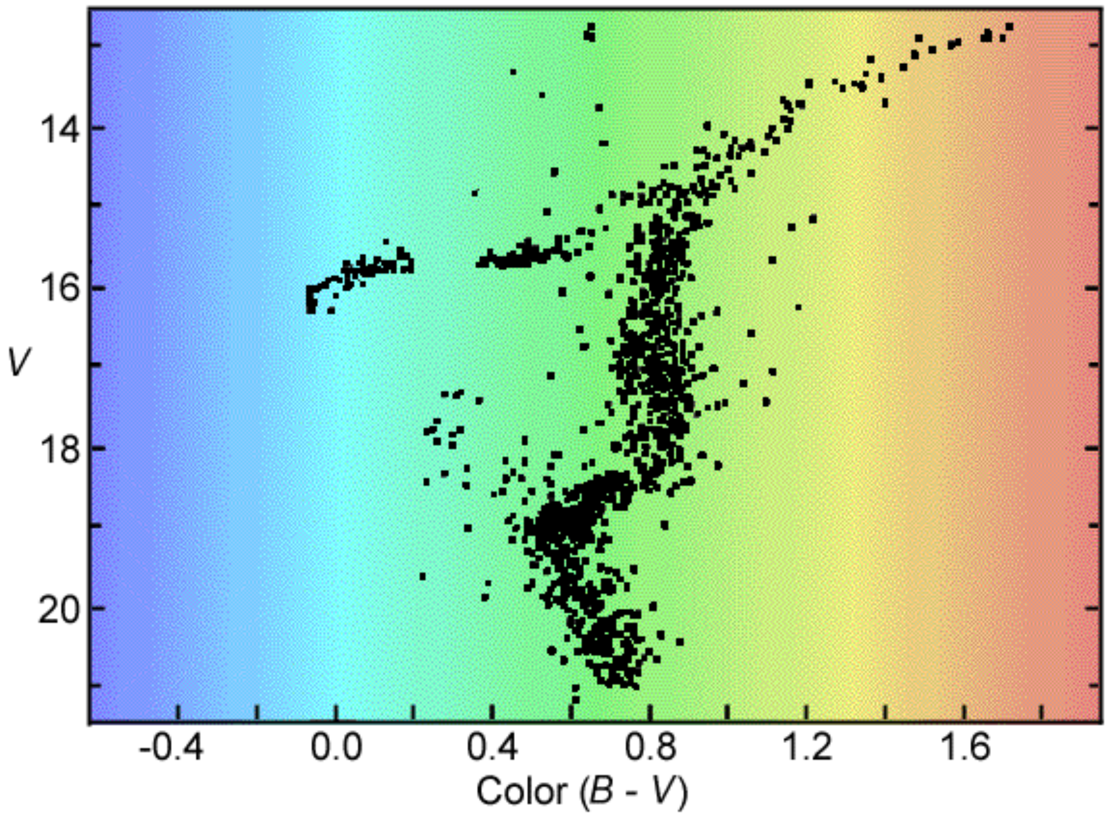
Color Magnitude Diagram Using the HLA



Background:

A familiar staple of the study of stellar evolution is the Hertzsprung-Russell (H-R) Diagram, like the one above. Developed in the early 1900s, the original H-R diagram plotted stars' spectral type versus their absolute magnitude. Today, diagrams plot stars' B-V color index (observed magnitude in the B band minus magnitude in the V band) versus magnitude. For obvious reasons, this is also known as a color magnitude diagram. H-R digrams can also be made by plotting effective temperature versus luminosity. These two forms of the H-R diagram are similar in that they can both be used to identify stars of different ages and match observations to theoretical stellar evolution models, however the transformation between the two is not trivial. Because it relies solely on observation, we will focus on the color magnitude diagram (CMD).

A CMD of a single cluster gives a snapshot of that cluster's evolution. We assume that all the stars in a cluster formed together, and so are the same age. This allows theorists to construct stellar isochrones – models of a group of stars at various ages. Typically, these isochrones are in absolute magnitude while observations are in apparent magnitude. Fortunately, the value m-M (the distance modulus) is directly related to distance, so one can use this shift to measure the distance to the cluster.

A star's position in a CMD is a function solely of its mass. Most stars fall along the very distinct main sequence, where they spend 90% of their lives. This stage is characterized the fusing of hydrogen into helium in the stellar core. More massive stars burn fuel faster, and so exhaust their inner supply of hydrogen before their less-massive neighbors. When this occurs, these stars "turn off" the main sequence, becoming red giants. Matching a CMD to an isochrone with a "turn-off point" at the same place gives the age of the cluster.

Purpose:

In this lab, you will plot a CMD of M80, and use it to find its distance and age. You should produce the isochrone overplotted with the cluster data along with your hard numbers (astronomers always have figures to back up their claims!)

Things you will need to get:

DAOphot catalogs for HST project ID 11233, visit 6 (Hubble Legacy Archive)

Metallicity and Extinction values for M80 (check out William Harris' "Catalog of parameters for Milky Way globular clusters: the database")

Stellar isochrones for the correct metallicity and extinction (The Padova models - http://pleiadi.pd.astro.it/ - are some of the commonly used isochrones, and their CMD database allows you to select specific parameters)

Hints:

$A_v = 3.1 * E(B-V)$

$[FE/H]_{object} \approx \log[Z_{object}/Z_{sun}]$