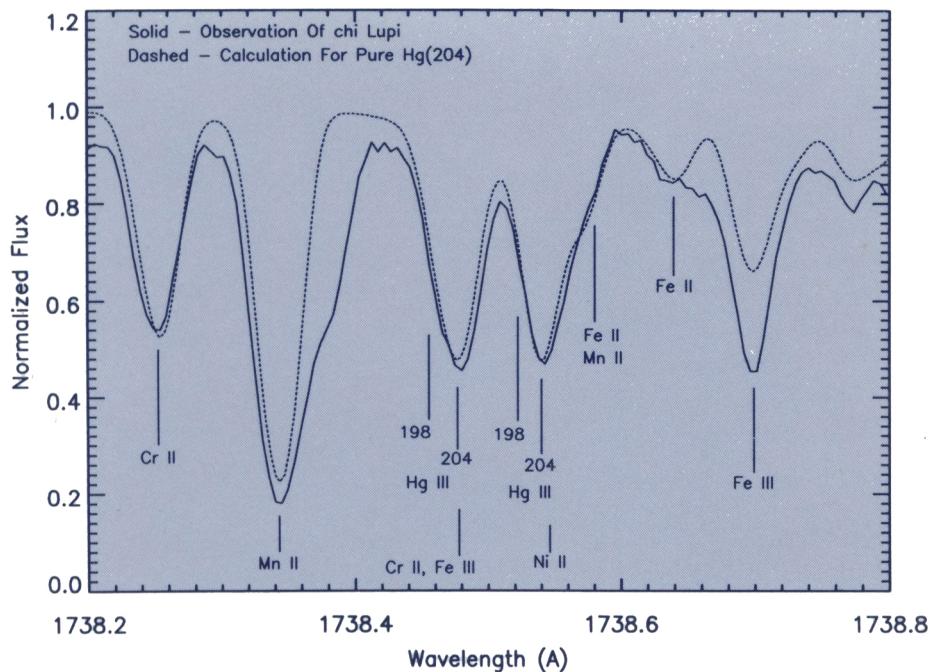




## PECULIAR VERSUS NORMAL PHENOMENA IN A-TYPE AND RELATED STARS

International Astronomical Union  
Colloquium No. 138

Trieste, Italy July 1992



Edited by  
**M. M. Dworetsky, F. Castelli, and R. Faraggiana**

**PECULIAR VERSUS NORMAL PHENOMENA IN  
A-TYPE AND RELATED STARS**

**International Astronomical Union  
Colloquium No. 138**

**Trieste, Italy      July 1992**

# **A SERIES OF BOOKS ON RECENT DEVELOPMENTS IN ASTRONOMY AND ASTROPHYSICS**

---

---

## **A.S.P. CONFERENCE SERIES BOARD OF EDITORS**

**Dr. Bruce Carney, Chair  
Dr. John P. Huchra  
Dr. Roberta M. Humphreys**

**© Copyright 1993 Astronomical Society of the Pacific  
390 Ashton Avenue, San Francisco, California 94112**

**All rights reserved**

**Printed by BookCrafters, Inc.**

**First published 1993**

**Library of Congress Catalog Card Number: 93-70704  
ISBN 0-937707-63-5**

**D. Harold McNamara, Managing Editor of Conference Series  
408 ESC Brigham Young University  
Provo, UT 84602  
801-378-2298**

# A SERIES OF BOOKS ON RECENT DEVELOPMENTS IN ASTRONOMY AND ASTROPHYSICS

---

- Vol. 1-*Progress and Opportunities in Southern Hemisphere Optical Astronomy: The CTIO 25th Anniversary Symposium*  
ed. V. M. Blanco and M. M. Phillips ISBN 0-937707-18-X
- Vol. 2-*Proceedings of a Workshop on Optical Surveys for Quasars*  
ed. P. S. Osmer, A. C. Porter, R. F. Green, and C. B. Foltz ISBN 0-937707-19-8
- Vol. 3-*Fiber Optics in Astronomy*  
ed. S. C. Barden ISBN 0-937707-20-1
- Vol. 4-*The Extragalactic Distance Scale: Proceedings of the ASP 100th Anniversary Symposium*  
ed. S. van den Bergh and C. J. Pritchett ISBN 0-937707-21-X
- Vol. 5-*The Minnesota Lectures on Clusters of Galaxies and Large-Scale Structure*  
ed. J. M. Dickey ISBN 0-937707-22-8
- Vol. 6-*Synthesis Imaging in Radio Astronomy: A Collection of Lectures from the Third NRAO Synthesis Imaging Summer School*  
ed. R. A. Perley, F. R. Schwab, and A. H. Bridle ISBN 0-937707-23-6
- Vol. 7-*Properties of Hot Luminous Stars: Boulder-Munich Workshop*  
ed. C. D. Garmany ISBN 0-937707-24-4
- Vol. 8-*CCDs in Astronomy*  
ed. G. H. Jacoby ISBN 0-937707-25-2
- Vol. 9-*Cool Stars, Stellar Systems, and the Sun. Sixth Cambridge Workshop*  
ed. G. Wallerstein ISBN 0-937707-27-9
- Vol. 10-*The Evolution of the Universe of Galaxies. The Edwin Hubble Centennial Symposium*  
ed. R. G. Kron ISBN 0-937707-28-7
- Vol. 11-*Confrontation Between Stellar Pulsation and Evolution*  
ed. C. Cacciari and G. Clementini ISBN 0-937707-30-9
- Vol. 12-*The Evolution of the Interstellar Medium*  
ed. L. Blitz ISBN 0-937707-31-7
- Vol. 13-*The Formation and Evolution of Star Clusters*  
ed. K. Janes ISBN 0-937707-32-5
- Vol. 14-*Astrophysics with Infrared Arrays*  
ed. R. Elston ISBN 0-937707-33-3
- Vol. 15-*Large-Scale Structures and Peculiar Motions in the Universe*  
ed. D. W. Latham and L. A. N. da Costa ISBN 0-937707-34-1
- Vol. 16-*Atoms, Ions and Molecules: New Results in Spectral Line Astrophysics*  
ed. A. D. Haschick and P. T. P. Ho ISBN 0-937707-35-X
- Vol. 17-*Light Pollution, Radio Interference, and Space Debris*  
ed. D. L. Crawford ISBN 0-937707-36-8
- Vol. 18-*The Interpretation of Modern Synthesis Observations of Spiral Galaxies*  
ed. N. Duric and P. C. Crane ISBN 0-937707-37-6
- Vol. 19-*Radio Interferometry: Theory, Techniques, and Applications, IAU Colloquium 131*  
ed. T. J. Cornwell and R. A. Perley ISBN 0-937707-38-4

Vol. 20-Frontiers of Stellar Evolution, celebrating the 50th Anniversary of McDonald Observatory ed. D. L. Lambert	ISBN 0-937707-39-2
Vol. 21-The Space Distribution of Quasars ed. D. Crampton	ISBN 0-937707-40-6
Vol. 22-Nonisotropic and Variable Outflows from Stars ed. L. Drissen, C. Leitherer, and A. Nota	ISBN 0-937707-41-4
Vol. 23-Astronomical CCD Observing and Reduction Techniques ed. S. B. Howell	ISBN 0-937707-42-4
Vol. 24-Cosmology and Large-Scale Structure in the Universe ed. R. R. de Carvalho	ISBN 0-937707-43-0
Vol. 25-Astronomical Data Analysis Software and Systems I ed. D. M. Worrall, C. Biemesderfer, and J. Barnes	ISBN 0-937707-44-9
Vol. 26-Cool Stars, Stellar Systems, and the Sun, Seventh Cambridge Workshop ed. M. S. Giampapa and J. A. Bookbinder	ISBN 0-937707-45-7
Vol. 27-The Solar Cycle ed. K. L. Harvey	ISBN 0-937707-46-5
Vol. 28-Automated Telescopes for Photometry and Imaging ed. S. J. Adelman, R. J. Dukes, Jr., and C. J. Adelman	ISBN 0-937707-47-3
Vol. 29-Workshop on Cataclysmic Variable Stars ed. N. Vogt	ISBN 0-937707-48-1
Vol. 30-Variable Stars and Galaxies, in honor of M. S. Feast on his retirement ed. B. Warner	ISBN 0-937707-49-X
Vol. 31-Relationships Between Active Galactic Nuclei and Starburst Galaxies ed. A. V. Filippenko	ISBN 0-937707-50-3
Vol. 32-Complementary Approaches to Double and Multiple Star Research, IAU Colloquium 135 ed. H. A. McAlister and W. I. Hartkopf	ISBN 0-937707-51-1
Vol. 33-Research Amateur Astronomy ed. S. J. Edberg	ISBN 0-937707-52-X
Vol. 34-Robotic Telescopes in the 1990s ed. A. V. Filippenko	ISBN 0-937707-53-8
Vol. 35-Massive Stars: Their Lives in the Interstellar Medium ed. J. P. Cassinelli and E. B. Churchwell	ISBN 0-937707-54-6
Vol. 36-Planets and Pulsars ed. J. A. Phillips, S. E. Thorsett, and S. R. Kulkarni	ISBN 0-937707-55-4
Vol. 37-Fiber Optics in Astronomy II ed. P. M. Gray	ISBN 0-937707-56-2
Vol. 38-New Frontiers in Binary Star Research ed. K. C. Leung and I. S. Nha	ISBN 0-937707-57-0
Vol. 39-The Minnesota Lectures on the Structure and Dynamics of the Milky Way ed. Roberta M. Humphreys	ISBN 0-937707-58-9
Vol. 40-Inside the Stars, IAU Colloquium 137 ed. Werner W. Weiss and Annie Baglin	ISBN 0-937707-59-7
Vol. 41-Astronomical Infrared Spectroscopy: Future Observational Directions ed. Sun Kwok	ISBN 0-937707-60-0

Vol. 42-Gong 1992: Seismic Investigation of the Sun and Stars ed. Timothy M. Brown	ISBN 0-937707-61-9
Vol. 43-Sky Surveys: Protostars to Protogalaxies ed. B. T. Soifer	ISBN 0-937707-62-7
Vol. 44-Peculiar Versus Normal Phenomena in A-Type and Related Stars ed. M. M. Dworetsky, F. Castelli, and R. Faraggiana	ISBN 0-937707-63-5

Inquiries concerning these volumes should be directed to the:

Astronomical Society of the Pacific  
CONFERENCE SERIES  
390 Ashton Avenue  
San Francisco, CA 94112-1722  
415-337-1100

ASTRONOMICAL SOCIETY OF THE PACIFIC  
CONFERENCE SERIES



**Volume 44**

**PECULIAR VERSUS NORMAL PHENOMENA IN  
A-TYPE AND RELATED STARS**

**International Astronomical Union  
Colloquim No. 138**

**Trieste, Italy      July 1992**

**Edited by  
M. M. Dworetsky, F. Castelli, and R. Faraggiana**

## TABLE OF CONTENTS

Preface	xi
Organizing Committees	xiii
List of Participants	xiv
Editors' Notes and Acknowledgements	xviii

Note: Discussions of posters are indicated by (D) after the names of the authors.

### I. GENERAL PROPERTIES OF CP STARS

<b>Introductory Reviews:</b>	
Hg-Mn Stars versus Normal Stars <i>M.M. Dworetsky</i>	1
Abundances in Magnetic Ap Stars <i>C.R. Cowley</i>	18
Discussion: <i>Dworetsky, Cowley</i>	26
<b>Invited Talks:</b>	
Recent Results on Abundance Determinations <i>S.J. Adelman</i>	27
Exploring Abundance and Isotope Anomalies in CP Stars with the HST/GHRS: High Resolution UV Spectroscopy of $\chi$ Lupi <i>D.S. Leckrone, G.M. Wahlgren, S.G. Johansson and S.J. Adelman</i>	42
Similarities and Differences between Magnetic and Non-magnetic CP Stars <i>T. Lanz</i>	60
Abundances of Heavy Elements in CP Stars <i>K. Sadakane</i>	72
Discussion: <i>Adelman, Leckrone et al, Lanz, Sadakane</i>	85
A New Opacity-Sampling Model Atmosphere Program for Arbitrary Abundances <i>R.L. Kurucz</i>	87
Modelling A-Type Atmospheres: NLTE Models <i>I. Hubeny and T. Lanz</i>	98
Atomic Data: Needs and Progress <i>M.C. Artru</i>	113
Discussion: <i>Kurucz, Hubeny, Artru</i>	120
<b>Posters:</b>	
Using HST/GHRS Echelle Spectra as Templates for IUE Data Analysis <i>G.M. Wahlgren, D.S. Leckrone, S. Johansson and M. Rosberg</i>	121
How Normal are the Peculiar A Stars <i>G.S.D. Babu and B.S. Shylaja</i>	126
Abundance Correlations in Mercury-Manganese Stars <i>K.C. Smith and M.M. Dworetsky</i>	131

Chemically Peculiar Stars among Spectroscopic Binaries—Revisited <i>W. Seggewiss</i> (D)	137
The Impact of Reddening on the Observed Fluxes of A Stars <i>P. Bonifacio and F. Castelli</i>	143
An Abundance Analysis of the Silicon CP Star HD 43819 <i>Z. Lopez-Garcia and S.J. Adelman</i>	149
N and Fe-Peak Elemental Abundances from IUE Co-added Spectra of Hg-Mn and Normal Stars <i>S.W. Roby, S.J. Adelman, D.S. Leckrone, C. Cowley and G.M. Wahlgren</i>	154
Spectrum Analysis of the Binary Star 53 Aur with a CP3 Component <i>J. Zverko, J. Budaj, M. Zboril, J. Žižňovský</i>	161
On Stark Broadening of Heavy Elements Lines in A-Type Star Spectra: Bi II Lines <i>M.S. Dimitrijević and L. Č. Popović</i>	165
Search for the Companion in the $\beta$ CrB Spectrum <i>R. Faraggiana and M. Gerbaldi</i>	169
$H_{\beta}$ Profiles of 25 CP Stars <i>R. Kroll</i>	173
Line Identification of Schneider's Star (BD + 24° 3675) around $H_{\beta}$ <i>R. Kroll</i>	178
Comparison of Different Methods for Determining Atmospheric Parameters of A and F Stars <i>B. Smalley and M.M. Dworetsky</i>	182
Li in Clusters: A and Am Stars <i>C. Burkhardt and M.F. Coupry</i>	187
Physical Parameters and Chemical Composition of Components of the Am-Type Binary System RR Lyncis <i>L.S. Lyubimkov and T.M. Rachkovskaya</i>	192
MK Process and the Am Stars <i>S. Sreedhar Rao and K.D. Abhyankar</i> (D)	197
The Colors of Am Stars <i>B.S. Shylaja and G.S.D. Babu</i>	203
The Effective Temperature of Am Stars <i>C. Mégezquier and C. van 't Veer</i> (D)	208
Elemental Abundances of Sharp-lined Metallic-lined and Comparable Normal Stars <i>D. Koçer, S.J. Adelman, G. Bolcal and G. Hill</i>	213

## II. MAGNETIC FIELDS: OBSERVATIONS AND THEORIES

Introductory Review: Magnetic Fields: Observations and Topology <i>J.D. Landstreet</i>	218
Invited Talks: Magnetic Field Diagnosis through Spectropolarimetry <i>G. Mathys</i>	232
Zeeman Doppler Imaging <i>W. Wehlau and J. Rice</i>	247

Mapping the Surface Distribution of Elements on Ap Stars Using the Maximum Entropy Method	258
<i>A.P. Hatzes</i>	
Discussion: <i>Landstreet, Mathys, Wehlau &amp; Rice, Hatzes</i>	272
 Posters:	
Broadband Measurements of the Transverse Magnetic Field of Cool Ap Stars	274
<i>J.-L. Leroy, J.D. Landstreet, E. Landi degl'Innocenti and M. Landolfi</i>	
Stellar Spots—Heating and Cooling Diamagnetically	279
<i>R. Steinitz and U. Goldstein</i>	
A New Model for Stellar Magnetism	284
<i>P.F. Browne</i>	
Determination of Stellar Magnetism Based on the Computerized Evaluation of Zeeman-spectra	291
<i>E. Gerth</i>	
Estimation of Stellar Magnetic Fields from Line-Strengths: Refined Hensberge-de Loore Method	295
<i>Y. Takeda</i>	
Observations of Magnetically Split Lines in Ap Stars	300
<i>G. Mathys, J.D. Landstreet and T. Lanz</i>	
Broadband Linear Polarization in Ap Stars	305
<i>M. Landolfi, E. Landi degl'Innocenti, M. Landi degl'Innocenti, J.-L. Leroy and S. Bagnulo</i>	
Search for Magnetic Fields in Vega, Gamma Geminorum, and Sirius	310
<i>M. Takada-Hidai and J. Jugaku</i>	

### III. MAGNETIC VERSUS NON-MAGNETIC STARS

Invited Talks:	
Have Non-magnetic Stars a Complex Geometry ?	315
<i>F.A. Catalano</i>	
Variability among Magnetic and Non-magnetic Stars	327
<i>W. Schöneich and E. Źelwanowa</i>	
Discussion: <i>Catalano, Schöneich</i>	339
 Posters:	
Do Bp Stars have Flares ?	340
<i>B. Veto</i>	
Variations of Ultra-Violet Lines for C, N, and O in the Ap Stars HD 18296 and HD 25823	345
<i>J.-F. Gonzalez and M.-C. Artru</i>	
Line Variability in 33 Gem ?	350
<i>S. Hubrig and R. Launhardt (D)</i>	

<b>Introductory Review:</b>	
Carbon and Silicon in Normal A Stars and in Lambda Bootis Stars <i>H. Holweger and S. Stürenburg</i>	356
Discussion: <i>Holweger</i>	367
<b>Invited Talks:</b>	
The $\lambda$ Bootis and Related Stars <i>M. Gerbaldi and R. Faraggiana</i>	368
Discussion: <i>Gerbaldi &amp; Faraggiana</i>	382
<b>Rotational Velocities for the Brighter A-type Stars</b>	384
<i>H.A. Abt and N.I. Morrell</i>	
He-abnormal Stars <i>K. Hunger and D. Groote</i>	394
Discussion: <i>Abt &amp; Morrell, Hunger</i>	405
<b>Posters:</b>	
Abundances in Rapidly Rotating A Stars <i>M. Lemke</i> (D)	407
Parameters $T_{eff}$ and $L/L_\odot$ for a Group of $\lambda$ Boo Candidate Stars and their Evolutionary Status <i>M. Gerbaldi J. Zorec, F. Castelli and R. Faraggiana</i>	413
A Search for $\lambda$ Bootis Stars in OB Associations <i>R.O. Gray and C.J. Corbally</i> (D)	418
Hydrogen-Line Profiles of Some $\lambda$ Bootis Stars <i>I.Kh. Iliev and I.S. Barzova</i> (D)	423
Search for $\lambda$ Bootis Stars in Open Clusters <i>K. Pavlovski, A. Schnell and H.M. Maitzen</i>	429
Spectral Characteristics of A-Type Stars in the Galactic Halo <i>C.J. Corbally and R.O. Gray</i> (D)	432
A Theoretical Period-Luminosity Relation of Dwarf Cepheids <i>D.H. McNamara and J.M. Powell</i>	437

## V. THEORY OF CP STAR PHOTOSPHERES

<b>Introductory Review:</b>	
Mechanisms of Separation of Elements <i>G.J. Michaud and C.R. Proffitt</i>	439
<b>Invited Talks:</b>	
Diffusion: Theoretical Computations for Non-magnetic Stars <i>G. Alecian</i>	450
Diffusion Models for Magnetic Ap Stars <i>J. Babel</i>	458
Discussion: <i>Alecian, Babel</i>	473

Chemical Separation vs Rotation in A and F-Stars <i>P. Charbonneau</i>	474
Discussion: <i>Charbonneau</i>	490
<b>Posters:</b>	
Non-LTE Analysis of CNO Lines in Vega <i>Y. Takeda (D)</i>	491
Models for Vega <i>F. Castelli and R.L. Kurucz (D)</i>	496
Steady State Diffusion Processes under Turbulent Conditions: Gallium and Aluminium Cases <i>J. Budaj, M. Zboril, J. Zverko, J. Žizňovský and J. Klačka</i>	502

## VI. MAGNETO-HYDRODYNAMICAL PHENOMENA IN CP STARS

<b>Invited Talks:</b>	
Radio and X-ray Emissions from Chemically Peculiar B- and A-Type Stars: Observations and a Model <i>J.L. Linsky</i>	507
Spectral Diagnoses of Chromospheres and Winds in A-type Stars <i>T. Lanz and I. Hubeny</i>	517
The Magnetospheres of the Helium Peculiar Stars of the Upper Main Sequence <i>S.N. Shore</i>	528
Discussion: <i>Linsky, Lanz, Shore</i>	539
<b>Posters:</b>	

Periodic Radio Emission from the Helium Rich Stars HD 37017 and $\sigma$ Ori E <i>F. Leone and G. Umana</i>	541
---	-----

## VII. PHOTOMETRIC VARIABILITY AND EVOLUTIONARY STATUS

<b>Invited Talks:</b>	
Long Term Variability in CP Stars <i>H. Hensberge</i>	547
Determination of Luminosity, Atmospheric Structure, and Magnetic Geometry from Studies of the Pulsation in roAp Stars <i>D.W. Kurtz and P. Martinez</i>	561
Discussion <i>Hensberge, Kurtz &amp; Martinez</i>	576
Chemically Peculiar Stars in Clusters: Upper and Lower Age Limits of CP Stars <i>P. North</i>	577
CP Stars at High Galactic Latitude: Photometry near the Galactic Poles <i>H. Schneider</i>	592
Discussion: <i>North, Schneider</i>	603

<b>Posters:</b>	
Photometric Properties of CP Stars in the Infrared <i>F.A. Catalano, F. Leone and R. Kroll</i> (D)	605
Radial Velocity and Magnetic Variations of $\alpha$ Draconis <i>H. Lehmann and G. Scholz</i>	612
An Empirical T- $\tau$ Curve for the roAp Star HR 3831: Atmospheric Structure from Pulsation Amplitudes <i>J.M. Matthews, W.H. Wehlau, J. Rice and G.A.H. Walker</i> (D)	617
Complications of Studies of Galactic Structure, Caused by CP Stars <i>L.O. Lodén and A. Sundman</i>	623
Statistics of CP Stars in a Magnitude-limited Sample: The Bright Star Catalogue <i>H. Schneider</i>	629
Age Determination for Am Stars <i>F. Figueras, J. Torra, C. Jordi and R. Asai</i>	634
CP3 Stars in Open Clusters <i>H. Schneider</i>	639
Photometry of Chemically Peculiar Stars with Automatic Photoelectric Telescopes <i>S.J. Adelman and D.M. Pyper</i> (D)	644
Variability of 56 Ari <i>W. Czechowski and K. Stępień</i> (D)	650
Growth Rate in the Study of Normal and Chemically Peculiar Stars of the Upper Main Sequence <i>J. Jugaku</i>	655
<b>VIII. SUMMARY AND GENERAL DISCUSSION</b>	657
<b>Index</b>	664