

2015 Joint Conference of the IEEE International Frequency Control Symposium & the European Frequency and Time Forum

(FCS 2015)

**Denver, Colorado, USA
12-16 April 2015**



IEEE Catalog Number: CFP15FRE-POD
ISBN: 978-1-4799-8867-9

**Copyright © 2015 by the Institute of Electrical and Electronic Engineers, Inc
All Rights Reserved**

Copyright and Reprint Permissions: 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 Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

******This publication is a representation of what appears in the IEEE Digital Libraries. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number: CFP15FRE-POD
ISBN 13: 978-1-4799-8867-9

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

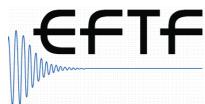


2015 JOINT CONFERENCE OF THE IEEE INTERNATIONAL FREQUENCY CONTROL SYMPOSIUM & EUROPEAN FREQUENCY AND TIME FORUM

April 12-16, 2015 | Colorado Convention Center | Denver, Colorado - USA

PROCEEDINGS

Organized and Sponsored
by:



© 2015 IEEE. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to use any copyrighted component of this work in other works must be obtained from the IEEE.

Technical Support:
Conference Catalysts, LLC
Phone: +1 352 872 5544
cdyer@conferencecatalysts.com

**2015 Joint Conference of the IEEE International Frequency
Control Symposium & the European Frequency and Time Forum**

© 2015 IEEE. Personal use of this material is permitted. However, permission to reprint/republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the IEEE.

TABLE OF CONTENTS

Technical Papers	iv
Welcome from the General Co-Chairs	xi
IEEE IFCS-EFTF 2015 Organizing Committee	xxiii
IFCS-EFTF 2015 Joint Technical Program Committee	xxv
Special Thanks	xxix
Exhibitors	xxx
IFCS 2015 Awards	xxxiii
EFTF 2015 Awards	xxxiv
Student Paper Competition	xxxv
Future Symposia	xxxvii
Tutorials	xxxix
Entrepreneurs Forum	xl
IEEE Women in Engineering	xl
Time & Frequency and Fundamental Physics	xli
Plenary Session Invited Talk	xlii

TECHNICAL PAPERS

Monday, April 13, 2015

Session: A1L-A: Non Linear Phenomena & Mechanical Signal Processors

Parametric Excitation in Geometrically Optimized AlN Contour Mode Resonators	1
<i>Ruochen Lu, Anming Gao, Songbin Gong</i>	
<i>University of Illinois at Urbana Champaign, United States</i>	
Third Order Intermodulation Distortion in Capacitive-Gap Transduced Micromechanical Filters	5
<i>Jalal Naghash Nilchi, Ruonan Liu, Scott Li, Mehmet Akgul, Tristan Rocheleau, Clark Nguyen</i>	
<i>University of California, Berkeley, United States</i>	
Nonlinear Acceleration Sensitivity of Quartz Resonators	11
<i>Jianfeng Chen², Yook-Kong Yong², Randall Kubena¹, Deborah Kirby¹, David Chang¹</i>	
<i>¹HRL Laboratories, LLC, United States; ²Rutgers University, United States</i>	

Multiple SAW Resonance Sensing Through One Communication Channel with Multiple Phase Detectors	17
<i>Yoshinori Takizawa², Takayuki Shibata¹, Shinji Kashiwada¹, Yasuo Yamamoto¹, Masayoshi Esashi², Shuji Tanaka²</i>	
<i>¹DENSO Corporation, Japan; ²Tohoku University, Japan</i>	

Session: A1L-B: Vapor Cell Properties

Imaging the Static Magnetic Field Distribution in a Vapor Cell Atomic Clock	21
<i>Christoph Affolderbach², Guan-Xiang Du¹, Thejesh Bandi², Andrew Horsley¹, Philipp Treutlein¹, Gaetano Milet²</i>	
<i>¹Universität Basel, Switzerland; ²Université de Neuchâtel, Switzerland</i>	

87Rb Isoclinic Point Thermometry	25
<i>Nathan Wells, Travis Driskell, James Campano</i>	
<i>Aerospace Corporation, United States</i>	

Spectroscopy and Hyperfine Clock Frequency Shift Measurements in Cs Vapor Cells Coated with Octadecyltrichlorosilanes (OTS)	33
<i>Moustafa Abdel Hafiz¹, Vincent Maurice¹, Ravinder Chutani¹, Nicolas Passilly¹, Christophe Gorecki¹, Stéphane Guérardel², Emeric De Clercq², Rodolphe Boudot¹</i>	
<i>¹FEMTO-st Institute, France; ²Observatoire de Paris, France</i>	

Buffer Gas Consumption in Rubidium Discharge Lamps	37
<i>Bernardo Jaduszliwer, Michael Huang, James Campano</i>	
<i>Aerospace Corporation, United States</i>	

Session: A1L-C: Applications of Optical Clocks

mSTAR: Testing Special Relativity in Space Using High Performance Optical Frequency References	47
<i>Thilo Schulte², Shailendra Saraf⁷, Alberto Stochino⁷, Klaus Döringshoff³, Sasha Buchman⁷, Grant D. Cutler⁷, John Lipa⁷, Si Tan⁷, John Hanson⁶, Belgacem Jaroux⁶, Claus Braxmaier⁸, Norman Gürlebeck⁸, Sven Herrmann⁸, Claus Lämmerzahl¹</i>	
<i>¹Airbus DS GmbH, Germany; ²German Aerospace Center, Germany; ³Humboldt-Universität zu Berlin, Germany; ⁴King Abdulaziz City for Science and Technology, Saudi Arabia; ⁵King Abdulaziz City for Science and Technology / Stanford University, Saudi Arabia; ⁶NASA Ames Research Center, United States; ⁷Stanford University, United States; ⁸Universität Bremen, Germany</i>	

Geometrical Scale-Factor Stabilization of Square Cavity Ring Laser Gyroscopes	51
<i>Jacopo Belfi¹, Angela Di Virgilio¹, Nicolò Beverini², Giorgio Carelli², Enrico Maccioni², Andreino Simonelli², Rosa Santagata³</i>	
<i>¹Istituto Nazionale di Fisica Nucleare, Italy; ²Università di Pisa, Italy; ³Università di Siena and Istituto Nazionale di Fisica Nucleare, Italy</i>	

Session: A2L-A: Small Scale Oscillators**Möbius Metamaterial Topology: Applications in Resonators and Tunable Oscillator Circuits** 56Ajay Poddar², Ulrich Rohde¹¹Brandenburgische Technische Universität / Synergy Microwave Corporation, Germany; ²Synergy Microwave Corporation, United States**Frequency Signal Source's PN (Phase Noise) Measurements: Challenges and Uncertainty** 62Ulrich Rohde¹, Ajay Poddar³, Enrico Rubiola², Marius Alexandru Silaghi⁴¹Brandenburgische Technische Universität / Synergy Microwave Corporation, Germany; ²FEMTO-st Institute, France;³Synergy Microwave Corporation, United States; ⁴Universitatea din Oradea, Romania**Model for Acoustic Locking of Spin Torque Oscillator** 68Tanay Gosavi², Sunil Bhave¹¹Analog Devices Inc, United States; ²Cornell University, United States**Piezoelectrically-Acutated Opto-Acoustic Oscillator** 72

Siddhartha Ghosh, Jeronimo Segovia-Fernandez, Gianluca Piazza

Carnegie Mellon University, United States

UHF SiGe Push-Pull VCO MEMS Oscillators 76Yeong Yoon, Harris Moyer, Deborah Kirby, Randall Kubena, Richard Joyce, Ross Bowen, Hung Nguyen, David Chang
HRL Laboratories, LLC, United States**Ultra-Low Phase Noise Frequency Synthesis Chains for High-Performance Vapor Cell Atomic Clocks** 81Bruno François¹, Rodolphe Boudot¹, Claudio Eligio Calosso², Jean-Marie Danet³¹FEMTO-st Institute, France; ²Istituto Nazionale di Ricerca Metrologica, Italy; ³Observatoire de Paris, Italy**Session: A2L-B: Sensors & Precision Measurements****Design of a Novel Length Extension Vibratory Gyroscope** 84

Gobong Choi, Yook-Kong Yong

Rutgers University, United States

Remote Atomic Vapor Magnetometer with Sub-pT Resolution Operating at Ambient Temperature 90Janet Lou¹, Fredrik Fatemi², Geoffrey Cranch²¹Sotera Defense Solutions, Inc., United States; ²U. S. Naval Research Laboratory, United States**Session: A3P-D: Materials for Resonators****UHF Acoustic Attenuation and Quality Parameter Limits in the Diamond Based HBAR** 94Arseniy Telichko¹, Boris Sorokin², Gennady Kvashnin³¹Moscow Institute of Physics and Technology, Russia; ²Moscow Institute of Physics and Technology / Technological Institute for Superhard and Novel Carbon , Russia; ³Technological Institute for Superhard and Novel Carbon Materials, Russia**How to Qualify LGT Crystal for Acoustic Devices?** 100Maroua Allani³, Xavier Vacheret³, Alexandre Clairet³, Thomas Baron³, Jean-Jacques Boy³, C. Reibel⁵, O. Cambon⁵, Jean-Marc Lesage², Olivier Bel⁴, Hugues Cabane¹, C. Pecheyran⁶¹Cristal Innov / Université Lyon1, France; ²DGA - Ministère de la Défense, France; ³FEMTO-st Institute, France; ⁴RAKON, France; ⁵Université de Montpellier, France; ⁶Université de Pau, France**Langasite Family Crystals as Promising Materials for Microacoustic Devices at Cryogenic Temperatures** 106Andrey Sotnikov³, Elena Smirnova¹, Hagen Schmidt³, Manfred Weihnacht³, Jens Götze⁴, Sergey Sakharov²¹A.F.Ioffe Physical-Technical Institute St. Petersburg, Russia; ²FOMOS-MATERIALS, OAO, Russia; ³Leibniz-Institut für Festkörper- und Werkstoffforschung, Germany; ⁴Technische Universität Bergakademie Freiberg, Germany**As-Doped Si's Complex Permittivity and its Effects on Heating Curve at 2.45 GHz Frequency** 111

Siddharth Varadan, George Pan, Zhao Zhao, Terry Alford

Arizona State University, United States

Sputtered Al(I-x)SCxN Thin Films with High Areal Uniformity for Mass Production	117
Valeriy Felmetsgier ¹ , Mikhail Mikhov ¹ , Mario DeMiguel-Ramos ² , Marta Clement ² , Jimena Olivares ² , Teona Mirea ² , Enrique Iborra ²	
¹ OEM Group, United States; ² Universidad Politécnica de Madrid, Spain	
Session: A3P-E: Oscillators, Synthesizers, Noise & Circuit Techniques I	
Micro OXCO EWOS-0513: a 20 Years Space Odyssey Up to 67P/Churyumov-Gerasimenko	121
Philippe Guillemot ¹ , Gilles Cibiel ¹ , Yves Richard ² , Jean-Marie Tarot ² , Guy Richard ²	
¹ CNES - French Space Agency, France; ² Syrlinks, France	
Noise Modeling Methodology of an Integrated Circuit for Quartz Crystal Oscillator	125
Nikolay Vorobyev ² , Joel Imbaud ² , Thomas Baron ² , Gilles Cibiel ¹ , Serge Galliou ²	
¹ CNES - French Space Agency, France; ² FEMTO-st Institute, France	
The Prediction, Simulation and Verification of the Phase Noise in Low-Phase-Noise Crystal Oscillator	129
Xianhe Huang, Junjie Jiao, Fuyu Sun, Wei Fu	
University of Electronic Science and Technology of China, China	
The Border Effect in Frequency Signal Processing and the Phase Measurement with Arbitrary Frequency Relationship	133
Wei Zhou, Lina Bai, Zhiqi Li, Faxi Chen, Xiaotian Cao, Yadong Duan, Xuyang Zhou, Longfei Xu	
Xidian University, China	
A 250nm CMOS Low Phase Noise Differential VCO Circuit Without Varactors	136
Anatoly Kosykh, Konstantin Murasov, Alexandr Lepetaev, Sergey Zavyalov	
Omsk State Technical University, Russia	
Novel Gyroscopic Mounting for Crystal Oscillator (Payload) Applied in High Dynamic Host Vehicle (Platform) to Improve its Output Stability	139
Maryam Abedi, Tian Jin	
Beihang University, China	
Frequency Performance of the New Horizons Ultra-Stable Oscillators: Nine Years of Continuous in-Flight Monitoring	145
Robert Jensen, Gregory Weaver	
Johns Hopkins Applied Physics Laboratory, United States	
A CMOS LC-Based Frequency Reference with ±40ppm Stability from -40°C to 105°C	151
David Gaiad, Mohamed Khairy, Mohamed Atef, Ayman Ahmed, Mostafa Shadoufa, Amr Hassanein, Omar El-Aassar, Mostafa Gamal, Ahmed El-Sayed, Ahmed Badawy, Amr Adel, Mazen Erfan, Nabil Sinoussi, Ahmed Helmy	
Si-Ware Systems, Egypt	
Effects of Pressure and Bias Voltage on the Phase Noise of CMOS-MEMS Oscillators	155
Wan-Cheng Chiu, Ming-Huang Li, Chao-Yu Chen, Sheng-Shian Li	
National Tsing Hua University, Taiwan	
1/F Noise of Quartz Resonators: Measurements, Modelization and Comparison Studies	158
Fabrice Stha ² , Michel Deve ² , Joel Imbaud ² , Roger Bourquin ² , Ahmed Bakir ² , Cedric Vuillemin ² , Santunu Ghosh ² , Philippe Abbé ² , David Vernier ² , Gilles Cibiel ¹	
¹ CNES - French Space Agency, France; ² FEMTO-st Institute, France	
Session: A3P-F: Microwave Standards I	
Estimation of the Light Shift in Ramsey-Coherent Population Trapping	162
Yuichiro Yano ² , Shigeyoshi Goka ² , Masatoshi Kajita ¹	
¹ National Institute of Information and Communications Technology, Japan; ² Tokyo Metropolitan University, Japan	
CPT Pulse Excitation Method Based on VCSEL Current Modulation for Miniature Atomic Clocks	167
Takumi Ide, Shigeyoshi Goka, Yuichiro Yano	
Tokyo Metropolitan University, Japan	

Preliminary Results of a Cs Vapor Cell CPT Clock Using Push-Pull Optical Pumping	171
<i>Moustafa Abdel Hafiz, Rodolphe Boudot</i>	
<i>FEMTO-st Institute, France</i>	
Alkali Metal Source Tablet for Vapor Cells of Atomic Magnetometers	174
<i>Kazuhiro Ban¹, Akira Terao¹, Natsuhiko Mizutani¹, Kazuya Tsujimoto², Yoshikazu Hirai², Tetsuo Kobayashi², Osamu Tabata²</i>	
<i>¹Canon Inc., Japan; ²Kyoto University, Japan</i>	
Alkali Metal Consumption by Discharge Lamps Fabricated from GE-180 Aluminosilicate Glass	180
<i>Charles Klimcak, Michael Huang, James Campano</i>	
<i>Aerospace Corporation, United States</i>	
Mercury Lamp Studies in Support of Trapped Ion Frequency Standards	188
<i>Lin Yi, Eric Burt, Robert Tjoelker</i>	
<i>Jet Propulsion Laboratory / California Institute of Technology, United States</i>	
Session: A3P-G: Sensors III	
Multimode SiC Trampoline Resonators Manipulate Microspheres to Create Chladni Figures	193
<i>Hao Jia, Hao Tang, Philip Feng</i>	
<i>Case Western Reserve University, United States</i>	
Calibrating Temperature Coefficient of Frequency (TCf) and Thermal Expansion Coefficient (Alpha) of MoS₂ Nanomechanical Resonators	198
<i>Rui Yang, Zenghui Wang, Philip Feng</i>	
<i>Case Western Reserve University, United States</i>	
Performance Evaluation of CMOS-MEMS Thermal-Piezoresistive Resonators in Ambient Pressure for Sensor Applications	202
<i>Jung-Hao Chang, Cheng-Syun Li, Cheng-Chi Chen, Sheng-Shian Li</i>	
<i>National Tsing Hua University, Taiwan</i>	
Comparison of Acoustic Wave Pressure Sensors for TPMS Applications	205
<i>Manohar Nagaraju², Suresh Sridaran¹, Andrew Lingley², John Larson III¹, Brian Otis², Richard Ruby¹</i>	
<i>¹Avago Technologies, United States; ²University of Washington, United States</i>	
Micromechanical Piezoelectric-on-Silicon BAW Resonators for Sensing in Liquid Environments	209
<i>Abhinav Prasad, Ashwin Seshia, Jerome Charmet</i>	
<i>University of Cambridge, United Kingdom</i>	
Stress Sensitivity Coefficients of HBAR	214
<i>Thomas Baron², Valérie Petrin², Gilles Martin², Guillaume Combe², Alexandre Clairet², Bernard Dulmet², Jean-Marc Lesage¹, Thierry Laroche³, Sylvain Ballandras³</i>	
<i>¹DGA - Ministère de la Défense, France; ²FEMTO-st Institute, France; ³frec-n-sys SAS, France</i>	
A 400µW Differential FBAR Sensor Interface IC with Digital Readout	218
<i>Manohar Nagaraju², Suresh Sridaran¹, Andrew Lingley², Reed Parker¹, Richard Ruby¹, Brian Otis²</i>	
<i>¹Avago Technologies, United States; ²University of Washington, United States</i>	
Dual-Mode NEMS Self-Oscillator for Mass Sensing	222
<i>Guillaume Gourlat, Marc Sansa, Guillaume Jourdan, Patrick Villard, Gilles Sicard, Sébastien Hentz</i>	
<i>Commissariat à l'énergie atomique et aux énergies alternatives, France</i>	
Session: A3P-H: Timekeeping, Time & Frequency Transfer, GNSS Applications I	
Uncertainty Evaluation of 2013 TL METODE Link Calibration Tour	226
<i>Shinn-Yan Lin, Yi-Jiun Huang, Wen-Hung Tseng</i>	
<i>Chunghwa Telecom Co., Ltd, Taiwan</i>	

Link Calibration or Receiver Calibration for Accurate Time Transfer	230
<i>Zhiheng Jiang International Bureau of Weights and Measures, France</i>	
The Performance Evaluation of the BD One-Way Time Service	236
<i>Wei Li, Wei Guang, Zhe Gao, Jihai Zhang, Yongliang Xu, Yajing Wei National Time Service Center, CAS, China</i>	
Techniques of Antenna Cable Delay Measurement for GPS Time Transfer	239
<i>Daniele Rovera¹, Michel Abgrall¹, Pierre Uhrich¹, Marco Siccardi² ¹Observatoire de Paris, France; ²SKK Electronics, Italy</i>	
Relative Calibration of Galileo Receivers Within the Time Validation Facility (TVF)	245
<i>Ricardo Píriz², Daniel Rodríguez², Pedro Roldán², Alexander Mudrak¹, Andreas Bauch⁴, Julia Leute⁴, P. Pánek³, Alexander Kuna³ ¹European Space Agency / European Space Research and Technology Centre, Netherlands; ²GMV Innovating Solutions, Spain; ³Institute of Photonics and Electronics, Academy of Sciences CR, v.v.i., Czech Rep.; ⁴Physikalisch-Technische Bundesanstalt, Ger</i>	
A New Modem for Two Way Satellite Time and Frequency Transfer	250
<i>Shengkang Zhang, Xueyun Wang, Haifeng Wang, Hongbo Wang, Yuan Yuan, Keming Feng Beijing Institute of Radio Metrology and Measurement, China</i>	
SASO Time Scale and Measurement Capability	254
<i>Khalid AlDawood Saudi Standards, Metrology and Quality Organization, Saudi Arabia</i>	
Stability Analysis of the French Timescale UTC(OP)	257
<i>Michel Abgrall, Sébastien Bize, Baptiste Chupin, Jocelyne Guéna, Philippe Laurent, Peter Rosenbusch, Pierre Uhrich, Daniele Rovera Observatoire de Paris, France</i>	
Preliminary Step for a UTC(It) Steering Algorithm Based on the ITCsF2 Primary Frequency Standard Measurements	260
<i>Giovanna Signorile, Patrizia Tavella, Davide Calonico, Filippo Levi, Giovanni A. Costanzo, Giancarlo Cerretto, Roberto Costa, Elena Cantoni, Ilaria Sesia Istituto Nazionale di Ricerca Metrologica, Italy</i>	
Acquisition Method of Loran-C Signal Based on Matched Filter	265
<i>Yuanyuan Gao¹, Yu Hua¹, Yuanhong Cao², Haifeng Jiang¹ ¹National Time Service Center, CAS, China; ²Sichuan Spaceon Time & Frequency Tech. Co., Ltd, China</i>	
Verification of Time Telegrams in Long Wave Radio Systems	270
<i>Matthias Schneider, Christoph Ruland Universität Siegen, Germany</i>	
Two-Way Coherent Frequency Transfer in a Commercial DWDM Communication Network in Sweden	276
<i>Sven-Christian Ebenhag², Martin Zelan², Per Olof Hedekvist², Magnus Karlsson¹, Börje Josefsson³ ¹Chalmers University of Technology, Sweden; ²SP Technical Research Institute of Sweden, Sweden; ³Swedish University Computer Network, Sweden</i>	
Frequency Distribution in Delay-Stabilized Optical DWDM Network Over the Distance of 3000 km	280
<i>Lukasz Sliwczynski¹, Przemyslaw Krehlik¹, Marcin Lipinski¹, Krzysztof Turza², Artur Binczewski² ¹AGH University of Science and Technology, Poland; ²Pozna? Supercomputing and Networking Center, Poland</i>	
The Research Progress of Two Way Time Synchronization with Fiber Based on Spread Spectrum Signal	284
<i>Xiangwei Zhu², Hang Gong², Guangfu Sun², Kun Liang¹ ¹National Institute of Metrology, China; ²National University of Defense Technology, China</i>	

High Precise Time-Synchronization Based on Ultra-Short Pulse 290

Fan Shi, Shengkang Zhang, Huaiying Shang, Hongbo Wang, Haifeng Wang, Hang Yi, Zhenggang Ding, Feng Nian, Keming Feng

Beijing Institute of Radio Metrology and Measurement, China

Study on Autonomous and Distributed Time Synchronization Method for Formation UAVs 293

Tao Liu, Yonghui Hu, Yu Hua, Haifeng Jiang

National Time Service Center,CAS, China

Analysis of System Time Performance in BeiDou Satellite Navigation System 297

Jun Lu¹, Ye Ren², Xiaohui Li², Ya Liu², Shougang Zhang²

¹Beijing Institute of Tracking and Telecommunication Technology, China; ²National Time Service Center,CAS, China

Session: A3P-J: Optical Clocks

Ytterbium Optical Lattice Clock at INRIM 300

Marco Pizzocaro¹, Filippo Bregolin¹, Gianmaria Milani¹, Benjamin Rauf¹, Pierre Thoumany¹, Giovanni Antonio Costanzo², Filippo Levi¹, Davide Calonico¹

¹Istituto Nazionale di Ricerca Metrologica, Italy; ²Politecnico di Torino, Italy

Two Independent Strontium Optical Lattice Clocks for Practical Realization of the Meter and Secondary Representation of the Second 304

Michał Zawada², Marcin Bober², Piotr Morzyński², Agata Cygan², Daniel Lisak², Piotr Masłowski², Mateusz Prymaczek², Piotr Wcisło², Piotr Ablewski², Mariusz Piwiński², Szymon Wójciewicz², Katarzyna Bielska², Dobrosława Bartoszek-Bobę

¹Jagiellonian University, Poland; ²Nicolaus Copernicus University, Poland; ³University of Warsaw, Poland

Session: A3P-K: Student Contest

A Magnetometer Based on Coherent Population Beating 307

Li Liu, Yigen Wang, Xiaona Zhao, Yuxin Zhuang, Zhong Wang

Peking University, China

Tuesday, April 14, 2015

Session: B1L-A: Sensors I

- Monitoring the Adhesion Process of Tendon Stem Cells Using Shear-Horizontal Surface Acoustic Wave Sensors** 310
Huiyan Wu, Hongfei Zu, Qing-Ming Wang, Guangyi Zhao, James H-C. Wang
University of Pittsburgh, United States

- A Wireless Temperature Sensor Powered by a Piezoelectric Resonant Energy Harvesting System** 316
Peng Wang¹, Robert Gray², Zenghui Wang¹, Philip Feng¹
¹Case Western Reserve University, United States; ²Case Western Reserve University / Hawken School, United States

Session: B1L-B: GNSS Development

- The Time Validation Facility (TVF): an All-New Key Element of the Galileo Operational Phase** 320
Ricardo Píriz², Daniel Rodríguez², Pedro Roldán², Alexander Mudrak¹, Andreas Bauch⁵, Franziska Riedel⁶, Egle Staliuniene⁵, Francisco Javier Galindo⁶, Héctor Esteban⁶, Ilaria Sesia³, Giancarlo Cerretto³, Kenneth Jaldehag⁷, Carsten Rieck⁷, Pierre Uhrich⁴, Daniele Rovera⁴

¹European Space Agency / European Space Research and Technology Centre, Netherlands; ²GMV Innovating Solutions, Spain; ³Istituto Nazionale di Ricerca Metrologica, Italy; ⁴Observatoire de Paris, France; ⁵Physikalisch-Technische Bundesanstalt, Germany; ⁶Presentación Real Instituto y Observatorio de la Armada, Spain; ⁷SP Technical Research Institute of Sweden, Sweden

Session: B3L-A: Phase Noise

- Front-End Receiver: Recent and Emerging Trend** 326
Ulrich Rohde¹, Ajay Poddar³, Enrico Rubiola², Marius Alexandru Silaghi⁴
¹Brandenburgische Technische Universität / Synergy Microwave Corporation, Germany; ²FEMTO-st Institute, France;
³Synergy Microwave Corporation, United States; ⁴Universitatea din Oradea, Romania

- Oscillator Phase Noise: a 50-Year Retrospective** 332
David Leeson
Stanford University, United States

- Least-Square Fit, Omega Counters, and Quadratic Variance** 338
Francois Vernotte², Michel Lenczner¹, Pierre-Yves Bourgeois¹, Enrico Rubiola¹
¹FEMTO-st Institute, France; ²Observatoire de Besançon / University of Franche-Comté, France

- SDR and Self-Focusing Radar Techniques for milliHerz Measurement of Multi-Component Phase Noise Spectra** 343
Michael Underhill
Underhill Research Ltd, United Kingdom

- Characterization of a Set of Cryocooled Sapphire Oscillators at the 10-16 Level with the Three-Cornered Hat Method** 349
Christophe Fluhr, Serge Grop, Timothée Accadia, Ahmed Bakir, Yann Kersalé, Enrico Rubiola, Vincent Giordano, Benoît Dubois
FEMTO-st Institute, France

Session: B3L-B: Atomic Laser Stabilization

- Generating Entanglement Between Atomic Spins with Low-Noise Probing of an Optical Cavity** 351
Kevin Cox¹, Joshua Weiner¹, Graham Greve¹, James Thompson²
¹University of Colorado Boulder, United States; ²University of Colorado Boulder and NIST, United States

- Laser Stabilization on Velocity Dependent Nonlinear Dispersion of Sr Atoms in an Optical Cavity** 357
Bjarke Takashi Røjle Christensen², Stefan Alaric Schäffer², Martin Romme Henriksen², Philip Grabow Westergaard¹, Jun Ye³, Jan Westenkær Thomsen²
¹Danish Fundamental Metrology, Denmark; ²Niels Bohr Institute, University of Copenhagen, Denmark; ³University of Colorado Boulder, United States

Ten Years of Active Optical Frequency Standards 363

Duo Pan², Wei Zhuang¹, Xiaobo Xue², Xiaogang Zhang², Mo Chen², Zhichao Xu², Jingbiao Chen²

¹National Institute of Metrology, China; ²Peking University, China

Session: B3L-C: Ground & Space Time Scales

Precise Cascade Synchronization of Two Digitally Tuned Space Clocks to UTC (GPS) 369

He Wang, Gebriel Iyanu

Aerospace Corporation, United States

Robust Clock Ensemble for Time and Frequency Reference System 374

Qinghua Wang, Fabien Droz, Pascal Rochat

Orolia Switzerland SA, Switzerland

A Status Report on Time Scale Generation in PTB 379

Andreas Bauch², Egle Staliuniene², Gihan Gomah¹

¹National Institute for Standards, Egypt; ²Physikalisch-Technische Bundesanstalt, Germany

Makkah Timescale Generation and Measurement Capability 384

Yaseen M. Almleaky, Alaa Almleaky, Hamzah Almleaky, Samy Khadem-Al-Charieh

King Abdullah Centre for Crescent Observation & Astronomy, Saudi Arabia

Session: B4P-D: Acoustic Microresonators

Balanced Low-Loss 2-IDT Double Mode SAW Filter with Narrowed Passband and Improved Selectivity 388

Sergei Doberstein

Omskiy Nauchno Issledovatelskiy Institut Priborostroeniya, Russia

Switchable and Tunable Resonators with Barium Strontium Titanate on GaN/Sapphire Substrates 392

Thottam Kalkur³, Milad Hmeda², Almonir Mansour², Pamir Alpay⁴, Nick Sockey¹, Gary Tompa¹

¹Structured Material Ind., United States; ²University of Colorado Boulder, United States; ³University of Colorado Colorado Springs, United States; ⁴University of Connecticut, United States

Resonant Transformation of Acoustic Waves Observed for the Diamond Based HBAR 396

Gennady Kvashnin³, Boris Sorokin², Arseniy Telichko¹

¹Moscow Institute of Physics and Technology, Russia; ²Moscow Institute of Physics and Technology / Technological Institute for Superhard and Novel Carbon, Russia; ³Technological Institute for Superhard and Novel Carbon Materials, Russia

An Analysis of Thickness-Shear Vibrations of an Annular Plate with the Mindlin Plate Equations 402

Ji Wang¹, Hui Chen¹, Tingfeng Ma¹, Jianke Du¹, Lijun Yi¹, Yook-Kong Yong²

¹Ningbo University, China; ²Rutgers University, United States

Thickness-Shear Vibration Frequencies of an Infinite Plate with a Generalized Material Property Grading Along the Thickness 406

Ji Wang, Wenliang Zhang, Dejin Huang, Tingfeng Ma, Jianke Du, Lijun Yi

Ningbo University, China

Wideband Ladder Filters Fully Covering Digital TV Band Based on Shear Horizontal Plate Wave 412

Michio Kadota, Shuji Tanaka

Tohoku University, Japan

Enhancement of Effective Electromechanical Coupling Factor by Mass Loading in Layered SAW Device Structures 416

Gongbin Tang¹, Tao Han³, Akihiko Teshigahara², Takao Iwaki², Ken-Ya Hashimoto¹

¹Chiba University, Japan; ²DENSO Corporation, Japan; ³Shanghai Jiao Tong University, China

Second Order Temperature Compensated Piezoelectrically Driven 23 MHz Heavily Doped Silicon Resonators with +/-10 ppm Temperature Stability 420

Antti Jaakkola, Panu Pekko, James Dekker, Mika Prunnila, Tuomas Pensala

VTT Technical Research Centre of Finland, Finland

Highly Tuneable X-Band Bragg Resonator - Initial Results	423
<i>Pratik Deshpande, Simon Bale, Mark Hough, Jeremy Everard University of York, United Kingdom</i>	
The Effect of Contour Concentricity on the Acceleration Sensitivity of Quartz Crystal Resonators	427
<i>Peter Morley Vectron International, United States</i>	
Anchor Loss Suppression Using Butterfly-Shaped Plates for AlN Lamb Wave Resonators	432
<i>Jie Zou¹, Chih-Ming Lin¹, Alber Pisano² ¹University of California, Berkeley, United States; ²University of California, San Diego, United States</i>	
Session: B4P-E: Oscillators, Synthesizers, Noise & Circuit Techniques II	
Ultra-Low Noise All Fiber Mode-Locked Laser	436
<i>Yaolin Zhang, Quansheng Ren, Shuangyou Zhang, Dong Hou, Jianye Zhao Peking University, China</i>	
Digitally Temperature Compensated SAW Oscillator Based on the New Excitation Circuit	439
<i>Alexei Liashuk, Sergey Zavyalov, Alexandr Lepetaev, Anatoly Kosykh, Igor Khomenko Omsk State Technical University, Russia</i>	
Phase Group Characteristics and Phase Coincidence Detection Based Phase Noise Measurement Method	443
<i>Shaofeng Dong, Wei Zhou, Wei Hu, Jinsong Zhan, Hongbo Qin Xidian University, China</i>	
Precise Measurement of Complicated Frequency Signals	445
<i>Lina Bai, Meina Xuan, Yuzhen Jin, Bo Ye, Zhenjian Cui, Wei Zhou Xidian University, China</i>	
Single-Bit-Output All-Digital Frequency Synthesis Using Multi-Step Look-Ahead Bandpass Sigma-Delta Modulator-Like Quantization Processing	448
<i>Charis Basetas, Paul Sotiriadis National Technical University of Athens, Greece</i>	
Hardware Implementation Aspects of Multi-Step Look-Ahead Sigma-Delta Modulation-Like Architectures for All-Digital Frequency Synthesis Applications	452
<i>Charis Basetas, Anthimos Kanteres, Paul Sotiriadis National Technical University of Athens, Greece</i>	
Session: B4P-F: Microwave Standards II	
Compact Clocks for Industrial Applications: the EMRP Project IND 55 MClocks	456
<i>Salvatore Micalizio², Filippo Levi², Aldo Godone², Claudio Eligio Calosso², Bruno François¹, Stéphane Guérardel⁴, David Holleville⁴, Emeric De Clercq⁴, Luigi De Sarlo⁴, Peter Yun⁴, Jean-Marie Danet⁴, Mehdi Langlois⁴, Rodolphe Boudo¹ ¹FEMTO-st Institute, France; ²Istituto Nazionale di Ricerca Metrologica, Italy; ³Muquans, France; ⁴Observatoire de Paris, France; ⁵TÜBITAK National Metrology Institute, Turkey; ⁶Université de Neuchâtel, Switzerland</i>	
Advances of Chip-Scale Atomic Clock in Peking University	462
<i>Jianye Zhao, Yaolin Zhang, Haoyuan Lu, Dong Hou, Shuangyou Zhang, Zhong Wang Peking University, China</i>	
An Atomic Frequency Micrometer Based on the Coherent Population Beating Phenomenon	465
<i>Zhong Wang, Jianye Zhao, Xiaona Zhao, Li Liu, Yuxin Zhuang, Dawei Li Peking University, China</i>	
Digital Servo System Based on FPGA for Optically Pumped Magnetometer	471
<i>Sheng Zhou², Chang Liu², Yanhui Wang², Daonong Zhang¹ ¹North China Engineering Co. LTD, China; ²Peking University, China</i>	

Measuring Buffer-Gas Pressure in Sealed Glass Cells	474
<i>Travis Driskell, Michael Huang, James Camparo</i>	
<i>Aerospace Corporation, United States</i>	
Majorana Atomic Transition Research in H-Maser's Magnetic State Selection Region	480
<i>Aleynikov Mikhail</i>	
<i>FGUP VNIIFTRI, Russia</i>	
Noise Investigation on Optical Detection in a Cesium Beam Clock with Magnetic State Selection	483
<i>Chang Liu, Sheng Zhou, Yanhui Wang</i>	
<i>Peking University, China</i>	
The Effect of Bend on the Ramsey Cavity	487
<i>Fuyu Sun, Xianhe Huang</i>	
<i>University of Electronic Science and Technology of China, China</i>	
Design of the New NIM6 Fountain with Collecting Atoms from a 3D MOT Loading Optical Molasses	492
<i>Fang Fang, Weiliang Chen, Nian Feng Liu, Kun Liu, Rui Suo, Tianchu Li</i>	
<i>National Institute of Metrology, China</i>	
Advances in the Atomic Fountain Clock at SIOM	495
<i>Yuanbo Du, Rong Wei, Richang Dong, Fan Zou, Yuzhu Wang</i>	
<i>Shanghai Institute of Optics and Fine Mechanics, China</i>	
Session: B4P-G: Sensors IV	
Comparison of Frequency Estimators for Interrogation of Wireless Resonant SAW Sensors	498
<i>Victor Kalinin</i>	
<i>Transense Technologies PLC, United Kingdom</i>	
Acoustic Power Gain Induced by 2D Electron Drifting	504
<i>Lei Shao, Kevin Pipe</i>	
<i>University of Michigan, United States</i>	
Modelling and Control of a Travelling Wave in a Finite Beam, Using Multi-Modal Approach and Vector Control Method	509
<i>Sofiane Ghenna, Frédéric Giraud, Christophe Giraud-Audine, Michel Amberg, Betty Lemaire-Semail</i>	
<i>Université Lille1, France</i>	
Measurement and Analysis of a Circular Wedge Acoustic Waveguide Using a PZT Sensor	515
<i>Tai-Ho Yu</i>	
<i>National United University, Taiwan</i>	
Characterization and Temperature Sensor Application of Ca₃TaGa₃Si₂O₁₄ Crystals	518
<i>Hongfei Zu², Huiyan Wu², Qing-Ming Wang², Quanming Lin¹, Yanqing Zheng¹</i>	
<i>¹Shanghai Institute of Ceramics, China; ²University of Pittsburgh, United States</i>	
Improvement in Tracking Loop Threshold of High Dynamic GNSS Receiver by Installation of Crystal Oscillator on Gyroscopic Mounting	522
<i>Maryam Abedi, Tian Jin</i>	
<i>Beihang University, China</i>	
Feasibility Study of Proximity Sensing by Using a Conventional Airborne Transducer	528
<i>Ken Yamada, Shu Agatsuma</i>	
<i>Tohoku-Gakuin University, Japan</i>	
Interrogation of Orthogonal Frequency Coded SAW Sensors Using the USRP	530
<i>James Humphries, Mark Gallagher, Daniel Gallagher, Arthur Weeks, Donald Malocha</i>	
<i>University of Central Florida, United States</i>	

SH-SAW -- Based Sensor for Heavy Metal Ion Detection	536
<i>Zeinab Ramshani, Binu B. Narakathu, Avuthu S. G. Reddy, Massood Z. Atashbar, Jared Wabeke, Sherine Obare Western Michigan University, United States</i>	
Session: B4P-H: Timekeeping, Time & Frequency Transfer, GNSS Applications II	
The Study of BeiDou Timing Receiver Delay Calibration	541
<i>Hongbo Wang¹, Hang Yi¹, Shengkang Zhang¹, Haifeng Wang¹, Fan Shi¹, Huaiying Shang¹, Yujie Yang¹, Jun Ge¹, Zhiqi Li² ¹Beijing Institute of Radio Metrology and Measurement, China; ²Xidian University, China</i>	
Developing of One Time Link Calibrator with GNSS at NIM	545
<i>Kun Liang², Aimin Zhang², Zhiqiang Yang², Weibo Wang², Hang Yang¹ ¹Beijing JiaoTong University, China; ²National Institute of Metrology, China</i>	
Discovery of Persistent Ionospheric Frequency Shifts of a Few Herz and Impact on Time and Frequency Transfer	549
<i>Michael Underhill Underhill Research Ltd, United Kingdom</i>	
Research on Time and Frequency Transfer Based on BeiDou Common View	553
<i>Hang Yi¹, Hongbo Wang¹, Shengkang Zhang¹, Haifeng Wang¹, Fan Shi¹, Huaiying Shang¹, Jun Ge¹, Yujie Yang¹, Zhiqi Li² ¹Beijing Institute of Radio Metrology and Measurement, China; ²Xidian University, China</i>	
Preparing ACES-PHARAO Data Analysis	557
<i>Frédéric Meynadier, Pacôme Delva, Christophe Le Poncin-Laffite, Christine Guerlin, Philippe Laurent, Peter Wolf Observatoire de Paris, France</i>	
Investigating the Correlation Between Hydrogen-Maser Clocks in the Same Place	562
<i>Chao Gao², Bo Wang², Xi Zhu², Tianchu Li¹, Lijun Wang² ¹National Institute of Metrology, China; ²Tsinghua University, China</i>	
LMJ Timing and Fiducial System: Overview of the Global Architecture and Performances	565
<i>Vincent Drouet, Michel Prat, Pierre Raybaut, Damien Sainte-Beuve CEA-DAM, France</i>	
Practical Limitations of NTP Time Transfer	570
<i>Andrew N. Novick, Michael A. Lombardi National Institute of Standards and Technology, United States</i>	
Precise Three-Channel Integrated Time Counter	575
<i>Ryszard Szplet, Paweł Kwiatkowski, Zbigniew Jachna, Krzysztof Różyc Military University of Technology, Poland</i>	
A Fiber Link for the Remote Comparison of Optical Clocks and Geodesy Experiments	579
<i>Cecilia Clivati, Davide Calonico, Matteo Frittelli, Alberto Mura, Filippo Levi Istituto Nazionale di Ricerca Metrologica, Italy</i>	
OPTIME - the System Grows - a New 330 km Line	583
<i>Lukasz Buczek¹, Jacek Kolodziej¹, Przemyslaw Krehlik¹, Marcin Lipinski¹, Lukasz Sliwczynski¹, Piotr Dunst², Dariusz Lemanski², Jerzy Nawrocki², Paweł Nogas², Albin Czubla³, Artur Binczewski⁶, Wojbor Bogacki⁶, Piotr Ostapowicz⁶, Maciej Stroinski⁶, Krzysztof Turza⁶, Waldemar Adamowicz⁵, Jacek Igłason⁵, Tadeusz Pawszak⁵, Janusz Pieczerak⁵, Michał Zawada⁴ ¹AGH University of Science and Technology, Poland; ²Astrogeodynamic Observatory, Poland; ³Central Office of Measures, Poland; ⁴Nicolaus Copernicus University, Poland; ⁵Orange Polska S.A., Poland; ⁶Poznan Supercomputing and Networking Center, Poland</i>	
Design of the Optical Fiber Transmission Link in a Femtosecond-Precision, Fiber-Optic Timing Synchronization System	587
<i>Huaiying Shang, Shengkang Zhang, Fan Shi, Hongbo Wang, Haifeng Wang, Hang Yi, Feng Nian, Keming Feng Beijing Institute of Radio Metrology and Measurement, China</i>	

The Method of Determination of GEO Satellite Precise Clock Bias During Maneuvering	591
<i>Meifang Wu, Pei Wei, Xuhai Yang, Shougang Zhang</i>	
<i>National Time Service Center,CAS, China</i>	

Session: B4P-J: Combs & Stable Lasers

Comparison of Different Carrier-Envelope Frequency Stabilization Methods for a High Performance DPSSL Frequency Comb	594
<i>Stefan Kundermann, Steve Lecomte</i>	
<i>Centre Suisse d'Électronique et de Microtechnique, Switzerland</i>	

Development of an Erbium-Fiber-Laser-Based Optical Frequency Comb at NTSC	599
<i>Yanyan Zhang¹, Lulu Yan¹, Songtao Fan¹, Long Zhang¹, Wenyu Zhao¹, Wenge Guo², Shougang Zhang¹, Haifeng Jiang¹</i>	
<i>¹National Time Service Center,CAS, China; ²Xi'an Shiyou University, China</i>	

High Spectral Purity Laser Characterization with a Self-Heterodyne Frequency Discriminator	602
<i>Olivier Llopis, Zeina Abdallah, Vincent Auroux, Arnaud Fernandez</i>	
<i>LAAS-CNRS, France</i>	

External Cavity Diode Laser with Long-Term Frequency Stabilization Based on Mode Boundary Detection	606
<i>Zhouxiang Xu, Kaikai Huang, Xuanhui Lu</i>	
<i>Zhejiang University, China</i>	

Faraday Anomalous Dispersion Optical Filter at 461nm Utilizing a Strontium Hollow Cathode Lamp	611
<i>Duo Pan, Xiaobo Xue, Xiang Peng, Jingbiao Chen, Hong Guo, Bin Luo</i>	
<i>Peking University, China</i>	

A Cavityless Laser Using Cesium Cell with 459 nm Laser Pumping	614
<i>Xiaobo Xue, Duo Pan, Jingbiao Chen</i>	
<i>Peking University, China</i>	

Active Optical Frequency Standard Based on Narrow Bandwidth Faraday Atomic Filter	618
<i>Xiaogang Zhang², Jingbiao Chen², Wei Zhuang¹</i>	
<i>¹National Institute of Metrology, China; ²Peking University, China</i>	

All-Fiber Implementation of Modulation Transfer Spectroscopy for 4He Atoms	622
<i>Wei Gong, Xiang Peng, Wenhao Li, Teng Wu, Haidong Wang, Jingbiao Chen, Hong Guo</i>	
<i>Peking University, China</i>	

Large Waist Cavity for Ultra-Narrow Transition Spectroscopy	625
<i>Stefan Alaric Schäffer, Sigrid Skovbo Adsersen, Bjarke Takashi Røjle Christensen, Jan Westenkær Thomsen</i>	
<i>Niels Bohr Institute, University of Copenhagen, Denmark</i>	

Wednesday, April 15, 2015

Session: C1L-A: Sensors II

Resonant Infrared Detector Based on a Piezoelectric Fishnet Metasurface 630
Yu Hui, Zhenyun Qian, Matteo Rinaldi
Northeastern University, United States

NSPUTD Using C-Axis Tilted ScAlN Thin Film 633
Abhay Kochhar³, Yasuo Yamamoto², Akihiko Teshigahara², Ken-Ya Hashimoto¹, Shuji Tanaka³, Masayoshi Esashi³
¹Chiba University, Japan; ²DENSO Corporation, Japan; ³Tohoku University, Japan

Session: C1L-B: Space Clocks

GNSS RAFS Latest Improvements 637
Fabien Droz, Pascal Rochat, Sébastien Boillat, Batiste Scheidegger
Orolia Switzerland SA, Switzerland

Session: C1L-C: GNSS Time & Frequency Transfer

Use of Two Traveling GPS Receivers for a Relative Calibration Campaign Among European Laboratories 643
Pierre Uhrich³, Daniele Rovera³, Baptiste Chupin³, Francisco Javier Galindo⁵, Héctor Esteban⁵, Kenneth Jaldehag⁶, Carsten Rieck⁶, Andreas Bauch⁴, Thomas Polewka⁴, Giancarlo Cerretto², Gianluca Fantino², Ricardo Píriz¹
¹GMV Innovating Solutions, Spain; ²Istituto Nazionale di Ricerca Metrologica, Italy; ³Observatoire de Paris, France; ⁴Physikalisch-Technische Bundesanstalt, Germany; ⁵Presentación Real Instituto y Observatorio de la Armada, Spain; ⁶SP Technical Research Institute of Sweden, Sweden

GPS Time Link Calibrations in the Frame of EURAMET Project 1156 649
Héctor Esteban⁶, Francisco Javier Galindo⁶, Andreas Bauch⁵, Thomas Polewka⁵, Giancarlo Cerretto², Roberto Costa², Peter Whibberley³, Pierre Uhrich⁴, Baptiste Chupin⁴, Zhiheng Jiang¹
¹International Bureau of Weights and Measures, France; ²Istituto Nazionale di Ricerca Metrologica, Italy; ³National Physical Laboratory, United Kingdom; ⁴Observatoire de Paris, France; ⁵Physikalisch-Technische Bundesanstalt, Germany; ⁶Presentación Real Instituto y Observatorio de la Armada, Spain

Comparison of Two Continuous GPS Carrier-Phase Time Transfer Techniques 655
Jian Yao³, Ivan Skakun¹, Zhiheng Jiang², Judah Levine³
¹Central Research Institute of Machine Building, Russia; ²International Bureau of Weights and Measures, France; ³National Institute of Standards and Technology / University of Colorado at Boulder, United States

Correction for Code-Phase Clock Bias in PPP 662
Pascale Defraigne¹, Jean-Marie Sleewaegen²
¹Royal Observatory of Belgium, Belgium; ²Septentrio Satellit Navigation NV, Belgium

Session: C2L-A: Digital Signal Processing

All Digital Frequency Synthesis Based on New Sigma-Delta Modulation Architectures 667
Paul Sotiriadis
National Technical University of Athens, Greece

Noise in High-Speed Digital-to-Analog Converters 672
Pierre-Yves Bourgeois¹, Takeshi Imaike², Gwenhaël Goavec-Merou¹, Enrico Rubiola¹
¹FEMTO-st Institute, France; ²Nihon University, Japan

Simple Method for ADC Characterization Under the Frame of Digital PM and AM Noise Measurement 676
Andrea Carolina Cárdenas-Olaya², Enrico Rubiola¹, Jean Michel Friedt¹, Massimo Ortolano³, Salvatore Micalizio², Claudio Eligio Calosso²
¹FEMTO-st Institute, France; ²Istituto Nazionale di Ricerca Metrologica, Italy; ³Politecnico di Torino, Italy

6/12-Channel Synchronous Digital Phasemeter for Ultrastable Signal Characterization and Use	681
<i>Massimo Caligaris², Giovanni A. Costanzo¹, Claudio Eligio Calosso¹</i>	
<i>¹Istituto Nazionale di Ricerca Metrologica, Italy; ²Politecnico di Torino, Italy</i>	

Session: C2L-C: Emerging Time Dissemination Techniques

Time Signals Converging Within Cyber-Physical Systems	684
<i>Marc Weiss¹, Sundeep Chandhoke², Hugh Melvin³</i>	

¹National Institute of Standards and Technology, United States; ²National Instruments, United States; ³National University of Ireland, Galway, Ireland

Ns-Level Time Transfer Over a Microwave Link Using the PTP-WR Protocol	690
---	------------

*Mathieu Rico, Jean-Pierre Aubry, Cyril Botteron, Pierre-André Farine
École Polytechnique Fédérale de Lausanne, Switzerland*

Precise UTC Dissemination Through Future Telecom Synchronization Networks	696
--	------------

*Wen-Hung Tseng, Sammy Siu, Shinn-Yan Lin, Chia-Shu Liao
Chunghwa Telecom Co., Ltd., Taiwan*

Session: C3L-A: Aluminum Nitride MEMS Resonators

Gap Reduction Based Frequency Tuning for AlN Capacitive-Piezoelectric Resonators	700
---	------------

*Robert Schneider, Thura Lin Naing, Tristan Rocheleau, Clark Nguyen
University of California, Berkeley, United States*

Switchable 2-Port Aluminum Nitride MEMS Resonator Using Monolithically Integrated	
--	--

3.6 THz Cut-Off Frequency Phase-Change Switches	706
--	------------

*Gwendolyn Hummel, Matteo Rinaldi
Northeastern University, United States*

Analysis of the Impact of Release Area on the Quality Factor of Contour-Mode	
---	--

Resonators by Laser Doppler Vibrometry	709
---	------------

Brian Gibson², Kamala Qalandar², Kimberly Turner², Cristian Cassella¹, Gianluca Piazza¹

¹Carnegie Mellon University, United States; ²University California Santa Barbara, United States

Session: C3L-B: Cavity Laser Stabilization

Accurate Removal of Ram from FM Laser Beams	713
--	------------

*John Hall, Wei Zhang, Jun Ye
University of Colorado Boulder, United States*

Session: C3L-C: Microwave Time & Frequency Transfer

Carrier Phase and Pseudorange Disagreement as Revealed by Precise Point Positioning Solutions	717
--	------------

Demetrios Matsakis², Zhiheng Jiang¹, Wenjun Wu¹

¹International Bureau of Weights and Measures, China; ²United States Naval Observatory, United States

Long-Term Uncertainty in Time Transfer Using GPS and TWSTFT Techniques	723
---	------------

Victor Zhang¹, Thomas Parker¹, Jian Yao²

¹National Institute of Standards and Technology, United States; ²National Institute of Standards and Technology / University of Colorado at Boulder, United States

Session: C4L-A: Temperature Effects and Frequency Tuning in Resonators

Quality Factors of Quartz Crystal Resonators Operating at 4 Kelvins	728
--	------------

Serge Galliou¹, Philippe Abbé¹, Maxim Goryachev², Michael Tobar², Roger Bourquin¹

¹FEMTO-st Institute, France; ²University of Western Australia, Australia

Session: C4L-B: Atomic Fountains

Bias Corrections in Primary Frequency Standards 733

Thomas Parker, Thomas Heavner, Steven Jefferts

National Institute of Standards and Technology, United States

Session: C4L-C: Optical Time Transfer in Telecommunication Networks

Transmission of a Frequency Channel Through a Long-Haul Optical Fiber Communications Link 736

Curtis Menyuk

University of Maryland Baltimore County, United States

Preliminary Time Transfer Through Optical Fiber at NIM 742

Kun Liang², Aimin Zhang², Zhiqiang Yang², Weiliang Chen², Weibo Wang², Long Bai¹, Guitao Fu¹

¹Beijing Satellite Navigation Center, China; ²National Institute of Metrology, China

Actively and Passively Compensated RF Frequency Disseminations on Branching Fiber Network 747

Bo Wang, Xi Zhu, Yu Bai, Chao Gao, Lijun Wang

Tsinghua University, China

Thursday, April 16

Session: D1L-A: Photonic Microwave Signal Generation

Comparison of Self-ILPLL Forced Oscillators 749

Tianchi Sun², Li Zhang², Kevin Receveur², Afshin Daryoush², Ajay Poddar³, Ulrich Rohde¹

¹Brandenburgische Technische Universität / Synergy Microwave Corporation, United States; ²Drexel University, United States; ³Synergy Microwave Corporation, United States

Session: D1L-B: Ion Microwave Clocks

Miniature Trapped-Ion Frequency Standard with 171Yb+ 752

Peter D.D. Schwindt⁵, Yuan-Yu Jau⁵, Heather Partner⁴, Darwin Serkland⁵, Aaron Ison⁵, Andrew McCants⁵, Edward Winrow⁵, John Prestage¹, James Kellogg¹, Nan Yu¹, Dan Boschen², Igor Kosvin², David Mailloux², David Scherer², Craig Nelson³, Archita Hati³, David A. Howe³

¹Jet Propulsion Laboratory / California Institute of Technology, United States; ²Microsemi Inc., United States; ³National Institute of Standards and Technology, United States; ⁴Physikalisch-Technische Bundesanstalt / Sandia National Laboratories, United States; ⁵Sandia National Laboratories, United States

Towards a High-Performance Microwave Frequency Standard Based on 113Cd+ Ions 758

Jianwei Zhang, Kai Miao, Lijun Wang, Xiaolin Sun, Lijun Wang
Tsinghua University, China

Session: D1L-C: Fiber Optic Time Transfer Technology

ELSTAB - Electronically Stabilized Time and Frequency Distribution Over Optical Fiber - an Overview 761

Przemyslaw Krehlik, Lukasz Sliwczynski

AGH University of Science and Technology, Poland

Comparison of Forward- and Backward-Propagating Optical-Fiber-Induced Noise

for Application to Optical Fiber Frequency Transfer 765

James Cahill², Olukayode Okusaga¹, Weimin Zhou¹, Curtis Menyuk², Gary Carter²

¹U. S. Army Research Laboratory, United States; ²University of Maryland Baltimore County, United States

The Optical Fiber Link LIFT for Radioastronomy 769

Cecilia Clivati², Roberto Ambrosini¹, Claudio Bortolotti¹, Giovanni A. Costanzo², Matteo Frittelli², Filippo Levi², Alberto Mura², Federico Perini¹, Mauro Roma¹, Massimo Zucco², Davide Calonico²

¹Istituto Nazionale di Astrofisica, Italy; ²Istituto Nazionale di Ricerca Metrologica, Italy

A Round-Trip Fiber-Optic Time Transfer System Using Bidirectional TDM Transmission 773

Guiling Wu, Liang Hu, Hao Zhang, Jianping Chen

Shanghai Jiao Tong University, China

Session: D2L-A: Materials for Acoustic Resonators

Manufacturability of Highly Doped Aluminum Nitride Films 777

Sergey Mishin, Yury Oshmyansky

Advanced Modular Systems, Inc, United States

Observation of Strong Temperature Hysteresis in Molybdenum Disulfide (MoS2) Vibrating

Nanomechanical Resonators 783

Zenghui Wang, Rui Yang, Arnob Islam, Philip Feng

Case Western Reserve University, United States

New Capacitive Micro-Acoustic Resonators Machined in Single-Crystal Silicon Stacked Structures 787

Nesrine Belkadi, Thomas Baron, Bernard Dulmet, Laurent Robert, Etienne Herth, Florent Bernard

FEMTO-st Institute, France

Evaluation of Elastic Properties of SiO2 Thin Films by Ultrasonic Microscopy 793

Kensuke Sakamoto¹, Tatsuya Omori¹, Jun-Ichi Kushibiki¹, Matsuda Matsuda², Ken-Ya Hashimoto¹

¹Chiba University, Japan; ²Taiyo Yuden Ltd., Japan

Session: D2L-B: Vapor Cell Clocks

Study on Double-Modulation Coherent Population Trapping Resonance 797

*Peter Yun, Sinda Mejri, Francois Tricot, David Holleville, Emeric De Clercq, Stéphane Guérardel
Observatoire de Paris, France*

Compact and High-Performance Rb Clock Based on Pulsed Optical Pumping for Industrial Application 800

*Songbai Kang, Mohammadreza Gharavipour, Florian Gruet, Christoph Affolderbach, Gaetano Milet
Université de Neuchâtel, Switzerland*

Session: D2L-C: Free Space Optical Links

Identification and Calibration of Ground System Biases in Ground to Space Laser Time Transfer 804

Ivan Prochazka¹, Josef Blažej¹, Jan Kodeč²

¹Czech Technical University in Prague, Czech Rep.; ²Czech Technical University in Prague & Technical University Munich, Czech Rep.

Characterization of an Ultra Stable Quartz Oscillator Thanks to Time Transfer by Laser Link (T2L2, Jason-2) ... 808

Alexandre Belli², Pierre Exertier², Etienne Samain², Clément Courde², François Vernotte³, Albert Auriol¹, Christian Jayles¹

¹CNES - French Space Agency, France; ²Géoazur, France; ³Observatoire de Besançon / University of Franche-Comté, France

Author Index 813