Computing the Interstellar Reddening of the Metal-Poor Open Cluster NGC 2194 by Determining Spectroscopic Temperatures of Red Giant Stars

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Introduction

•Lithium plays a crucial role in constraining both cosmological and stellar evolution theories. Modern predictions of primordial Lithium abundance differ significantly with observed values for metal poor halo stars, known as the Lithium Problem.

•Open Cluster NGC 2194 is believed to have a unique combination of age and metallicity, making it of prime interest.

•This research attempts to quantify cluster reddening and metallicity for NGC 2194 through spectroscopic analysis of stellar effective temperatures for Red Giants.

Observations

Spectra were obtained using the Hydra Optical Spectrograph at the WIYN 3.5m Telescope at the Kitt Peak National Observatory.

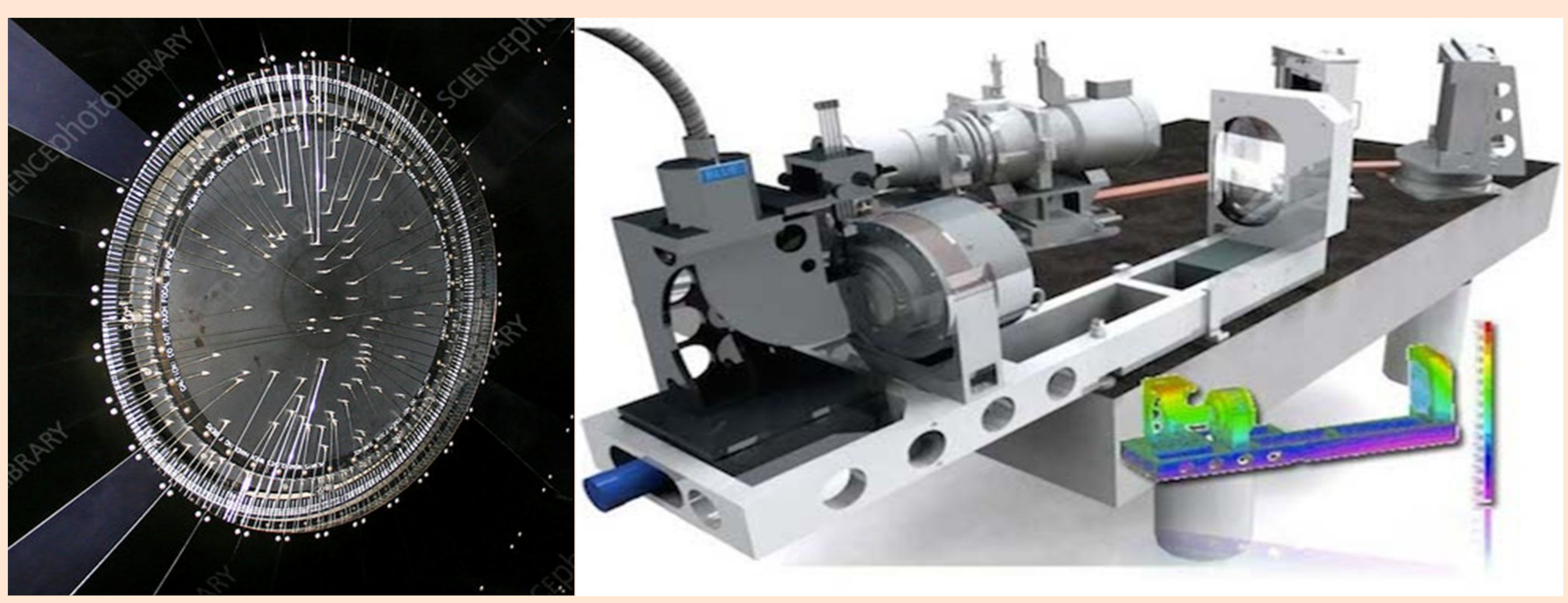

Figure 1. The focal plate of the Hydra Optical Spectrograph with fiber optics cables attached and the bench Spectrograph.. Photos courtesy of the WIYN 3.5m Observatory funded through the WIYN Consortium.

Data Reduction

Reductions were performed using standard processing techniques, including overscan and bias subtraction, dome flat correction, throughput and dispersion correction, and continuum normalizing. Cosmic ray removal was facilitated with the use of L.A. Cosmic python software, all credits to Dr. Pieter van Dokkum of Yale University.

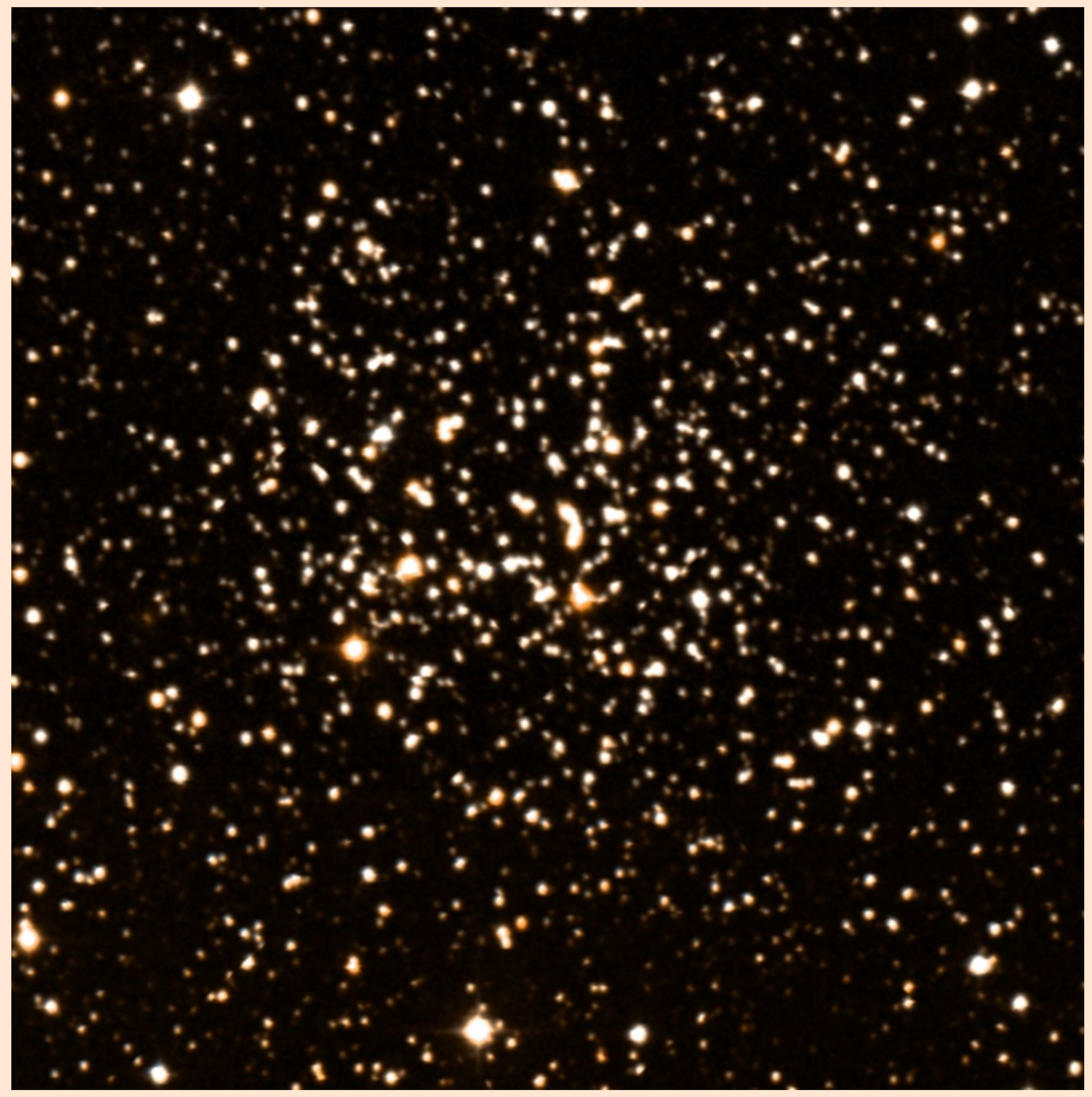

Figure 2. NGC 2194. Photo courtesy of "Aladin sky atlas" developed at CDS, Strasbourg Observatory, France.

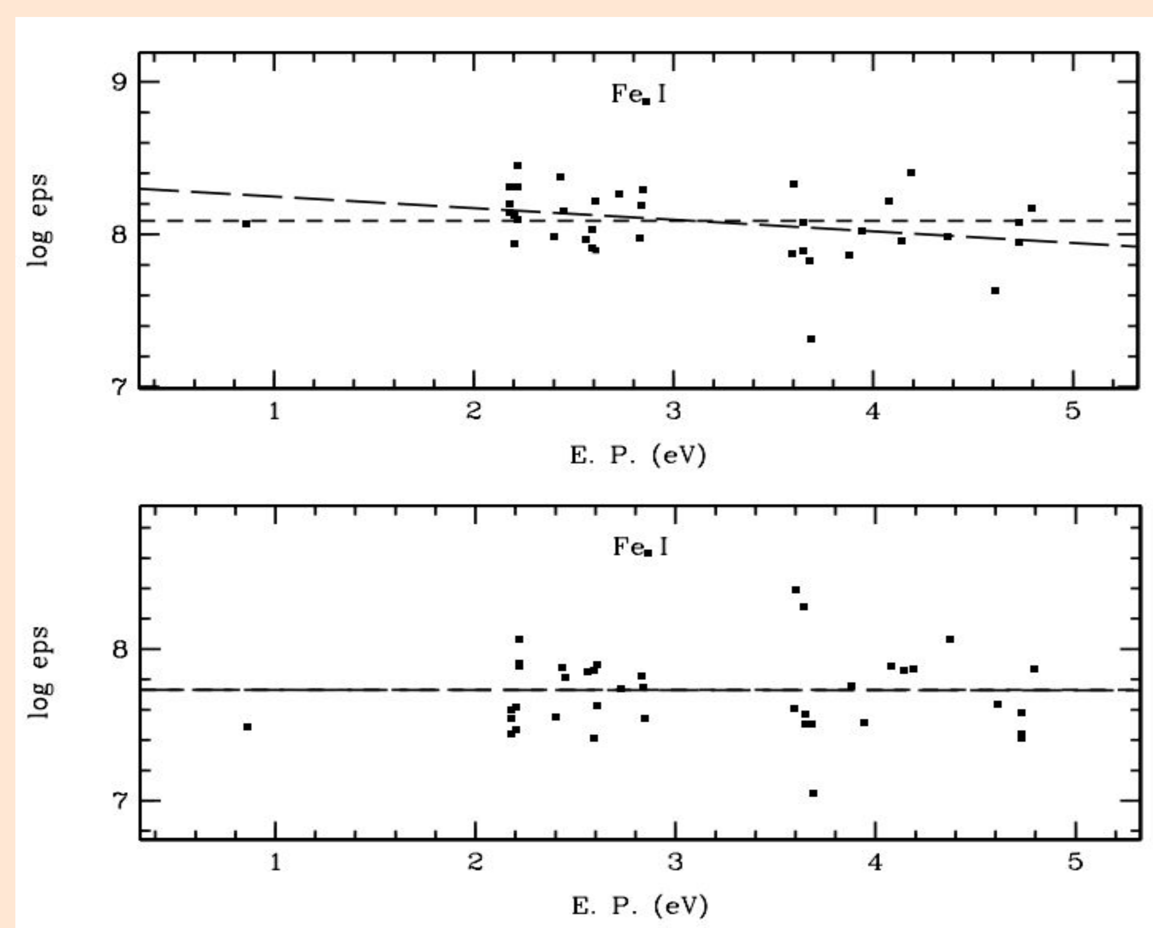

Figure 4. (Top) An initial MOOG plot showing neutral Fe abundance for multiple absorption lines as a function of excitation potential.
(Bottom) A finalized MOOG plot showing zero slope.

[Fe/H]	+0.264 ± 0.007
E(B-V)	0.453 ± 0.013

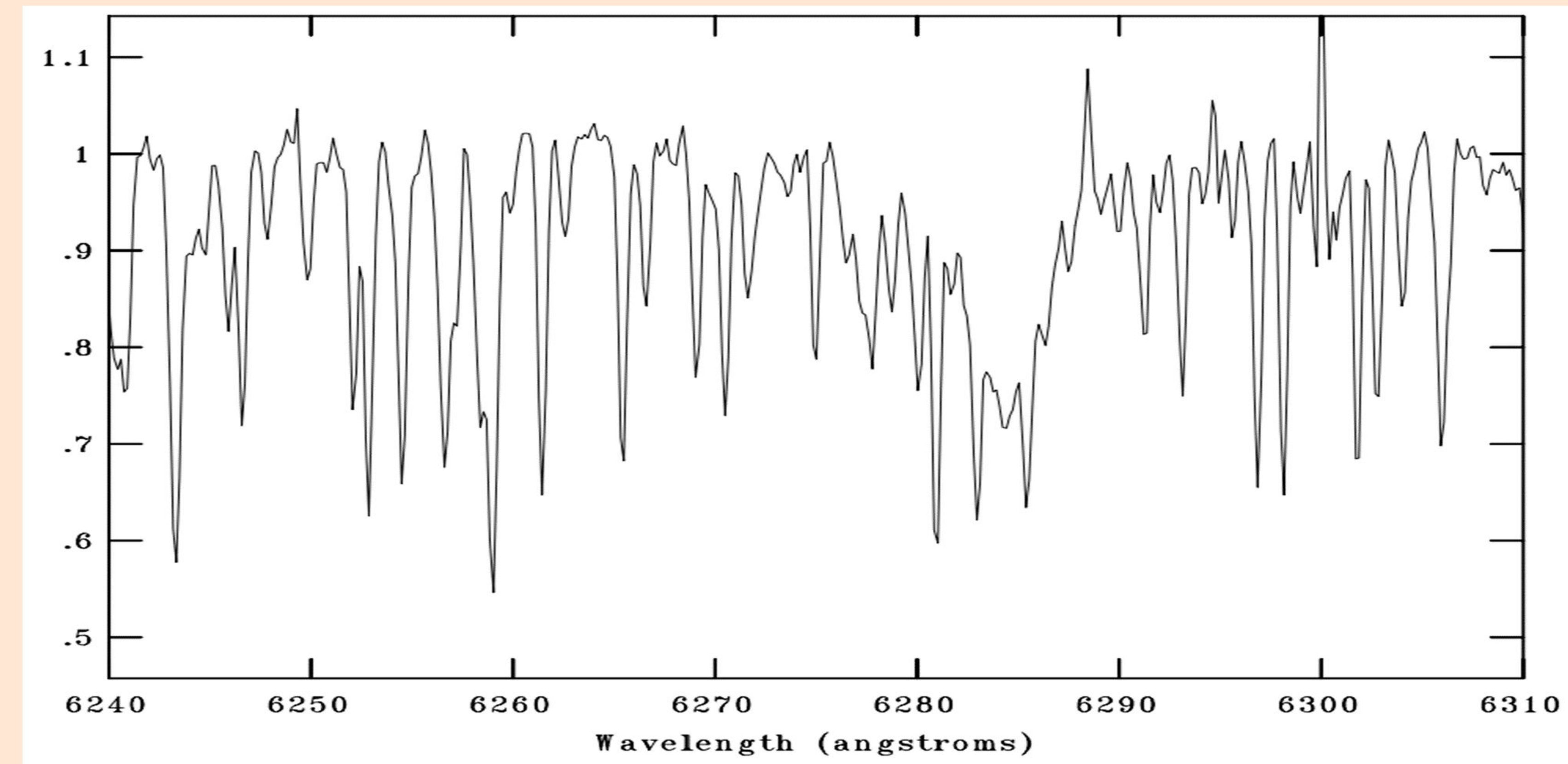

Figure 3. A sample of spectrum, y-axis continuum intensity normalized to 1.

Data Analysis

Finished spectra were compared to line lists from Jacobs et. al, the NOAO Arcturus high resolution spectrum, and the Moore Solar Spectrum Tables. Viable spectral lines were chosen by-eye, and equivalent widths were measured using IRAF software (Fig. 3).

Computing Parameters

Log g statistic weights were obtained by passing solar EW measurements through MOOG spectral analysis software courtesy of R. L. Kurucz, and MSPAWN72 stellar atmospheric software. Stellar effective temperatures were estimated via adjustment until plotted abundance vs. excitation potential trends disappeared (Fig. 4). Cluster metallicity was obtained from averaging Fe abundance for each star, and cluster reddening was obtained from comparing derived B-V magnitudes using the formula of Ramirez et. al. to photometrically obtained B-V values.

Results

Finalized values were converged upon through reiteration of previous steps until consistent. Cluster metallicity arrived at +0.264, which was significantly higher than considered probable. Interstellar reddening resolved to 0.453, which agreed exceptionally with prior results. Further analysis is required to probe the anomalous result in metallicity.

References:
Jacobson, Heather R., Pilachowski, Catherine A., Friel, Eileen D., 2011, AJ, 142, 59
Moore, Charlotte E., Minnaert, M. G. J., Houtgast, J., 1966

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