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ORIGINAL ARTICLE

Metal abundance calibration of the Ca(II) triplet lines in RR Lyrae stars

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Abstract The Gaia satellite is likely to observe thousands of RR Lyrae Stars with a small spectral range, between 8470 Å to 8750 Å, at a resolution of 11,500. In order to derive metallicity from Gaia, we have obtained numerous spectra of RR Lyrae stars at a resolution of 35,000 with the Apache Point Observatory 3.5 m echelle spectrograph. We have correlated Ca(II) triplet line strengths with metallicity as derived from Fe(II) abundances, analogous to Preston (Astrophys. J., 130:507, 1959) use of the Ca(II) K line to estimate metallicity in RR Lyrae Stars.

Keywords RR Lyrae · Abundances · Gaia

1 Introduction: the Gaia satellite

During the next decade, the study of galactic structure will be greatly enhanced thanks to two new instruments, the Large Synoptic Survey Telescope (LSST) and the Gaia satellite. The European Space Agency (ESA) is heading the Gaia satellite project, an enormous improvement over *Hipparcos*.

In addition to measuring parallaxes and proper motions, Gaia is expected to observe a small spectral window between 8470 Å and 8750 Å with a resolution of 11,500 to capture the Ca(II) triplet for radial velocity measurements. This expected spectral window also includes some of the Paschen hydrogen series. Gaia's mission plan is to measure each star multiple times in order to get other information about each star, for example, if the star is variable and to better refine various measurements. The spectra taken over the course of the mission will be averaged to get a radial velocity. The Gaia spectral window is shown for several RR Lyrae (X Ari, RR Leo and DX Del) in Fig. 1. The spectra presented have been reduced from the Apache Point Observatory (APO) resolution to the expected Gaia resolution. We correlated [Fe/H] against the EW of the Ca(II) triplet for RR Lyrae in the same manner as Cole et al. (2004) did for red giants. This is important because Gaia will map an estimated one billion stars, including many RR Lyrae variable stars, which are important for galactic structure and stellar populations. This relationship allows us to know one of the fundamental properties of RR Lyrae without additional information.

2 Observations and data analysis

We have observed many RR Lyrae stars with the APO echelle spectrograph, which has a resolution of 35,000, that covers a wavelength interval from 3500 Å to 10,400 Å with good signal-to-noise in the 8500 Å region (S/N ranged from 70 to 200). Data reduction was accomplished using pro-

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