

ELECTROMAGNETIC PHENOMENA IN
COSMICAL PHYSICS

INTERNATIONAL ASTRONOMICAL UNION
SYMPOSIUM No. 6

HELD IN STOCKHOLM, AUGUST 1956

ELECTROMAGNETIC PHENOMENA
IN COSMICAL PHYSICS

EDITED BY

B. LEHNERT

Royal Institute of Technology, Stockholm

*Printed with
financial assistance from
U.N.E.S.C.O.*



CAMBRIDGE
AT THE UNIVERSITY PRESS
1958

PUBLISHED BY
THE SYNDICS OF THE CAMBRIDGE UNIVERSITY PRESS

Bentley House, 200 Euston Road, London, N.W. 1
American Branch: 32 East 57th Street, New York 22, N.Y.

*Printed in Great Britain at the University Press, Cambridge
(Brooke Crutchley, University Printer)*

CONTENTS

Preface *page ix*

H. ALFVÉN: Opening address 1

PART I

MAGNETO-HYDRODYNAMICS

A. THEORY

PAPER

1. H. C. VAN DE HULST: Magnetic fields in astrophysics 5
2. A. BAÑOS, JR.: Magneto-hydrodynamic waves in compressible fluids with finite viscosity and heat conductivity 15
3. L. DAVIS, JR.: A fluid self-excited dynamo 27
4. A. J. KIPPER: Non-stable magneto-hydrodynamical processes in stars 33
5. S. CHANDRASEKHAR and K. H. PRENDERGAST: The axisymmetric case in hydromagnetics (*Abstract*) 46

B. EXPERIMENTS

6. B. LEHNERT: Magneto-hydrodynamic experiments 50
7. Y. NAKAGAWA and K. H. PRENDERGAST: Experimental work at the University of Chicago on the onset of thermal instability in a layer of fluid heated from below 61

C. IONIZED GAS IN A MAGNETIC FIELD

8. A. SCHLÜTER: Ionized gas in a magnetic field 71
9. E. ÅSTRÖM: Waves in a hot ionized gas in a magnetic field 81
10. W. H. BOSTICK: Experimental study of plasmoids 87
11. R. S. PEASE: A characteristic line current in a fully ionized gas 99

PART II

SOLAR ELECTRODYNAMICS

12. T. G. COWLING: Solar electrodynamics 105
13. A. B. SEVERNY: The processes in active regions on the sun and electromagnetics 114

14. P. A. SWEET: The neutral point theory of solar flares	<i>page</i> 123
15. J. W. DUNGEY: The neutral point discharge theory of solar flares. A reply to Cowling's criticism	135
16. J. H. PIDDINGTON: Some effects of hydromagnetic waves in the solar atmosphere	141
17. S. ROSSELAND, E. JENSEN and E. TANDBERG-HANSEN: Some considerations on thermal conduction and magnetic fields in prominences	150

PART III

STELLAR MAGNETISM

18. H. W. BABCOCK: Stellar magnetic fields	161
19. Y. ÖHMAN: Astrophysical applications of selective magnetic rotation	166
20. L. SPITZER, JR.: Theoretical problems of stellar magnetism	169
21. G. A. SHAJN: On the magnetic fields in interstellar space and in nebulae	182
22. E. R. MUSTEL: On the magnetic fields of novae and super-novae	193
23. K. SERKOWSKI: Interpretation of the polarization measurements of the double cluster in Perseus	204
24. A. J. DEUTSCH: Harmonic analysis of the periodic spectrum variables	209
25. E. M. BURBIDGE, G. R. BURBIDGE and W. A. FOWLER: Nuclear reactions and element synthesis in stellar atmospheres	222

PART IV

SOLAR AND INTERPLANETARY MAGNETIC FIELDS

26. H. W. BABCOCK and H. D. BABCOCK: Photospheric magnetic fields	239
27. L. BIERMANN: On meridional circulations in stellar convective zones	248
28. E. JENSEN: The magnetic fields of sunspots and the Evershed effect	258
29. A. SCHLÜTER and S. TEMESVÁRY: The internal constitution of sunspots	263
30. T. GOLD: The magnetic field in the corona	275
31. J. P. TERLETZKY: On the theory of ionized interstellar gas motion	281
32. H. ALFVÉN: Interplanetary magnetic field	284

PART V
ELECTROMAGNETIC STATE IN
INTERPLANETARY SPACE

A. THEORIES OF MAGNETIC STORMS

33. V. C. A. FERRARO: The present state of the corpuscular theory of magnetic storms *page* 295
34. L. BLOCK: The present state of the electric field theory of magnetic storms and aurorae 312
35. S. F. SINGER: A new model of magnetic storms and aurorae (*Abstract*) 329

B. COSMIC RAY METHODS OF
EXPLORING INTERPLANETARY SPACE

36. S. E. FORBUSH: The 27-day variation in cosmic ray intensity and in geomagnetic activity 332
37. D. VENKATESAN: Correlation between cosmic ray intensity and geomagnetic activity 345
38. J. A. SIMPSON: Solar production and modulation of cosmic rays, and their propagation through interplanetary space 355
39. V. SARABHAI, N. W. NERURKAR, S. P. DUGGAL and T. S. G. SASTRY: The anisotropy of primary cosmic radiation and the electromagnetic state in interplanetary space 377
40. E. Å. BRUNBERG: Separation of extra terrestrial variations in cosmic ray intensity and atmospheric effects by differential measurements with G-M telescopes 386
41. H. ELLIOT and P. ROTHWELL: The solar daily variation of the cosmic ray intensity 392
42. A. EHMERT: Solar cosmic radiation and the interstellar magnetic field 404
43. E. N. PARKER: On the variations of the primary cosmic ray intensity 420
44. W. F. G. SWANN: Electromagnetic acceleration of particles to cosmic ray energies 428
45. Y. SEKIDO, S. YOSHIDA and Y. KAMIYA: Further observations of the point source of cosmic rays 441
46. W. H. BENNETT: The Störmertron 446

PART VI
HIGH CURRENT DISCHARGES

47. L. A. ARTSIMOVICH: Untersuchungen über Impulsentladungen im Zusammenhang mit der Möglichkeit von kontrollierbaren thermonuklearen Reaktionen page 451
48. A. L. BESBATSCHENKO, I. N. GOLOVIN, D. P. IVANOV, V. D. KIRILLOV und N. A. JAVLINSKIJ: Untersuchung einer Starkstromgasentladung im magnetischen Längsfelde 464
49. W. D. SCHAFRANOW: Über die Stabilität eines zylindrischen Gasleiters im magnetischen Felde 491

PART VII
ADDITIONAL CONTRIBUTIONS

50. P. A. SWEET: Magneto-hydrostatic equilibrium in an external magnetic field 499
51. S. A. KAPLAN: Theory of isotropic magnetic turbulence in gases 504
52. M. КОРЕЦКÝ: An approximative calculation of electric conductivity in the lower layers of the solar atmosphere 513
53. I. S. SHKLOVSKY: On the nature of the emission from the galaxy NGC 4486 517
54. I. S. SHKLOVSKY: Optical emission from the Crab nebula in the continuous spectrum 520
55. G. R. BURBIDGE: Magnetic fields in radio sources 529
56. S. B. PIKELNER: Some effects which can accompany magnetic storms 534
- Name index* 539
- Subject index* 543