually rotating. There is something out there that has mass but does not produce or interact with light. We call this dark matter. In this project, we "prove" dark matter must exist, and estimate the amount of dark matter in galaxies.

Hubble's Law
In 1922, Edwin Hubble discovered that our universe is expanding! He did so by measuring the distances and velocities of a few galaxies that were relatively nearby and identifying that the further away a galaxy was, the faster it was moving from us. Today, we have observed thousands more galaxies, so we can do his calculation with more precision and check his work. In this project, you'll use data from the Sloan Digital Sky Survey to reproduce Hubble's calculation and figure out just how fast our universe is expanding!

Variable Stars and the Distance Ladder
In 1912, Henrietta Swan Leavitt found that a certain class of variable stars – called Cepheid Variables – have variability that relates to their intrinsic brightness. This relationship is called Leavitt's law and is used to measure distances to nearby galaxies and clusters. In this project, you'll use a database of Cepheid data to derive Leavitt's law for yourself and use it to estimate the distance to Andromeda, the closest galaxy to the Milky Way!

Star Clusters and Stellar Evolution
Clusters are collections of millions of stars that form at the same time. When we plot the color and brightness of each star, we see that stars tend to fall in a line: this is called the "main sequence" and traces stars that are burning hydrogen. For older clusters, some stars have already run out of hydrogen and fall off from the main sequence, creating a turnoff which is used to estimate the age of clusters. In this project, you'll use data taken at the Nickel Telescope to create a color-magnitude diagram of M5, a globular cluster. By the end of the summer, you'll know how long ago this cluster formed!

Asteroid Tracking
Our solar system is a shooting gallery for asteroids and comets flying between the major planets. Impacts between Earth and large asteroids can be catastrophic, as is well known from the extinction of the dinosaurs 66 million years ago. The only way to know that an impact won't happen in the future is to find and track the orbit of asteroids near Earth. In this project, you will calculate the orbit of a near-Earth asteroid to find out how often, and how closely it approaches the Earth.

Exploring Habitable Zones
In the search for life in the universe, water is usually considered an important ingredient in the habitability of a planet. Because of this, we define 'habitable zones' around stars as locations where planets get just enough star light to host liquid water. In the Solar System, this zone extends from about Earth to Mars, but the range of the zone can vary a lot from star to star. In this project, you'll make your own habitable zone calculator and use data from the NASA Exoplanet Archive to search for exoplanets located in habitable zones.

Exoplanets-Transit
An exoplanet is a planet found orbiting a star outside of our solar system. We currently have discovered 5,400+ of these planets and are finding new ones daily. One method of discovering such planets is known as the "transit method". The technique looks at the brightness of a star over a long period of time, looking for dips in the star's brightness as the planet transits in front of the star. The dip is caused by the planet moving into our light of sight with the star and blocks a small fraction of the photons emitted. From this technique we can infer the planet's radius and orbital period. Create a light curve which shows the eclipsing planet and measure key planetary parameters.