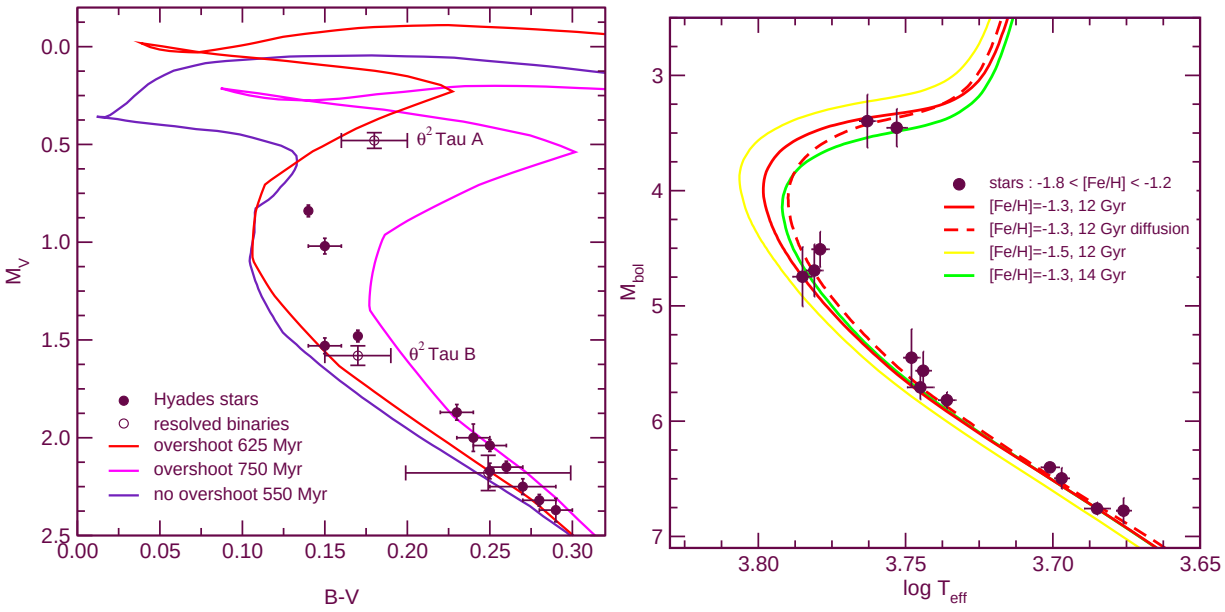

Left: estimation of the age of the Hyades at turn-off. Gaia will obtain clean sequences in the Hertzsprung–Russell diagram for many open clusters, allowing stellar-age determinations in the Galactic disc. Right: estimation of the age of 13 halo stars for which high-quality Hipparcos data exists. With Gaia, the number of subgiants with accurate parameters will increase, yielding improved age determinations of the oldest stars.

Precise stellar-age determinations are required for various Galactic structure and evolution studies and for cosmological studies. The primary age-determination method relies on comparisons of stellar models or isochrones with the best available data, in particular luminosity, effective temperature, and abundances, for individual stars or stellar groups. The principle of the method is general, but its application to different types of stars requires specific considerations.

A–F stars, open clusters and Galactic evolution: Galactic-evolution studies require the determination of the ages of relatively young objects in the Galactic disc, mainly open clusters and main-sequence A–F stars with ages ranging from several million to a few billion years. By providing accurate data for a large number of A–F stars, Gaia will reduce drastically the impact of the distance uncertainty on the age estimates for single stars. Gaia will also provide clean sequences in the Hertzsprung–Russell diagram for many open clusters containing hundreds to thousands of members. Cluster stars with masses spanning a large interval, and assumed to share the same age and chemical composition, constitute a unique tool for age determinations.

Helium abundance and chemical evolution of the Galaxy: The position of the zero-age main-sequence in the Hertzsprung–Russell diagram depends critically on the chemical composition of stars. The large sample of non-evolved low-mass stars with determined metallicities and accurate positions in the Hertzsprung–Russell diagram, that will be constituted from Gaia observations of K–M dwarfs, will be a key tool for interpreting the stellar helium abundances and the possible relation between helium and metallicity.

The oldest stars and the age of the Universe: The determination of the age of the oldest objects in the Galaxy (Population II) provides a lower limit to the age of the Universe. This can be used to constrain cosmological models and parameters. Currently, the best estimate for the age of the oldest stars is based on the absolute magnitude of the main-sequence turn-off in globular clusters, and is affected by the uncertainty on the cluster distances.

Gaia will improve the age estimate of the oldest stars. The number of subdwarfs with accurate distances will considerably increase in each metallicity interval allowing us to derive the distance of an increased number of globular clusters of various chemical compositions by main-sequence fitting. Furthermore, distances of a substantial number of field subgiants will be measured, improving the age determination of the field halo stars.