Lectures on stellar astrophysics

READING THE COLOR-MAGNITUDE DIAGRAM

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Resolved stellar population

- We can measure the luminosity of single stars (photometry)
- and infer detailed chemical abundances of single stars
  (e.g. from the spectra)
– We can obtained integrated luminosity or integrated spectra.
A simple stellar population (SSP) is an assembly of **coeval**, initially **chemically homogeneous** single stars.

A SSP is described by **four main parameters**:

i) age,

ii) chemical composition \((Y, Z)\),

iii) initial mass function.

Figure. Simple stellar population.
Simple stellar population

– By definition stars of a SSP are coeval: They formed in a single star formation burst

– stars of a SSP are chemically homogeneous: All stars are born with the same chemical composition

– When one or more of these properties are not fulfilled, the stellar population under scrutiny is a complex stellar population and is composed by various SSPs.
Historically, **globular clusters** were considered the best examples of **old** SSPs in nature (Renzini & Buzzoni 1986)
Globular clusters are populated by up to millions of old stars. Their stars are very tightly bound by gravity, which gives them their spherical shapes and relatively high stellar densities toward their centers.

Globular clusters were considered the best example of old SSPs in nature (Renzini & Buzzoni 1986)
Historically, **open clusters** were considered the best examples of **young** **SSPs** in nature (Renzini & Buzzoni 1986).
Celestial Firework
Group of up to a few thousand stars (weakly) gravitationally bound that were formed by the same molecular cloud
Open clusters are often populated by young stars. Since they are weakly gravitationally bounded, they can dissolve after few hundreds Myr.
Open Clusters
Open Clusters

Double cluster in Perseus.
Open Clusters

M35 and NGC2158.
Historically, Milky Way stars are classified as Population I and II. Population I is composed of metal rich stars, whereas Population-II stars are metal poor.
Stars in clusters:

i) have different colors.
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i) \textit{have different colors.}

ii) \textit{have different luminosities.}

iii) \textit{share the same distance.}
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The color-magnitude diagram (CMD) is a plot of the star’s magnitude (which is indicative of the stellar luminosity) as a function of the color (which is a proxy of the temperature). The CMD is an **observer’s** diagram.
The Color-Magnitude diagram

CMD OF A YOUNG CLUSTER

NGC2099
Age ~ 500 Myr