

CONTENTS

Preface	v
ELECTRON CYCLOTRON THEORY	1
Summary on Electron Cyclotron Theory <i>E. Westerhof</i>	3
Electron Cyclotron Radiative Transfer in Fusion Plasmas (<i>invited</i>) <i>F. Albajar, M. Bornatici, F. Engelmann</i>	7
Electron Bernstein Wave Experiments in an Over-dense Reversed Field Pinch Plasma (<i>invited</i>) <i>C.B. Forest, J.K. Anderson, M. Carter, M. Cengher, P.K. Chattopadhyay, R.W. Harvey, R.I. Pinsky, A.P. Smirnov</i>	17
Poynting Theorem and Spatio-temporal Dynamics of HF Field Intensity in Regions of Resonant Absorption <i>M.D. Tokman, E. Westerhof, M.A. Gavrilova</i>	27
Surface Cyclotron O-modes at Harmonics of Electron Cyclotron Frequencies <i>V.O. Girka</i>	35
Radial Transport Effects on ECCD in the TCV and DIII-D Tokamaks and on Ohmic Discharges in the MST RFP <i>R.W. Harvey, O. Sauter, R. Prater, P. Nikkola, R. O'Connell, C.B. Forest</i>	41
The Effect of the Electromagnetically Induced Transparency in High-Temperature Magnetoactive Plasmas <i>A.Yu. Kryachko, M.D. Tokman</i>	47
Numerical Simulation of EC-heating at the Tangent Injection of RF Radiation in Tokamak <i>M.A. Balakina, O.B. Smolyakova, M.D. Tokman</i>	53
EC + LH Current Drive in the Presence of an Internal Transport Barrier <i>P.R. da S. Rosa, L.F. Ziebell</i>	59

EC + LH Power Deposition Profiles in the Presence of an Internal Transport Barrier <i>L.F. Ziebell, P.R. da S. Rosa</i>	65
Power Absorption during Nonlinear Electron Cyclotron Wave-Particle Interaction <i>R. Kamendje, S. Kasilov, W. Kernbichler, M.F. Heyn</i>	71
Statistical Description of Currents Induced by Two Electron Cyclotron Counter-Propagating Waves <i>D. Carati, M. Ponomarjov</i>	77
Electrodynamical Model of the Gas Discharge Sustained by Surface Flute Modes <i>V.O. Girka, I.O. Girka, I.V. Pavlenko</i>	83
Electron Cyclotron Current Drive in High β_p Tokamak Plasmas <i>Y.R. Lin-Liu</i>	89
Evolution of Full Stokes Parameters in Polarized Radiative Transfer of Electron Cyclotron Waves on LHD <i>H. Idei, S. Kubo, T. Shimozuma, K. Tsumori, T. Watari, T. Notake I, S. Ito, S. Kobayashi, Y. Mizuno, Y. Takita, Y. Yoshimura, K. Ohkubo, S. Sakakibara, K. Narihara, I. Yamada, K. Tanaka, T. Morisaki, K.Y. Watanabe, H. Nakanishi, S. Ohdachi, M. Emoto, K. Matsuoka, O. Motojima, M. Fujiwara, LHD Experimental Group</i>	95
ECRH and Electron Heat Transport in Tokamaks <i>X.L. Zou, G. Giruzzi, R. Dumont</i>	101
Performance of the ITER ECRF Launchers <i>B. Lloyd, C. Warrick, M. O'Brien</i>	107
Self-consistent ECCD Calculations with Bootstrap Current <i>J. Decker, Y. Peysson, A. Bers, A.K. Ram</i>	113
Operations Space Diagram for ECRH and ECCD in JET and ITER <i>H. Bindslev</i>	119
General Proof of Symmetry Relations in Mode Conversion with Application to Excitation of, and Emission from, Electron Bernstein Waves <i>A. Bers, A.K. Ram</i>	125

Electron Cyclotron Resonance Heating of Plasmas in Spherical Tori <i>A.K. Ram, A. Bers</i>	131
Kinetic Simulations of Relativistic Electron Flows in Time-Dependent Electromagnetic Fields <i>M. Ponomarjov, D. Carati</i>	137
ELECTRON CYCLOTRON EMISSION	143
Summary of Electron Cyclotron Emission Measurements <i>A. Krämer-Flecken</i>	145
Mode-Converted Electron Bernstein Wave Emission Research on CDX-U and NSTX (<i>invited</i>) <i>G. Taylor, P.C. Efthimion, B. Jones, T. Munsat, J.C. Hosea, R. Kaita, R. Majeski, J. Spaleta, J.R. Wilson, J.B. Wilgen, G.L. Bell, D.A. Rasmussen, A.K. Ram, A. Bers, R.W. Harvey, A.P. Smirnov</i>	151
Recent Results on Electron Cyclotron Emission from Aditya Tokamak <i>D. Sriram, H.B. Pandya, P.K. Atrey, K.K. Jain, Aditya Team</i>	161
Electron Cyclotron Emission Measurement Diagnostics for SST-1 <i>H.B. Pandya, K.K. Jain</i>	169
Diagnosing the Electron Distribution Function with Oblique Electron Cyclotron Emission on FTU <i>E. de la Luna, V. Krivenski, O. Tudisco, P. Amadeo, A. Bruschi, F. Gandini, G. Granucci, V. Muzzini, FTU and ECRH groups</i>	177
Theory of ECE Fluctuations in a Tokamak Plasmas <i>A.D. Piliya, A.Yu. Popov</i>	183
Nonthermal Microwave Radiation under Plasma Ohmic Heating in the Spherical Globus-M Tokamak <i>A.S. Ana'nev, V.K. Gusev, S.V. Krikunov, R.G. Levin, V.B. Minaev, A.B. Mineev, A.N. Novokhatskii, M.I. Patrov, Yu.V. Petrov, K.A. Podushnikova, V.V. Rozhdestvensky, N.V. Sakharov, I.N. Chugunov, A.E. Shevelev</i>	191
Heterodyne ECE Diagnostic in the Mode Detection and Disruptions Avoidance at TEXTOR <i>A. Krämer Flecken, K.H. Finken, H. Larue, V.S. Udintsev, TEXTOR Team</i>	197

Calibration and Upgrade of the ECE Imaging Diagnostic for TEXTOR <i>M.J. van de Pol, A.J.H. Donné, B.H. Deng, C.W. Domier, N.C. Luhmann Jr., E. Mazzucato, T. Munsat, H. Park</i>	203
Precision and Resolution on Tore-Supra ECE Electron Temperature Profile Measurements <i>J.L. Ségui, D. Molina, M. Goniche</i>	209
Large and Small Scale MHD Mode Studies at TEXTOR <i>V.S. Udintsev, B.Ph. van Milligen, F.C. Schüller, A. Krämer-Flecken, B.H. Deng, C.W. Domier, A.J.H. Donné, J.C. van Gorkom, N.C. Luhmann Jr.</i>	215
Electron Bernstein Emission Diagnostic of Electron Temperature Profiles at W7-AS Stellarator <i>F. Volpe, H.P. Laqua, W7-AS Team</i>	221
Fast ECE Diagnostics Applications for Real Time Control at JET <i>M. Zerbinì, J.M. Chareau, D. Mazon, M. Riva, R. Felton, E. Joffrin, M. Lennholm, R. Prentice</i>	227
ELECTRON CYCLOTRON HEATING AND CURRENT DRIVE EXPERIMENTS	233
Summary on Electron Cyclotron Heating and Current Drive Experiments <i>T.P. Goodman</i>	235
Stabilization of Neoclassical Tearing Modes by Localized ECCD in DIII-D (<i>invited</i>) <i>R. Prater, R.J. La Haye, J.M. Lohr, T.C. Luce, C.C. Petty, J.R. Ferron, D.A. Humphreys, E.J. Strait, F.W. Perkins, R.A. Ellis, III</i>	239
Formation of High Electron Temperature Plasmas in ECH Experiments on JT-60U Tokamak (<i>invited</i>) <i>Y. Ikeda, T. Suzuki, A. Isayama, K. Kajiwara, S. Ide, T. Ozeki, S. Moriyama, M. Seki, T. Fujita, M. Takechi, Y. Koide, T. Fukuda, H. Takenaga, O. Naito, K. Hamamatsu, T. Hatae, T. Fujii, JT-60 team</i>	247
Fully Off-Axis ECCD Driven Plasmas in TCV (<i>invited</i>) <i>P. Nikkola, O. Sauter, R. Behn, S. Coda, I. Condrea, T.P. Goodman, M.A. Henderson, R.W. Harvey, Y. Peysson, TCV Team</i>	257

Recent ECRH Results in ASDEX Upgrade (invited)	267
<i>F. Leuterer, R. Dux, G. Gantenbein, T. Goodman, J. Hobirk, F. Imbeaux, K. Kirov, P. Mantica, M. Maraschek, A. Mück, R. Neu, A.G. Peeters, G. Pereverzev, F. Ryter, J. Stober, W. Suttrup, G. Tardini, E. Westerhof, H. Zohm, AUG Team</i>	
Measurements of the Microwave Power Absorbed by a Plasma During Second Harmonic ECR Heating in the L-2M Stellarator	277
<i>D.K. Akulina, G.M. Batanov, M.S. Berezhetskii, G.S. Voronov, G.A. Gladkov, S.E. Grebenschikov, N.P. Donskaya, N.F. Larionova, A.I. Meshcheryakov, K.A. Sarksyian, O.I. Fedyanin, N.K. Kharchev, Yu.V. Khol'nov, S.V. Shchepetov</i>	
High Power Long Pulse Performance of the DIII-D Gyrotron Installation	283
<i>J. Lohr, Y.A. Gorelov, R.W. Callis, H.J. Grunloh, J.J. Peavy, R.I. Pinsker, D. Ponce, R. Prater, R.A. Ellis</i>	
Detailed Measurements of ECCD Efficiency on DIII-D for Comparison with Theory	291
<i>C.C. Petty, R. Prater, J. Lohr, T.C. Luce, R.A. Ellis, R.W. Harvey, J.E. Kinsey, L.L. Lao, M.A. Makowski</i>	
Magnetic Configuration Effects on Temperature Profile Perturbations Observed During ECH Experiments in TJ-II	297
<i>E. de la Luna, T. Estrada, F. Medina, J.A. Jiménez, A. Cappa, M. Ochando, E. Ascasibar, F. Castejón, A. Fernández, K. Likin, B.Ph. van Milligen</i>	
Electron Bernstein Wave Heating and Current Drive Experiments on COMPASS-D	303
<i>V. Shevchenko, Y. Baranov, M. O'Brien, A. Saveliev</i>	
The 3 MW ECRH/ECCD Transmission and Launching System on Tore Supra	309
<i>M. Lennholm, G. Agarici, G. Berger-By, P. Bosia, F. Bouquey, J. Clary, C. Darbos, G. Giruzzi, M. Jung, R. Magne, D. Roux, T. Petit, J.L. Segui, X.L. Zou</i>	
Electron Bernstein Wave Heating in Heliotron Systems	317
<i>K. Nagasaki, N. Yanagi, H. Shidara, F. Sano, K. Kondo, T. Mizuuchi, H. Okada, M. Nakasuga, S. Besshou, Y. Manabe, W. L. Ang, H. Kawazome, S. Maeno, K. Tomiyama, H. Tsuru, T. Takamiya, M. Takeda, T. Obiki</i>	

- Detection of EC Absorption Radius for Real-Time Control Applications 323
S. Cirant, F. Gandini, O. Tudisco
- Impact of ECRH Launcher Flexibility on NTM Stabilization and
 Advanced Scenarios in Large Toroidal Configurations as JET Plasmas 329
*S. Nowak, A. Bruschi, G. Ramponi, S. Cirant, E. Lazzaro,
 A.G.A. Verhoeven, H. Zohm*
- Physics Studies with the ECH System on FTU Tokamak 335
*S. Cirant, G. Bracco, A. Bruschi, P. Buratti, F. De Luca,
 F. Gandini, E. Giovannozzi, G. Granucci, A. Jacchia, E. Lazzaro,
 E. Minardi, S. Nowak, G. Ramponi, C. Sozzi, O. Tudisco*
- Experiments of ECCD and ECRH in a LHCD Sustained Plasma on
 FTU Tokamak 341
*G. Granucci, E. Barbato, A. Bruschi, C. Castaldo, R. Cesario,
 S. Cirant, B. Esposito, D. Farina, F. Gandini, G. Giruzzi,
 M. Marinucci, L. Panaccione, V. Pericoli-Ridolfini, S. Podda,
 A.N. Saveliev, A. Simonetto, C. Sozzi*
- Microwave Power Absorption into TJ-II ECRH Plasmas 347
*A. Fernández, A. Cappa, K. Likin, S. Eguilior, E. de la Luna,
 F. Castejón, R. Martín*
- Applications of Dense Plasma of ECR Discharge Sustained by
 Powerful Millimeter Wave Radiation 353
*S.V. Golubev, S.V. Razin, V.A. Skalyga, A.V. Vodopyanov,
 V.G. Zorin, P. Sortais, T. Lamy*
- ECRH Experiment in an Extended Power Regime on the Large
 Helical Device 359
*T. Shimosuma, S. Kubo, H. Idei, Y. Yoshimura, T. Notake,
 T. Watari, Y. Mizuno, S. Ito, S. Kobayashi, Y. Takita, K. Narihara,
 I. Yamada, N. Ohyabu, K. Ida, S. Inagaki, Y. Nagayama, Y. Takeiri,
 H. Funaba, M. Yokoyama, S. Murakami, M. Emoto, M. Goto,
 K. Ikeda, R. Kumazawa, S. Masuzaki, T. Minami, J. Miyazawa,
 S. Morita, T. Morisaki, S. Muto, T. Mutoh, H. Nakanishi,
 Y. Narushima, K. Nishimura, N. Noda, S. Ohdachi, Y. Oka,
 M. Osakabe, T. Ozaki, B.J. Peterson, A. Sagara, S. Sakakibara,
 R. Sakamoto, M. Sasao, M. Sato, K. Satoh, T. Seki, S. Shoji,
 H. Suzuki, K. Tanaka, K. Toi, K. Tokuzawa, K. Tsumori,
 K.Y. Watanabe, M. Yoshinuma, K. Kawahata, Y. Nakamura,
 H. Yamada, O. Kaneko, A. Komori, K. Yamazaki, K. Ohkubo,
 S. Sudo, K. Itoh, K. Matsuoka, O. Motojima, LHD Experimental Group*

- Exploitation of a Diamagnetic Loop for Modulated ECH Power
Absorption Measurements in TCV 365
*A. Manini, J.-M. Moret, S. Alberti, T.P. Goodman,
M.A. Henderson*
- Preliminary Results of Top Launch 3rd Harmonic X-mode Electron
Cyclotron Heating in the TCV Tokamak 371
J.-P. Hogge, S. Alberti, L. Porte, G. Arnoux
- First ECRH Modulation Experiments in Tore Supra 377
*X.L. Zou, J.F. Artaud, F. Bouquey, J. Clary, C. Darbos,
G. Giruzzi, M. Lennholm, R. Magne, J.L. Ségui*
- Experimental Investigation of the Whistler Cyclotron Instability in
ECR-produced Plasma in a Simple Mirror Trap 383
*A.V. Vodopyanov, S.V. Golubev, S.V. Razin, V.G. Zorin,
D.A. Mansfeld, A.G. Demekhov, V.Yu. Trakhtengerts*
- Heat Transport Study by Modulated ECH on FTU Tokamak 389
*A. Jacchia, F. De Luca, S. Cirant, C. Sozzi, G. Bracco,
A. Bruschi, P. Buratti, O. Tudisco*
- Electron Cyclotron Resonance Heating on TEXTOR: Results from
the Preliminary 110 GHz System 395
*E. Westerhof, G.M.D. Hogewey, J.A. Hoekzema,
F.C. Schüller, C.J. Barth, H. Bindslev, A.J.H. Donné,
P. Dumortier, J.C. van Gorkom, R.J.E. Jaspers, D. Kalupin,
H.R. Koslowski, A. Krämer-Flecken, N.J. Lopes Cardozo,
H.J. van der Meiden, A. Messiaen, T. Oyevaar, R.W. Polman,
L. Porte, V.S. Udintsev, B. Unterberg, M. Vervier, D. van Eester,
G. van Wassenhove, TEC Team*
- Electron Bernstein Wave Heating and Current Drive in Overdense
Plasmas at the Wendelstein7-AS-Stellarator 403
*H.P. Laqua, V. Erckmann, F. Volpe, H. Maassberg,
W7-AS Team, ECRH-Group*
- Current Profile Tailoring with Far Off-axis ECH Power Deposition in
TCV Elongation Experiments 407
*Y. Camenen, A. Pochelon, F. Hofmann, C. Angioni,
T.P. Goodman, M.A. Henderson, P. Nikkola, L. Porte,
O. Sauter*

Characteristic Features of the Behavior of ECRH-Produced Moderate- and Low-Density Plasmas in the L-2M Stellarator	413
<i>D.K. Akulina, G.M. Batanov, M.S. Berezhetskii, G.S. Voronov, G.A. Gladkov, S.E. Grebenshchikov, I.S. Danilkin, N.P. Donskaya, L.V. Kolik, N.F. Larionova, A.I. Meshcheryakov, K.A. Sarksyian, O.I. Fedyanin, N.K. Kharchev, Yu.V. Khol'nov, S.V. Shchepetov</i>	
ELECTRON CYCLOTRON TECHNOLOGY	419
Summary on Electron Cyclotron Technology	421
<i>G. Bosia</i>	
Advantages of Coaxial Cavity Gyrotrons (invited)	423
<i>V.E. Zapevalov, V.I. Khizhnyak, M.A. Moiseev, A.B. Pavelyev, N.I. Zavolsky</i>	
Experimental Results of the 140 GHz, 1 MW Long-Pulse Gyrotron for W7-X (invited)	433
<i>K. Koppenburg, A. Arnold, E. Borie, G. Dammertz, E. Giguët, R. Heidinger, S. Illy, M. Kuntze, G. Le Cloarec, F. Legrand, W. Leonhardt, C. Liévin, G. Neffe, B. Piosczyk, M. Schmid, M. Thumm</i>	
A Coaxial Cavity Gyrotron - Experimental Results and Technical Conditions	443
<i>B. Piosczyk, A. Arnold, H. Budig, G. Dammertz, O. Drumm, O. Dumbrajs, M. Kuntze, M. Thumm</i>	
Tests of Compact Dummy Loads Designed for 1 MW-cw	449
<i>J.L. Doane</i>	
Waveguide Diamond Vacuum Windows with Helicoflex® Seals	455
<i>J.L. Doane</i>	
Infrared Monitoring of 110 GHz Gyrotron Windows at DIII-D	461
<i>Y. Gorelov, J. Lohr, R.W. Callis, D. Ponce</i>	
The Utilization of Gyrotrons in the Field of ECR Ion Sources for Accelerators, First Results and Perspectives	467
<i>A. Girard, D. Hitz, G. Melin, S. Gammino, G. Ciavola, L. Celona</i>	

- Recent Progresses in the 110 GHz ECRF System on
JT-60U Tokamak 475
*Y. Ikeda, M. Seki, S. Moriyama, K. Kajiwara, K. Anno,
S. Hiranai, K. Ikagarshi, M. Isaka, A. Isayama, T. Imai,
K. Sakamoto, H. Sato, M. Shimono, S. Shinozaki,
M. Takahashi, M. Terakado, K. Yokokura, T. Fujii,
JT-60 Team*
- Performance of a Remote Steering Antenna for ECRH/ECCD
Applications Using 4-Wall Corrugated Square Waveguide 481
*W. Kasperek, G. Gantenbein, B. Plaum, R. Wacker,
E. Filipovic, A.V. Chirkov, G.G. Denisov, S.V. Kuzikov,
K. Ohkubo, F. Hollmann, D. Wagner*
- Operation of the 118 GHz Very Long Pulse Gyrotron for the
ECRH Experiment on Tore Supra 487
*C. Darbos, S. Alberti, F. Bouquey, J. Clary, E. Giguet,
G. Giruzzi, J.P. Hogge, M. Jung, M. Lennholm, C. Liévin,
R. Magne, T. Petit, Ch. Portafaix, D. Roux, J.L. Ségui,
M. Thumm, X. Zou*
- Progress of the 10 MW ECRH System for W7-X 493
*G. Michel, P. Brand, G. Dammertz, V. Erckmann,
G. Gantenbein, F. Hollmann, L. Jonitz, W. Kasperek,
H.P. Laqua, W. Leonhardt, G. Müller, F. Purps,
M. Schmid, T. Schulz, M. Thumm, Karlsruhe and
Stuttgart ECRH Teams*
- Characteristics of the Light Emission from CVD Diamond Windows 499
R. Heidinger, G. Dammertz, L. Steinbock, M. Thumm
- High Power Test of Single Mirror Polarizer for 170 GHz
ECCD System 505
M. Saigusa, K. Takahashi, S. Yuasa, K. Sakamoto, T. Imai
- The 113 GHz ECRH System for JET 511
*A.G.A. Verhoeven, W.A. Bongers, B.S.Q. Elzendoorn,
M. Graswinckel, P. Hellingman, J.J. Kamp, W. Kooijman,
O.G. Kruijt, J. Maagdenberg, D. Ronden, J. Stakenborg,
A.B. Sterk, J. Tichler, S. Alberti, T. Goodman, M. Henderson,
J.A. Hoekzema, J.W. Oosterbeek, A. Fernandez, K. Likin,
A. Bruschi, S. Cirant, S. Nowak, B. Piosczyk, M. Thumm,
H. Bindslev, A. Kaye, C. Fleming, H. Zohm*

Development of Quasi-Optical Components for Electron Cyclotron Heating based on Phase Measurements	517
<i>H. Idei, T. Notake, M. Shapiro, W. Kasperek, T. Shimosuma, S. Kubo, S. Ito, M. Sato, R.J. Temkin, K. Ohkubo</i>	
Test Results of the Prototype for Frequency Step Tunable 105-170 GHz 1MW Gyrotron	523
<i>V.E. Zapevalov, A.A. Bogdashov, A.V. Chirkov, G.G. Denisov, A.N. Kuftin, V.K. Lygin, M.A. Moiseev</i>	
Design of the Evacuated Waveguide Transmission Lines for JET-EP	529
<i>M.A. Henderson, S. Alberti, J. Bird, B. Elzendoorn, T.P. Goodman, F. Hoekzema, G. MacMillan, B. Piosczyk, L. Porte, A.G.A. Verhoeven</i>	
Development of EC Technology in JAERI	535
<i>K. Sakamoto, K. Takahashi, A. Kasugai, K. Hayashi, Y. Ikeda, K. Kajiwara, T. Kariya, Y. Mitsunaka, T. Fujii, T. Imai</i>	
The 140 GHz ECW System on TEXTOR	541
<i>J.A. Hoekzema, W.A. Bongers, A.F. van der Grift, O.G. Kruijt, J.W. Oosterbeek, A.J. Poelman, P.R. Prins, J. Scholten, F.C. Schüller, A.B. Sterk, C.J. Tito, E. Westerhof, TEC team</i>	
Results of 170 GHz Gyrotron Tests	547
<i>A.A. Borschegovsky, V.I. Il'in, J.V. Roschin, I.N. Roy, N.V. Shapotkovskij, M.V. Agapova, V.N. Il'in, V.E. Mjasnikov, V.O. Nichiporenko, L.G. Popov, S.V. Usachev, D.V. Hmara, G.G. Denisov, A.G. Litvak, V.I. Malygin, V.E. Zapevalov, M. Thumm, G. Dammertz, S. Illy</i>	
Position Control of ECRH Launcher Mirrors by Laser Speckle Sensor	553
<i>P.K. Michelsen, H. Bindslev, R.S. Hansen, S.G. Hanson</i>	
Matched Calorimetric Loads for High Power, Long Pulse Millimeter-Wave Gyrotrons	559
<i>A. Bruschi, S. Cirant, F. Gandini, V. Mellera, V. Muzzini, A. Nardone, A. Simonetto, C. Sozzi, N. Spinicchia</i>	
Recent Tests on 500 kW and 1 MW Multi-Second-Pulsed Gyrotrons	565
<i>K. Felch, M. Blank, P. Borchard, P. Cahalan, S. Cauffman, T.S. Chu, H. Jory</i>	

Current Status of ITER EC Design	571
<i>G. Bosia</i>	
The Power Measurement System of the Tore Supra ECRH Transmitter at 118 GHz	579
<i>G. Berger-By, J. Achard, M. Lennholm, D. Roux</i>	
List of Participants	585
Author Index	587