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Deriving Ages for Field Stars: Tools and Complications from Stellar Evolution

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In Galactic archeology, astronomers want to understand how the Milky Way formed and evolved. To be able to “time-stamp” events in chronological order, we need a reliable method to age-date large numbers of stars. Currently, the most reliable method is ages coming from star clusters, but they are limited in location and number. A useful tool to expand age-dating capabilities is chemical clocks: chemical abundances that are linked to stellar ages. In our work, we use open and globular clusters to establish a calibration between $[C/N]$ and age, covering a metallicity range of $-1.2 \leq [Fe/H] \leq +0.3$ dex. With this improved calibration, we can determine ages for over 300,000 stars within the SDSS/APOGEE DR17 survey. While these chemical changes help us to estimate ages on the red giant branch, chemical changes can also hinder age estimations in other parts of the HR diagram. On the main sequence and near the turnoff, the surface abundances of a star change from a combination of gravitational settling and radiative acceleration working against it, a process known as atomic diffusion. In this case, the surface abundance is not an accurate prediction of the bulk abundances that determine the stellar age. Recent studies suggest that this effect is not negligible, and in fact the ages derived from isochrones can be overestimated by 10-20% if atomic diffusion is not accounted for. We use SDSS/APOGEE DR17 to investigate atomic diffusion in the open clusters NGC 752 and Ruprecht 147 in order to constrain the variation of atomic diffusion signatures with age, and discuss how these results may affect the estimation of precise ages for subgiant stars.