

**2006 IEEE International Vacuum
Electronics Conference**

held jointly with

**2006 IEEE International Vacuum
Electron Sources**



IVEC/IVESC 2006

April 25 - 27, 2006

**Portola Plaza Hotel
Monterey, California, USA**

*Sponsored by the
IEEE Electron Devices Society*



<http://ivec2006.org>

Copyright and Reprint Permission: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923. For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Operations Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855 1331. All rights reserved. Copyright ©2006 by the Institute of Electrical and Electronics Engineers

IEEE Catalog Number: 06EX1278

ISBN: 1-4244-0108-9

Library of Congress: 2005938127

WELCOME

On behalf of the Program Committee and the EDS Technical Committee on Vacuum Devices, I would like to welcome you to IVEC-IVESC 2006. This joint conference combines the Seventh IEEE International Vacuum Electronics Conference and the Sixth IEEE International Vacuum Electron Sources Conference. The conference is dedicated to the fields of vacuum electronics and electron sources. The meeting this year, sponsored by the IEEE Electron Devices Society, is being held at the Portola Plaza Hotel in the beautiful city of Monterey, California.

I am certain that you will find the program that the Program Committee has put together to be an exciting and rewarding one. The conference will open Tuesday morning, April 25, with a Plenary Session consisting of an excellent group of speakers covering subjects of special interest to the community. This will be followed by two and a half days of technical presentations, both oral and poster. During the conference, the special IVEC Award for Excellence and Student Paper Award will be granted. An IVESC award presentation will also be made. This year's conference banquet will be held at the beautiful Monterey Bay Aquarium on Wednesday evening.

This conference has been arranged to enhance the presentation and discussion of useful information to manufacturers, device users, academics, and students. As the expanded conference attracts a broader group of attendees, it is our hope that an environment will be created which will allow for the broadening of our circles of interaction. During the meeting and social events, please take the time to reacquaint yourself with friends and colleagues, establish new relationships, and interact with the students.

The conference Web site (<http://ivec2006.org>) is a valuable source of information on the conference and will continue to serve as a clearinghouse for news and other IVEC-related information after the conference.

I would like to take this time to thank the Committee Members for their help and support, the presenters and contributors to the meeting for their participation, and finally Ralph Nadell of Palisades Convention Management for doing such an excellent job with the program coordination.

Bob Fickett
General Chairman
IVEC-IVESC 2006

IVEC/IVESC 2006 CONFERENCE COMMITTEE

General
Conference Chair: **Bob Fickett**
*Communications and Power Industries
Palo Alto, CA*

Technical
Program Co-Chair: **Baruch Levush**
*Naval Research Laboratory
Washington DC*

Technical
Program Co-Chair: **Edwin Wintucky**
*NASA Glen Research Center
Cleveland, OH*

Local
Arrangements: **John Beighley**
*CPI
Granite Bay, CA*

Monica Blank
*Communications and Power Industries
Palo Alto, CA*

George Caryotakis
*SLAC
Menlo Park, CA*

Dan M. Goebel
*Jet Propulsion Laboratory
Pasadena, CA*

Yehuda Goren
*Teledyne Electronic Technologies
Rancho Cordova, CA*

Michael Green
*Varian Medical Systems
Mountain View, CA*

Carol L. Kory
*Calabazas Creek Research, Inc.
Westlake, OH*

William L. Menninger
*L-3 Electron Technologies,
Torrance, CA*

Armand Staprans
*Communications and Power Industries
Palo Alto, CA*

Richard B. True
*L-3 Communications, Electron Devices
San Carlos, CA*

Conference
Coordinator: **Ralph Nadell**
*Palisades Convention Management
New York, NY*

EDS TECHNICAL COMMITTEE ON VACUUM DEVICES

Dan M. Goebel, Chairman
NASA Jet Propulsion Laboratory, Pasadena, CA

John H. Booske
University of Wisconsin, Madison, WI

Ernst Bosch
Thales Electron Devices, Ulm, Germany

Richard G. Carter
Lancaster University, Lancaster, U.K.

George Caryotakis
Stanford Linear Accelerator Center, Palo Alto, CA

Han-Ying Chen
Air Asia Technology, Hsinchu, Taiwan

Takao Kageyama
*Kitakyushu Foundation for the Advancement of Industry,
Science and Technology, Kitakyushu, Japan*

Carol L. Kory
*Calabazas Creek Research & Analex/
NASA Glenn Research Center, Cleveland, OH*

Lalit Kumar
*Microwave Tube Research & Development Centre, Bangalore,
India*

Baruch Levush
Naval Research Laboratory, Washington, DC

Fu Jiang Liao
BVERI, Beijing, China

Shenggang Liu
*University of Electronic Science and Technology,
Chengdu, ROC*

William McGeary
L-3 Communications, San Carlos, CA

Gun-Sik Park
Seoul National University, Seoul, Korea

Michael I. Petelin
*Russian Academy of Science – Institute of Applied Physics,
Nizhny Novgorod, Russia*

Charles A. Spindt
SRI International, Menlo Park, CA

Armand Staprans
Communications and Power Industries, Palo Alto, CA

Philippe Thouvenin
Thales Electron Devices, Velizy, France

Manfred Thumm
Research Center Karlsruhe, Baden-Württemberg, Germany

Richard True
L-3 Communications

Pierre Waller
European Space Agency, Noordwijk, The Netherlands

Table of Contents

IVEC/IVESC 2006 Conference Committee	iv
EDS Technical Committee on Vacuum Devices	iv

Opening Session: PLENARY SESSION

PL.1 Solid-State and Vacuum Electron Device (VED) Radars — Past, Present and Future	1
<i>E. Brookner, Raytheon Co., Sudbury, MA</i>	
PL.2 WITHDRAWN	
PL.3 Trends in Satellite Communications Amplifier Applications	5
<i>T. Shroyer, General Dynamics C4 Systems, San Jose, CA</i>	
PL.4 Vacuum Electron Devices for Applications in “Big Science”	7
<i>R. J. Temkin, Massachusetts Institute of Technology, Cambridge, MA</i>	
PL.5 Directed Energy Applications for High Power Vacuum Electronics	11
<i>K. E. Hackett, Air Force Research Laboratory, Kirtland AFB, NM</i>	
PL.6 University Training of Tube Engineers, in the US and Abroad	15
<i>G. Caryotakis, Stanford Linear Accelerator Center, Menlo Park, CA</i>	
PL.7 Priming the Vacuum Electronics Industry for Continued Prosperity in the 21st Century	17
<i>C. M. Armstrong, L-3 Communications Electron Devices, San Carlos, CA</i>	

Session 1: TWT I

1.1 Seventy Percent Efficient Flight Set Average Ku-band Traveling Wave Tubes for Satellite Communications	21
<i>W. L. Menninger, S. T. Blunk, W. L. McGeary, L-3 Communications Electron Technologies, Inc., Torrance, CA</i>	
1.2 New 750W DBS Band and 250W Ka Band TWT's	23
<i>A. Gallien, R. Hallay, P.-F. Alleaume, R. Siret, P. Thouvenin, Thales Electron Devices 2, Vélizy Cedex, France</i>	
1.3 Ka-Band Space Traveling Wave Tube Amplifiers	25
<i>N. R. Robbins, W. L. Menninger, D. R. Dibb, D. E. Lewis, L-3 Communications Electron Technologies, Inc., Torrance, CA</i>	
1.4 Linearity of the Transverse Field Interaction in a Traveling Wave Tube	27
<i>D. Chernin, Science Applications International Corp., McLean, VA</i> <i>T. M. Antonsen, Jr., University of Maryland, McLean, VA</i> <i>Y. Pchelnikov, Science Applications International Corp., McLean, VA</i> <i>B. Levush, S. J. Cooke, W. Manheimer, US Naval Research Laboratory, Washington, DC</i>	
1.5 Space Applications for L-Band Traveling Wave Tubes	29
<i>P. Ehret, T. Monsees, E. Bosch, W. Gerum, Thales Electron Devices, Postfach, Germany</i>	

Session 2: WINDOWS AND DIELECTRICS

2.1 Session Keynote: Transition of Window Breakdown from the Vacuum Multipactor Discharge to the Collisional RF Plasm	31
<i>H. C. Kim, J. P. Verboncoeur, University of California at Berkeley, Berkeley, CA</i> <i>G. F. Edmiston, A. A. Neuber, Texas Tech University, Lubbock, TX</i> <i>Y. Y. Lau, R. M. Gilgenbach, University of Michigan, Ann Arbor, MI</i>	
2.2 High Power Aluminum Nitride RF Vacuum Window	33
<i>R. D. Kowalczyk, M. F. Kirshner, C. B. Wilsen, L. Turek, L-3 Communications Electron Devices, San Carlos, CA</i>	
2.3 High Thermal Conductivity Aluminum Nitride for High Power Microwave Windows - An Update	35
<i>E. Savrun, V. Nguyen, Sienna Technologies, Inc., Woodinville, WA</i>	
2.4 Broadband Microwave and W-Band Characterization of BeO-SiC and AlN-Based Lossy Dielectric Composites for Vacuum Electronics	37
<i>J. P. Calame, M. Garven, D. Lobas, R. E. Myers, F. Wood, D. K. Abe, Naval Research Laboratory, Washington, DC</i>	
2.5 Analysis of the Complex Dielectric Permittivity Behavior of Composites Based on Al₂O₃/AlN and Precursor-Derived-SiC in the 1 MHz – 18 GHz Frequency Range	39
<i>J. Battat, J.P. Calame, Naval Research Laboratory, Washington, DC</i>	

Table of Contents

Session 3: GUN DESIGN I

3.1	Session Keynote: Electron Gun Thermal Design, Analysis and Experimental Validation	41
	<i>L. K. Behnke, K. L. Montgomery, D. R. Whaley, R. B. True, L-3 Communications - Electron Devices, San Carlos, CA</i>	
3.2	W-band Sheet Beam Klystron Gun Design Using MICHELLE	43
	<i>A. Burke, R. Phillips, G. Scheitrum, Stanford Linear Accelerator Center, Menlo Park, CA</i>	
3.3	Off-Axis Gridded Gun for Multi-Beam Applications	45
	<i>C. B. Wilsen, M. F. Kirshner, R. D. Kowalczyk, D. R. Whaley, R. B. True, R. J. Hansen, L. Turek, L-3 Communications Electron Devices, San Carlos, CA</i>	
3.4	Design and Evaluation of Electron Gun and Beam Focusing for Ku-Band 140W Space TWT	47
	<i>R. K. Sharma, V. Srivastava, A. R. Choudhury, A. Bera, S. N. Joshi, Central Electronics Engineering Research Institute (CEERI), Pilani, India</i> <i>V. Kiran, Bharat Electronics Ltd., Bangalore, India, T. K. Ghosh, E2V Technology, U.K.</i>	
3.5	Beam Generation and Transport for a THz TWT	49
	<i>M. Read, C. Kory, G. Miram, L. Ives, Calabazas Creek Research Inc., Plainfield, VT</i> <i>J. Booske, University of Wisconsin at Madison, Madison, WI</i>	

Session 4: SCANDATES

4.1	Session Keynote: Recent Developments in Scandia-Doped Dispenser Cathodes	51
	<i>J. Li, H. Wang, Y. Gao, H. Yuan, K. Pan, K. Zhang, Q. Chen, T. Yan, F. Liao, Beijing Vacuum Electronics Research Institute, Beijing, China</i> <i>J. Wang, Y. Wang, W. Liu, Beijing University of Technology, Beijing, China</i>	
4.2	Performance of High Current Density Cathodes with Scandia Doped Tungsten Powders	53
	<i>J. Wang, Y. Wang, W. Liu, Beijing University of Technology, Beijing, China</i> <i>K. Zhang, J. Li, Beijing Vacuum Electronics Research Institute, Beijing, China</i>	
4.3	Investigation of Cathodes with Scandia and Rare-Earth Oxide Co-Doped Matrices	55
	<i>J. Wang, T. Gao, W. Liu, Y. Wang, Beijing University of Technology, Beijing, China</i> <i>J. Li, H. Yuan, Beijing Vacuum Electronics Research Institute, Beijing, China</i>	
4.4	Characterization of W-Ir Mixed Metal Matrix Scandate Cathode	57
	<i>M. Ravi, P. D. Devi, K. S. Kumar, K. S. Bhat, Microwave Tube Research & Development Centre, Bangalore, India</i>	

Session 5: SPACE COMMUNICATIONS AND LINEARIZATION

5.1	Session Keynote: Evolution of Space TWT Requirements and Specifications for Modern Communication Satellites	59
	<i>M. Aloisio, E. Casini, A. Ginesi, P. Waller, European Space Agency ESA/ESTEC, Noordwijk, The Netherlands</i>	
5.2	TWTA versus SSPA: A New Look at Boeing Fleet On-Orbit Reliability Data and Comparison Factors	61
	<i>E. F. Nicol, B. J. Mangus, M. K. De Pano, Boeing Corporation, Los Angeles, CA</i>	
5.3	High Power Combining of Ka-Band TWTs for Deep Space Communications	63
	<i>E. G. Wintucky, R. N. Simons, K. R. Vaden, NASA Glenn Research Center, Cleveland, OH</i> <i>G. G. Lesny, Alphaport, Inc., Cleveland, OH, J. L. Glass, Zin Technologies, Inc., Cleveland, OH</i>	
5.4	Wideband Linear and Nonlinear Distortion Mitigation of a Mismatched Ka-Band Coupled-Cavity Traveling-Wave Tube	65
	<i>J. X. Qui, D. K. Abe, Naval Research Laboratory, Washington, DC</i> <i>T. M. Antonsen, Jr., Univ. of Maryland, College Park, MD & Science Applications International Corp., McLean VA</i> <i>B. G. Danly, B. Levush, Naval Research Laboratory, Washington, DC</i> <i>R. E. Myers, ATK Mission Research Corporation, Newington, VA</i>	
5.5	The 20 Minute Effect - An Anomalous TWT Anode Discharge Phenomenon	67
	<i>H. Wolkstein, Consultant to Lockheed Martin, Livingston, NJ, J. Beck, Lockheed Martin, Newtown, PA</i>	
5.6	Pulsed Mode TWT Phase Noise Reduction by Direct Sampled Voltage Ripple from Power Supply	69
	<i>J. S. Lee, Meggitt Safety Systems Inc., Simi Valley, CA</i> <i>Y. Goren, Teledyne Electronic Technologies-MEC, Rancho Cordova, CA</i>	

Table of Contents

Session 6: KLYSTRONS

6.1	Compact High Power Ka-Band Extended Interaction Klystron for Terrestrial and Space Applications	71
	A. Roitman, D. Sweeney, P. Mathieson, D. Berry, B. Steer, <i>Communications & Power Industries Canada Inc., Ontario, Canada</i>	
6.2	PPM Focused Ku Band Pulsed EIK	73
	A. J. Durand, <i>Thales Electron Devices, Vélizy Cedex, France</i>	
6.3	Test Results for a 19 kW, 1497 MHz Klystron for Accelerators	75
	M. Read, A. Mizuhara, G. Collins, G. Miram, L. Song, L. Zitelli, L. Ives, <i>Calabazas Creek Research Inc., Plainfield, VT</i>	
6.4	500MHz 800 kW CW Klystron for Synchrotron	77
	R. Marchesin, A. Beunas, P. Thouvenin, <i>Thales Electron Devices, Vélizy Cedex, France</i>	
6.5	Using Large Signal Code TESLA for Wide Band Klystron Simulations	79
	A. N. Vlasov, I. A. Chernyavskiy, <i>Science Applications International Corporation, McLean, VA</i> T. M. Antonsen, Jr., <i>University of Maryland, College Park, MD</i> K. T. Nguyen, <i>Beam Wave Research, Inc., Silver Spring, MD</i> D. E. Pershing, <i>Mission Research Corporation, Newington, VA</i> S. J. Cooke, B. Levush, <i>Naval Research Laboratory, Washington, DC</i>	
6.6	Investigation of Possible Multipactor Discharge in a Klystron Input Cavity	81
	C. Hill, R. G. Carter, <i>Lancaster University, Lancaster, UK</i>	

Session 7: GUN/COLLECTOR DESIGN

7.1	Session Keynote: Application of the Finite-Element MICHELLE Beam Optics Code to RF Gun Modeling	83
	J. Petillo, <i>Science Applications International Corporation, Burlington, MA</i> J. DeFord, <i>Simulation Technology & Applied Research, Inc., Mequon, WI</i> E. Nelson, <i>Los Alamos National Laboratory, Los Alamos, NM</i> K. Jensen, B. Levush, <i>Naval Research Laboratory, Washington, DC</i>	
7.2	Michelle Code Usage and Validation at CPI	85
	J. Atkinson, R. Begum, M. Chee, <i>Communications and Power Industries, Palo Alto, CA</i> B. Levush, <i>Naval Research Laboratory, Washington, DC</i> J. Petillo, <i>Science Applications International Corp., Burlington, MA</i>	
7.3	Optimization of Multistage Collectors Using the MICHELLE Code Within the Analyst Modeling Framework	87
	J. DeFord, B. Held, L. Chernyakova, <i>Simulation Tech. & Applied Research, Inc., Mequon, WI</i> J. Petillo, <i>Scientific Applications International Corp., Burlington, MA</i> B. Levush, <i>Naval Research Laboratory, Washington, DC</i>	
7.4	Computerized Electron Gun Design Using the 3D Beam Optics Code BOA	89
	L. Ives, T. Bui, D. Marsden, <i>Calabazas Creek Research Inc., Saratoga, CA</i> J. David, H. Tran, <i>North Carolina State University, Raleigh, NC</i>	
7.5	The Multiple Beam Electron Gun Computer Simulations	91
	S. V. Kozlov, V. M. Pikunov, A. N. Sandalov, <i>M. V. Lomonosov Moscow State University, Moscow, Russia</i>	

Session 8: EMISSION FUNDAMENTALS

8.1	Work Function of Cathode Emitter Materials Obtained by <i>Ab-initio</i> Quantum Mechanical Modeling	93
	V. Vlahos, E. F. Holby, A. K. Berta, D. D. Morgan, J. H. Booske, <i>University of Wisconsin at Madison, Madison, WI</i>	
8.2	Theoretical Study of Triple Junction Electron Emission for a New Type of Cold Cathode	95
	M. S. Chung, H. K. Bae, Y. J. Jang, <i>University of Ulsan, Ulsan, Korea</i> P. H. Cutler, N. M. Miskovsky, <i>Pennsylvania State University, University Park, PA</i>	
8.3	A General Thermal-Field Emission Equation	97
	K. L. Jensen, <i>Naval Research Laboratory, Washington, DC</i> , M. Cahay, <i>University of Cincinnati, Cincinnati, OH</i>	

Table of Contents

8.4	Transition from Fowler-Nordheim Field Emission to Space Charge Limited Current Density in the Relativistic and Quantum Limits	99
	Y. Feng, J. P. Verboncoeur, <i>University of California at Berkeley, Berkeley, CA</i> Y. Y. Lau, <i>University of Michigan, Ann Arbor, MI</i>	
8.5	A Study of Macroscopic Emission Non-Uniformity in Thermionic Cathodes Due to Profilometry Variation	101
	K. L. Jensen, <i>Naval Research Laboratory, Washington, DC</i> Y. Y. Lau, <i>Naval Research Laboratory and University of Michigan, Washington, DC</i> N. Jordan, <i>University of Michigan, Ann Arbor, MI</i>	
8.6	Space Charge Effects on Thermionic Emission: the Knee of the Transition from TL to FSCL Operation	103
	C.-Y. Chang, <i>Fu Jen University, Taiwan, China</i> P.-S. Lu, <i>Fu Jen University, Taiwan, China & National Taiwan Ocean University, Taiwan, China</i> K.-H. Huang, M.-C. Lin, <i>Fu Jen University, Taiwan, China</i>	
Poster Session: POSTER SESSION I		
P1.1	Klystron - Generator of Chaotic Radioimpulses	105
	B. S. Dmitriev, Y. D. Zharkov, V. N. Skorokhodov, A. A. Biryukov, <i>Saratov State University, Russia</i>	
P1.2	The Rigorous Excitation Equations for the Arbitrary-Irregular Waveguides with Finite Conduction of the Wall	107
	A. A. Kurayev, A. K. Sinitsyn, <i>Belarusian State University of Informatics & Radioelectronics, Minsk, Belarus</i>	
P1.3	The Charged Particle Motion under Electrostatic Space-Period Field in Cross-Field Systems	109
	O. M. Nikitenko, M. V. Volovenko, <i>Kharkiv National University of Radioelectronics, Kharkiv, Ukraine</i>	
P1.4	Limiting Currents in Magnetically Focused Intense Relativistic Beams Filled with Background Plasma	111
	L. Jianqing, M. Yuanlong, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P1.5	Microminiaturization of Passive Elements with Distributed Parameters	113
	Y. N. Pchelnikov, <i>SloWaveS, Inc., Cary, NC</i>	
P1.6	Sheet-Beam Electron Gun Design for Millimeter and Sub-Millimeter Wave Vacuum Electronic Sources	115
	B. G. Danly, <i>U.S. Naval Research Laboratory, Washington, DC</i> J. J. Petillo, <i>Science Applications International Corporation, Burlington, MA</i> J. X. Qiu, B. Levush, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
P1.7	Application of CAD Simulation Technology in Microwave Tube Research and Fabrication	117
	Z. Zhu, B. Jia, Z. Luo, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P1.8	Numerical Determination of Interaction Impedance on Birdsall Slow-Wave Structures	119
	D. T. Lopes, <i>IPEN/CNEN, São Paulo, Brazil</i> C. C. Motta, <i>Centro Tecnológico da Marinha em São Paulo, São Paulo, Brazil</i>	
P1.9	Propagation of Short Radio Pulses through Delay Line of a Cold TWT	121
	A. V. Gritsunov, N. V. Skachkova, <i>Kharkiv National University of Radio Electronics, Ukraine</i>	
P1.10	Optimized Relativistic TWT and BWO on Corrugated Waveguides with Groove-Modulator	123
	A. A. Kurayev, A. K. Sinitsyn, <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i>	
P1.11	Characterization of Commonly Used Cold Cathodes in Explosive Emission Diodes	125
	R. Verma, A. Shyam, S. Chaturvedi, D. Lathi, V. Chaudhary, R. Shukla, S. Sharma, J. Sonara, K. Shah, B. Adhikary, R. Mehida, T. Bhavsar, C. Mehta, <i>Institute for Plasma Research, Gandhinagar, India</i>	
P1.12	Rapid Startup in Magnetrons Using the Transparent Cathode	127
	H. Bosman, S. Prasad, M. Fuks, E. Schamiloglu, <i>University of New Mexico, Albuquerque, NM</i>	
P1.13	Secondary Electron Emission from REO-Mo Metal Cermet Cathode	129
	W. Liu, J. Wang, M. Zhou, <i>Beijing University of Technology, Beijing, China</i>	

Table of Contents

P1.14	Lumen Efficiency of Cold Cathode Fluorescent Lamp (CCFL) Improvement with MgO Coated Cathode	131
	X. Zhang, D. den Englesen, <i>Southeast University, Nanjing, China</i> K. Raper, <i>LG-Philips Displays, Lancashire, UK</i> , W. Lei, <i>Southeast University, Nanjing, China</i>	
P1.15	A New Structure to Improve the Luminance Efficiency of a FED Panel	133
	L. Chen, L. Wei, Z. Xiaobing, Z. Hongping, <i>Southeast University, Nanjing, China</i> G. Yang, <i>Huadong Electronics Optoelectronics Science & Technology Co., Ltd., Nanjing, China</i>	
P1.16	An Analysis Tool for Preliminary Heater Design	135
	J. E. Paff, <i>Spectra-Mat, Inc., Watsonville, CA</i>	
P1.17	Study of Novel Helical Slow-Wave Circuits for Millimeter Wave TWTs	137
	Z. XiaoFang, Y. ZhongHai, L. Bin, L. Li, Z. BaoQing, Y. LieMing, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P1.18	Thermal Analysis of Novel Helix TWTs	139
	Y. LieMing, Y. ZhongHai, L. Bin, L. Li, Z. BaoQing, Z. XiaoFang, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P1.19	Design, Simulation and Scale Model Cold Test of a Sever for the Los Alamos 94GHz TWT RF Structure	141
	J. Godin, <i>University of California at San Diego and Los Alamos National Laboratory, Los Alamos, NM</i> L. M. Earley, E. I. Smirnova, B. E. Carlsten, <i>Los Alamos National Laboratory, Los Alamos, NM</i>	
P1.20	Sheet Beam Development for mm-Wave Microwave Tubes at Los Alamos National Laboratory	143
	S. J. Russell, K. A. Bishofberger, R. W. Brown, B. E. Carlsten, L. M. Earley, W. B. Haynes, H. C. Kirbie, F. L. Krawczyk, F. P. Romero, F. E. Sigler, E. I. Smirnova, R. M. Wheat, Jr., Z.-F. Wang, <i>Los Alamos National Laboratory, Los Alamos, NM</i> S. Humphries, Jr., <i>Field Precision, Albuquerque, NM</i> , P. Ferguson, <i>MDS Company, Oakland, CA</i>	
P1.21	Extraction of Lumped Circuit Parameters of Coupled-Cavity Structures by Using 3D Finite Element Method	145
	W.-C. Lin, Y.-H. Liao, K.-L. Peng, S.-J. Tzun, M.-C. Lin, <i>Fu Jen University, Taiwan, China</i>	
P1.22	Analysis of Helix Slow-Wave Structure for Space TWT Using Ansoft HFSS	147
	M. K. Alaria, A.K. Sinha, V. Srivastava, <i>Central Electronics Engineering Research Institute (CEERI), Rajasthan, India</i>	
P1.23	Design and Simulation of Inductively Loaded Inter-Digital SWS	149
	V. L. Christie, L. Kumar, <i>Microwave Tube Research & Development Centre, Bangalore, India</i> N. Balakrishnan, <i>Indian Institute of Science, Bangalore, India</i>	
P1.24	Interaction Impedance Measurements in Slow-Wave Structures via Nonresonant Perturbation Method	151
	D. T. Lopes, <i>IPEN/CNEN, São Paulo, Brazil</i> C. C. Motta, <i>Centro Tecnológico da Marinha em São Paulo, São Paulo, Brazil</i>	
P1.25	A Novel Dispersion Measurement Technique for Helix SWS	153
	P. R. R. Rao, R. Seshadri, S. K. Datta, <i>Microwave Tube Research & Development Centre, Bangalore, India</i>	
P1.26	Design and Development of Electron Gun and PPM Focusing for Vacuum Power Booster TWT of Broadband MPM	155
	R. K. Sharma, S. M. Sharma, A. R. Choudhury, R. K. Gupta, <i>Central Electronics Engineering Research Insitute, Pilani, India</i> T. K. Ghosh, <i>E2V Technology, UK</i>	
P1.27	Effect of the Magnetic Field of PPM Stack on Electron Beam in the Gun and Transit Area	157
	X. Liu, J. Feng, F. Huang, <i>Beijing Vacuum Electronics Research Institute, Beijing, China</i> B. Du, <i>Tsinghua University, Beijing, China</i>	
P1.28	Influence of Attenuator on the Performance of the Helix TWTs	159
	Z. Duan, Y. Gong, W. Wang, <i>University of Electronic Science & Technology of China (UESTC), Sichuan, China</i> B. N. Basu, <i>College of Engineering and Technology, Moradabad, India</i> Y. Wei, <i>University of Electronic Science & Technology of China (UESTC), Sichuan, China</i>	

Table of Contents

P1.29	On-Board Performance Enhancement of a Satellite Communication TWT	161
	S. Ghosh, S. Prakash, K. S. Prasad, P. V. Bhaskar, R. R. Singh, V. Kiran, <i>Bharat Electronics, Bangalore, India</i>	
P1.30	Development of an X-Band Antenna-Amplifier: Numerical Simulations and Plasma-Related Investigations	163
	A. Shlapakovski, <i>Nuclear Physics Institute, Tomsk, Russia</i> W. Jiang, <i>Nagaoka University of Technology, Niigata, Japan</i> I. Vintzenko, V. Matvienko, A. Mashchenko, <i>Nuclear Physics Institute, Tomsk, Russia</i> E. Schamiloglu, <i>University of New Mexico, Albuquerque, NM</i>	
P1.31	Powerful TWT High Perveance Electron Gun with Low Voltage Gridles “Zero-Minus” Control and High Beam Compression	165
	A. V. Arkhipov, O. Y. Maslennikov, S. P. Morev, K. V. Stanislavchik, <i>FSUE R & P Corp. (Toriy), Moscow, Russia</i>	
P1.32	The Forming Peculiarities of Intensive Electron Beams of the Millimeter Wave Radiations Sources	167
	Y. G. Gamaunov, A. I. Toreev, E. V. Patrusheva, <i>Saratov State University, Saratov, Russia</i>	
P1.33	A Correction Method for Analysis of Inhomogeneously-Loaded Helical Slow-Wave Structures	169
	Z. XiaoFang, Y. ZhongHai, L. Bin, L. Li, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P1.34	Relativistic Folded Waveguide BWO	171
	A. V. Aksenchyk, A. A. Kurayev, A. V. Kiyko, <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i>	
P1.35	On Statistical Description of Nonstationary Emission Processes	173
	V. M. Anikin, <i>Saratov State University, Saratov, Russia</i>	
P1.36	Terahertz Smith-Purcell Radiation from Surface Plasmon Wave in One-Dimensional Photonic Crystal Structure Using Counter-Streaming Electron Beam	175
	Y. M. Shin, J. K. So, K. H. Jang, J. H. Won, A. Srivastava, G. S. Park, <i>Seoul National University, Seoul, Korea</i>	
Session 9: TWT II		
9.1	Session Keynote: A 1kW Microwave Power Module for Pulsed Radar	177
	A. Perle, T. A. Hargreaves, R. B. True, G. Good, C. M. Armstrong, T. Schoemehl, <i>L-3 Communications Electron Devices, San Carlos, CA</i> G. Tucker, <i>GERACO Engineering, Palo Alto, CA</i> R. Duggal, <i>L-3 Communications Electron Devices, San Carlos, CA</i>	
9.2	Development of 400 W CW Ka-Band Communications Helix-TWT and 1 kW Peak Power Ka-Band Radar Helix-TWT	179
	C. K. Chong, J. A. Davis, J. Forster, R. H. Le Borgne, M. Ramay, R. J. Stolz, R. N. Tamashiro, <i>L-3 Communications Electron Technologies, Inc., Torrance, CA</i>	
9.3	Development of a I-J Band High Power Mini TWT	181
	F. Yang, L. Roeder, B. Stockwell, <i>Communications & Power Industries, Palo Alto, CA</i>	
9.4	Experimental Investigation of a Novel Circuit for MM-Wave TWTs	183
	A. J. Theiss, C. J. Meadows, R. B. True, <i>L-3 Communications Electron Devices, San Carlos, CA</i>	
9.5	High Power CW BeO Block Brazed Copper Helix TWT	185
	J. S. Lee, <i>Meggitt Safety Systems Inc., Simi Valley, CA</i> C. Everleigh, <i>Pendulum Electromagnetics, Inc., Raleigh, NC</i>	
9.6	Fabrication and Experiments on a 6-18 GHz, Vaned Helix TWT Amplifier	187
	W. B. Seo, H. J. Kim, J. H. Joo, J. J. Choi, <i>Kwangwoon University, Seoul, Korea</i> J. H. So, <i>Agency for Defense Development, Daejeon, Korea</i>	

Table of Contents

Session 10: THz

10.1	Experimental Investigation on High Order Mode Reflex Klystron Using Cold Cathode	189
	K. H. Jang, S. G. Jeon, <i>Seoul National University, Seoul, Korea</i> J. K. So, J. I. Kim, Y. M. Shin, J. H. Won, G. S. Park, <i>Seoul National University, Seoul, Korea</i>	
10.2	Extended Interaction Klystrons for Submillimeter Applications	191
	A. Roitman, P. Horoyski, M. Hyttinen, D. Berry, B. Steer, <i>Communication & Power Industries Canada Inc., Georgetown, Ontario</i>	
10.3	Transportable, High-Power THz Source	193
	H. P. Bluem, A. M. M. Todd, <i>Advanced Energy Systems, Inc., Princeton, NJ</i> R. H. Jackson, <i>Consultant, Grayson, GA</i> , H. P. Freund, <i>SAIC, McLean, VA</i>	
10.4	Study on the Generation of THz Waves in a Vacuum Electronic Device	195
	M.-C. Lin, <i>Fu Jen University, Taiwan, China</i> P.-S. Lu, <i>Fu Jen University and National Taiwan Ocean University, Taiwan, China</i> K.-H. Huang, <i>Fu Jen University, Taiwan, China</i>	
10.5	Simulation of a THz Vacuum Triode Using Carbon-Nanotube Emitter	197
	E. Petrolati, C. Paoloni, A. Di Carlo, <i>University of Roma "Tor Vergata", Roma, Italy</i>	
10.6	A Millimeter-Wave Two-Stage Orbotron	199
	A. V. Gurevich, <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i> V. D. Yeryomka, <i>Usikov Institute of Radiophysics & Electronics of National Academy of Sciences of Ukraine, Kharkiv, Ukraine</i> A. K. Sinitsyn, <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i>	

Session 11: THERMIONIC SOURCES

11.1	Development of a (100) Hafnium Carbide Thermionic Electron Source with Built-in Guard Ring and Heater	201
	W. A. Mackie, K. J. Kagarice, C. L. Fast, <i>Applied Physics Technologies, Inc., McMinnville, OR</i>	
11.2	Effect of Nanocrystalline Structure on Work Function of Tungsten	203
	R. Z. Bakhtizin, Y. M. Yumaguzin, <i>Bashkir State University, Ufa, Russia</i> R. R. Mulyukov, <i>Institute for Metals Superplasticity Problems of Russian Academy of Sciences, Ufa, Russia</i>	
11.3	Controlled Porosity Cathodes Using Sintered Tungsten Wires	205
	L. Ives, G. Miram, <i>Calabazas Creek Research Inc., Saratoga, CA</i> L. Falce, P. Borchard, R. Wilcox, <i>Consultants</i> S. Schwartzkopf, R. Witherspoon, <i>Ron Witherspoon, Inc., Campbell, CA</i> K. Gunther, <i>HeatWave Laboratories, Inc., Watsonville, CA</i>	
11.4	A Method of Predicting Dispenser Cathode Performance by the Measurement of Barium Flux	207
	L. Garbini, N. Sun, L. Falce, <i>Communications and Power Industries, Palo Alto, CA</i>	
11.5	LaB6-Based Gun Brightness vs Cathode Life	209
	V. Katsap, <i>NuFlare Technology, Hopewell Junction, NY</i>	
11.6	Cathode Emission Characterization Improvement	211
	R. C. Dawson, W. G. Tighe, <i>L-3 Communications Electronic Technologies, Inc., Torrance, CA</i>	

Poster Session: POSTER SESSION II

P2.1	Current Development Programs for the Satcom Ka-Band EIK	213
	R. Dobbs, M. Hyttinen, A. Roitman, <i>Communications & Power Industries Canada Inc., Ontario, Canada</i>	
P2.2	Preliminary Modeling and Simulation Results of a Megawatt HOM-IOT	215
	E. Wright, H. Bohlen, <i>Communications and Power Industries, Palo Alto, CA</i>	
P2.3	Design of a 200 MW L-Band Annular Beam Klystron	217
	M. Read, P. Ferguson, L. Ives, L. Song, <i>Calabazas Creek Research Inc., Plainfield, VT</i> B. Carlsten, M. Fazio, <i>Los Alamos National Laboratory, Los Alamos, NM</i>	

Table of Contents

P2.4	Large Signal Klystron Simulation	219
	R. D. Kowalczyk, C. F. Malcolm III, M. F. Kirshner, C. B. Wilsen, <i>L-3 Communications Electron Devices, San Carlos, CA</i>	
P2.5	TESLA Code Modeling of a 1.3 GHz, 10 MW Multiple Beam Klystron	221
	R. Begum, A. Balkcum, <i>Communications and Power Industries, Inc., Palo Alto, CA</i> I. Chernyavskiy, A. Vlasov, <i>Science Applications International Corporation, McLean, VA</i> S. Cooke, B. Levush, <i>Naval Research Laboratory, Washington, DC</i>	
P2.6	Analysis and Simulation of Multi-Beam Interaction	223
	W. Shuzhong, D. Yaogen, W. Yong, <i>The Chinese Academy of Sciences, Beijing, China</i>	
P2.7	Estimation of Cold Characteristics for Fundamental-Mode MBK Cavities	225
	K. T. Nguyen, <i>Beam-Wave Research, Inc., Bethesda, MD</i> D. K. Abe, <i>U.S. Naval Research Laboratory, Washington, DC</i> D. E. Pershing, <i>ATK Mission Research, Newington, VA</i> B. Levush, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
P2.8	Shunt Impedance of the MBK Cavities	227
	A. N. Sandalov, K. A. Zaytsev,, <i>M. V. Lomonosov Moscow State University, Beijing, China</i> Y. Ding, B. Shen, <i>Institute of Electronics CAS, Moscow, Russia</i>	
P2.9	Tuning Characteristics of Reentrant Klystron Cavities	229
	J. J. Barroso, J. P. Leite Neto, <i>National Institute for Space Research, São José dos Campos, Brazil</i>	
P2.10	Comparisons Between Fundamental and Higher Order TM Modes in Microwave Cylindrical and Coaxial Cavity of Klystron	231
	Y.-h. Dong, <i>Chinese Academy of Sciences, Beijing, China</i> , <i>Science Tech. University, Mongolia, China</i> Y. Ding, B. Shen, L. Xiao, <i>Chinese Academy of Sciences, Beijing, China</i>	
P2.11	Installation of a Getter Vacuum Pump in Cathode-Anode Region of a High-Power Klystron Amplifier – Propose and Feasible	233
	F. T. Degasperi, <i>FATEC-SP – CEETEPS – UNESP São Paulo-SP, São Paulo, Brazil</i> S. L. L. Verardi, <i>Escola Politécnica da Universidade de São Paulo, São Paulo, Brazil</i> C. C. Motta, <i>Centro Tecnológico da Marinha em São Paulo, São Paulo, Brazil</i>	
P2.12	U.S. Army Beam Power Tetrode Based Broadband Resonant Coaxial Cavity High Power Amplifier System	235
	D. B. Elkins, <i>Redstone Technical Test Center, Redstone, AL</i> R. Heckman, <i>BURLE Industries, Inc., Lancaster, PA</i>	
P2.13	Small-Sized High Voltage Vacuum Triode GMI 30/25	237
	K. V. Stanislavchik, O. Y. Maslennikov, I. A. Guzilov, S. V. Lamonov, <i>FSUE “TORIY”, Moscow, Russia</i>	
P2.14	Design of an Inverted TMO11 Cavity Locked HPM Magnetron	239
	M. L. Tracy, <i>CPI Beverly Microwave Division, Beverly, MA</i>	
P2.15	Design of a 600-to-1200 kW Peak-Power, 50% Duty L-Band Magnetron	241
	J. Robinson, B. Guss, W. Dumphy, M. Doherty, T. Treado, <i>Communications & Power Industries, Beverly, MA</i>	
P2.16	Simulation of Lock Mode in Two-Stage Magnetron	243
	G. I. Churyumov, T. I. Frolova, K. M. Basrawi, <i>Kharkov National University of Radio Electronics, Kharkiv, Ukraine</i>	
P2.17	Phase Variant CFA Study	245
	W. C. Guss, M. L. Tracy, J. Deveau, <i>CPI – Beverly Microwave Division, Beverly, MA</i>	
P2.18	Monitoring and Data Acquisition of CFA Processing Parameters	247
	W. C. Guss, L. Dragun, M. L. Tracy, J. Deveau, T. Treado, <i>CPI – Beverly Microwave Division, Beverly, MA</i>	
P2.19	The Outgassing Characteristics of CNT and ZnO Cathodes	249
	Y. Cui, <i>Southeast University and Nanjing Institute of Technology, Nanjina, China</i> X. Zhang, W. Lei, J. Wang, Y. Di, M. Xiao, F. Mao, <i>Southeast University, Nanjina, China</i> Y. Wang, <i>San Le Group Limited Company, Nanjina, China</i> C. Huang, <i>Guoguang Electric Co., Ltd., Chengdu, China</i>	
P2.20	Outgassing of FED Under Operation	251
	J. Wang, X. Zhang, W. Lei, M. Xiao, Y. Cui, Y. Di, F. Mao, <i>Southeast University, Nanjina, China</i> G. Yang, <i>Huadong Electronics Optoelectronics Science & Technology Co., Ltd., Nanjina, China</i> C. Huang, <i>Guoguang Electric Co. Ltd., Chengdu, China</i>	

Table of Contents

P2.21	The Growth of Layer-by-Layer Aligned Carbon Nanotubes	253
	<i>Y. Zhao, B. Zeng, Y. Zhao, H. Ouyang, Z. Yang, University of Electronic Science & Technology of China, Chengdu, China</i>	
P2.22	The Effects of Synthesis Process on Aluminate Emitters Thermionic Properties	255
	<i>C. Higashi, Instituto de Pesquisas Energéticas e Nucleares, São Paulo, Brazil</i> <i>C. Giovedi, C. C. Motta, Centro Tecnológico da Marinha em São Paulo – CTMSP, São Paulo, Brazil</i>	
P2.23	The Effects of Osmium Coating and Chemical Cleaning on SEM Images of Dispenser Cathode Surface Porosity	257
	<i>J. O. Tarter, S. Roberts, Semicon Associates, Lexington, KY</i>	
P2.24	High Current Density Cathode Evaluation	259
	<i>C. B. Wilsen, M. F. Kirshner, R. D. Kowalczyk, L-3 Communications Electron Devices, San Carlos, CA</i>	
P2.25	Modelling of Cusp Gun for a Gyro-TWA	261
	<i>A. R. Young, W. He, D. H. Rowlands, E. G. Rafferty, C. G. Whyte, K. Ronald, A. W. Cross, A. D. R. Phelps, University of Strathclyde, Glasgow, Scotland</i>	
P2.26	Study on Ballistic Bunching in Frequency Multiplying Distributed Interaction Gyroklystron Amplifier	263
	<i>J. H. Won, C. W. Baik, J. I. Kim, Y. D. Joo, G. S. Park, Seoul National University, Seoul, Korea</i>	
P2.27	Preliminary Design of a Ka-Band, Three-Stage, Harmonic-Multiplying Gyrotron Traveling Wave Amplifier	265
	<i>C.-Q. Jiao, J.-R. Luo, Chinese Academy of Sciences, Beijing, China</i>	
P2.28	W-band Single-Anode MIG for Gyro-TWT	267
	<i>R.-J. Yin, P.-K. Liu, G.-J. Lai, Chinese Academy of Sciences, Beijing, China</i>	
P2.29	Simulation and Experiment of a New Type of Complex Cavity for Gyrotron Applications	269
	<i>J. Luo, W. Guo, M. Zhu, Chinese Academy of Sciences, Beijing, China</i>	
P2.30	Electromagnetic Field Distribution in Matched Intervals of Periodically-Irregular Waveguides for Gyrotrons	271
	<i>A. A. Kurayev, S. I. Yaramionak, Byelorussian State University of Electronics and Informatics, Minsk, Belarus</i>	
P2.31	Second-Harmonic Axis-Encircling Electron Beam Gyro-TWT Amplifier	273
	<i>S. B. Harriet, University of California at Davis, Davis, CA</i> <i>, Naval Surface Warfare Center, Crane, IN</i> <i>D. B. McDermott, N. C. Luhmann, Jr., University of California at Davis, Davis, CA</i>	
P2.32	UCD Ka-Band Harmonic Peniotron Status	275
	<i>L. J. Dressman, D. B. McDermott, N. C. Luhmann, Jr., University of California at Davis, Davis, CA</i>	
P2.33	The Design of a 16GHzTE01 Gyrotron Traveling Wave Amplifier	277
	<i>G.-J. Lai, P.-K. Liu, Y.-F. Jia, R.-J. Yin, Chinese Academy of Sciences, Beijing, China</i>	
P2.34	Microwave Source with Goffered Cavity	279
	<i>S. V. Kolosov, A. A. Kurayev, A. A. Lavrenov,</i> <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i>	
P2.35	Time-Dependent Simulation of Free-Electron Lasers	281
	<i>H. P. Freund, Science Applications International Corporation, McLean, VA</i>	
P2.36	The Simplest Ubitron in Crossed Fields	283
	<i>M. Fuks, E. Schamiloglu, University of New Mexico, Albuquerque, NM</i>	
Session 12: TWT SIMULATION / ENVIRONMENT		
12.1	Session Keynote: Robust Design Algorithm for High-Frequency Traveling-Wave Tube Slow-Wave Circuits	285
	<i>J. D. Wilson, NASA Glenn Research Center, Cleveland, OH</i> <i>C. T. Chevalier, Analex Corporation, Cleveland, OH</i>	
12.2	The Determination of Tape Helix Cold Test Parameters Using Fourier and Convolution Techniques	287
	<i>V. Cun, Communications & Power Industries, Palo Alto, CA</i>	

Table of Contents

12.3	The Field Marshal Electromagnetic Simulation Environment	289
	R. H. Jackson, M. McLay, <i>Calabazas Creek Research Inc., Saratoga, CA</i> R. P. Joshi, <i>Old Dominion University, Norfolk, VA</i>	
12.4	Analysis with Code Dev. 5.0 of Output Characteristics of Coupled Cavity TWT with Below-Cutoff Sections and with Direct and Inverse Bands Sequence	291
	A. V. Konnov, A. V. Malykhin, V. V. Petenkova, <i>FSUE R & P Corporation "Toriy", Moscow, Russia</i> G. V. Ruvinskiy, T. I. Chernobay, D. S. Scherbakov, <i>FSUE "R & P Corporation "Istok", Moscow, Russia</i>	
12.5	Recent Developments to TWTCAD Integrated Framework	293
	L. Bin, Y. ZhongHai, L. JianQing, Z. XiaoFang, H. Tao, H. Quan, L. Li, X. Li, G. Peng, Z. BaoQing, Y. LieMing, H. GuoXian, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
12.6	Electron Beam Transverse Waves and Microwave Electronics	295
	V. A. Vanke, <i>M. V. Lomonosov Moscow State University, Moscow, Russia</i> Y. A. Budzinskiy, S. V. Bykovskiy, <i>SRPC "Istok", Moscow, Russia</i>	

Session 13: MBK

13.1	Session Keynote: Comparative Study of Microwave Power Modules (MPM) and Complex Microwave Devices (CMD) Parameters and Their Preferable Application Areas	297
	A. S. Kotov, E. A. Gelvich, A. D. Zakurdayev, <i>FSUE RPC "Istok", Fryazino, Russia</i>	
13.2	Research Progress on C-band Broadband Multi-Beam Klystron	301
	Y. Ding, Y. Zhu, X. Yin, X. Sun, B. Shen, Y. Miao, C. Wang, <i>Chinese Academy of Sciences, Beijing, China</i>	
13.3	Mode Selectivity in Multiple-Beam Klystrons	303
	G. S. Nusinovich, <i>Science Applications International Corporation, College Park, MD</i> D. K. Abe, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
13.4	Bandwidth Extension of an S-band, Fundamental-Mode Eight-Beam Klystron	305
	K. T. Nguyen, <i>Beam-Wave Research, Inc., Bethesda, MD</i> , D. E. Pershing, <i>ATK Mission Research, Newington, VA</i> , D. K. Abe, B. Levush, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
13.5	Application of the Multi-Beam Klystrons with Reverse Permanent Magnet Focusing System in RF Systems of the Compact Electron Accelerators	307
	I. A. Frejdovich, P. V. Nevsky, V. P. Sakharov, M. Y. Vorob'ev, <i>FSUE R & P Corporation "Toriy", Moscow, Russia</i> A. S. Alimov, V. I. Shvedunov, <i>Moscow State University, Moscow, Russia</i> E. A. Knapp, W. P. Trower, <i>World Physics Technologies Inc., Blacksburg, VA</i> Y. D. Chernousov, I. V. Shebolaev, <i>Institute of Chemical Kinetics and Combustion, Novosibirsk, Russia</i> H. Yamada, A. Kleev, <i>Photon Production Ltd., Kyoto, Japan</i> Y. N. Gavrish, V. M. Nikolaev, <i>D. V. Efremov Scientific Research Institute of Electrophysical Apparatus, St. Petersburg, Russia</i>	
13.6	Electrostatically Focused Multibeam Klystron	309
	B. Vancil, R. Mueller, K. Hawken, <i>e beam, inc., Beaverton, OR</i> E. G. Wintucky, C. Kory, <i>NASA Glenn Research Center, Cleveland, OH</i>	

Session 14: THERIONIC TECHNOLOGY

14.1	Reservoir Cathodes – Recent Development	311
	B. Vancil, <i>e beam, inc., Beaverton, OR</i> E. G. Wintucky, <i>NASA Glenn Research Center, Cleveland, OH</i>	
14.2	An Examination of Magnetic Fields from Cathode Heaters	313
	J. E. Paff, <i>Spectra-Mat, Inc., Watsonville, CA</i>	
14.3	Hot Resistance Studies on Tungsten/Rhenium Wire	315
	S. Roberts, M. Effgen, <i>Semicon Associates, Lexington, KY</i>	
14.4	Space TWT Cathode Manufacturing at L-3 Communications ETI	317
	W. Tighe, M. Patterson, J. Venecio, <i>L-3 Communications Electron Technologies Inc., Torrance, CA</i>	
14.5	Hollow Cathode Life Issues	319
	W. Tighe, <i>L-3 Communications Electron Technologies Inc., Torrance, CA</i>	

Table of Contents

Poster Session: POSTER SESSION III

P3.1	Generation of Electromagnetic Oscillations by Electron Beam in Open Resonator: 3D Modeling	321
	K. Lukin, <i>Usikov Institute for Radiophysics and Electronics NAS of Ukraine, Kharkov, Ukraine</i> G. Churyumov, Y. Starchevskiy, <i>Kharkov National University of Radio Electronics, Kharkov, Ukraine</i>	
P3.2	A New Vacuum Oscillator with Open Resonator	323
	K. Lukin, <i>Usikov Institute for Radiophysics and Electronics NAS of Ukraine, Kharkov, Ukraine</i>	
P3.3	A 6.6 GHz Monotron with a Coaxial Bragg Reflector	325
	J. J. Barroso, J. P. Leite Neto, <i>National Institute for Space Research, São José dos Campos, Brazil</i>	
P3.4	Orbotron-Frequency Multipliers 300-2000GHz	327
	A. V. Aksenchyk, A. A. Kurayev, A. A. Hrin, <i>Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus</i>	
P3.5	A Field Emission Based Ka-Band Millimeter Wave Generator	329
	P.-S. Lu, <i>Fu Jen University and National Taiwan Ocean University, Taiwan, China</i> K.-H. Huang, M.-C. Lin, <i>Fu Jen University, Taiwan, China</i>	
P3.6	Investigations on the Radiation from a Modified Grating Structure using a Relativistic Electron Beam	331
	J. K. So, Y. M. Shin, K. H. Jang, J. H. Won, A. Srivastava, G. S. Park, <i>Seoul National University, Seoul, Korea</i>	
P3.7	Improve the Emission Stability with Large Current from a CNTs Cathode	333
	Y. Di, <i>Southeast University and Nanjing Normal University, Nanjing, China</i> W. Lei, X. Zhang, K. Chu, Y. Cui, J. Wang, <i>Southeast University, Nanjing, China</i> G. Yang, <i>Huadong Electronics Optoelectronics Science & Technology Co., Ltd., Nanjing, China</i> C. Huang, <i>Guoguang Electric Co., Ltd., Chengdu, China</i>	
P3.8	Field Emitters with Low Turn On Electric Field Based on Carbon Fibres	335
	Q. Wang, H. Mu, X. Zhang, W. Lei, J. Wang, H. Zhao, <i>Southeast University, Nanjing, China</i> C. Huang, <i>GuoGuang Electric Co., Ltd., Chengdu, China</i> Y. Wang, <i>Cathodal Branch Electron Device Institute San Le Group Limited Company, Nanjing, China</i>	
P3.9	Study of the Charge Deposition on the Insulator Walls in a Field Emission Display Panel ..	337
	L. Wei, X. Zhang, C. Lou, <i>Southeast University, Nanjing, China</i> G. Yang, <i>Huadong Electronics Optoelectronics Science & Technology Co., Ltd., Nanjing, China</i> C. Huang, <i>Guoguang Electric Co., Ltd., Chengdu, China</i>	
P3.10	High-Voltage Gun Micro-Arcs and Beam Energy Variations	339
	V. Katsap, R. A. Kendall, V. A. Scales, W. W. Yahn, <i>NuFlare Technology, Hopewell Junction, NY</i>	
P3.11	Optimization of Normally-On Driving Under-gate CNT FED	341
	X. Zhong, X. Zhang, H. Yin, W. Lei, X. Zhang, <i>Southeast University, Nanjing, China</i>	
P3.12	A Compact Cathode Performance Test System	343
	J. Yang, Y. Wang, Z. Nie, J. Wang, <i>Beijing University of Technology, Beijing, China</i> Y. Lu, <i>University of Electronic Science & Technology of China, Chengdu, China</i> K. Zhao, <i>Chinese Academy of Sciences, Shenyang, China</i>	
P3.13	Three Dimensional PIC Simulations of the Transparent and Eggbeater Cathodes in the Michigan Relativistic Magnetron	345
	T. Fleming, P. Mardahl, L. Bowers, <i>Air Force Research Laboratory, Kirtland AFB, NM</i> H. Bosman, S. Prasad, M. Fuks, E. Schamiloglu, <i>University of New Mexico, Albuquerque, NM</i>	
P3.14	Development of 3D Electromagnetic PIC Simulation Code for Magnetron	347
	H. Usui, S. Ohashi, K. Tada, T. Mitani, N. Shinohara, H. Matsumoto, <i>Kyoto University, Kyoto, Japan</i>	
P3.15	3-D Simulation of Millimeter-Wave Cold Secondary-Emission Cathode Drift-Orbital Resonance Magnetrons	349
	V. D. Yeryomka, M. A. Kopot', O. P. Kulagin, V. D. Naumenko, <i>National Academy of Sciences of Ukraine, Kharkiv, Ukraine</i>	
P3.16	3-D Simulation of Magnetrons Having a Secondary-Emission Cathode Stimulated by Electrons from a Field Emitter	351
	M. A. Kopot', <i>National University of Radioelectronics, Kharkiv, Ukraine</i> V. D. Yeryomka, <i>National Academy of Sciences of Ukraine, Kharkiv, Ukraine</i> V. P. Dzyuba, <i>Special Design Office "Spectr", Kyiv, Ukraine</i>	

Table of Contents

P3.17	Reduction of Noise in Strapped Magnetron by Electric Priming using Anode Shape Modification	355
	J. I. Kim, J. H. Won, G. S. Park, <i>Seoul National University, Seoul, Korea</i> H. J. Ha, J. C. Shon, <i>Samsung Electronics, Suwon, Korea</i>	
P3.18	Noise Reduction Effects of an Oven Magnetron with a Cathode Shield	357
	T. Mitani, N. Shinohara, H. Matsumoto, <i>Kyoto University, Kyoto, Japan</i> M. Aiga, N. Kuwahara, T. Ishii, <i>Panasonic Semiconductor Discrete Devices Co., Ltd., Tochigi, Japan</i>	
P3.19	Electromagnetic and 3D Effects in the Multipactor Discharge on a Dielectric	359
	H. C. Kim, Y. Chen, J. P. Verboncoeur, <i>University of California at Berkeley, Berkeley, CA</i> Y. Y. Lau, <i>University of Michigan, Ann Arbor, MI</i>	
P3.20	Development of a 2D Multistage Depressed Collector Code for TWT	361
	H. Tao, Y. ZhongHai, L. Bin, H. Quan, L. Li, X. Li, Z. XiaoFang, <i>University of Electronic Science & Technology of China, Chengdu, China</i>	
P3.21	Resistance Spot Welding of 50Mo-50Re Refractory Alloy Foils	363
	J. Farrell, W. Umstead, <i>Semicon Associates, Lexington, KY</i> J. Xu, T. Zhai, <i>University of Kentucky, Lexington, KY</i>	
P3.22	Influence of Periodic Magnetic Field Profiles on the Focusing of Electron Beams	365
	E. A. Périgo, <i>Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN, São Paulo, Brazil</i> C. C. Motta, <i>Centro Tecnológico da Marinha em São Paulo, São Paulo, Brazil</i>	
P3.23	Off-Axis Magnetic Flux Density of a PPM Focusing System	367
	E. A. Périgo, <i>Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN, São Paulo, Brazil</i> C. S. Muranaka, <i>Globalmag Transdutores Magnéticos LTDA, São Paulo, Brazil</i> C. C. Motta, <i>Centro Tecnológico da Marinha em São Paulo, São Paulo, Brazil</i>	
P3.24	Output Analysis of a Circular Horn Antenna: Higher Order Modes	369
	S.-J. Tzun, T.-L. Lin, Y. Wan, M.-C. Lin, <i>Fu Jen University, Taiwan, China</i>	
P3.25	Output Horn Antennas Profile Optimization for Far Field Radiation Pattern	371
	A. A. Kurayev, A. K. Sinityn, <i>Belarusian State University of Informatics & Electronic Engineering, Minsk, Belarus</i>	
P3.26	Solid-State Upgrade for the COBRA JUDY S-Band Phased Array Radar	373
	M. A. Kempkes, T. J. Hawkey, M. P. J. Gaudreau, R. A. Phillips, <i>Diversified Technologies, Inc., Bedford, MA</i>	
P3.27	Study on the Impedance Matching of a Coaxial Marx Generator with a Field Emission Limited Diode	375
	K.-L. Peng, Y.-Y. Chang, T.-W. Ma, M.-C. Lin, <i>Fu Jen University, Twiwan, China</i>	
P3.28	Investigation into Carbon-Trigger Vacuum Switches for High-Voltage, High-Current Switch Applications	377
	K. J. Bunch, A. Roesler, T. Friedman, C. Walker, B. Wroblewski, V. C. Hodges, <i>Sandia National Laboratories, Albuquerque, NM, T. Baginski, Auburn University, Auburn, AL</i>	
P3.29	Operational Performance and Improvements to the RF Power Sources for the Compact Linear Collider Test Facility (CTF3) at CERN	379
	G. McMonagle, <i>CERN Switzerland, Geneva, Switzerland</i>	
P3.30	High Voltage Breakdown Levels in Various EPC Potting Materials	381
	D. S. Komm, <i>California Institute of Technology, Pasadena, CA</i>	
P3.31	Computer Aided Design of Ka-band Waveguide Hybrid Junctions for Power Combining Architectures in Interplanetary Spacecraft	383
	V. Simons, <i>NASA Glenn Research Center, Brookpark, OH</i>	
P3.32	Temperature Profiles in Ceramic Cylinders Produced by Microwave and Millimeter-wave Heating	385
	A. W. Fliflet, S. H. Gold, R. W. Bruce, D. Lewis III, <i>Naval Research Laboratory, Washington, DC</i>	
P3.33	Microwave Decomposition of Hydrogen Peroxide	387
	E. Savrun, S. Sawhill, <i>Sienna Technologies, Inc., Woodinville, WA</i>	
P3.34	Medical Application of Slow-Wave Structures	389
	Y. N. Pchelnikov, <i>SloWaveS, Inc., Cary, NC</i>	

Table of Contents

P3.35	The Composite Pyramidal-Rectangular Resonator for Microwave Dryer	391
	<i>I. N. Kizhlai, A. A. Kurayev, A. K. Sinitsyn, A. V. Scherbakov, Byelorussian State University of Informatics and Electronic Engineering, Minsk, Belarus</i>	
P3.36	IOT Development at Electron Devices	393
	<i>C. Wheeland, M. Boyle, M. Kirshner, C. Wilsen, J. Cipolla, C. Malcolm, L-3 Communications Electron Devices, Williamsport, PA</i>	
P3.37	The Planar Low-Voltage, Multibeam Electrovacuum Amplifier of a Millimetric Range Based on the Field Emission Array	395
	<i>J. V. Gulyaev, J. F. Zakharchenko, N. I. Sinitsyn, Russian Academy of Sciences, Saratov, Russia</i>	
P3.38	Phase Composition and Luminescent Characteristics of Y₂O₃: Eu and Y₂O₂S: Eu Crystals Obtained using Borate Flux	397
	<i>A. V. Strel'tsov, G. V. Torgashov, N. I. Sinitsyn, I. G. Torgashov, Y. V. Gulyaev, Russian Academy of Sciences, Saratov, Russia V. P. Dmitrienko, A. O. Dmitrienko, Saratov State University, Moscow, Russia</i>	
Session 15: TWT III		
15.1	Validation Studies for CHRISTINE-CC Using a Ka-Band Coupled-Cavity TWT	399
	<i>D. Chernin, D. Dialetis, T. M. Antonsen, Jr., Science Applications International Corp., McLean, VA J. Legarra, CPI, Inc., Palo Alto, CA, J. Qiu, B. Levush, U.S. Naval Research Laboratory, Washington, DC</i>	
15.2	Ka-Band CCTWT Development at L-3 Electron Devices Division	401
	<i>J. Welter, K. Montgomery, R. B. True, M. Barsanti, J. Rominger, L-3 Communications Electron Devices, San Carlos, CA</i>	
15.3	Simulation of the BWO Threshold Current in a Helix TWT	403
	<i>P. Birtel, A. F. Jacob, Technische Universität Hamburg-Harburg, Harburg, Germany W. Schwertfeger, J.-F. David, A. Le Clair, Thales Electron Devices, Ulm, Germany</i>	
15.4	Recent Advances in Millimeter Wave Power Modules (MPPMs)	405
	<i>J. Taylor, T. Schoemehl, J. Kennedy, C. Colombo, R. True, R. Watkins, T. Hargreaves, L-3 Communications Electron Devices, San Carlos, CA</i>	
15.5	Investigation of Characteristics of High-Power Wide-Band Plasma-Filled Traveling-Wave Tubes (TWT)	407
	<i>V. Perevodchikov, P. Borovikov, V. Ivanov, Y. Kuznetsov, V. Konkin, A. Shapiro, P. Tjurjukanov, M. Zavialov, VEI, Moscow, Russia</i>	
Session 16: GYROTRONS I		
16.1	Session Keynote: Recent Results in GYCOM/IAP Development of High-Power Gyrotrons	409
	<i>G. G. Denisov, A. G. Litvak, Russian Academy of Sciences, Novgordo, Russia V. E. Myasnikov, E. M. Tai, GYCOM Ltd., Novgordo, Russia</i>	
16.2	Improved Beam-Forming Mirror System for a Multi-Frequency Gyrotron at FZK	411
	<i>X. Yang, Forschungszentrum Karlsruhe, Karlsruhe, Germany A. Arnold, Forschungszentrum Karlsruhe and Universitaet Karlsruhe, Karlsruhe, Germany G. Dammertz, K. Koppenburg, B. Piosczyk, Forschungszentrum Karlsruhe, Karlsruhe, Germany D. Wagner, Max-Planck-Institut für Plasmaphysik, Garching, Germany M. Thumm, Forschungszentrum Karlsruhe and Universitaet Karlsruhe, Karlsruhe, Germany</i>	
16.3	Optimal Synthesis of Quasi-Optical Converters for High Power Gyrotrons	413
	<i>J. M. Neilson, CCR, Inc., Saratoga, CA</i>	
16.4	170 GHz, 2 MW Coaxial Cavity Gyrotron — Test of the RF output system for the first industrial prototype tube	415
	<i>T. Rzesnicki, J. Jin, B. Piosczyk, Institut für Hochleistungsimpuls- und Mikrowellentechnik, Karlsruhe, Germany M. Thumm, Institut für Hochleistungsimpuls- und Mikrowellentechnik & Universität Karlsruhe, Karlsruhe, Germany G. Michel, D. Wagner, Max-Planck-Institut für Plasmaphysik, Greifswald, Germany & Max-Planck-Institut für Plasmaphysik, Garching, Germany</i>	
16.5	Experimental Study of a High Efficiency 1.5 MW, 110 GHz Gyrotron	417
	<i>E. M. Choi, M. A. Shapiro, J. R. Sirigiri, R. J. Temkin, Massachusetts Institute of Technology, Cambridge, MA</i>	

Table of Contents

Session 17: BWO/MICROFABRICATION

17.1	Experimental Investigation of 95GHz Folded Waveguide Backward Wave Oscillator Fabricated by Two-Step LIGA.....	419
	Y. M. Shin, J. K. So, K. H. Jang, J. H. Won, A. Srivastava, S. T. Han, G. S. Park, <i>Seoul National University, Seoul, Korea</i> J. H. Kim, S. S. Chang, <i>Pohang Accelerator Center, Pohang, Korea</i> R. K. Sharma, S. N. Joshi, <i>Central Electronics Engineering Research Institute, Philani, India</i>	
17.2	Generation of Terahertz Regime Radiation by Microfabricated Folded Waveguide Traveling Wave Tubes.....	421
	S. Sengele, H. Jiang, J. H. Booske, D. W. van der Weide, S. Limbach, A. Mashal, B. Yang, A. Marconnet, M. He, P. Larsen, <i>University of Wisconsin at Madison, Madison, WI</i>	
17.3	Backward Wave Oscillator Development at 300 and 650 GHz	423
	J. A. Dayton, Jr., C. L. Kory, G. T. Mearini, <i>Genvac Aerospace Corporation, Cleveland, OH</i>	
17.4	Terahertz Backward-wave Oscillators with Photonic Crystal Waveguides	425
	G. O. Vela, <i>University of Utah, Salt Lake City, UT</i> M. S. Miller, <i>Terahertz Device Corporation, Salt Lake City, UT</i> R. W. Grow, <i>University of Utah, Salt Lake City, UT</i> J. M. Baird, <i>Terahertz Device Corporation, Salt Lake City, UT</i>	
17.5	Latest Test of a Submillimeter-Wave Backward Wave Oscillator	427
	L. Ives, M. Caplan, C. Kory, M. Read, T. Robinson, R. Wilcox, J. Neilson, <i>Calabazas Creek Research, Inc., Saratoga, CA</i> S. Schwartzkopf, R. Witherspoon, <i>Ron Witherspoon, Inc., Campbell, CA</i>	

Session 18: PHOTOEMISSION AND SECONDARY EMISSION

18.1	Experimental Validation of a Photoemission Model for End-to-End Beam Simulations and Custom Photocathode Designs.....	429
	N. A. Moody, <i>University of Maryland, McLean, VA</i> K. L. Jensen, <i>Naval Research Laboratory, Washington, DC</i> D. W. Feldman, P. G. O'Shea, <i>University of Maryland, McLean, VA</i>	
18.2	Scanning Photoemission Microscopy of Photo-cathode Surfaces.....	431
	J. L. Shaw, J. E. Yater, J. E. Butler, <i>Naval Research Laboratory, Washington, DC</i> D. W. Feldman, N. Moody, P. G. O'Shea, <i>University of Maryland, College Park, MD</i>	
18.3	Photoelectron Emission and Secondary Electron Emission Characteristics of Cesium-doped p-type GaN.....	433
	J. E. Yater, J. L. Shaw, K. L. Jensen, <i>Naval Research Laboratory, Washington, DC</i> D. W. Feldman, N. Moody, P. G. O'Shea, <i>University of Maryland, College Park, MD</i>	
18.4	High-Energy Electron/Solid State Interaction Modeling with MONSEL.....	435
	V. Katsap, <i>NuFlare Technology, Hopewell Junction, NY</i> J. Villarrubia, <i>National Institute of Standards and Technology, Gaithersburg, MD</i>	
18.5	Diamond Technology for High Current Density Patterned Cathodes.....	437
	J. L. Shaw, J. E. Yater, J. E. Butler, <i>Naval Research Laboratory, Washington, DC</i>	

Session 19: CODES AND OPTIMIZATION

19.1	An Improved Treatment of AC Space Charge Fields in Large Signal Simulation Codes	439
	D. Dialetis, D. Chernin, T. M. Antonsen, Jr., <i>Science Applications International Corporation, McLean, VA</i> B. Levush, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
19.2	Large-Signal Code TESLA: Improvements in the Implementation and in the Model.....	441
	I. A. Chernyavskiy, A. N. Vlasov, <i>Science Applications International Corporation, McLean, VA</i> S. J. Cooke, B. Levush, <i>Naval Research Laboratory, Washington, DC</i> T. M. Anderson, Jr., <i>University of Maryland, College Park, MD</i> K. T. Nguyen, <i>Beam-Wave Research, Inc., Silver Spring, MD</i>	

Table of Contents

19.3	Two-Dimensional, Time-Domain Simulation of Klystrons and Inductive Output Tubes	443
	H. P. Freund, J. Verboncoeur, <i>Science Applications International Corp., McLean, VA</i> J. Pasour, <i>ATK-Mission Research Corp., Newington, VA</i>	
19.4	A Multi-Objective Genetic Algorithm for Optimizing Dispersion and Coupling Impedance in Helix TWTs	445
	L. Xiao, <i>Chinese Academy of Sciences, Beijing, China</i> Y.-h. Dong, <i>Chinese Academy of Sciences, Beijing, China & University of Science and Technology, Mongolia, China</i> X.-B. Su, P.-K. Liu, <i>Chinese Academy of Sciences, Beijing, China</i>	
Session 20: SLOW MM-WAVE		
20.1	Overview of W-Band Traveling Wave Tube Programs.....	447
	C. Kory, R. L. Ives, M. Read, <i>Calabazas Creek Research, Inc., Palo Alto, CA</i> J. Booske, H. Jiang, D. van der Weide, S.-J. Ho, S. Sengele, <i>University of Wisconsin at Madison, Madison, WI</i> P. Phillips, <i>Calabazas Creek Research, Inc., Palo Alto, CA</i>	
20.2	Simulation and Measurement of the Los Alamos 94GHz TWT RF Structure	449
	L. M. Earley, F. L. Krawczyk, E. I. Smirnova, B. E. Carlsten, Z. F. Wang, W. B. Haynes, S. J. Russell, <i>Los Alamos National Laboratory, Los Alamos, NM</i>	
20.3	Design Study of a Permanent-Magnet Quadrupole Focusing Lattice for a mm-wave Traveling Wave Tube	451
	R. A. Kishek, <i>Science Applications International Corporation, College Park, MD</i> D. K. Abe, <i>U.S. Naval Research Laboratory, Washington, DC</i> D. Chernin, J. J. Petillo, <i>Science Applications International Corporation, McLean, VA</i> B. Levush, <i>U.S. Naval Research Laboratory, Washington, DC</i>	
20.4	Investigation of W-Band Folded Waveguide Slow-Wave Structure using MAFIA	453
	J. Cai, <i>Beijing Vacuum Electronics Research Institute, Beijing, China & Shandong University, China</i> J. Feng, F. Liao, <i>Beijing Vacuum Electronics Research Institute, Beijing, China</i>	
20.5	Design and Initial Testing of Omnidirectional Traveling-Wave Tube Structures	455
	E. I. Smirnova, B. E. Carlsten, L. M. Earley, <i>Los Alamos National Laboratory, Los Alamos, NM</i>	
20.6	State of the Art and Future Development of Vacuum Electronics in the IRE NAS of Ukraine	457
	K. Lukin, A. Tsvyk, V. Eremka, B. Skrynnik, V. Korneenkov, V. Miroshnichenko, A. Tishenko, <i>National Academy of Sciences of Ukraine, Kharkov, Ukraine</i>	
Session 21: GYRO AMPLIFIERS AND FELs		
21.1	Demonstration of a Broadband W-Band Gyro-TWT Amplifier	459
	M. Blank, P. Borchard, S. Cauffman, K. Felch, <i>CPI, Palo Alto, CA</i>	
21.2	140 kW W-Band TE₀₁ Ultra High Gain Gyro-TWT Amplifier	461
	L. R. Barnett, W. C. Tsai, H. L. Hsu, N. C. Luhmann, Jr., <i>University of California at Davis, Davis, CA</i> C. C. Chiu, K. F. Pao, K. R. Chu, <i>National Tsing Hua University, Taiwan, China</i>	
21.3	Broadband Gyro-TWA Simulations and Comparison with Experiment	463
	C. G. Whyte, A. R. Young, E. G. Rafferty, J. Thomson, A. D. R. Phelps, W. He, A. W. Cross, K. Ronald, <i>University of Strathclyde, Glasgow, UK</i>	
21.4	Design of a Wideband 140 GHz, 1 kW Gyro-Amplifier	465
	C. D. Joye, A. Cerfon, M. A. Shapiro, J. R. Sirigiri, R. J. Temkin, A. C. Torrezan, <i>Massachusetts Institute of Technology, Cambridge, MA</i>	
21.5	Study on Photonic Crystal Cavity for Harmonic Multiplying Gyrokystron using Axis-encircling Electron Beam.....	467
	Y. D. Joo, J. H. Won, G. S. Park, <i>Seoul National University, Seoul, Korea</i>	
21.6	First Operation of Free-Electron Maser Based on a Combined Two-Mirror Cavity Based on 2D and 1D Bragg Structures.....	469
	A. W. Cross, I. V. Konoplev, W. He, P. McInnes, A. D. R. Phelps, K. Ronald, C. G. Whyte, C. W. Robertson, <i>University of Strathclyde, Glasgow, UK</i>	

Table of Contents

Session 22: FIELD EMITTER FABRICATION & CHARACTERIZATION

22.1	Session Keynote: High Voltage Compatible Micromachined Vacuum Electronic Devices with Carbon Nanotube Cold Cathodes	471
	C. A. Bower, K. H. Gilchrist, S. Broderick, J. R. Piascik, B. R. Stoner, <i>RTI International, Triangle Park, NC</i> C. B. Parker, S. Natarajan, S. D. Wolter, J. T. Glass, <i>Duke University, Durham, NC</i>	
22.2	Custom Spindt Cathode for Diamond Based BWO	473
	C. Holland, C. Spindt, <i>SRI International, Menlo Park, CA</i> J. A. Dayton, Jr., <i>Genvac Aerospace Corporation, Cleveland, OH</i>	
22.3	A New Method for Nanometer Scale Imaging of Field Emission Current Distribution	475
	T. Sato, M. Saida, <i>University of Tsukuba, Ibaraki, Japan</i> M. Nagao, S. Yamamoto, <i>National Institute of Advanced Industrial Science & Technology, Ibaraki, Japan</i> M. Sasaki, <i>University of Tsukuba, Ibaraki, Japan</i>	
22.4	High Current Density Advanced Cold Cathode Experiments	477
	X. He, V. Valahos, J. Scharer, J. Booske, S. Sengele, R. Miller, <i>University of Wisconsin at Madison, Madison, WI</i> N. Jordan, R. Gilgenbach, <i>University of Michigan, Ann Arbor, MI</i>	
22.5	Beam Emission Test on Carbon Nanotube Cathode of a Gridded Pierce Gun	479
	H. J. Kim, W. B. Seo, J. J. Choi, <i>Kwangwoon University, Seoul, Korea</i> J.-H. Han, J.-B. Yoo, <i>Sungkyunkwan University, Gyeonggi-do, Korea</i>	

Session 23: SHEET BEAMS

23.1	Session Keynote: W-band Sheet Beam Klystron Research at SLAC	481
	G. Scheitrum, G. Caryotakis, A. Burke, A. Jensen, E. Jongewaard, M. Neubauer, R. Phillips, R. Steele, <i>Stanford Linear Accelerator Center, Menlo Park, CA</i>	
23.2	Axial vs Transverse Bunching in Sheet Beam TWTs	483
	T. M. Antonsen, Jr., <i>SAIC and University of Maryland, College Park, MD</i> S. J. Cooke, B. Levush, <i>Naval Research Laboratory, Washington, DC</i> Y. N. Pchelnikov, <i>SloWaveS, Inc., Cary, NC</i>	
23.3	W-band Sheet Beam Klystron PCM Focusing Design	485
	A. Burke, V. Besong, K. Granlund, A. J. Jensen, E. Jongewaard, R. Phillips, K. Rauenbuehler, G. Scheitrum, R. Steele, <i>Stanford Linear Accelerator Center, Menlo Park, CA</i>	
23.4	A Coupled-Cavity Slow-wave Structure for Sheet-Beam Devices	487
	S. J. Cooke, B. Levush, <i>Naval Research Laboratory, Washington, DC</i> T. M. Antonsen, Jr., <i>SAIC and University of Maryland, College Park, MD</i>	
23.5	Sheet Beam Klystron Simulations Using AJDISK	489
	A. J. Jensen, G. Caryotakis, G. Scheitrum, D. Sprehn, B. Steele, <i>Stanford Linear Accelerator Center, Menlo Park, CA</i>	

Session 24: COMPONENT TECHNOLOGIES

24.1	Simplified Methodology to Evaluate Effect of Backscattered Electrons in Gyrotrons with Depressed Collectors	491
	A. Singh, <i>University of Maryland, College Park, MD</i> , W. B. Herrmannsfeldt, <i>Stanford University, Stanford, CA</i>	
24.2	X-ray Generation in Energetic Surface Impact for the Particle Simulation Model of Plasmas	493
	C.-H. Lim, J. P. Verboncoeur, <i>University of California at Berkeley, Berkeley, CA</i>	
24.3	The Effect of Non Uniform Permanent Magnet Material on Transverse Fields in Periodic Permanent Magnet Focused Traveling Wave Tubes	495
	J. Willhite, <i>Semicon Associates</i> , L. Falce, M. Chesnut, <i>Communications and Power Industries</i> ,	
24.4	The Relationship Between Reversible Temperature Coefficient of Br and the Axial Field Profile of a TWT Magnet Stack	497
	J. Liu, M. Walmer, <i>Electron Energy Corporation, Landisville, PA</i>	
24.5	Analysis and Simulation of a TM₀₁-Mode Launcher for an Overmoded Waveguide	499
	M. Sumathy, S. K. Chhotray, L. Kumar, <i>Microwave Tube Research & Development Centre, Bangalore, India</i>	

Table of Contents

Session 25: GUN DESIGN II

25.1	New and Improved Emission Models in the Finite-Element Gun Code MICHELLE	501
	E. M. Nelson, <i>Los Alamos National Laboratory, Los Alamos, NM</i> J. J. Petillo, <i>Science Applications International Corporation, Burlington, MA</i> K. Jensen, <i>Naval Research Laboratory, Washington, DC</i>	
25.2	A New Grided Electron Gun Configuration Projected to Operate from Beam Full on to Near Cutoff	503
	B. H. Smith, <i>Consultant, Lexington, KY</i>	
25.3	An Experimental Study and Modeling of the Field Emission Properties of an Isolated Individual Multi-Walled Carbon Nanotube	505
	B. Ribaya, <i>Santa Clara University, Santa Clara, CA</i> , <i>NASA Ames Center for Nanotechnology, Moffett Field, CA</i> D. Niemann, N. Gunther, M. Rahman, <i>Santa Clara University, Santa Clara, CA</i> C. V. Nguyen, <i>ELORET Corporation & NASA Ames Center for Nanotechnology, Moffett Field, CA</i>	
25.4	Field Emitter Array Electron Gun for Traveling Wave Tubes	507
	X. Li, G. Bai, M. Ding, F. Zhang, J. Feng, F. Liao, <i>Beijing Vacuum Electronics Research Institute, Beijing, China</i>	
25.5	Numerical Analysis-the Performance of Field Emission Display with Secondary Electrons Emission	509
	H. Zhao, W. Lei, X. Zhang, <i>Southeast University, Nanjing, China</i> G. Yang, <i>Huadong Electronics Optoelectronics Science & Technology Co., Ltd., Nanjing, China</i>	

Session 26: FIELD EMISSION DEVICES

26.1	Field Emission Arrays for Tomographic Medical X-Ray Imaging	511
	P. R. Schwoebel, C. E. Holland, C. A. Spindt, <i>SRI International, Menlo Park, CA</i>	
26.2	Small-Sized X-Ray Tube with the Field Electron Emitter on the Base of Carbon Nanotubes	513
	O. Y. Maslennikov, <i>FSUE "Toriy", Moscow, Russia</i> Y. V. Gulyaev, K. R. Izrael'yants, A. L. Musatov, A. B. Ormont, <i>Institute of Radio Engineering & Electronics RAS, Moscow, Russia</i> K. V. Stanislavchik, I. A. Guzilov, S. V. Lamonov, <i>FSUE "Toriy", Moscow, Russia</i> N. A. Kiselev, <i>Institute of Crystallography RAS, Moscow, Russia</i> E. F. Kukovitskiy, <i>Kazan Physical-Technical Institute, Kazan, Russia</i>	
26.3	Gate-substrated Structure to Improve FED Performance	515
	G. Wei, L. Wei, Z. Xiaobing, <i>Southeast University, Nanjing, China</i>	
26.4	Milliamp-Class, Back-Gated, Triode Field Emission Devices Based on Free-Standing, Two-Dimensional Carbon Nanostructures	517
	B. C. Holloway, M. Zhu, X. Zhao, J. Wang, S. Wang, P. Miraldo, R. Outlaw, <i>College of William & Mary, Williamsburg, VA</i> T. Tyler, O. Shenderova, M. Ray, J. Dalton, G. McGuire, <i>International Technology Center, Williamsburg, VA</i>	
26.5	Buried-Line Back-Gated Triode Field Emission Devices	519
	T. Tyler, O. Shenderova, M. Ray, J. Dalton, G. McGuire, <i>International Technology Center, Raleigh, NC</i> M. Zhu, X. Zhao, J. Wang, S. Wang, R. Outlaw, B. C. Holloway, <i>College of William & Mary, Williamsburg, VA</i>	

Session 27: NONLINEAR AND CHAOS

27.1	Session Keynote: Secure Chaos Communications Using Driven Traveling Wave Tube Amplifiers with Delayed Feedback	521
	P. B. Larsen, L. M. Earley, B. E. Carlsten, R. M. Wheat, <i>Los Alamos National Laboratory, Los Alamos, NM</i> J. H. Booske, <i>University of Wisconsin at Madison, Madison, WI</i>	
27.2	Simulated Impact of Non-Linear Memory Effects on Digital Communications in a Klystron	523
	J. P. Calame, B. Levush, <i>Naval Research Laboratory, Washington, DC</i>	

Table of Contents

27.3	Investigation of Synchronization and Transition to Chaos in a Driven TWT Delayed Feedback Oscillator	525
	N. M. Ryskin, D. A. Guskov, V. N. Titov, <i>Saratov State University, Saratov, Russia</i> P. B. Larsen, S. Sengele, J. H. Booske, <i>University of Wisconsin at Madison, Madison, WI</i> C. Marchewka, <i>Massachusetts Institute of Technology, Cambridge, MA</i> S. Bhattacharjee, <i>Indian Institute of Technology, Kanpur, India</i>	
27.4	Experimental and Theoretical Study of Chaotic Microwave Oscillations and Pattern Formation in Non-relativistic Electron Beam with Virtual Cathode	527
	D. I. Trubetskov, A. E. Hramov, E. N. Egorov, R. A. Filatov, Y. A. Kalinin, A. A. Koronovskii, <i>Saratov State University, Saratov, Russia</i>	
27.5	High Dimension Chaotic Attractors in Gyrotron with Non-Fixed Field Structure	529
	E. V. Blokhina, A. G. Rozhnev, <i>Saratov State University, Saratov, Russia</i> S. P. Kuznetsov, <i>Institute of Radio-Engineering and Electronics of RAS, Saratov, Russia</i>	
27.6	Experiment of TWT Chaos Central Frequency Fast- and Continuously-Tuning System	531
	Y. Chen, J. Feng, X. Wu, <i>Beijing Vacuum Electronics Research Institute, Beijing, China</i>	

Session 28: GYROTRONS II

28.1	Session Keynote: Status of the 1-MW, 140-GHz, CW Gyrotron for W7-X	533
	G. Gantenbein, G. Dammertz, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> S. Alberti, <i>Centre de Recherche en Physique des Plasmas, Lausanne, Suisse</i> A. Arnold, <i>Forschungszentrum Karlsruhe and Universität Karlsruhe, Karlsruhe, Germany</i> V. Erckmann, <i>Max-Planck-Institut für Plasmaphysik, Greifswald, Germany</i> E. Giguet, <i>Thales Electron Devices, Vélizy Cedex, France</i> R. Heidinger, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> J. P. Hogge, <i>Centre de Recherche en Physique des Plasmas, Lausanne, Suisse</i> S. Illy, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> W. Kasperek, <i>Universität Stuttgart, Karlsruhe, Germany</i> K. Koppenburg, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> H. Laqua, <i>Max-Planck-Institut für Plasmaphysik, Greifswald, Germany</i> F. Legrand, <i>Thales Electron Devices, Vélizy Cedex, France</i> W. Leonhardt, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> C. Liévin, <i>Thales Electron Devices, Vélizy Cedex, France</i> G. Michel, <i>Max-Planck-Institut für Plasmaphysik, Greifswald, Germany</i> G. Neffe, B. Piosczyk, M. Schmid, <i>Forschungszentrum Karlsruhe, Karlsruhe, Germany</i> M. Thumm, <i>Forschungszentrum Karlsruhe and Universität Karlsruhe, Karlsruhe, Germany</i> M. Q. Tran, <i>Centre de Recherche en Physique des Plasmas, Lausanne, Suisse</i>	
28.2	Observation of Low-Frequency Parasitic Oscillations in a 1.5 MW, 110 GHz Gyrotron	535
	C. D. Marchewka, E. M. Choi, M. A. Shapiro, J. R. Sirigiri, R. J. Temkin, <i>Massachusetts Institute of Technology, Cambridge, MA</i>	
28.3	Operation of a 95 GHz 100kW Gyrotron in a High-Tc (BSCCO) Magnet	537
	S. Cauffman, M. Blank, P. Cahalan, K. Felch, <i>Communications and Power Industries, Inc., Palo Alto, CA</i> R. W. McGhee, M. Coffey, <i>Cryomagnetics, Inc., Oak Ridge, TN</i>	
28.4	Stable Operation of a 0.46 THz Continuous Wave Gyrotron Oscillator	539
	S. T. Han, C. D. Joye, I. Mastovsky, M. A. Shapiro, J. R. Sirigiri, R. J. Temkin, P. P. Woskov, <i>Massachusetts Institute of Technology, Cambridge, MA</i>	
28.5	Phase Sensitivity in Relativistic Gyrotrons	541
	G. S. Nusinovich, R. Ngogang, O. V. Sinitsyn, V. L. Granatstein, <i>University of Maryland, College Park, MD</i>	
28.6	Preliminary Design of a High Power, High Efficiency, Ka-Band Complex Cavity Gyrotron Oscillator	543
	F. Wang, J.-R. Luo, C.-Q. Jiao, <i>Chinese Academy of Sciences, Beijing, China</i>	

Table of Contents

Session 29: HIGH POWER TRANSMITTER TECHNOLOGIES

29.1	The RF System for the European XFEL	545
	<i>S. Choroba, Deutsches Elektronen-Synchrotron, Hamburg, Germany</i>	
29.2	Experimental Study on 100MW X-band Relativistic Backward Wave Oscillator	547
	<i>H. C. Jung, D. H. Kim, S. H. Min, Z. Q. Yang, M. C. Wang, M. J. Rhee, G. S. Park, Seoul National University, Seoul, Korea</i>	
	<i>J. H. Kim, S. Y. Park, Pohang University of Science & Technology (POSTECH), Pohang, Korea</i>	
29.3	A New High-Efficiency Zero-Voltage, Zero-Current Switching Topology	549
	<i>S. H. Weinberg, European Space Agency, Noordwijk, The Netherlands</i>	
29.4	W-Band Transmitter Upgrade for the Haystack UltraWideband Satellite Imaging Radar (HUSIR)	551
	<i>M. A. Kempkes, T. J. Hawkey, M. P. J. Gaudreau, R. A. Phillips, Diversified Technologies, Inc., Bedford, MA</i>	
29.5	High Power Microwave Control by Quasi-Optical Gratings	553
	<i>M. I. Petelin, Institute of Applied Physics, Novgordo, Russia</i>	
29.6	Microwave Pulse Compression using Helically Corrugated Waveguides	555
	<i>A. R. Young, K. Ronald, P. MacInnes, C. G. Whyte, G. Burt, W. He, I. V. Konoplev, A. D. R. Phelps, A. W. Cross, University of Strathclyde, Glasgow, Scotland</i>	
	<i>S. V. Samsonov, V. L. Bratman, G. G. Denisov, Russian Academy of Sciences, Saratov, Russia</i>	

Session 30: MAGNETRONS AND RELATIVISTIC MAGNETRONS

30.1	Magnetic Priming Experiments on a Relativistic Magnetron	557
	<i>B. W. Hoff, R. M. Gilgenbach, Y. Y. Lau, N. M. Jordan, W. White, E. Cruz, M. C. Jones, V. B. Neculaes, T. A. Spencer, D. Price, University of Michigan, Ann Arbor, MI</i>	
30.2	Use of DSP and Fast Feedback for Accurate Phase Control of an Injection Locked Magnetron	559
	<i>I. Tahir, A. C. Dexter, R. G. Carter, Lancaster University, Lancaster, UK</i>	
30.3	Experimental Investigation of Giga-watt Magnetically Insulated Transmission Line Oscillator (MILO) by Improved Axial Power Extraction	561
	<i>D. H. Kim, H. C. Jung, S. H. Min, M. C. Wang, M. J. Rhee, G. S. Park, Seoul National University, Seoul, Korea</i>	
	<i>C. H. Kim, D. W. Yim, Agency for Defense Development, KaeJeon, Korea</i>	
30.4	Effect of the External Coupling of Cavities on the Stability and Output Power of a Relativistic Magnetron	563
	<i>I. Vintzenko, Nuclear Physics Institute, Tomsk, Russia</i>	
	<i>A. Zarevich, S. Novikov, Tomsk State University, Tomsk, Russia</i>	
	<i>A. Shlapakovski, Nuclear Physics Institute, Tomsk, Russia</i>	
30.5	Improvement of the Output Characteristics of a Relativistic Magnetron using a Small Diameter Cathode Surrounded by a Transparent Cathode	565
	<i>L. Bowers, T. Fleming, P. Mardahl, Air Force Research Laboratory, Kirtland AFB, NM</i>	
	<i>H. Bosman, M. Fuks, S. Prasad, E. Schamiloglu, University of New Mexico, Albuquerque, NM</i>	
30.6	Development of a Long Life Ka-band Inverted Coaxial Magnetron for Use in an Airborne Military Radar System	567
	<i>G. Blanchette, B. Guss, M. Doherty, Communications & Power Industries, Beverly, MA</i>	

AUTHOR INDEX	A-1
---------------------------	-----