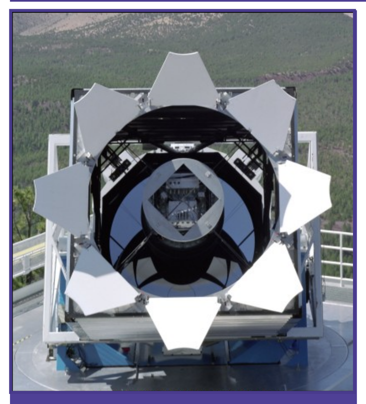
Ages of Nearby Giants Using APOGEE



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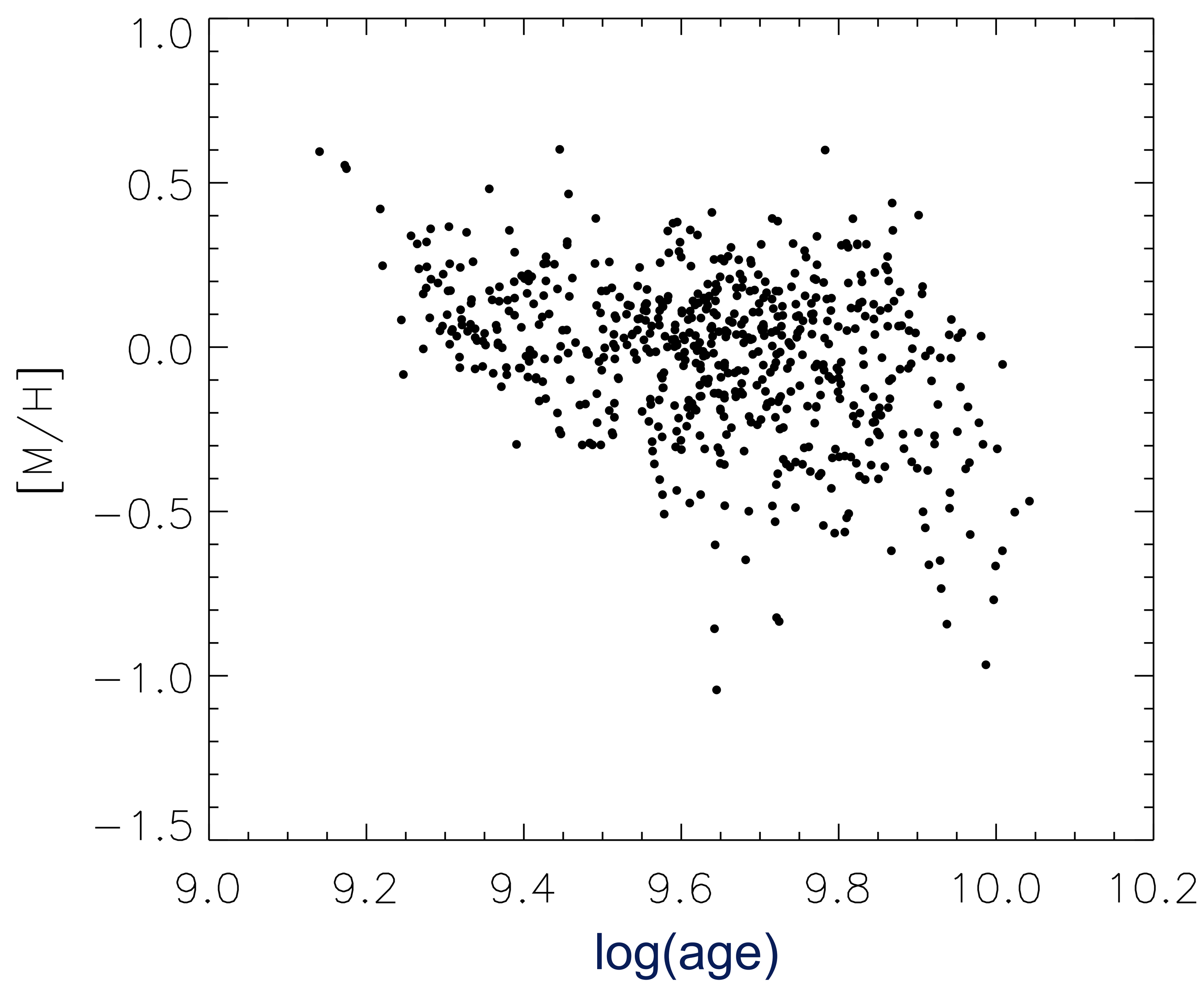
AAS extras

PROJECT DESCRIPTION

Detailed chemical abundances of large samples of stars throughout the Milky Way are crucial to constraining Galactic evolution mechanisms. Absolute calibration of traditionally used chemical clocks is needed to determine the timescale of this evolution. We are obtaining high-resolution, NIR spectra of nearby giants with accurate Hipparcos parallax measurements in order to constrain their ages. The spectra are taken with the NMSU 1m telescope and the SDSS III APOGEE spectrograph. Our full sample of possible targets contains over 3500 giants with parallax errors <10% and J-K color cut of 0.5. Here we present an initial age-metallicity relation from over 600 giants in the solar neighborhood.



The age-metallicity relation for our current sample of nearby giants. There is a trend in metallicity with age even for stars in the solar neighborhood.

REDUCTION AND ANALYSIS

Since the targets are observed using the APOGEE spectrograph, the spectra can be reduced using the existing APOGEE software, see APOGEE Data Reduction Pipeline poster (440.04). Unfortunately, the linear configuration of the 1m fibers does not allow for simultaneous observing of telluric stars. Therefore the removal of telluric absorption features must be treated differently. Telluric removal is done through an iterative fitting of terrestrial atmospheric models. As there are 10 fibers on the 1m, most of those fibers view the sky and the sky emission removal is the same as for the main survey. These spectra are analyzed with the APOGEE Stellar Parameters and Chemical Abundances Pipeline, see the ASPCAP poster (440.07).

1M + APOGEE

The NMSU 1m telescope has been fitted with 10 fibers feeding to the SDSS III APOGEE spectrograph. This exciting capability allows for observations of single targets using a powerful, high-resolution, NIR spectrograph on a 1m telescope. The fibers run about 50 m from the NMSU 1m to the APOGEE port at the Sloan 2.5m telescope.

Left: Apache Point Observatory (apo.nmsu.edu) with the Sloan 2.5m telescope in the lower center and the NMSU 1m above it. Right: The pickoff mirror in the focal plane of one of the NMSU 1m ports. The small holes with fibers that lead to the APOGEE spectra can be seen near the middle of the mirror.

MASS AND AGE DETERMINATION

The known distances were used to calculate the luminosities which, combined with the measured temperatures and surface gravities, yield masses. We then used isochrone matching to PARSEC isochrones (Bressan+ 2012, MNRAS, 427, 1) to estimate the stellar ages. The probability that an isochrone point matches the spectroscopically derived parameters for each star is:

$$p \propto exp[-(T_{eff}-T_{iso})^2/2\sigma^2_{T_{eff}}] \times exp[-([M/H]-[Fe/H]_{iso})^2/2\sigma^2_{[M/H]}]$$
$$\times exp[-(\log(g)-\log(g)_{iso})^2/2\sigma^2_{\log(g)}] \times exp[-(M-M_{iso})^2/2\sigma^2_M].$$

We weight the probability of each isochrone point by the number of stars at that isochrone point and sum the probabilities in each age bin. Since the age bins are evenly spaced in log(age), the bins are then weighted by the size of the bin in linear age space. The age is then taken to be the age-weighted average of the PDF.

FUTURE WORK

We plan to refine our age determination method by exploring a Bayesian approach. Observations for this project are ongoing and will continue into SDSS IV. We will also include kinematic information in our future analysis.