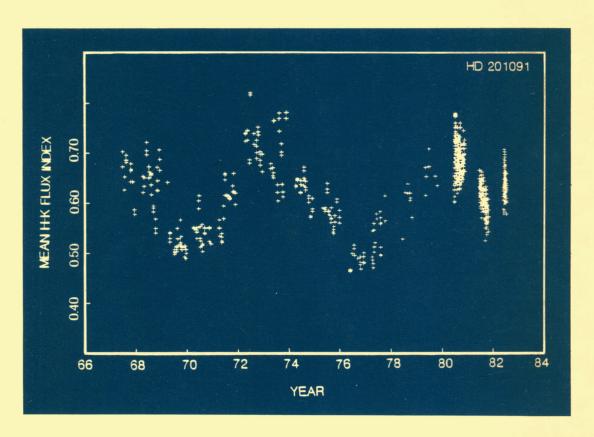
SYMPOSIUM No. 102

SOLAR AND STELLAR MAGNETIC FIELDS: ORIGINS AND CORONAL EFFECTS

Edited by J. O. STENFLO





INTERNATIONAL ASTRONOMICAL UNION

D. REIDEL PUBLISHING COMPANY

DORDRECHT / BOSTON / LANCASTER



SOLAR AND STELLAR MAGNETIC FIELDS: ORIGINS AND CORONAL EFFECTS

UNION ASTRONOMICUE INTERNATIONALE

场合约

INTERNATIONAL ASTRONOMICAL UNION 61 AV DE L'UBSÉRVATOIRE, F-75014 PARIS

INTERNATIONAL ASTRONOMICAL UNION UNION ASTRONOMIQUE INTERNATIONALE

SYMPOSIUM No. 102
HELD IN ZURICH, SWITZERLAND, AUGUST 2-6, 1982

SOLAR AND STELLAR MAGNETIC FIELDS: ORIGINS AND CORONAL EFFECTS

EDITED BY

J. O. STENFLO
Institute of Astronomy, Zurich, Switzerland

D. REIDEL PUBLISHING COMPANY

A MEMBER OF THE KLUWER ACADEMIC PUBLISHERS GROUP
DORDRECHT / BOSTON / LANCASTER



Library of Congress Cataloging in Publication Data Main entry under title:

ISBN 90-277-1621-8 (pbk.)



Solar and stellar magnetic fields: origins and coronal effects

At head of title: International Astronomical Union. Includes indexes.

1. Solar magnetic field—Congresses. 2. Stars—Magnetic fields—Congresses. 3. Sun—Corona—Magnetic fields—Congresses. 4. Stars—Corona—Magnetic fields—Congresses. I. Stenflo, Jan Olof, 1942—II. International Astronomical Union.

QB539.M23S64 1983 523.8'2 83-9571
ISBN 90-277-1619-6

Published on behalf of the International Astronomical Union by D. Reidel Publishing Company, P. O. Box 17, 3300 AA Dordrecht, Holland

All Rights Reserved
Copyright © 1983 by the International Astronomical Union

Sold and distributed in the U.S.A. and Canada by Kluwer Academic Publishers, 190 Old Derby Street, Hingham, MA 02043, U.S.A.

In all other countries, sold and distributed by Kluwer Academic Publishers Group, P.O. Box 322, 3300 AH Dordrecht, Holland

No part of the material protected by this copyright notice may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, recording or by any informational storage and retrieval system, without written permission from the publisher

Printed in The Netherlands

TABLE OF CONTENTS

FOREWORD		ix
I.	MAGNETIC FIELDS IN STELLAR PHOTOSPHERES	1
	Observations of Magnetic Fields on Late-type Stars	
	G.W. Marcy (Invited Review) Long-term Coherent Periodicities in the Mean Magnetic Field of the Sun	3
	V.A. Kotov and L.S. Levitsky Methods and Results for Detecting Magnetic Fields on Late-type Stars	23
	M.S. Giampapa and S.P. Worden	29
	Zeeman Effect Observations in the RS CVn Star HR 5110 and in Late-type Stars with Strong Ca II Emission	
	W.K. Bonsack and T. Simon Theory of Photospheric Magnetic Fields	35
	H.C. Spruit (Invited Review)	41
	Solitons in Magnetic Flux Tubes B. Roberts	61
	Self-consistent Models for Small Photospheric Flux Tubes W. Deinzer, G. Hensler, D. Schmitt, M. Schüssler, and E. Weisshaar	67
	Time-dependent Convective Collapse of Flux Tubes	
	S.S. Hasan Numerical 3-D Simulations of the Collapse of Photospheric Flux Tubes	73
	A. Nordlund Chromospheric and Coronal Indicators of Stellar Magnetic Structure	79
	C. Zwaan (Invited Review)	85
п.	ROTATION - ACTIVITY - CYCLE - AGE CONNECTION:	
	OBSERVATIONS	99
	The Observed Relationships between Some Solar Rotation Parameters and the Activity Cycle	
	R. Howard and B.J. LaBonte (Invited Review) The Mount Wilson Program for Stellar Activity Cycles	101
	A.H. Vaughan (Invited Review)	113
	The Relation between Rotation and Magnetic Activity on Lower Main Sequence Stars as Derived from Chromospheric Indicators	
	R.W. Noyes (Invited Review)	133
	Magnetic Fields and Convection: New Observations W.C. Livingston	149
	Possibilities and Attempts to Determine the Differential Rotation on F-type Main-sequence Stars	
	H. Wöhl	155

	IUE Observations of the Chromospheric Activity-Age Relation		
	in Young Solar-type Stars T. Simon and A.M. Boesgaard	161	
	Stellar X-ray Emission as an Indicator of Stellar Magnetic Activity	101	
	G.S. Vaiana (Invited Review)	165	
	Fractional Stellar Convection Zone Depth and the Generation of		
	Magnetic Flux: An Empirical Approach		
	M.S. Giampapa The Connel Betation Activity Relations in Late type Stars	187	
	The Coronal Rotation-Activity Relations in Late-type Stars F. M. Walter	193	
	Period-Activity Relations in Close Binary Systems	100	
	G. Basri, R. Laurent, and F. Walter	199	
	Coronal Activity in F-, G-, and K-type Stars;		
	Empirical Relations between Stellar Parameters		
	R. Mewe, C.J. Schrijver, E.H.B.M. Gronenschild, and C. Zwaan	205	
m.	THEORY OF STELLAR MAGNETIC FIELD GENERATION	211	
	Stellar Dynamo Theory		
	M. Schüssler (Invited Review)	213	
	A Molecular Weight Gradient Battery Mechanism for Stellar Magnetic Fields L. Mestel and D. Moss	237	
	Topological Magnetic Flux Pumping Revisited	0.40	
	W. Arter Dynamos of the Sun and Stars, and Associated Convection Zone Dynamics	243	
	P.A. Gilman (Invited Review)	247	
	Helical and Non-helical Dynamos		
	U. Frisch, A. Pouquet, and M. Meneguzzi	271	
	A Quantitative Study of Magnetic Flux Transport on the Sun		
	N.R. Sheeley, Jr., J.P. Boris, T.R. Young, Jr., C.R. DeVore, and	273	
	K.L. Harvey On the Stellar Rotation—Activity Connection	213	
	R. Rosner (Invited Review)	279	
	Amplification of Magnetic Fields by Compressible Convection		
	M.R.E. Proctor	301	
	Periodic and Aperiodic Behaviour in Stellar Dynamos		
	F. Cattaneo, C.A. Jones, and N.O. Weiss	307	
IV.	THE ROLE OF MAGNETIC FIELDS IN THE STRUCTURE AND		
	ENERGY BALANCE OF STELLAR ATMOSPHERES	311	
	The Role of Magnetic Fields in Stellar Chromospheres and Transition Regions		
	J.L. Linsky (Invited Review)	313	
	The Magnetic Field Configuration in Solar and Stellar Chromospheres	339	
	U. Anzer and D.J. Galloway Empirical Scaling Laws for Coronal Heating	งอช	
	L. Golub (Invited Review)	345	
	Radio Wavelength Observations: Structure, Strength and Variability of		
	Magnetic Fields in the Transition Region and the Solar Corona		
	K.R. Lang	363	

TABLE OF CONTENTS vii

	Coronal and Chromospheric Structures in AR Lac:	
	I. Data and Models	900
	D.M. Gibson, F.M. Walter, and G.S. Basri	369
	The Role of Magnetic Fields in the Heating of Stellar Atmospheres - Theory C. Chiuderi (Invited Review)	375
	VLA Observations of Quiescent and Flare Microwave Emission from	0.0
	Late-type Stars: A Unique Probe of Coronal Magnetic Fields	
	D.E. Gary, J.L. Linsky, and G.A. Dulk	387
	Electrodynamic Coupling in Magnetically Confined Stellar X-ray Loops	
	J.A. Ionson	391
	A Thermal Catastrophe in a Resonantly Heated Coronal Loop	
	P.C.H. Martens and M. Kuperus	397
	Finite Amplitude Effects of Torsional Alfvén Waves in a Flux Tube	
	Ø. Andreassen and P. Maltby	401
	Observations of Alfvén Waves Simultaneously in $H\alpha$ and K	
	R.G. Giovanelli and J. Beckers	407
	Heating of Intense Magnetic Flux Tubes by Magnetohydrodynamic Waves	
	Z. Musielak and E. Bielicz	413
V.	STELLAR WINDS AND SPINDOWN IN LATE-TYPE STARS	417
	Stellar Winds and Spindown - Observations	
	L. Hartmann (Invited Review)	419
	Angular Momentum Loss and Chromospheric Activity in Late-type Dwarfs	
	D.R. Soderblom	439
	Magnetic Topology and the Heating of Extended Chromospheres	
	R.E. Stencel	445
	Stellar Winds and Spindown in Solar Type Stars	
	I.W. Roxburgh (Invited Review)	449
	The Remarkable Rotational Braking of G5 Giants	
	D.F. Gray	461
	Expulsion of Magnetized Plasmas from Coronae	
	B.C. Low	467
	Plasma Flow and Solar Wind Acceleration in	
	Non-radial Coronal Magnetic Fields	
	H. Biernat, N. Kömle, and H. Rucker	473
	Magnetic Braking and Angular Momenta of Protostars	
	T.Ch. Mouschovias	479
	Closed and Open Magnetic Fields in Stellar Atmospheres:	
	Effects on Mass Loss from Cool Giant Stars	405
•	D.J. Mullan	487
	Stellar Winds and Spindown in Red Giants A.S. Endal	493
VI.	SUMMARY AND FUTURE DIRECTIONS	499
	Observational Needs for Progress in	
	Solar/Stellar Magnetic Activity: Overview	2 0.4
	R.W. Noyes	501

Observational Requirements: Ground-based	
C. Zwaan	503
Outlook for Ground-based and Space Observations	
G.S. Vaiana	505
Theoretical Problems	
M. Stix	509
Discussion	511
Relationships between Solar and Stellar Magnetic Fields	
L.E. Cram (Summary Lecture)	515
LIST OF POSTER PAPERS	533
LIST OF PARTICIPANTS	537
AUTHOR INDEX	543
SUBJECT INDEX	545