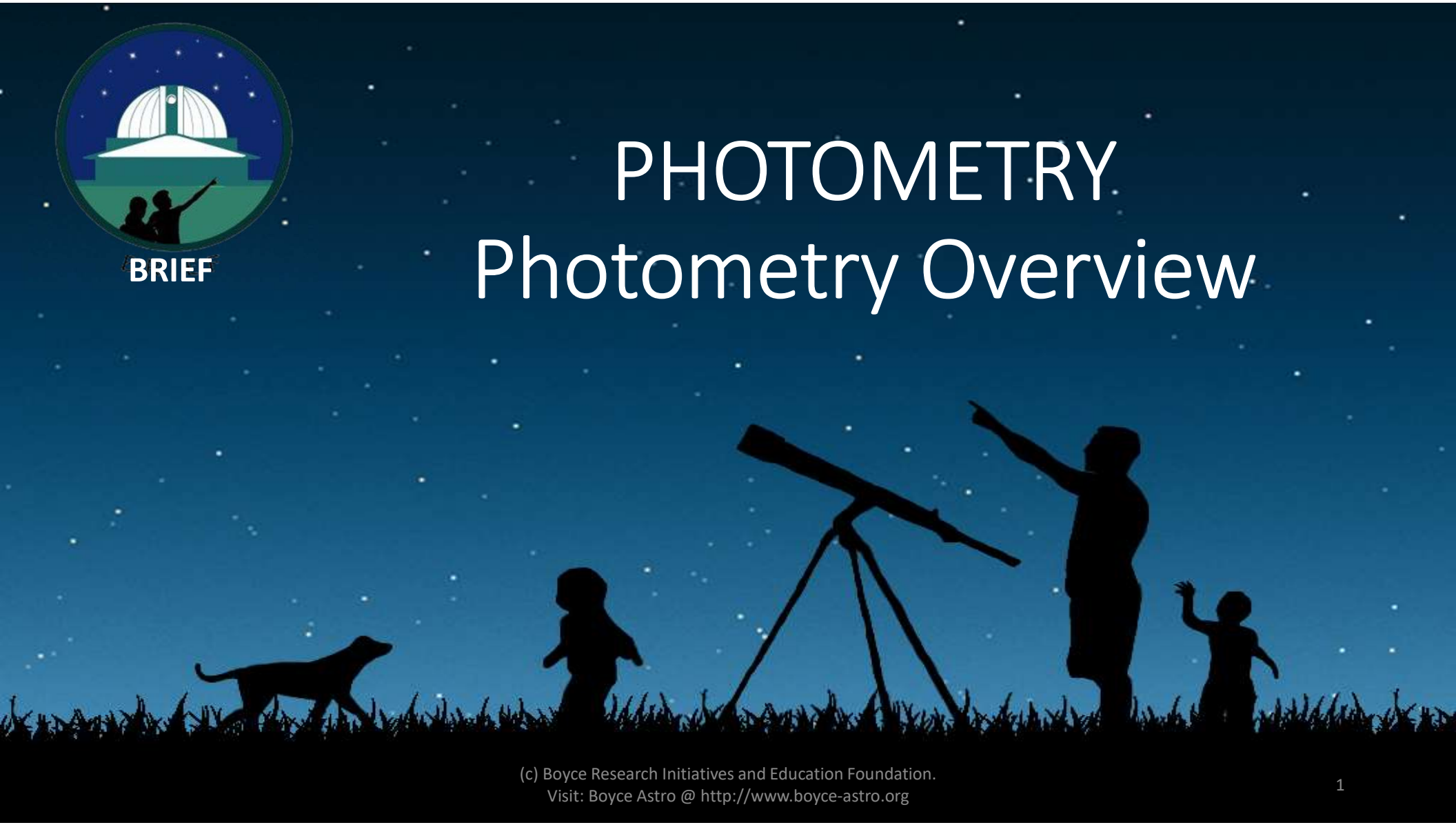
BRIEF

PHOTOMETRY
Photometry Overview

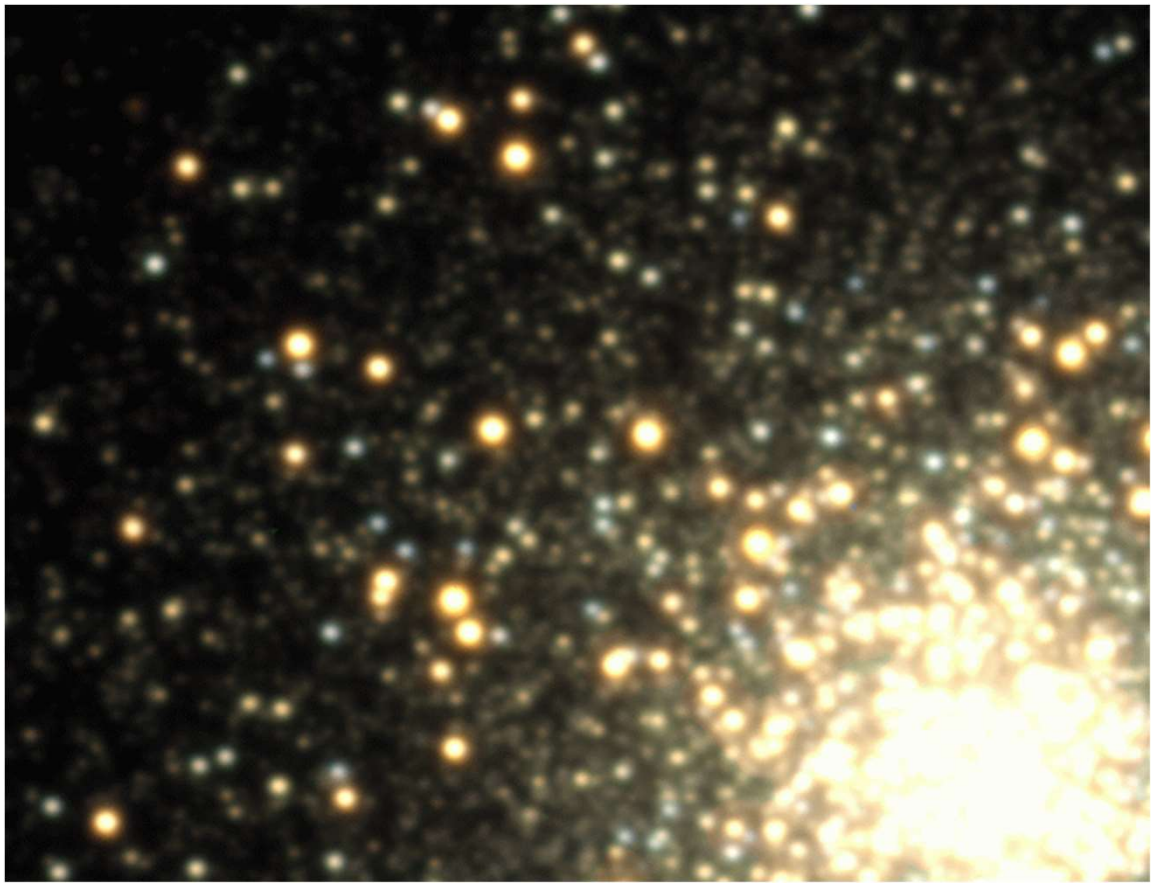


Overview

The science of Photometry is the measurement of changes in Flux (light) from an object, or objects, to better understand the nature of what you're observing.

This could be a variable star, eclipsing binary star, Exoplanet, quasar, supernova, novae, blazar, or any number of other targets.

This image, from Astronomy Photo of the Day (APOD) shows a time lapse of RR Lyrae variable stars in the object M3, a globular cluster.



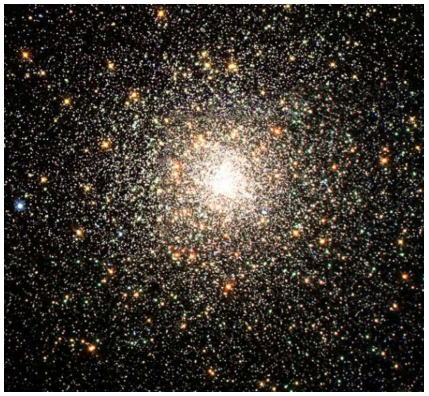
What is Photometry

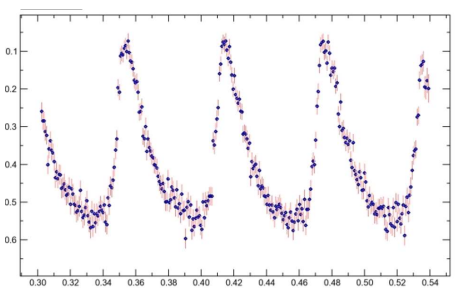
In the context of astronomy, photometry means measuring how much light is reaching us from stars and galaxies by capturing the brightness or flux of an object that reaches us.

The amount of light received from an object depends on several factors including the intrinsic power emitted by the object, the distance of the object, and the observing conditions such as exposure time and air mass.

Photometry often tell us more than what a specific star is doing at a given time. It also tell us something about the circumstances under which stars form, how they spend their lives, and how they eventually evolve and die.

This gives us a more complete picture of the universe that we live in both in the present and over cosmic timescales, providing insights on everything from planets and stars to galaxies and beyond.

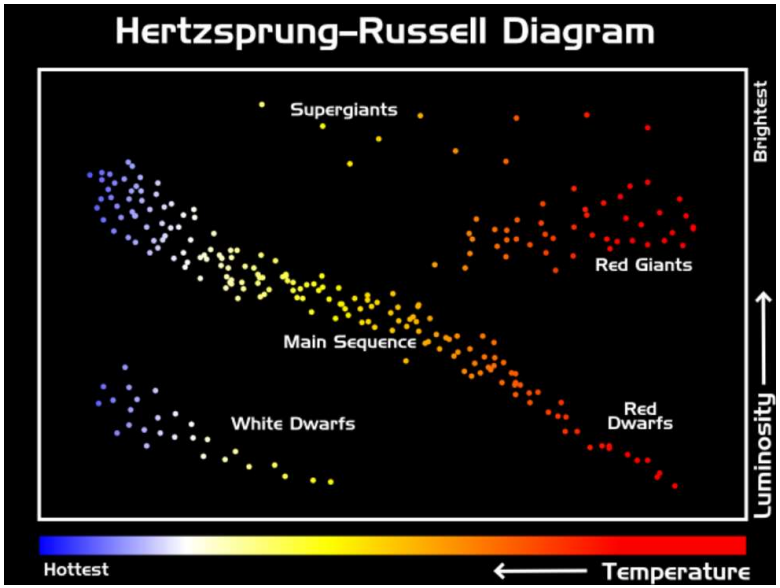




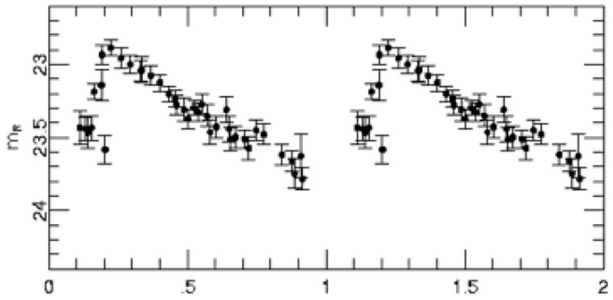
Why study Photometry

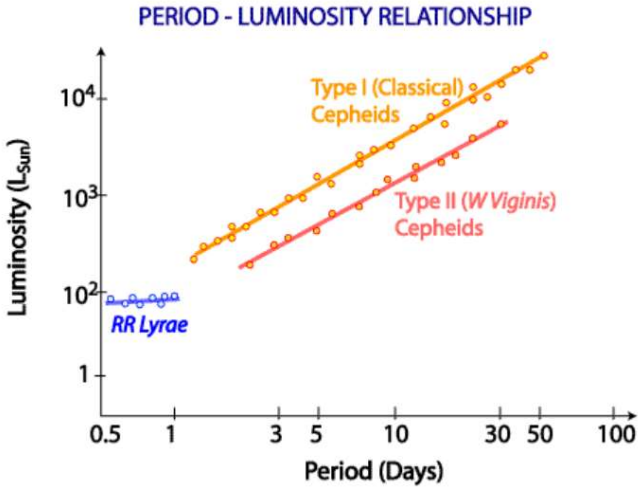
Photometry reveals some important information about the objects being observed, and can provide:

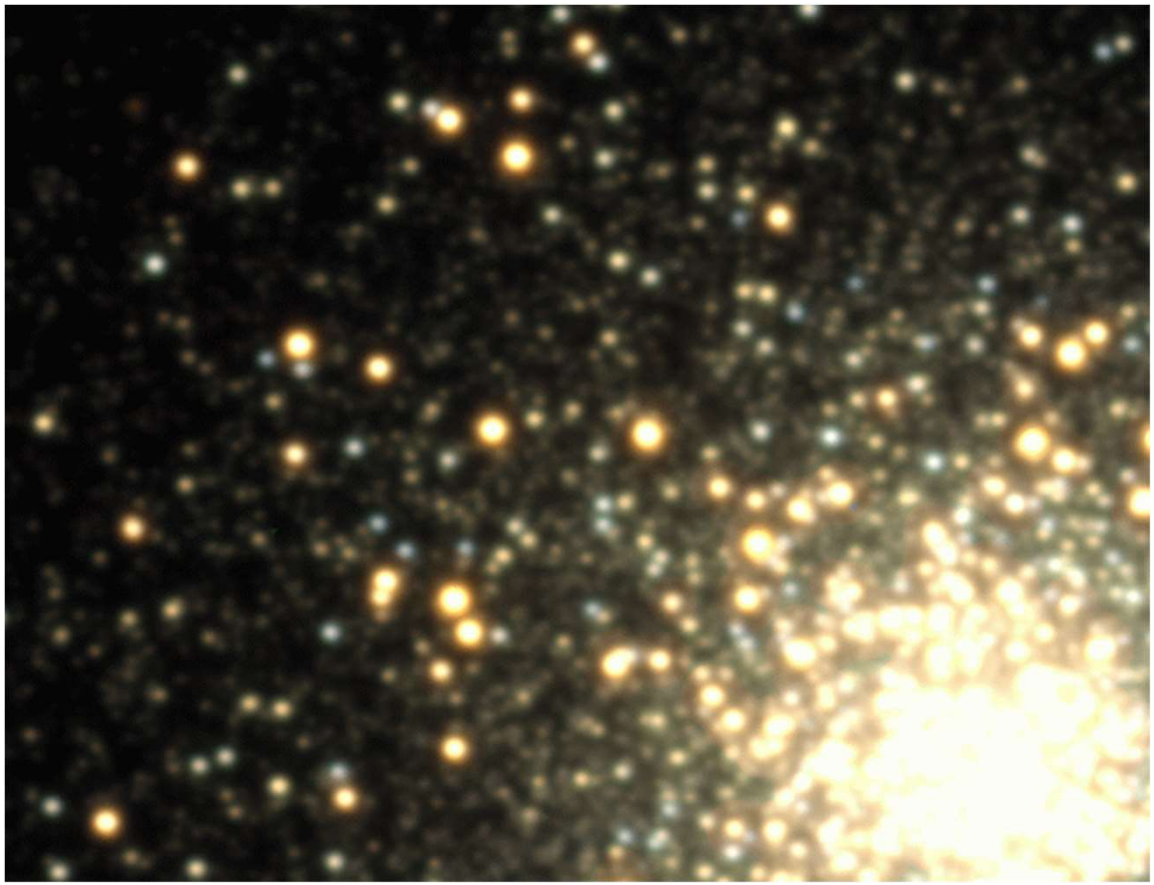
- Temperature information by measuring the colors of stars
- Distance and mass information of stars studied in star clusters
- Structure and character of stars
- Constraints on the models of stellar evolution by observing the energy output of stars at several wavelengths (its spectral energy distribution)
- Finding asteroids, comets, and supernova, and Novae



Practical Example: RR Lyrae





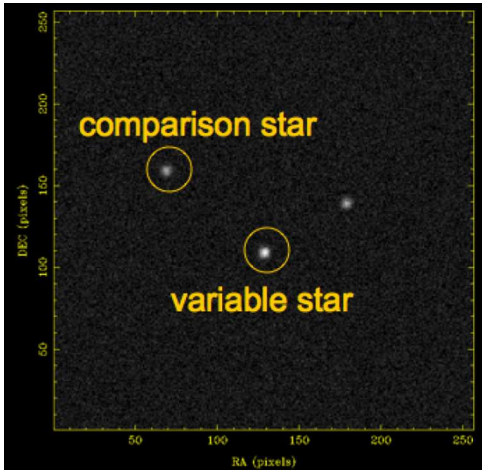


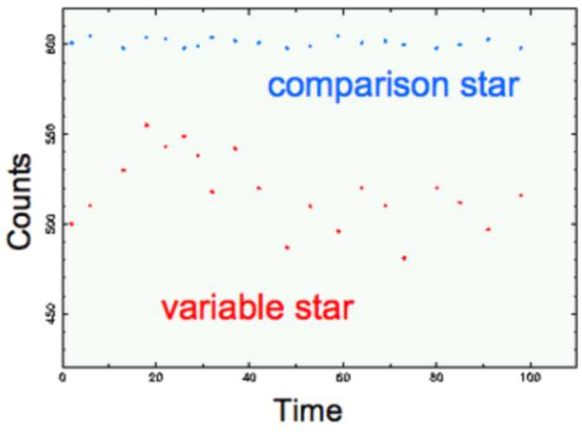
Types of Photometry

Absolute photometry: Determining the actual magnitude for an object observed by comparing the star to a photometric standard star, i.e. a star of known magnitude and color. Accomplished by observing the object(s) of interest through multiple filters as well as observing a number of photometric standard stars.

Differential photometry: Simultaneous measuring of a comparison star/s against a target star to note the difference in counts/magnitude between the two. Differential photometry is the simplest of the calibrations and most useful for time series observations. By viewing at the same time, observation variables are negated since they apply equally to both stars.

Relative photometry: Comparison of the instrumental magnitude of the target to a known comparison object, correcting the measurements for spatial variations in sensitivities of the instrument and atmospheric extinction. The two objects may, or may not, be in the same field of view.





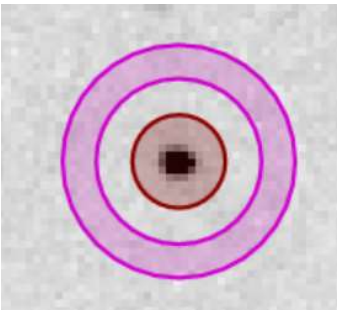
Common Definitions used in Photometry

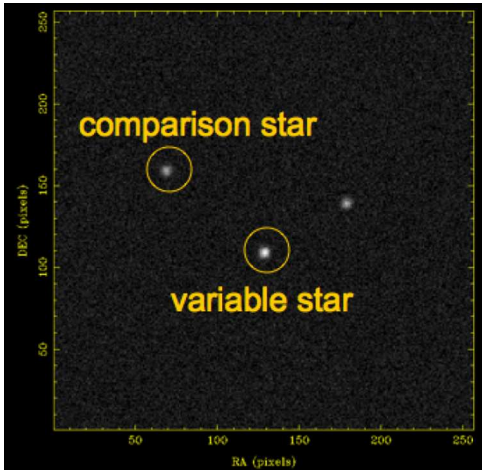
Background: The flux from the sky that is comprised of light from objects such as the Moon, street lights, city glare, etc.

Counts: Measure of the amount of light that each pixel of your CCD receives from an object.

Comparison star: A star whose brightness does not change from one night to the next, near the target in the sky

Standard star: Similar to a comparison star except that is has an agreed-upon brightness or magnitude. Usually from a sky survey.





Performing Photometry – Process Overview

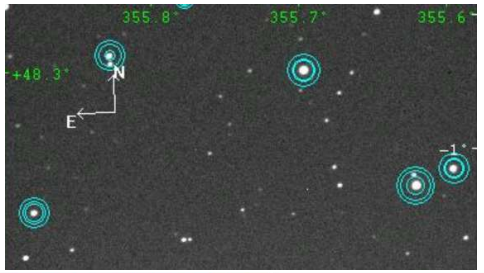
The key components are a charged–coupled device or “CCD” camera, and telescope on a solid mount and target located in low airmass.

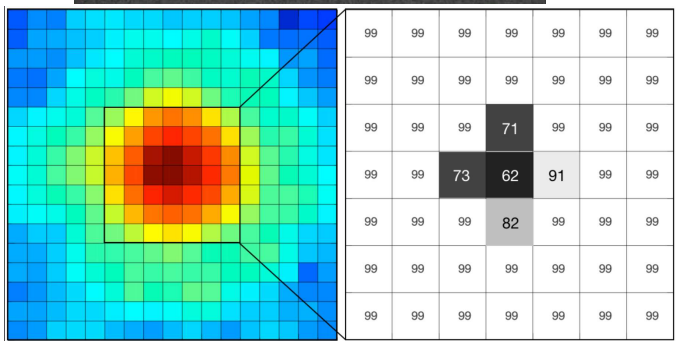
Measure the number of photons received from an object (star, exoplanet, asteroid, comet, etc) along with a set of known “comparison stars” observed at the same time.

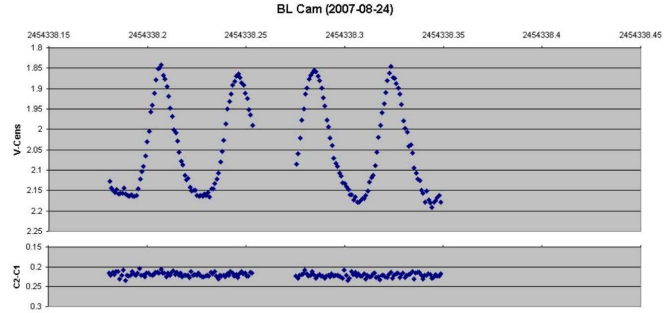
Those numbers, from well calibrated images, turn your measurements of the number of photons into a calibrated, physical measure of the brightness of a star at one moment in time.

Repeat the measurement over and over again to learn how the light from the star changes over time.

That’s the essence of photometry.







Summary

Photometry allows us to learn about the nature of objects by measuring the output of their light.

Using a CCD, telescope, mount, and standardized filters, we can determine items such as:

- Stellar type
- Temperature
- Distance
- Exoplanet transfers and orbits
- Distance to clusters
- Distance to galaxies, and more.

To perform good photometry requires careful processes and calibrations. Other video lessons will describe these steps.

Questions?