

**DETERMINATION OF CHEMICAL ABUNDANCES OF
HD 73574 AND BD +19°2045**


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Declaration

I, Gabriel Modo, declare that the work presented in this dissertation is my own and has not been presented to this institution or any other institution for any award. I confirm that where I have quoted from the works of other authors, the source is always acknowledged. With the exception of such quotations, this dissertation is my original work.

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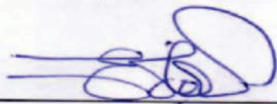
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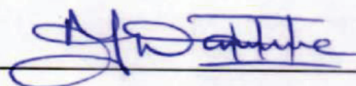


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Dedication

To my beloved family and parents.

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Table of Contents

List of Figures	vii
List of Tables	viii
Abbreviations	ix
Astrophysical Constants	x
Symbols	xi
Abstract	xii
1 Introduction	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Aim	4
1.4 Objectives	4
1.5 Significance	4
1.6 Scope of the Study	4
2 Theory and Literature Review	5
2.1 Introduction	5
2.2 A-type Stars	5
2.2.1 Chemical Peculiarities or Anomalies	6
2.2.2 Atomic Diffusion	7
2.3 Chemically Peculiar Stars	8
2.3.1 Am/Fm Stars	9
2.3.2 Ap/Bp Stars	10
2.4 Chemical Composition Changes During Stellar Evolution	10
2.5 Atmospheric Parameters	11
2.5.1 Effective Temperature	11
2.5.2 Surface gravity	12
2.5.3 Microturbulence velocity	13
2.5.4 Radial velocity	13
2.5.5 Rotational velocity	13

2.5.6	Metallicity	14
2.6	General methods of determining atmospheric parameters	14
2.7	Spectroscopy of Stars	17
3	Data and Methods	18
3.1	Introduction	18
3.2	The Hanle Échelle spectrograph	18
3.3	Observation and Data reduction	20
3.4	Spectral Classification	21
3.5	Atmospheric Parameters	22
3.5.1	Radial velocity	23
3.5.2	Projected rotational velocity	24
3.5.3	Effective temperature	24
3.5.4	Surface graviyt	24
3.5.5	Metallicities	24
3.5.6	Micro-turbulent velocity	24
3.6	Chemical Abundances	25
4	Results, Analysis, and Discussion	27
4.1	Introduction	27
4.2	Spectral Classification	27
4.3	Atmospheric Parameters from SED	28
4.4	Atmospheric Parameters from Spectroscopy	29
4.4.1	Radial velocity	29
4.4.2	Projected rotation velocity	30
4.4.3	Microturbulent velocity	30
4.4.4	Effective temperature	31
4.4.5	Surface gravity	31
4.5	Chemical Abundances	33
4.6	Comments on Individual Stars	37
4.6.1	HD 73574	38
4.6.2	BD +19°2045	38
4.7	Location in the HR Diagram	39
5	Conclusions and Recommendation	42
5.1	Conclusions	42
5.2	Recommendation	43
5.3	Future work	43
	References	44
	References	44

List of Figures

2.1	Groups of stars showing abundance anomalies in the HR diagram . . .	7
3.1	3D overview of the HESP spectrograph layout	19
4.1	The H_β , MgI triplet and H_α spectral regions of the targets.	32
4.2	Individual element chemical abundance of the BD +19°2045 and HD 73574 compared with the solar values.	35
4.3	Location of the stars on the HR diagram, showing the evolutionary status of the target stars.	41

List of Tables

4.1	The spectral classification of the target stars.	28
4.2	Estimated values of $E(B - V)$ from 3D models, BC , distance from GAIA database , T_{eff} , $\log g$ and $[M/H]$ determined from SED fitting and ξ_t estimated from Equation 3.1.	28
4.3	List of atmospheric parameters from spectroscopic analysis of the target stars: T_{eff} , $\log g$, ξ_t , $[M/H]$ and $v \sin i$	30
4.4	Chemical elements with their atomic numbers given in brackets, chemical abundances of BD +19°2045 and HD 73574 and their uncertainties, the number of analysed segments are given in brackets.	34
4.5	Chemical elements with their atomic numbers given in brackets, difference in chemical abundances of BD +19°2045 and solar abundance values, difference in chemical abundances of HD 73574 and solar abundances	36
4.6	The different columns lists: Target, absolute magnitude (M_v), luminosity $\log(\frac{L_*}{L_\odot})$, $\log(T_{\text{eff}})$, mass (M/M_\odot), Age (τ) and Radius (R/R_\odot).	40

Abbreviations

MS	Main-ssequence.
CP	Chemically Peculiar.
H-R	Hertzsprung -Russell.
HESP	Hanle Échelle Spectrograph.
HCT	Himalayan Chandra Telescope
IAO	Indian Astronomical Observatory.
ZAMS	Zero-Age-Main-Sequence.
TAMS	Terminal-Age-Main-Sequence.
Am	metallic line A stars.
Ap	peculiar A stars.
γDor	gamma Doradus stars.
SED	spectral energy distribution.
CNO	Carbon-Nitroen-Oxygen.
SME	Spectroscopy Made Easy.
LTE	Local Thermodynamical Equilibrium.
CREST	Centre for Research and Education in Science and Technology.
IIA	Indian Institute of Astrophysics.
CCD	Coupled Charged Device.
DSO	Darkk Sky Observatory.
VOSA	Virtual Observatory Sed Analyzer.
NASA	National Aeronautics Space Administration.
2MASS	Two Micron All Sky Survey.
WISE	Wide-field Infrared Survey Explorer.
GALEX	Galaxy Evolution Explorer.
TESS	Transiting Exoplanet Survey Satellite.

Astrophysical Constants

Parsec (pc) = 3.085×10^{16} m.

Solar mass (M_{\odot}) = 1.988×10^{30} kg.

Solar luminosity (L_{\odot}) = 3.839×10^{26} W.

Solar metallicity (m_{\odot}) = 0.02.

Symbols

L_{\odot} = Solar luminosity.

M_{\odot} = Solar mass.

ξ_t = Microturbulent velocity.

$[M/H]$ = Metallicity.

T_{eff} = Effective temperature.

$v \sin i$ = Projectional rotational velocity.

$\log g$ = Surface gravity.

V_r = Radial velocity.

pc = Parsec.

Abstract

The intermediate mass stars on the upper main sequence (MS) of the Hertzsprung-Russell diagram (HRD) show interesting phenomena. These include chemical peculiarities, magnetic field variability, pulsations and rotation. The high resolution photometric data and low resolution ground-based spectroscopic data have been used in the past decades to characterise intermediate mass stars. The number of intermediate mass stars that have been fully characterised as chemically peculiar stars using high resolution ground-based spectroscopic data is still limited. This study increased the number of chemically peculiar stars in the general catalogue by using high resolution ground-based spectroscopic data. This data was used to determine fundamental atmospheric parameters and individual chemical abundances of HD 73574 and BD +19°2045 to fully characterise the target stars. The spectral types of the targets were determined and their fundamental atmospheric parameters obtained by spectral synthesis. The detailed chemical abundance analysis for each target was also performed. The masses of HD 73574 and BD +19°2045 were derived as $1.998 \pm 0.1 M_{\odot}$ and $1.499 \pm 0.1 M_{\odot}$, respectively. The ages were found to be 665 ± 34 Myr for BD +19°2045 and 702 ± 69 Myr for HD 73574. HD 73574 was classified as kA7hA8mK2 and BD +19°2045 as F2 V. Therefore, HD 73574 is an Am star while BD +19°2045 is a normal star. To estimate their evolutionary phases, all the targets were placed in the HRD. Based on spectral classification and the chemical abundance pattern of each target, HD 73574, previously treated as chemically normal A-type star, was reclassified as a chemically peculiar Am star (kA7hA8mK2) and BD +19°2045 remained a chemically normal F-type star as previously classified.

Chapter 1

Introduction

1.1 Background

The A- and F-type stars of the main sequence (MS) are intermediate mass stars with a high proportion of chemically peculiar (CP) stars (Preston, 1974; Renson, 1988; Monier, 2019). These stars show various interesting phenomena such as chemical peculiarities, pulsation, magnetic field variability and rotation (Preston, 1974; Monier, 2019; Trust et al., 2021a). Several categories of CP stars populate the interval $7000 \text{ K} \leq T_{\text{eff}} \leq 30000 \text{ K}$ in a well defined but overlapping temperature domain on the upper MS of the Hertzsprung–Russell (HR) diagram (Preston, 1974). The CP stars (Renson, 1988; Monier, 2019) can be distinguished from the normal A-stars (Adelman, 1986, 2004) based on the enhancement of absorption lines in their spectra. The spectra of the CP stars have strong lines of Si and Cr metals and other heavy metals (Ba, Zr, Sr and Y) and/or rare–earth elements with weak lines of Ca (Titus & Morgan, 1940; Conti, 1970; Fossati et al., 2009; Trust et al., 2021a,b). The CP stars are dominated by the metallic line (Am/Fm) stars, followed by magnetic Ap stars in the intermediate mass MS part of the HR diagram (Trust et al., 2021a).

The standard classification given by Preston (1974) subdivided the CP stars into four groups, based on the magnetic field strength and the strength of the absorption lines in their optical spectra. These groups are metallic line A–stars (CP1, Am stars), magnetic Ap stars (CP2), mercury–manganese stars (CP3: HgMn) and Helium weak stars (CP4: He-weak). In Am stars, the commonly used classification includes the three spectral types with prefix *k*, *h* and *m* corresponding to Ca II K-lines, hydrogen-lines and metallic-lines, respectively (Catanzaro et al., 2015, 2019). The Am stars

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