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EFTF-IFCS 2022

SYMPOSIUM PROCEEDINGS

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**2022 Joint Conference of the European Frequency and Time Forum and IEEE
International Frequency Control Symposium (EFTF/IFCS)**

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Welcome from the Chairs

Dear Attendees,

It is a great pleasure for us to welcome you to the 2022 Joint Conference of the European Frequency and Time Forum (EFTF) and IEEE International Frequency Control Symposium (IFCS). After the in person joint organizing meeting in Orlando in 2019 and the virtual joint organizing meeting in 2021, we are looking forward to meeting again physically in Paris, France at the conference center of the Cité des Sciences et de l'Industrie. We hope this edition will perpetuate the long-standing quality of the EFTF and IFCS joint conferences with a tutorial session, an industrial exhibition, technical poster session, and oral lecture sessions.

Because travel restrictions still affect several countries, this conference will follow a hybrid format with talks, posters and discussions accessible to remote attendees. The hybrid format will be as close as possible to the traditional physical conference format: remote attendees will be able to present their talks, and listen to other virtual or on-site talks with a real-time Q&A feature. The authors of on-site posters will have the opportunity to present their work to physical attendees, while all posters will be presented in an interactive virtual platform during the second poster session.

This adventure to redefine the format of our joint conference, in a context where hybrid events may eventually become the norm, is fostered by the IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society (UFFC) and the Société Française des Microtechniques et de Chronométrie (SFMC), who fully support the event despite its uncertain conditions. Also, gratitude is given to the attendees, some willing to travel in still fragile pandemic conditions, others remaining in the virtual format.

We will have the pleasure to listen to two outstanding plenary speakers. Nobel Laureate Roger Penrose of the Oxford Mathematical Institute, famous for his work in general relativity, cosmology and the geometrical objects he discovered, will talk about the connection between time, relativity and black holes. David Kaiser of the Mathematics Institute of Technology, famous for his award-winning writing in Physics, will discuss his work on closing loop holes within tests of Bell inequalities in the cosmos.

Physical attendees will have the opportunity to enjoy a private visit to the on-site science museum, and the “Banquet” exhibition, a journey through gastronomy. The visit will be followed by a gala dinner under the carriage of the Solar Impulse plane. We wish you a stimulating and inspiring conference in Paris!

Jérôme Lodewyck, *General Co-Chair*

Eric Burt, *General Co-Chair*

Yann Le Coq, *TPC Co-Chair*

Andrew Ludlow, *TPC Co-Chair*

Philip Tuckey, *Chair of the EFTF EC*

Ekkehard Peik, *Chair of the IFCS SC*

Hybrid Format

All the oral sessions are accessible from the CONFlux platform at <https://eftf-ifcs-virtual.org>. The login information has been sent to you by email before the conference. The talks can be watched live via Zoom, or recorded (after a delay of 24 to 48 hours). Remote presenters are able to present their talk live or pre-recorded. Live remote Q&A is possible via the Zoom chat.

A traditional on-site poster session will take place on April 25th from 16:20 to 18:00. A virtual poster session on the Gather.Town platform will take place on April 26th from 8:40 to 10:20. Both in person and virtual participants can present their poster at the virtual poster session. A shorter virtual poster session is scheduled on April 25th at 18:00 to allow for student finalists from the North American time zones to present their poster.

Practical Information

Wi Access

SSID: IFCS 2022

Password: ifcs@2022

Direction

The conference center spreads over three floors: S1, S2, and S3, from top to bottom.

- » **S1 floor:** main entrance of the conference center. You will find at this floor:
 - The registration booths
 - The poster area
 - The “Commissariat General” on the right-hand side just before entering the conference center. Place for the **speakers’ breakfast**, and for the **WIE event** on April 25th during lunch.
- » **S2 floor:** down the staircase from S1. You will find at this floor:
 - The technical **exhibition**
 - The **coffee breaks**
 - The entrance of Room 1 (Gaston Berger amphitheater) for plenary and breakout sessions 1
- » **S3 floor:** down the staircase from S1. You will find at this floor:
 - The breakout rooms 2 and 3 (Louis Armand Est and Ouest)
 - Salles 1 and 2 for satellite events (student events, EFTF EC)

Lunches

Lunches will be served at “Le Loft”. Walk 20 meters in the opposite direction from the entrance of the conference center, and go down the staircase. Le Loft is **on the left of the aquarium**.

Speaker’s breakfast

Every day, the speakers and chairmen are required to have breakfast together. Speakers will be able to upload and check their slides on the conference computers. The breakfast starts at 8:00 every day, at the “Commissariat General”.

Welcome reception

You are invited to the welcome reception, on April 24th at 18:00 at “Le Loft”.

Gala dinner

The gala dinner will take place in the Cite des Sciences museum on April 26th at 20:00. The museum is accessed from the central escalators in the venue main hall. The gala dinner is accessed with your conference badge. Note that badges labeled "Exhibitor" or "Visitor" are not eligible unless they have a separate gala dinner ticket. From 18:00 to 20:00, the dinner participants are invited to a private visit of the museum. Enjoy the exhibitions "Banquet", a journey through gastronomy; the "Bio inspiree" ecosystem; and "Jean", a history.

No Recording or Job Postings

Please refrain from taking any video or photographs during any of the conference sessions or poster presentations. It is also IEEE policy that there be no job posting, of any kind, at the Symposium or at the Tutorials. Your cooperation is appreciated.

Symposium Proceedings

The Symposium Proceedings will be distributed via email to registered attendees after the Symposium.

Event Conduct and Safety Statement

IEEE believes that science, technology, and engineering are fundamental human activities, for which openness, international collaboration, and the free flow of talent and ideas are essential. Its meetings, conferences, and other events seek to enable engaging, thought-provoking conversations that support IEEE's core mission of advancing technology for humanity. Accordingly, IEEE is committed to providing a safe, productive, and welcoming environment to all participants, including staff and vendors, at IEEE-related events. IEEE has no tolerance for discrimination, harassment, or bullying in any form at IEEE-related events. All participants have the right to pursue shared interests without harassment or discrimination in an environment that supports diversity and inclusion. Participants are expected to adhere to these principles, and respect the rights of others IEEE seeks to provide a secure environment at its events. Participants should report any behavior inconsistent with the principles outlined here, to on site staff, security or venue personnel, or to eventconduct@ieee.org.

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SYRTE, Observatoire de Paris



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Patrons

We thank our sponsors for supporting the joint conference.



FIRST-TF is a French thematic network aiming to gather all the actors involved in time-frequency on a national scale. By building a network of experts, FIRST-TF supports collaborative projects in time and frequency metrology with a broad spectrum of applications from fundamental physics to satellite-based positioning systems. In the current socio-economical context where synchronization-related problems are omnipresent, encouraging laboratory innovations and ensuring effective technology transfers are of high importance for the network. Finally, the FIRST-TF network coordinates opportunities in teaching, as well as, tools for lifelong learners, the general public and school audiences on space-time metrology, a fascinating topic at the crossroads of several disciplinary fields.



TOPTICA develops and manufactures high-end laser systems for scientific and industrial applications. The portfolio includes diode lasers, ultrafast fiber lasers, terahertz systems and frequency combs. OEM customers, scientists, and over a dozen Nobel laureates all acknowledge the world-class exceptional specifications of TOPTICA's lasers, as well as their reliability and longevity. Founded in 1998 near Munich (Germany), TOPTICA became one of the leading laser photonics companies by aiming for, and consistently delivering high-end specifications. TOPTICA's diode lasers are appreciated for excellent coherence, wide tuning range and ideal beam profiles.



Menlo Systems is a leading developer and global supplier of instrumentation for precision metrology on the highest level. The company, with headquarters in Martinsried near Munich, is known for its Nobel Prize winning optical frequency comb technology. Our main product lines are optical frequency combs, solutions for time and frequency distribution, ultrastable lasers, terahertz systems, and femtosecond lasers. We deliver state-of-the-art products to customers from industry and academia worldwide. To push the limits of the measurable, we work closely with selected customers and develop new solutions for laser-based precision measurements.



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NEL Frequency Controls is a technology leader in the development and manufacture of leading-edge frequency control products. Customers choose NEL to supply the optimal solution for applications requiring crystal oscillators with challenging performance specifications such as ultra-low phase noise, ultra-low power, and ultra-high frequency capability. NEL's research and product development efforts support next generation customer applications that push performance boundaries in system speed, bandwidth, resolution, accuracy, and power consumption. Our customers benefit from our broad, low-cost product offering, which reflects globally competitive frequency control solutions. Customer technologists can rely on NEL for total technical support in selecting the best frequency control solution for their application.



VESCENT

Vescent develops and manufactures novel electro-optic and laser technologies. We offer frequency-stabilized diode laser systems, precision control electronics, accessory electro-optic modules, and now mode-locked lasers and frequency combs. Our scientists and engineers are continuously developing cutting-edge solutions to technical challenges. We are adding to our SLICE line of control electronics that includes the unique SLICE-QTC four-channel temperature controller and the SLICE-DHV high-bandwidth high-voltage amplifier.

Exhibitors

Please visit our industrial exhibitors, located around the coffee break areas.

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Awards

The 2022 EFTF awards



Young Scientist Award:

Marco Schioppo

“For his contributions to ultrastable lasers and measurement precision in optical frequency metrology that have impacted on the development and characterization of optical atomic clocks.”



EFTF Award:

Sébastien Bize

“For outstanding contributions to the development of microwave and optical frequency standards for tests of fundamental physics and the realization of the SI second.”



Marcel Ecabert Award:

Gérard Petit

“For his long-standing involvement and key contributions in the timing activities of the BIPM and more generally in International time and frequency metrology”

The 2022 IFCS awards



The C. B. Sawyer Award:

Elizabeth Donley

"For selfless and sustained leadership in the frequency control community."



The W. G. Cady Award:

Sylvain Ballandras

"For outstanding contributions to the modeling and development of crystal resonators and sensors."



The I. I. Rabi Award:

Thomas Udem

"For the development of the optical frequency comb and its application to precision measurement and fundamental physics."

Invited Speakers

Hanna Cho	Constructive Utilization of Nonlinear Dynamics in MEMS	The Ohio State University
John Clark	Design Challenges for MEMS Resonator-Based High-Performance Oscillators in Commercial Applications	Microchip
Michele Giunta	Photonic Microwave Generator as Quantum-Enabled Local Oscillator for Radars	Menlo Systems GmbH
Peter Schwindt	Integrated Photonics and Vacuum Package Development for a COLD-Atom Interferometer	Sandia National Laboratories
Jose A. De La Paz Espinosa	Long-Lived Spin Squeezing in a Metrologically Relevant Regime	LNE-SYRTE, Observatoire de Paris
Brun Pelle	Cold-Atom-Based Commercial Microwave Clocks at $1e-15$ Relative Instability Over More Than a Month	ixBlue
Johan Bertrand	H2MEMS Project: Resonant MEMS for Detection of Hydrogen Release in Radioactive Waste Disposal Facility	Andra
Levent Degertekin	CMUTs and CPUTs for Imaging and Sensing	Georgia Institute of Technology
Qi Shen	Long Distance Free Space Optical Time and Frequency transfer: Towards satellite-ground Link at 10^{-18} Instability	University of Science and Technology of China
Noel Dimarcq	Roadmap Towards the Redefinition of the SI Second	CNRS Universite Cote d'Azur
Jurgen Muller	Benefit of Optical Clocks for Geodesy	Leibniz Universitat Hannover
Emily Caldwell	Photon Efficient Optical Time Transfer	National Institute of Standards and Technology
Adam Kaufman	Tweezer clocks: a New Platform for Quantum Metrology	JILA, University of Colorado Boulder, NIST
Murray Barrett	High Accuracy Assessment of a $^{176}\text{Lu}^+$ Frequency Reference	Center for Quantum Technologies
Antoine Rolland	300 GHz Wave Generated with a Dissipative Kerr Soliton Divider	IMRA America, Inc
Steven King	Optical Frequency Ratios Between a Highly Charged Ion Clock and a $^{171}\text{Yb}^+$ Clock	Physikalisch-Technische Bundesanstalt
Jialing Yu	Noise Contributions in Crystalline Mirror Coatings	Physikalisch-Technische Bundesanstalt

Student Paper Competition Finalists

The student poster finalists will present their poster in front of a jury. Awardees will be selected from each technical group, who will receive a prize during the gala dinner. The first four student submissions will be presented at the virtual poster session 1b. The 24 other student submissions will be presented at the poster session 2.

5178	Michael D'Agati	High-Q Factor Multiferroic Resonant MEMS Low Frequency Magnetic Field Sensors	G4
5267	Xintian Liu	Temperature-Insensitive Resonant Strain Sensor	G4
5156	Zhao Xuanyi	Improving Thermal Linearity and Quality Factor of Al72Sc28N Contour Mode Resonators	G1
5291	Mo Dicheng	A 7GHz-13.4 GHz Complementary Switchable Thickness Extensional Bulk Acoustic Resonators using Laminated Ferroelectric Sc0.28Al0.72N	G1
5289	Onurcan Kaya	Frequency Reprogrammable Al0.7Sc0.3N Acoustic Delay Line with up to 13.5 % Bandwidth	G1
5159	Gabriel Garibaldi	X-Band Multi-frequency 30% Compound ScAlN Microacoustic Resonators and Filters for 5G	G1
5062	Pierre Travers	Parametric Study on the Phase Noise of an Optoelectronic Oscillator Submitted to Vibrations	G2
5200	Rachel Cannon	Miniaturized High-Reliability Lasers for Quantum Technologies	G2
5203	Alexis Bougaud	Numerical Study of a COEO Device Versus Loop Chromatic Dispersion and Detuning	G2
5230	Antoine Baudiquez	Comparison Between Cross-Spectrum and Spectrum Average Generalized to q-Devices	G2
5014	Clément Carlé	Tackling light-Shifts in a microcell Atomic Clock with Symmetric Auto-Balanced Ramsey Sequence	G3
5105	Gabriela Martinez	Progress Toward Miniaturized Atomic Beam Sources	G3
5006	Jize Han	Toward a high-Performance Transportable Microwave Frequency Standard Based on sympathetically-Cooled $^{113}\text{Cd}^+$ Ions	G3
5050	Samuel Walby	Normalised Detection of Clock States by Cold Atom Recapture Method	G3
5134	Antonacci Marco	Planar Grin Lenses for MEMS Energy Harvesters: a Macroscale Proof of Concept	G4
5169	Terence Blesin	Microwave-Optical Transduction Using High Overtone Bulk Acoustic Resonances	G4

5036	Emily Caldwell	Photon Efficient Optical Time Transfer	G5
5060	Nicolas Maron	Free Space Optical Link for Frequency Comparison and Chronometric Geodesy	G5
5021	Jaffar Kadum	Optical Frequency Transfer with 1×10^{-21} Uncertainty Using a DFB Laser-Based Fiber Brillouin Amplifier	G5
5046	Qi Li	New Method for Cascaded Fiber-Optic Radio Frequency Transfer	G5
5023	Nicholas Nardelli	Transfer Oscillator Technique for Generation of 10 GHz low- Noise Microwaves with High Accuracy	G6a
5096	Jialiang Yu	Noise Contributions in Crystalline Mirror Coatings	G6a
5195	Anat Siddharth	Low-Noise near-Ultraviolet Photonic Integrated Lasers	G6a
5239	Sheng Zhou	Towards a Continuous Active Optical Clock Using Super Radiance on the Strontium Clock Transition	G6a
5101	Johannes Kramer	$^{27}\text{Al}^+$ Clock at PTB – Recent Improvements on the Error Budget	G6b
5247	Irene Goti	New Absolute Frequency Measurement of the Improved ^{171}Yb Optical Lattice Clock at INRiM	G6b
5235	Miguel Cifuentes Marin	Generating LG Modes for Atom Trapping in a Sr Optical Lattice Clock	G6b
5191	Qixin Liu	Recent Progress of Mercury Lattice Clock in SIOM	G6b

Events

EFTF-IFCS's Women in Engineering Event

SPEAKING WITH CONFIDENCE:

"IT'S NOT WHAT YOU SAY, IT'S HOW YOU SAY IT!"

Date: April 25th, at 12:30 pm, during lunch, at the "Commissariat Général" room, -1 level, at the entrance of the conference center

Description: Inspiring, thought provoking and pragmatic! Please join us for a 1.5-hour workshop created especially for you! Together with your peers from around the world, we will explore ways in which messages can be delivered and how the way you speak can be a direct link to thriving professionally, and gaining positive visibility. If you are curious to discover more about the following questions, please don't hesitate to join us.

One on a scale of 1-10, what impact are you affecting in the meetings you attend? How can you leave a lasting (positive) impression on the audience? Why not only what you say, but how you say it really matters? What are the ingredients necessary to define an effective message?

Jody will share with you a powerful formula that you may begin to use to prepare for your next meeting or presentation that is in alignment with your authentic self and will help boost your confidence. This workshop has been designed to be very dynamic, interactive, and fun! You will have the unique opportunity to network and exchange in a variety of ways, including working in small and large groups, sharing collective intelligence, and beginning to define your next impact creating message.

Facilitators:



Jody Julien

Professional Coach & Facilitator

J2 Coaching & Consulting

My professional experience includes over 25 years in a variety of global executive roles in the areas of Human Resources Operations. I have lived and worked in North and South America, as well as, in Europe. I have a unique advantage of having worked within a multitude of work environments ranging from CAC 40 and Fortune 500 companies, academic, and start-ups. As a member of the International Coach Federation, I have been a certified executive leadership and life coach since 2007. I hold a Master's Degree in Strategic Human Resources and Bachelor's Degrees in International Business, and French. I head up an international mentoring programs for profit and non-profit organizations, and give lectures on the benefits of mentoring and reverse mentoring partnerships. I am the founder of J2 Coaching & Consulting since 2011, a global firm specializing in professional development and international organizational effectiveness.



Dr. Sinda Mejri

Scientist

Optical Frequency & Timing Expert European Space Agency

Student Events

The student representatives organize two student events, scheduled on April 27th, from 18:00 to 20:00 at the lowest S3 level, Satellite room 2.



UFFC's Young Professionals Event

Title: Startup Stories and Lessons

Date: April 25th, 16:30 to 17:30, Room 2, level S3

Description: Are you excited about starting a company and commercializing your technical ideas? Do you want to learn more strategies and problems you may never have thought of? You may have attended several startup workshops or panels, but the experience and tips may be too general. In this meet-up event, Dr. Mark Schafer, an established professional and experienced entrepreneur in ultrasonics for medical applications, will share his personal stories of running startups, some successful and some less so, and then draw thought-provoking lessons and tips leading to business success. Come and join us to enjoy the opportunity to talk with Dr. Mark Schafer and network with peers sharing common interests in entrepreneurship.

Organizer: IEEE UFFC Young Professionals Committee, 2022 EFTF-IFCS Joint Committee



Speaker Bio: Mark E. Schafer (Senior Member, IEEE) was born in Pittsburgh, PA, USA. He received the B.S. degree in electrical engineering from the Massachusetts Institute of Technology, Cambridge, MA, USA, in 1979, the M.S. degree in acoustics from Pennsylvania State University, State College, PA, USA, in 1982, and the Ph.D. degree in biomedical engineering from Drexel University, Philadelphia, PA, USA, in 1988. He is a serial entrepreneur and an inventor on over 30 patents. After 35 years as an independent consultant, entrepreneur, and corporate

technology leader, he recently joined Drexel's School of Biomedical Engineering, Science and Health Systems as a Research Professor. In addition to his research work, he consults with firms worldwide on design, development, intellectual property, regulatory, and clinical aspects of medical ultrasound products, including diagnostic, therapeutic, and surgical applications. He has authored numerous journal articles and book chapters on ultrasound measurement and applications. Dr. Schafer is a fellow of the American Institute of Ultrasound in Medicine, the Acoustical Society of America, and the American Institute of Medical and Biological Engineering. He was a recipient of the Chief's Award for Technology Trans-fer, U.S. Department of Agriculture and the Past President of the Ultrasonic Industry Association. He is currently the President of the IEEE UFFC.

Lab Tour at Paris Observatory

On April 28th, the LNE-SYRTE time and frequency laboratory at the Paris Observatory offers a tour for the participants of the conference from 14:30 to 18:30. The visit covers optical and microwave time and frequency metrology, atom interferometers and inertial sensors, and theory.

Note that the observatory premises can only welcome a limited number of participants. Please register early by filing the on-line form at the conference website.

Access: 77 avenue Denfert Rochereau, 75014 Paris

Public transportation: RER B or Metro 4, "Denfert Rochereau" station

Tutorials

The conference will conduct three parallel tutorial tracks on April 24th. The tutorials are expected to be given on-site. They will be recorded and available for students who registered under the virtual tutorials plan.

Track 1:

François Vernotte: Frequency stability estimation: Allan variance and friends

Nathan Newbury: Optical time & frequency transfer over fiber and free-space

Pascale Defraigne: Time transfer by satellites

Claudio Calosso: Low-noise digital electronics for T/F metrology

Track 2:

Eric Burt: The physics of atomic clocks

Christophe Salomon: Fundamental physics with atomic devices

Uwe Sterr: Technical challenges in setting up high performance optical cavities

Christian Roos: Quantum engineering for metrology

Track 3:

Paul Muralt: Piezoelectric transducers and their miniaturization

Valentina Zega: A mechanical perspective on MEMS gyroscopes: from new working principles to simulation challenges

Victor Plessky: High Frequency Acoustic Resonators based on LN membranes

Sunil Bhawe: MEMS + Photonic Systems

Abstracts

Pascale Defraigne, Royal Observatory of Belgium

Title: Time transfer by satellites

Abstract: Satellites are an ideal relay to transfer time and frequency to a remote location. They can be used for time dissemination, as well as, for remote clock comparisons. In this tutorial, we will mainly detail the current operational techniques used by the timing community, i.e., the Global Navigation Satellite Systems (GNSS) and the Two-Way Satellite Time and Frequency Transfer (TWSTFT). We will furthermore give an overview of the current developments using Low Earth Orbit satellites, and using optical links to satellites.

Nate Newbury, NIST, USA

Title: Optical time & frequency transfer over fiber and free-space

Abstract: Optically based methods of time-frequency transfer have been developed to support long distance connections between clocks over both fiber-optic networks and free-space (e.g. the air). As with optical clocks, these methods often exploit the high coherence possible with cavity-stabilized lasers and frequency combs. I will discuss and compare the approaches of optical time-frequency transfer over fiber optics and free space. The tutorial will discuss the basics of fiber-optic based methods, which are now well-developed and varied, and will then focus in more detail on recent work in free-space time-frequency transfer.

Claudio Calosso, INRiM, Italy

Title: Low-noise digital electronics for time and frequency metrology

Abstract: This tutorial focuses on the role of electronics in time and frequency metrology. It shows why a proper design of the electronic apparatus is a key aspect of an application: a new experiment, instrument or facility. After a brief comparison of off-the-shelf commercial versus custom solutions, the tutorial will show how to develop a custom high-performance and flexible apparatus. High performance is provided by low noise components, while flexibility is guaranteed by digital devices, in particular by Field Programmable Gate Arrays (FPGAs). Practical examples among vapor cell clocks, coherent fiber links and timescale generation in realtime are then provided for clarifying the advantages of this approach.

François Vernotte, FEMTO-ST, Observatory THETA, Besançon, France

Title: Frequency stability estimation: Allan variance and friends

Abstract: After a reminder of the notations, quantities and models used in the time and frequency field, we will first focus on the archetypal Allan variance (AVAR). We will see that it can be considered as a statistical estimator of frequency stability as well as a spectral analysis tool. We will also explore the different ways to compute AVAR and its confidence intervals.

Then, we will review the most utilized variance techniques, bringing out their advantages and drawbacks, as well as, the method to define a new variance adapted to a particular type of data. Along this way, we will see how the variance approach can be compared to wavelet analysis. We will end this section with the main innovations that have been made in this domain such as the three-cornered hat method, the dynamic variances and the increased confidence variances.

The last part of the tutorial will be devoted to the practical use of the variances by answering a few basic questions: how to interpret an AVAR curve? How to obtain a reliable τ of variance measurements? Is it possible to extrapolate a variance curve to assess the very long-term stability of an oscillator? Of course, similar questions from the audience will be welcome.

Uwe Sterr, PTB, Germany

Title: Technical challenges in setting up high performance cavities

Abstract: Ultrastable lasers are widely used in precision measurements and optical clocks. At present, most of these systems obtain their stability from Fabry-Perot reference cavities, thus relating the fractional frequency instability to fractional length fluctuations of the cavity. However, as macroscopic devices these cavities are susceptible to many perturbing influences and, ultimately, limited by fundamental thermodynamic fluctuations.

In this tutorial I will give an overview on cavity geometries, their mounting, and present approaches to decouple these systems from environmental noise. Depending on the application, transportability, ruggedness, and temperature control, possibly at cryogenic temperatures, needs to be considered. I will also address the optical and electronic interfacing of lasers to cavities, and finally give an outlook towards promising novel technological developments.

Christophe Salomon, Senior Research Director at CNRS, Ecole Normale Supérieure, France

Title: Fundamental physics with atomic devices

Abstract: Atoms and molecules are used in a variety of precision experiments aiming at testing fundamental physical laws. Dark matter and dark energy constitute a major part of the mass budget of the Universe but have unknown origin. The unification of the Standard Model of particle physics with gravity also represents a major challenge. We will show how atomic physics devices can be used to test modern physical theories and search for new physics beyond the Standard Model. We will describe tests of general relativity and the search for variations of fundamental constants with ultrastable clocks, equivalences principle tests and the search for an electric dipole moment of the electron.

Eric Burt, JPL, USA

Title: The physics of atomic clocks

Abstract: The basic fundamentals of atomic clocks are derived from work performed by Rabi and Ramsey in the 1930's on magnetic resonance. In this tutorial we will introduce magnetic resonance as it applies to clocks. In particular, we will describe the types of internal atomic states used in atomic clocks and will describe the Bloch sphere and how it can be used to visualize various clock interrogation methods. We will then discuss the underlying principles of several key clock technologies including optical pumping, Lamb-Dicke confinement, laser cooling, and both neutral atom, and ion trapping. Finally, we will cover some of the primary systematic frequency shifts that atomic clocks experience. These include the magnetic Zeeman effect, electric effects such as the AC Stark effect, light shift and its various orders, collision shifts, and the Doppler shift.

Christian Roos, Innsbruck Univ, Austria

Title: Quantum engineering for metrology

Abstract: Experiments in metrology and in quantum information processing using trapped ions and neutral atoms share many common requirements. Both research fields require quantum engineering techniques for coherently controlling both motional and electronic degrees of the trapped particles. This tutorial will give an overview of techniques for cooling and manipulating trapped ions with laser pulses with a focus on multi-ion experiments.

Paul Muralt, EPFL, Switzerland, IEEE Fellow 2013, IFCS C.B. Sawyer Memorial award 2016, Distinguished lecturer IEEE UFFC in 2017

Title: Piezoelectric transducers and their miniaturization

Abstract: A transducer is a device converting energy from one form to another. In piezoelectric transducers the two energy forms are mechanical and electrical. They are based on piezoelectric materials, which have the property to transform mechanical quantities into electrical signals (direct effect), and reciprocally, electrical signals into mechanical quantities (converse effect). In the ideal case, this effect is linear in both directions. These very versatile properties gave rise to roughly 100 application types. Their development started quite precisely 100 years ago. Today, several important applications are unthinkable without piezoelectric transducers, such as wireless communication, time and frequency control, ultrasound imaging, vibration sensors, and actuators for nano-probe techniques. During recent years, vibration energy harvesting has joined the long list of applications. Needless to underline that the electrical energy form is the most suited one for our modern, digital world.

This tutorial will first present the basic relations governing piezoelectricity. The importance of thermodynamical potentials, choice of variables and boundary conditions will be discussed. The thin film situation will be treated particularly. Two thin film materials systems will be introduced: the linear system $(\text{Al,Sc})\text{N}$ and the ferroelectric system $\text{Pb}(\text{Zr,Ti})\text{O}_3$. Apart of the classical parallel plate capacitor geometry, interdigitated electrode systems are discussed in some more details for the interesting case of ferroelectric materials. A second part of the tutorial will treat application related requirements for materials, properties and structures. Many applications are based on resonators. Their frequencies are defined by the dimensions of shapes (bulk waves), periodicity of interdigitated electrodes (surface acoustic waves or Lamb waves), or a mixture of both (plate waves), in combination with the involved sound velocities. Resonator structures may also include passive elastic materials. High quality factors are key requirements for good resonators. Some piezoelectric materials like AlN thin films, or LiNbO_3 single crystals are excellent choices in this respect and therefore dominate the RF filter market for mobile communication (1.8–5 GHz). In these resonators, the energy oscillates between elastic and electronic form, and they are part of passive elements in an electronic circuit. Energy harvesting requires a combination of different properties and structures. Suitable resonators must couple to some environmental vibration frequency spectrum, and the device constitutes an active energy source in the electronic circuit. The tutorial will also cover, to some extent, microfabrication and process issues as far as relevant for the presented matter.

Valentina Zega, Politecnico di Milano, Italy

Title: A mechanical perspective on MEMS gyroscopes: from new working principles to simulation challenges

Abstract: In recent years, the rapid spread of innovative applications and the increasing request of high performances at reduced footprints and costs, is posing new challenges for Micro-Electro-Mechanical Systems (MEMS) gyroscopes designers. They have to routinely manage complex multiphysics systems experiencing highly nonlinear dynamic responses, and at the same time, satisfy unprecedented requests in terms of scale factor stability against environmental fluctuations. In this tutorial, a mechanical perspective on the topic is provided. Firstly, a powerful numerical tool able to simulate, a priori and in real-time, the behavior of MEMS gyroscopes, both in the linear and nonlinear regime, will be proposed. Subsequently, an innovative working principle based on frequency modulation to improve MEMS gyroscopes scale-factor stability will be presented.

Sunil Bhawe, Purdue, United States

Title: MEMS + photonic systems

Abstract: Optomechanical systems offer one of the most sensitive methods for detecting mechanical motion using shifts in the optical resonance frequency of the optomechanical resonator. These systems are used for measuring mechanical thermal noise displacement or mechanical motion actuated by optical forces. Meanwhile, piezoelectric actuation and detection is the main transduction scheme used in RF MEMS resonators. The use of piezoMEMS is convenient as it allows direct integration with electronics used for processing the RF signals.

In this tutorial, I will present architectures based on piezoMEMS technology to demonstrate stress-optical modulation and tuning of silicon nitride and silicon photonic integrated circuits. We will define fundamental performance metrics and compare various monolithic and heterogeneous optomechanical systems. In the second part of the tutorial, I will introduce new applications enabled by optomechanics, including acousto-optic modulators, inertial sensors, magnetic-free optical isolators, and fast tunable lasers for LIDAR and micro-combs.

Victor Plessky

Title: High frequency acoustic resonators based on LN membranes

Abstract: Modern mobile phones and Hi-Fi devices demand filters operating within the 3 to 7 GHz frequency range with large bandwidth, and low loss. Such filters are usually ladder circuits built of resonators with large frequency spans between the anti-resonance and resonance points, with a few orders of impedance difference between them. Ideally, these resonators must be manufacturable with optical lithography, and the filters must tolerate an input power of a few Watts. This tutorial will cover the development of such devices based on Lamb modes in thin, sub-micron, crystalline platelets of strong piezoelectrics, such as lithium niobate (LN). Commercial availability of ion-sliced layers of different cuts of LN transferred on Si, SiC and other substrates opens wonderful possibilities for using materials with desired properties. In the first part of this tutorial, we discuss the Lamb modes in LN membranes of different cut angles, most suitable for resonator applications. We concentrate on low order modes, such as S0, SH0, S1, SH1 and A1, which provide the strongest piezoelectric coupling. Such suspended cavity membranes can reach excellent Q-factors and strong coupling. Meanwhile, their manufacturing is difficult, as they are fragile, and the devices can have power handling problems because of low heat evacuation from the thin LN membrane. Therefore, we will also discuss layered structures when such a membrane is mounted on a substrate, solving part of these problems at the cost of reduced coupling. In a subsequent section of the tutorial, we give an example of successful devices, at least at the sample level, such as XBARs exploiting the A1 mode in YZ-LN, and YBARs using a periodic system of bulk wave resonators, based on SH1 Lamb modes. This technology inevitably will dominate the area of micro-nano acoustic devices for frequencies higher than 3 GHz for the foreseeable future.

Plenary Speakers

Roger Penrose

University of Oxford

Title: The Journey from Black-Hole Singularities to a Cyclic Cosmology

Date: Monday April 25th, 9:20, Room 1



Abstract: The “singularity theorems” of the 1960s demonstrated that large enough celestial bodies, or collections of such bodies, would collapse gravitationally, to what are referred to as “singularities”, where the equations and assumptions of Einstein’s classical theory of general relativity cannot be mathematically continued. These singularities are normally expected to lie deep within what are now referred to as black holes, and would, themselves, not be observable from the outside. Nevertheless, their presence is regarded as fundamentally problematic for classical physics, and it is argued that a quantum theory of gravity would be needed to resolve the issue.

Similar arguments (largely developed by Stephen Hawking) apply also to the “Big-Bang” picture of the origin of the Universe, showing, again, the inevitability of a “singular” structure of such an initial state. However, a puzzling yet fundamental distinction between these two types of singularity is found deeply connected with the 2nd law of thermodynamics. It is hard to see how any ordinary procedures of “quantization” of the gravitational field can resolve this problem, and it is argued, irrespective of the singularity issue, that the structure of quantum theory itself may be profoundly altered when gravity is involved. Yet, a deeper understanding of the special nature of the Big Bang is obtained from the perspective of conformal geometry, removing the distinction between “big” and “small”, and whereby the Big-Bang singularity, unlike those in black holes, becomes non-singular, and can be regarded as the conformal continuation of a previous “cosmic aeon”, leading to the picture of conformal cyclic cosmology (CCC) according to which the Universe consists of a succession of such cosmic aeons, each of whose big bang is the conformal continuation of the remote future of a previous aeon. Some recently observed effects provide some remarkable support for this CCC picture.

Bio: Roger Penrose has conducted outstanding research in pure mathematics and theoretical physics. He is popularly known for his work on singularities, such as black holes, which he proved can arise from the gravitational collapse of massive, dying stars. He has also made important contributions that explore possible connections between physics and consciousness, and set these out in best-selling books such as *The Emperor’s New Mind* (1989). Roger invented twistor theory, a key tool in quantum theory. He proposed the cosmic censorship hypothesis — an idea of how the effects of the unpredictability of singularities are ‘hidden’ from us. His mathematical discoveries include a non-periodic form of tiling — Penrose tiling — since observed experimentally in quasicrystals.

David Kaiser

Massachusetts Institute of Technology

Title: Cosmic Bell Experiments: Testing Quantum Theory with the Cosmos

Date: Wednesday April 27th, 16:50, Room 1



Abstract: For decades, physicists have conducted experimental tests of quantum entanglement, a phenomenon that Albert Einstein once dismissed as “spooky action at a distance”. Despite Einstein’s misgivings, the experiments have consistently found results compatible with quantum theory; today entanglement is at the heart of next-generation devices like quantum computers and quantum encryption. Yet, every experimental test has been subject to one or more “loopholes”, which (in principle) could account for the results even in the absence of genuine quantum entanglement. This talk describes the latest experimental tests of quantum entanglement, including my group’s recent “Cosmic Bell” experiments that used real-time astronomical measurements of light from very distant quasars as random inputs, to determine which measurements to perform on pairs of Earthbound entangled particles. Our experiments provided compelling evidence that quantum entanglement is a robust feature of our world, while constraining certain types of alternative models—which exploit a particularly subtle loophole—more thoroughly than ever before.

Bio: David Kaiser is a Germeshausen Professor of the History of Science and Professor of Physics at the Massachusetts Institute of Technology (MIT). He is the author of several award-winning books about Modern Physics. His latest book, *Quantum Legacies: Dispatches from an Uncertain World* (2020), was honored as among the best books of the year by *Physics Today* and *Physics World* magazines, and also named a Choice Outstanding Academic Title. A Fellow of the American Physical Society, Kaiser has received MIT’s highest awards for excellence in teaching. His work has been featured in *Science*, *Nature*, the *New York Times*, and the *New Yorker*. His group’s recent efforts to conduct a “Cosmic Bell” test of quantum entanglement were featured in the documentary film, *Einstein’s Quantum Riddle*.

Click on the paper title to view the corresponding paper file.

Technical Sessions Program

Session AIL-1 – 25/04 10:50 – 12:30

G1: Surface Acoustic Wave Devices

Location: Room 1

Session chair: Thomas Baron, Femto-ST

10:50	5047	High Quality Factor Hybrid SAW/BAW Resonators
Saher Barsoum ¹ , Clemence Hellion ¹ , Elisa Vermande ¹ , Jean-Marie Quemper ¹ , Marie Bousquet ¹ , Alexandre Reinhardt ¹ , Thierry Laroche ² , Sylvain Ballandras ² , Bertrand Dubus ³		
¹ CEA-LETI, France, ² Frecjnjsys, France, ³ ISEN, France		
11:10	5094	Surface Cavity Wave Structures for Ultra-Compact Radio Frequency Filters
Eric Michoulier, Alexandre Clairet, Saly Ndiaye, Florent Bernard, Emilie Courjon, Thierry Laroche, Sylvain Ballandras		
Frecnsys, France		
11:30	5056	Shear-Horizontal Surface Acoustic Wave on Ca3TaGa3Si2O14 Piezoelectric Single Crystal
Ryoto Suzuki ² , Masashi Suzuki ² , Shoji Kakio ² , Noritoshi Kimura ¹		
¹ Piezo Studio Inc., Japan, ² University of Yamanashi, Japan		
11:50	5090	A High-Performance NS-SAW Resonator Using 30° Y-Cut Lithium Niobate
Shuxian Wu ¹ , Zonglin Wu ¹ , Hangyu Qian ¹ , Feihong Bao ¹ , Gongbin Tang ² , Feng Xu ¹ , Jie Zou ¹		
¹ Fudan University, China, ² Institute of Novel Semiconductors, Shandong University, China		
12:10	5233	High-Q SAW Resonator Using 36° YX-Cut Lithium Tantalate on Silicon Carbide Substrate
Zonglin Wu ¹ , Shuxian Wu ¹ , Hangyu Qian ¹ , Feihong Bao ¹ , Guomin Yang ¹ , Jie Zou ¹ , Gongbin Tang ²		
¹ Fudan University, China, ² Institute of Novel Semiconductors, Shandong University, China		

Session AIL-2 – 25/04 10:50 – 12:30

G6: Clocks I

Location: Room 2

Session chair: Ekkehard Peik, PTB

10:50	5179	High Accuracy Assessment of a $^{176}\text{Lu}^+$ Frequency Reference
Kyle Arnold ² , Michael Lee ¹ , Bianca Lee ² , Qichen Qin ² , Wen Yi Tan ² , Zhao Qi ² , Zhang Zhao ² , Zhiqiang Zhang ¹ , Murray Barrett ¹		
¹ Center for Quantum Technologies, National University of Singapore, Singapore, ² CQT, Singapore		
11:30	5265	Frequency Shift Evaluations of an $^{171}\text{Yb}^+(\text{E}3)$ Optical Clock Using Ancillary Transitions
Nils Huntemann ¹ , Melina Filzinger ¹ , Martin Steinel ¹ , Richard Lange ¹ , Burghard Lipphardt ¹ , Hu Shao ¹ , Tanja E. Mehlstäubler ² , Thomas Lindvall ³ , Ekkehard Peik ¹		
¹ Physikalisch-Technische Bundesanstalt, Germany, ² Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany, ³ VTT Technical Research Centre of Finland Ltd, Germany		
11:50	5044	Robust Operation of Two Sr Optical Lattice Clocks and Their Stability
Matthew Johnson, William Bowden, Richard Hobson, Marco Schioppo, Filip Butuc-Mayer, Ian Hill		
National Physical Laboratory, United Kingdom		
12:10	5180	Ca ⁺ Optical Clocks: Recent Progress and Prospects on Applications
Yao Huang, Hua Guan, Kelin Gao		
Innovation Academy for Precision Measurement Science and Technology, Chinese Academy of Sciences, China		

Session A1L-3 – 25/04 10:50 – 12:30

G5: Optical Frequency Transfer

Location: Room 3

Session chair: Pierre Waller, ESA

10:50	5187	A Coherent Optical Fibre Link Between France and Italy
<p>Matias Risaro¹, Simone Donadello¹, Alberto Mura¹, Cecilia Clivati¹, Irene Goti³, Stefano Condio², Marco Pizzocaro¹, Michele Gozzelino¹, Giovanni A. Costanzo³, Filippo Levi¹, Davide Calonico¹, Etienne Cantin⁴, Olivier Lopez⁴, Anne Amy-Klein⁴, Mads Tonnes⁵, Benjamin Pointard⁵, Clara Zyskind⁵, Changlei Guo⁵, Manuel Andia⁵, William Moreno⁵, Yannick Foucault⁵, Miguel-Angel Cifuentes Marin⁵, Haosen Shang⁵, Maxime Mazouth⁵, Rodolphe Le Targat⁵, Michel Abgrall⁵, Luca Lorini⁵, Jérôme Lodewyck⁵, Paul-Éric Pottie⁵, Sébastien Bize⁵</p> <p>¹INRiM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRiM – Istituto Nazionale di Ricerca Metrologica / Politecnico di Torino, Italy, ³INRiM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy, ⁴Laboratoire de Physique des Lasers, Université Sorbonne Paris Nord, CNRS, France, ⁵LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France</p>		
11:10	5140	A 5000 km Extended Optical Frequency Reference Dissemination with REFIMEVE
<p>Etienne Cantin², Olivier Lopez², Christian Chardonnet⁴, Anne Amy-Klein², Mads Tonnes³, Benjamin Pointard³, Rodolphe Le Targat³, Paul-Eric Pottie³, Martin Rabault¹, Vincent Menoret¹, Marie Houssin⁵, Nicolas Quintin⁶</p> <p>¹ixblue, France, ²Laboratoire de Physique des Lasers, Université Sorbonne Paris Nord, CNRS, France, ³LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ⁴LPL, Université Sorbonne Paris Nord, CNRS, France, ⁵PIIM, Aix Marseille University, CNRS, France, ⁶RENATER, France</p>		
11:30	5167	Noise Behavior and Uncertainty Contributions of Coherent Optical Fiber Links
<p>Mads Tonnes², Philip Tuckey³, Rodolphe Le Targat², Paul-Eric Pottie², Etienne Cantin¹, Olivier Lopez¹, Anne Amy-Klein¹</p> <p>¹Laboratoire de Physique des Lasers, Université Sorbonne Paris Nord, CNRS, France, ²LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ³Observatoire de Paris, France</p>		

Click on the paper title to view the corresponding paper file.

11:50	5021	Optical Frequency Transfer with 1×10^{-21} Uncertainty Using a DFB Laser-Based Fiber Brillouin Amplifier
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Jaffar Kadum, Alexander Kuhl, Jigxian Ji, Thomas Waterholter, Sebastian Koke
Physikalisch-Technische Bundesanstalt, Germany

12:10	5133	Noise Limit on the Accuracy of Frequency Locking of Lasers for Ultra-Accurate Fiber-Optic Time Transfer
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Lukasz Sliwczynski, Przemyslaw Krehlik, Lukasz Buczek
AGH University of Science and Technology, Poland

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Session A2L-1 – 25/04 14:00 – 16:00

G1: Acoustic Devices

Location: Room 1

Session chair: Cristian Cassella, Northeastern University

14:00	5124	A Capacitive Coupling Technique to Mitigate Frequency Mismatch Effects in MEMS Resonators
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Luca Colombo¹, Giuseppe Michetti¹, Pietro Simeoni¹, Mary E. Galanko Klemash², Sarah S. Bedair², Matteo Rinaldi¹

¹Northeastern University, United States, ²US Army Research Laboratory, United States

14:20	5125	Accurate Simulation of Voltage Amplification in High-Performance MEMS-Based Matching Networks
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Luca Colombo¹, Giuseppe Michetti¹, Pietro Simeoni¹, Mary E. Galanko Klemash², Tobiah M. Kiebala², Sarah S. Bedair², Matteo Rinaldi¹

¹Northeastern University, United States, ²US Army Research Laboratory, United States

14:40	5286	Constructive Utilization of Nonlinear Dynamics in MEMS
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Jun Yu, Hanna Cho

Ohio State University, United States

15:20	5282	Ultrahigh Quality Factors in Ferroelectric Hf _{0.5} Zr _{0.5} O ₂ Resonators with Remote Electrical Drive
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Xu-Qian Zheng, Troy Tharpe, Philip X.-L. Feng, Roozbeh Tabrizian

University of Florida, United States

15:40	5237	Terminal Gain in LN-on-Si Lamb Mode Acoustoelectric Waveguides
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Hakhamanesh Mansoorzare, Reza Abdolvand

University of Central Florida, United States

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Session A2L-2 – 25/04 14:00 – 16:00

G4: MEMS/NEMS & Ultrasonic Transducers

Location: Room 2

Session chair: Ashwin Seshia, University of Cambridge

14:00	5038	Temperature-Independent Near-Zero Power Flame Detector Based on MEMS Photoswitch
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Sila Deniz Caliskan, Vagesswar Rajaram, Sungho Kang, Antea Risso,
Zhenyun Qian, Matteo Rinaldi
Northeastern University, United States

14:20	5307	CMUTs and CPUTs for Imaging and Sensing
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F. Levent Degertekin
Georgia Institute of Technology, United States

15:00	5178	High-Q Factor Multiferroic Resonant MEMS Low Frequency Magnetic Field Sensors
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Michael DaGati³, Sydney Sofronici³, Yujia Huo³, Peter Finkel², Konrad Bussmann²,
Keith McLaughlin¹, Brad Wheeler¹, Thomas Mion², Margo Staruch², Roy H. Olsson III³
¹Leidos, United States, ²Naval Research Laboratory, United States, ³University of
Pennsylvania, United States

15:20	5267	Temperature-Insensitive Resonant Strain Sensor
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Xintian Liu, Qianyi Xie, Alper Ozgurluk, Clark T.-C. Nguyen
University of California, Berkeley, United States

15:40	5272	MoTe2 NEMS Resonators for Near-Infrared Light Detection
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S M Enamul Hoque Yousuf, Xu-Qian Zheng, Philip X.-L. Feng
University of Florida, United States

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Session A2L-3 – 25/04 14:00 – 16:00

G3: Novel Techniques for Atomic Clocks/Sensors

Location: Room 3

Session chair: Rodolphe Boudot, FEMTO-ST/CNRS

14:00	5269	Integrated Photonics and Vacuum Package Development for a Cold-Atom Interferometer
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Peter Schwindt¹, Jongmin Lee¹, Hayden McGuinness¹, Daniel Soh¹, Justin Christensen¹, Roger Ding¹, Gregory Hoth¹, Bethany Little¹, Adrian Orozco¹, Randy Rosenthal¹, Anthony Lentine¹, Michael Gehl¹, Ashok Kodigala¹, Eirk Skogen¹, Aaron Ison¹, Charles Walker¹, Grant Biedermann²

¹Sandia National Laboratories, United States, ²University of Oklahoma, United States

14:40	5162	Grating Magneto-Optical Trap with Integrated Magnetic Chip
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Alan Bregazzi, James McGilligan, Aidan Arnold, Paul Griffin, Erling Riis
University of Strathclyde, United Kingdom

15:00	5077	Millimeter-Wave Oscillator Disciplined by Molecular Rotational Spectroscopy
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James Greenberg, Antoine Rolland, Martin Fermann
IMRA America, Inc., United States

15:20	5105	Progress Toward Miniaturized Atomic Beam Sources
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Gabriela Martinez², John Kitching¹, William McGehee¹, Chao Li³, Chandra Raman³

¹National Institute of Standards and Technology, United States,

²National Institute of Standards and Technology and University of Colorado Boulder, United States, ³NIST, United States

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Session A3P-4 – 25/04 16:20 – 18:00

Posters 1, In-Person (G1)

Location: Poster Area 1

Session chair: Thomas Baron, Femto-st

Poster	5236	Solidly Mounted Resonators Based on ZnO/SiO ₂ Acoustic Reflectors and Their Performance After High Temperatures Exposure
Jose Manuel Carmona-Cejas, Teona Mirea, Marta Clement Lorenzo, Jimena Olivares Roza		
GMME-CEMDATIC-ETSI de Telecomunicación. Universidad Politécnica de Madrid, Spain		

Session A3P-5 – 25/04 16:20 – 18:00

Posters 1, In-Person (G2)

Location: Poster Area 2

Session chair: Guillaume De Giovanni, InnoDef

Poster	5007	Comparison of Additive Noise of DAC Technologies for Low Noise Microwave Frequency Synthesizers
Jean-Marc Lesage, Jean-François Penn		
DGA, France		

Poster	5064	Low Jitter Optical Pulse Train Based on a Phase Modulated Optoelectronic Oscillator
Sacha Welinski ¹ , Loic Morvan ¹ , Daniel Dolfi ² , Vincent Crozatier ¹		
¹ Thales Research & Technology, France, ² Thales Research and Technology, France		

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Session A3P-6 – 25/04 16:20 – 18:00

Posters 1, In-Person (G3)

Location: Poster Area 3

Session chair: Marco Belloni, ESA

Poster	5066	LEMAC: LTF-EPFL Miniature Atomic Clock
Matthieu Pellaton ³ , Christoph Affolderbach ³ , Yuanyan Su ¹ , Etienne Batori ³ , Maddalena Violetti ² , Anja K. Skrivervik ¹ , Gaetano Mileti ³		
¹ École Polytechnique Fédérale de Lausanne, Switzerland, ² Toscana Life Sciences, École Polytechnique Fédérale de Lausanne, Italy, ³ Université de Neuchâtel, Switzerland		

Poster	5089	Laser Intensity and Frequency Stabilization Implemented on a Miniature CPT Clock Breadboard
Jeremie Cotxet ³ , Francois Guty ² , Ghaya Baili ² , Loic Morvan ⁴ , Daniel Dolfi ⁵ , David Holleville ¹ , Stephane Guerandel ¹		
¹ LNE-SYRTE, Observatoire de Paris, France, ² Thales R&T France, France, ³ Thales R&T France and LNE-SYRTE, France, ⁴ Thales Research & Technology, France, ⁵ Thales Research and Technology, France		

Poster	5098	Experimental Determination of Relaxation Rates in a Ramsey-Mode Rubidium Cell Atomic Clock
Etienne Batori ³ , Christoph Affolderbach ³ , Florian Gruet ³ , Matthieu Pellaton ³ , Gaetano Mileti ³ , Yuanyan Su ¹ , Maddalena Violetti ² , Anja K. Skrivervik ¹		
¹ École Polytechnique Fédérale de Lausanne, Switzerland, ² Toscana Life Sciences, École Polytechnique Fédérale de Lausanne, Switzerland, ³ Université de Neuchâtel, Switzerland		

Poster	5160	An Elongated Atomic Vapour Cell for Precision Navigation and Timing
Sean Dyer, Paul Griffin, Aidan Arnold, Erling Riis, James McGilligan		
University of Strathclyde, United Kingdom		

Poster	5271	Nondestructive Microwave Detection for Compact Quantum Inertial Sensors
William Dubosclard, Leonid Sidorenkov, Carlos Leonardo Garrido Alzar		
LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France		

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Poster	5280	Air Pressure Dependent Frequency Shift in a Passive H-Maser – Modeling and Compensation
Harald Hauglin, Thomas Rødningen, Vette Øversjøen Justervesenet – Norwegian Metrology Service, Norway		

Session A3P-7 – 25/04 16:20 – 18:00

Posters 1, In-Person (G4)

Location: Poster Area 4

Session chair: Laura Popa, Exponent Inc.

Poster	5079	MEMS Resonator Parameter Estimation from Fast Frequency Sweeps
Jerome Juillard ² , Zalfa Jouni ² , Laurent Bourgois ² , Erwan Libessart ² , Margot Morlans ³ , Jean Guerard ³ , Raphael Levy ³ , Alexis Brenes ¹ , Elie Lefeuvre ¹ ¹ C2N, France, ² CentraleSupélec/GEEPS, France, ³ ONERA, France		

Poster	5261	Atomic Interferometry for Gravity Gradient Measurement
Raphael Piccon, Sumit Sarkar, Sebastien Merlet, Franck Pereira Dos Santos LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France		

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Session A3P-8 – 25/04 16:20 – 18:00

Posters 1, In-Person (G5)

Location: Poster Area 5

Poster	5073	A New Approach for Absolute Calibration of a GNSS Receiver: Use of a Software-Defined Radio (SDR) Technique
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Pierre Uhrich, Franziska Riedel, Baptiste Chupin, Michel Abgrall
LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France

Poster	5093	R2CGGTTS: Status and Evolution
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Pascale Defraigne², Elisa Pinat², Gérard Petit¹
¹BIPM Bureau International des Poids et Mesures, France, ²Royal Observatory of Belgium, Belgium

Poster	5102	An Efficient Timing System for IFMIF-DONES Facility Based on Ethernet Time Transfer Protocols
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Carlos Megías², Victor Vázquez², Eduardo Ros², Mauro Cappelli¹, Javier Diaz²
¹ENEA, Italy, ²Universidad de Granada, Spain

Poster	5103	Towards a More Reliable Communication Architecture in the Time Laboratory of the Royal Observatory of Belgium
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Bruno Bertrand², Aydin Ergen², Henri Martin², Natalia Vandenschrieck¹, Pascale Defraigne²
¹ECAM Institut Supérieur Industriel, Belgium, ²Royal Observatory of Belgium, Belgium

Poster	5231	Monitoring of Multi-GNSS Time Dissemination
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Pierre Waller, Cedric Plantard
ESA/ESTEC, Netherlands

Poster	5252	A New SDR-Based TX-RX Structure for Accurate Time and Frequency Transfer Over Optical Fibers
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Yan Xie, Erik Dierikx, Marijn van Veghel
VSL, Netherlands

Poster	5273	Czech Optical Infrastructure CITAF
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Vladimir Smotlacha, Josef Vojtech
CESNET, Czech Rep.

Click on the paper title to view the corresponding paper file.

Poster	5275	Stimulated Brillouin Scattering And Raman Amplification In Standard Telco Fibres For Metrology Applications
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Jan Radil, Josef Vojtech
CESNET, Czech Rep.

Poster	5201	Realization of a White Rabbit Timing Link in Italy
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Filippo Levi², Davide Calonico², Elena Cantoni², Giancarlo Cerretto², Roberto Concas², Franco Fiasca², Alberto Mura², Andrea Perucca², Marco Sellone², Ilaria Sesia², Giovanna Signorile², Tung Than Thai², Sani Sarcevic¹
¹IMBH, Bosnia, ²INRiM - Istituto Nazionale di Ricerca Metrologica, Italy

Poster	5254	Redefinition of the Si Second: Impact on Users and Stimulus for the Redefinition Subgroup a of the CCTF Task Force "Roadmap to the Redefinition of the Second"
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Marina Gertsvolf², Gaetano Mileti³, Frederic Meynadier¹
¹BIPM Bureau International des Poids et Mesures, France, ²National Research Council Canada, Canada, ³Université de Neuchâtel, Switzerland

Session A3P-9 – 25/04 16:20 – 18:00

Posters 1, In-Person (G6)

Location: Poster Area 6

Poster	5019	Automated Validation of Frequency Comb Data for Optical Time Scale Steering
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Jacob Tunesi, Alissa Silva, Adam Parsons, Jake Paterson, Marco Schioppo, Anthony Harwood, Helen S. Margolis
National Physical Laboratory, United Kingdom

Poster	5029	Towards the Development of an Optical Lattice Clock Using Bosonic Isotopes of Mercury
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Clara Zyskind, Manuel Andia, Changlei Guo, Sebastien Bize
LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France

Poster	5045	Towards the Generation and Fiber-Link Transfer of Ultra-Stable 895 nm Signal for Characterization of a Microcell-Stabilized Laser
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Anthony Gusching¹, Ivan Ryger¹, Moustafa Abdel Hafiz¹, Nicolas Passilly¹, Jacques Millo¹, Rodolphe Boudot²

¹FEMTO-ST Institute, France, ²FEMTO-ST Institute, CNRS, France

Poster	5052	Lifetime Assessment and Performance of a Microfabricated Strontium Atomic Vapor Cell
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Jacob Pate², John Kitching¹, Matthew Hummon¹

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

Poster	5061	Controlling Long Linear In+/Yb+ Crystals for Precision Spectroscopy
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Tabeca Nordmann¹, Hartmut Nimrod Hausser¹, Jonas Keller¹, Jan Kiethe¹, Leon Schomburg¹, Hongli Liu¹, Nishant Bhatti, Tanja E. Mehlstübler²

¹Physikalisch-Technische Bundesanstalt, Germany, ²Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany

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Poster	5072	Active Rejection at the Level of 10^{-7} of the Residual Amplitude Modulation
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Jonathan Gillot, Santerelli Falzon Tetsing-Talla, Severine Denis, Gwenhael Goavec-Merou, Jacques Millo, Clement Lacroute, Yann Kersale
FEMTO-ST Institute, France

Poster	5095	A Simple Frequency Stabilization Technique for Averaging Birefringent Noise in Crystalline Mirror Coatings
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Jialiang Yu², Thomas Legero², Fritz Riehle², Chun Yu Ma², Sofia Herbers², Daniele Nicolodi², Dhruv Kedar¹, Eric Oelker³, Jun Ye¹, Uwe Sterr²
¹JILA, NIST and university of Colorado, United States, ²Physikalisch-Technische Bundesanstalt, Germany, ³University of Glasgow, United Kingdom

Poster	5112	Optical Cavity Setup for Future Hybrid Lock Concept
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Timm Wegehaupt, Josep Sanjuan, Martin Gohlke, Thilo Schuldt, Claus Braxmaier
DLR e.V., Germany

Poster	5135	A Flexible All-Digital Transfer Beat Implementation for Precision Frequency Metrology
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Andreas Noack, Mattias Misera, Julia-Aileen Coenders, Erik Benkler, Uwe Sterr
Physikalisch-Technische Bundesanstalt, Germany

Poster	5152	A Hot Vapor Optical Clock Targeting Miniature Dimensions with Frequency Instability Below 10^{-13}
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Roman Blum, Sylvain Karlen, Stefan Kundermann, Steve Lecomte
CSEM SA, Switzerland

Poster	5155	Current Activities of CCTF to Update the Roadmap for a Re-definition of the Second: Options for the Redefinition
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Sebastien Bize², Ekkehard Peik⁴, Chris Oates³, Gérard Petit¹
¹BIPM Bureau International des Poids et Mesures, France, ²LNE-SYRTE, Observatoire de Paris - Université PSL, CNRS, Sorbonne Université, France, ³National Institute of Standards and Technology, United States, ⁴Physikalisch-Technische Bundesanstalt, Germany

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Poster	5175	Towards a Transportable Yb Lattice Clock at SYRTE
William Moreno ³ , Fatima Rahmouni ³ , Benjamin Pointard ³ , Paul-Eric Pottie ³ , Pacome Delva ³ , Jerome Lodewyck ³ , Rodolphe Le Targat ³ , Jesus Romero Gonzalez ⁴ , Marie-Francoise Lalancette ⁵ , Guillaume Lion ² , Olivier Jamet ¹		
¹ IGN, France, ² Institut de Physique du Globe de Paris, Université de Paris, CNRS, IGN, ENSG-Géomatique, France, ³ LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ⁴ Real Instituto y Observatorio de la Armada, Spain, ⁵ SHOM, France		
Poster	5198	Set-Up for Continuous Superradiance Clock Based on Strontium Atoms
Marcin Bober, Omid Vartehtarparvar, Sławomir Bilicki, Domagoj Kovacic, Adam Ledzinski, Piotr Morzynski, Mateusz Narożnik, Marcin Witkowski, Mehrdad Zarei, Michał Zawada		
Nicolaus Copernicus University, Poland		
Poster	5219	Superradiant Active Atomic Clock at UMK
Marcin Bober ² , Sławomir Bilicki ² , Georgy Kazakov ³ , Anahit Gogyan ¹ , Domagoj Kovacic ² , Adam Ledzinski ² , Piotr Morzynski ² , Mateusz Narożnik ² , Marcin Witkowski ² , Omid Vartehtarparvar ² , Mehrdad Zarei ² , Michał Zawada ²		
¹ Institute for Physical Research of National Academy of Sciences of Armenia, Armenia, ² Nicolaus Copernicus University, Croatia, ² Nicolaus Copernicus University, Poland, ³ Quantum metrology group, Atominstytut TU Wien, Austria		
Poster	5226	Distortion of the Mercury ISO-3P0 Clock Line in Two-Species Atomic Clock
Adam Linek, Roman Ciurylo, Piotr Zuchowski, Marcin Witkowski		
Nicolaus Copernicus University, Poland		
Poster	5227	Accurate Bootstrapping of an Optical Frequency Comb to a 1542 nm Reference
Benjamin Pointard, Michel Abgrall, Michel Lours, Paul-Eric Pottie, Rodolphe Le Targat		
LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France		

Click on the paper title to view the corresponding paper file.

Poster	5232	Towards Molecular Hg ₂ Clock for Testing Fundamental Physics
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Marcin Witkowski, Roman Ciurylo, Adam Linek, Rodolfo Munoz Rodriguez, Michał Zawada
Nicolaus Copernicus University, Poland

Poster	5241	New Physics Searches with Isotope Shifts of Two Hg Clock Transitions
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Marcin Witkowski², Roman Ciurylo², Anahit Gogyan¹, Adam Linek², Rodolfo Munoz Rodriguez², Paweł Tecmer², Michał Zawada²

¹Institute for Physical Research of National Academy of Sciences of Armenia, Armenia, ²Nicolaus Copernicus University, Poland

Poster	5243	Evaluation of Systematic Shifts and Frequency Ratio of 5s2 1S0–5s5p 3P0 Clock Transition for 87Sr and 88Sr Optical Clock
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Domagoj Kovacic, Sławomir Bilicki, Marcin Bober, Piotr Morzynski, Adam Ledzinski, Omid Vartehparvar, Mehrdad Zarei, Michał Zawada
Nicolaus Copernicus University, Poland

Poster	5246	Second-Stage Cooling of Indium Ions for Multi-Ion Clock Operation
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Hartmut Nimrod Hausser², Tabea Nordmann², Jonas Keller², Jan Kiethe², Moritz von Boehn², Nishant Bhatt², Valeriy Yudin¹, Oleg Prudnikov¹, Tanja E. Mehlstäubler³

¹Institute of Laser Physics, Novosibirsk State University, Russia, ²Physikalisch-Technische Bundesanstalt, Germany, ³Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany

Poster	5250	The Design of an Ultra-Stable Cavity with Crystalline Mirror Coatings for Atomic Optical Clock
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Mateusz Narożnik, Michał Zawada, Marcin Bober
Nicolaus Copernicus University, Poland

Poster	5251	Automatic Real-Time Control of Magnetic Field in an Optical Atomic Clock
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Mehrdad Zarei, Adam Ledzinski, Marcin Bober, Michał Zawada, Piotr Morzynski
Nicolaus Copernicus University, Poland

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Poster	5235	Generating LG Modes for Atom Trapping in a Sr Optical Lattice Clock
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Miguel-Angel Cifuentes Marin, Haosen Shang, Yannick Foucault, Rodolphe Le Targat, Jerome Lodewyck
LNE-SYRTE, Observatoire de Paris - Université PSL, CNRS, Sorbonne Université, France

Poster	5239	Towards a Continuous Active Optical Clock Using Superradiance on the Strontium Clock Transition
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Sheng Zhou, Francesca Fama, Camila Beli Silva, Stefan Alaric Schaffer, Shayne Bennetts, Florian Schreck
University of Amsterdam, Netherlands

Poster	5048	Transportable Hz Laser System for Quantum Applications
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Filippo Bregolin, Pierre Thoumany, Dominik Niemietz, Florian Tauser, Thomas Puppe, Rafal Wilk
TOPTICA Photonics AG, Germany

Poster	5148	Optically Loaded Strontium Lattice Clock
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Matteo Barbiero, Davide Calonico, Filippo Levi, Marco G. Tarallo
INRiM - Istituto Nazionale di Ricerca Metrologica, Italy

Poster	5234	Towards the Development of an Optical Lattice Clock Testbed Setup for the iqClock Project
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Abhilash Jha, Alok Singh, Qiushuo Sun, Markus Gellesch, Jonathan M. Jones, Richard Barron, Yogeshwar Kale, Manan Jain, Vijay Singh, Kai Bongs, Yeshpal Singh
University of Birmingham, United Kingdom

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Session B1P-4 – 26/04 08:40 – 10:20

Posters 2, Virtual (G1)

Location: Poster Area 1

Session chair: Thomas Baron, Femto-st

Poster	5012	Analysis of the Wave Modes for Super High-Frequency SAW Devices on the SiO ₂ /IDT/LiNbO ₃ Structure
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Danhua Li², Salahuddin Raju¹, Mansun Chan¹, Chanjian Zhou²

¹Hong Kong University of Science and Technology, Hong Kong, ²South China University of Technology, China

Poster	5051	Fundamental Precision Limit of Frequency Measurement of Linear Harmonic Oscillators
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Mingkang Wang¹, Rui Zhang², Robert Illic¹, Yuxiang Liu², Vladimir Aksyuk¹

¹National Institute of Standards and Technology, United States, ²Worcester Polytechnic Institute, United States

Poster	5116	Study on Quality Factor of the Ring Electrode QCM Resonator
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Jianguo Hu, Tian-Ling Ren
Tsinghua University, China

Poster	5174	Improvement in Laser Pulse Methods for Piezoelectric Device Analysis Using Laser Speckle Interferences
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Kengo Hara, Yasuaki Watanabe, Ryosuke Nishihara
Tokyo Metropolitan University, Japan

Poster	5293	The Effect of Reflector Trench Width on the Anchor Loss of a Lateral-Extensional Resonator
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Ankesh Todi, Hamideh Kermani, Reza Abdolvand
University of Central Florida, United States

Poster	5296	Tunable Te Mode Resonators Based on Ferroelectric AlScN Thin Film for RF Applications
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Mingyo Park, Azadeh Ansari
Georgia Institute of Technology, United States

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Poster	5123	Updated BVD Modelling of AlN-Based Solidly Mounted Resonators Working at Cryogenic and High Temperatures from -160 °C Up to 130 °C
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Eduardo Lugo-Hernandez³, Jose Manuel Carmona-Cejas², Teona Mirea², Jimena Olivares¹, Juan Carlos Collado Gomez³, Jordi Mateu Mateu³

¹CEMDATIC-ETSI de Telecomunicación Universidad Politécnica de Madrid, Spain,

²GMME-CEMDATIC-ETSI de Telecomunicación. Universidad Politécnica de Madrid, Spain, ³Universitat Politècnica de Catalunya, Spain

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Session B1P-5 – 26/04 08:40 – 10:20

Posters 2, Virtual (G2)

Location: Poster Area 2

Session chair: Guillaume De Giovanni, InnoDef

Poster	5071	Cancellation of Amplitude-to-Phase Noise Conversion by Adjusting Sweet Point of the Mixer
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Panxue Ma¹, Dongrui Yu², Xing Chen¹, Ziyang Chen², Bin Luo¹, Hong Guo²

¹Beijing University of Posts and Telecommunications, China, ²Peking University, China

Poster	5194	Sub-10-Attosecond Timing Jitter Mode-Locked Ti:sapphire Lasers
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Hao Xu, Zhaolong Li, Ping Guo, Lin Dan, Jianye Zhao

Peking University, China

Poster	5298	Figures of Merit of a Locked Tunable Oscillator
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Andrey Pluteshko

Advantex LLC, Russia

Poster	5142	Impact of Insulation Resistance of MLC Capacitor on Hysteresis Parameter of an OCXO
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Kamal Kumar S, Nalini Cv, Chandrashekar Mariyappa

Rakon India Private Limited, India

Poster	5153	Effective Detection Mechanism of Missing Output Clock Pulse of an OCXO Used for 5G Application
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Kamal Kumar S, Nalini Cv, Chandrashekar Mariyappa

Rakon India Private Limited, India

Poster	5111	Direct Measurement of Laser Noise Spectrum with a Frequency-to-Voltage Converter
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Gaspare Antona³, Giovanni A. Costanzo², Michele Gozzelino¹, Salvatore Micalizio¹, Claudio Calosso¹, Filippo Levi¹

¹INRIM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRIM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy, ³Politecnico di Torino, Italy

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Session B1P-6 – 26/04 08:40 – 10:20

Posters 2, Virtual (G3)

Location: Poster Area 3

Session chair: Fang Fang, NIM

Poster	5006	Toward a High-Performance Transportable Microwave Frequency Standard Based on Sympathetically-Cooled $^{113}\text{Cd}^+$ Ions
Jize Han, Haoran Qin, Nongchao Xin, Shengnan Miao, Yiting Chen, Ying Zheng, Jianwei Zhang, Lijun Wang Tsinghua University, China		

Poster	5008	A High-Stability Compact Optical System for Integrating Sphere Cold Atom Clock
Xiumei Wang ³ , Jin He ⁴ , Weili Wang ¹ , Chengyuan Zhang ¹ , Yanjun Chen ¹ , Liang Wang ¹ , Yaxuan Liu ¹ , Lianshan Gao ¹ , Jingbiao Chen ² ¹ Beijing Institute of Radio Measurement and Metrology, China, ² Peking University, China, ³ PKU-HKUST Shen Zhen-HongKong Institution, China, ⁴ PKU-HKUST Shenzhen-Hong Kong Institution, China		

Poster	5022	Progress Towards a Microwave Frequency Standard Based on Sympathetically-Cooled $^{113}\text{Cd}^+$ Ions
Shengnan Miao, Jianwei Zhang, Haoran Qin, Nongchao Xin, Yiting Chen, Jize Han, Lijun Wang Tsinghua University, China		

Poster	5028	Progresses Toward a Microwave Clock Based on Laser-Cooled $^{171}\text{Yb}^+$ Ions
Nongchao Xin, Jianwei Zhang, Shengnan Miao, Haoran Qin, Yiting Chen, Jize Han, Lijun Wang Tsinghua University, China		

Poster	5041	Magnetic-Field-Insensitive Coherent-Population- Trapping Resonances Excited by Bichromatic Linearly Polarized Fields on the D1 Line of ^{133}Cs
Kenta Matsumoto ³ , Sota Kagami ³ , Akihiro Kirihaara ³ , Shinya Yanagimachi ¹ , Takeshi Ikegami ² , Atsuo Morinaga ² ¹ AIST, Japan, ² Micromachine Center, Japan, ³ NEC Corporation, Japan		

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Poster	5081	Ramsey-CPT Resonance Observation Using Different Laser Sideband Combinations for the Two Interrogation Pulses
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Masahiro Fukuoka, Shigeyoshi Goka
Tokyo Metropolitan University, Japan

Poster	5085	Novel Light-Shift Measurement Method with Multiple Photo Detectors for Gas-Cell Based Atomic Clocks
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Masahiro Fukuoka, Akira Hanatani, Shigeyoshi Goka
Tokyo Metropolitan University, Japan

Poster	5141	Anomalous Level-Crossing Resonances in Rb Vapor Cells with Buffer Gas
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Wei Xiao, Meng Liu, Teng Wu, Xiang Peng, Hong Guo
Peking University, China

Poster	5199	Advances of Chip-Scale Atomic Clock in Peking University in 2021
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Jianye Zhao¹, Ping Guo¹, Lin Dan¹, Hao Xu¹, Hongling Meng²
¹Peking University, China, ²Zhongkeqidi Optoelectronic Technology (Guangzhou) Co., Ltd., China

Poster	5207	Noise Sources Evaluation of Compact Optically Pumped Cesium Beam Atomic Clock
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Xuan He¹, Shengwei Fang², Zhichao Yuan², Jiayuan Chen², Xianghui Qi², Xuzong Chen², Qing Wang²
¹Institute of Quantum Electronics, Peking University, China ²Peking University, China

Poster	5109	Optical Generation of Microwave Signals for Fountain Clocks in Continuous Operation
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Burghard Lipphardt, Patrick Walkemeyer, Michael Kazda, Johannes Rahm, Stefan Weyers
Physikalisch-Technische Bundesanstalt, Germany

Poster	5259	Initial Study of the Distributed Cavity Phase Shift for the New Microwave Cavities of Cs Fountains at NIST
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Gregory Hoth, Bijunath Patla, Neil Ashby, Vladislav Gerginov
National Institute of Standards and Technology, United States

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Session BIP-7 – 26/04 08:40 – 10:20

Posters 2, Virtual (G4)

Location: Poster Area 4

Session chair: Laura Popa, Exponent Inc.

Poster	5042	A Scale Factor Enhancement Method Based on Parametric Modulation for a Resonant MEMS Accelerometer
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Jingqian Xi², Fangzheng Li², Lu Gao², Lei Xu², Yuan Wang², Chun Zhao², Chengxin Li³, Kunfeng Wang¹, Xingyin Xiong¹, Xudong Zou¹

¹Aerospace Information Research Institute Chinese Academy of Sciences, China,

²Huazhong University of Science and Technology, China, ³University of Leuven, Belgium

Poster	5221	A High Sensitivity Temperature Sensor Using SH-SAW Resonator
--------	------	--

Hangyu Qian¹, Shuxian Wu¹, Zonglin Wu¹, Feihong Bao¹, Guomin Yang¹, Jie Zou¹, Gongbin Tang²

¹Fudan University, China, ²Institute of Novel Semiconductors, Shandong University, China

Poster	5268	Analysis of the Responses of Low-Noise Polymer-Plasticizer Coated Chemical Sensors in Liquids
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Nicholas Post, Florian Bender, Fabien Josse
Marquette University, United States

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Session B1P-8 – 26/04 08:40 – 10:20

Posters 2, Virtual (G5)

Location: Poster Area 5

Poster	5010	Stable 2.4 GHz Radio Frequency Transmission Based on Phase Modulation
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Chenxia Liu², Tianwei Jiang¹, Tao Liu², Song Yu¹

¹Beijing University of Posts and Telecommunications, China, ²North China Electric Power University, China

Poster	5026	A New Joint Time Scale Method of Hydrogen Maser and Cesium Atomic Clock
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Meng Jiang², Shaowu Dong¹

¹National Time Service Center, Chinese Academy of Sciences, China, ²Xi'an Polytechnic University, China

Poster	5046	New Method for Cascaded Fiber-Optic Radio Frequency Transfer
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Qi Li, Liang Hu, Jinbo Zhang, Jianping Chen, Guiling Wu
Shanghai Jiao Tong University, China

Poster	5055	Wavelet Analysis for Time and Frequency Transfer
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Sheng Li, Hong Guo
Peking University, China

Poster	5065	Optimization of EDFA Operating Parameters of Gain, SNR and Input Power in Frequency Transfer System
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Xuan Yang¹, Panxue Ma¹, Yufei Zhang², Guohua Wu¹, Ziyang Chen², Bin Luo¹, Hong Guo²

¹Beijing University of Posts and Telecommunications, China, ²Peking University, China

Poster	5078	Asymmetric Channel Attack Against Practical Round-Trip Fiber Time Synchronization System
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Zihao Liu¹, Yiming Bian¹, Yichen Zhang¹, Yang Li², Bingjie Xu², Song Yu¹

¹Beijing University of Posts and Telecommunications, China ²Institute of Southwestern Communication, Peking University, China

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Poster	5086	Correcting for Site Displacement in GNSS All-in-View Time Transfer
--------	------	--

Wen-Hung Tseng³, Tzu-Pang Tseng¹, Shinn-Yan Lin²

¹National Kaoshiung University of Science and Technology, Taiwan,

²Telecommunication Laboratories, Taiwan, ³Telecommunication Laboratories, Chunghwa Telecom Co., Ltd., Taiwan

Poster	5106	Phase-Modulation-Based Coarse Time Synchronization for Linear Optical Sampling System
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Haojie Wang¹, Chao Zhou², Ziyang Chen², Bin Luo¹

¹Beijing University of Posts and Telecommunications, China, ²Peking University, China

Poster	5115	Optical Time Transmission Over Dual 100 GHz-Grid Optical Channels in the Czech Republic
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Sarbojeet Bhowmick, Radek Velc, Lada Altmannova
CESNET, Czech Rep.

Poster	5210	Detection of Stimulated Brillouin Scattering in Bi-Directional Fiber-Optic Links
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Karol Salwik, Lukasz Sliwczynski, Przemyslaw Krehlik
AGH University of Science and Technology, Poland

Poster	5211	A Self-Time-Keeping Synchronization System Based on Timing Drift Fitting Algorithm
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Yefeng Gao, Junwei Ren, Guangkun Guo, Ke Liu, Dong Hou
University of Electronic Science and Technology of China, China

Poster	5220	The National System for Distribution of Reference Optical Carrier – First Link Evaluation
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Krzysztof Turza², Artur Binczewski², Wojbor Bogacki², Przemyslaw Krehlik¹, Lukasz Sliwczynski¹

¹AGH University of Science and Technology, Poland, ²Poznan Supercomputing and Networking Center, Poland

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Poster	5223	An Optimization Algorithm for Optical Gain in the Multi-EDFAs-Based Fiber-Optic Time Synchronization
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Bo Liu¹, Weicheng Kong², Xinxing Guo³, Bo Li³, Shougang Zhang³, Ruifang Dong³, Tao Liu⁴

¹National Time Service Center, Chinese Academy of Sciences, China, ²University of Chinese Academy of Sciences, CAS, China, ³University of Chinese Academy of Sciences, National Time Service Center, CAS, China ⁴University of the Chinese Academy of Sciences, National Time Service Center, CAS, China

Poster	5228	Ultra-Stable Optical Frequency Transfer via 609 km Communication Fiber Link
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Xiang Zhang, Xue Deng, Qi Zang, Dan Wang, Qian Zhou, Mengfan Wu, Tao Liu, Ruifang Dong, Shougang Zhang

University of Chinese Academy of Sciences, National Time Service Center, CAS, China

Poster	5240	Coherent Optical Frequency Transfer via a Fiber Link Laid Along the Railroad
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Qian Zhou¹, Xiang Zhang¹, Qi Zang¹, Xue Deng¹, Mengfan Wu¹, Jie Liu¹, Dan Wang¹, Tao Liu², Ruifang Dong¹

¹University of Chinese Academy of Sciences, National Time Service Center, CAS, China

²University of the Chinese Academy of Sciences, National Time Service Center, CAS, China

Poster	5188	Time and Frequency Dissemination and Time Scales Task Force on the Roadmap for the Redefinition of Second
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Davide Calonico², Tetsuya Ido³, Gianna Panfilo¹

¹BIPM Bureau International des Poids et Mesures, France, ²INRiM - Istituto Nazionale di Ricerca Metrologica, Italy, ³National Institute of Information and Communications Technology, Italy

Poster	5206	Improvements in the Realization of the Italian Time Scale UTC(IT)
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Elio Bertacco¹, Elena Cantoni¹, Giancarlo Cerretto¹, Roberto Costa¹, Franco Fiasca¹, Valerio Formichella¹, Filippo Levi¹, Alberto Mura¹, Andrea Perucca¹, Marco Pizzocaro¹, Fabrizio Pollastri¹, Marco Sellone¹, Ilaria Sesia¹, Giovanna Signorile¹, Paolo Terzi¹, Tung Than Thai¹, Daniele Rovera³, Giovanni A. Costanzo²
¹INRIM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRiM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy, ³Rovera Freelance Consulting, France

Poster	5024	Combined Time and Frequency Transfer Over Fibre Using Spread Spectrum Technique
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Wei Huang, Shukree Wassin, Elvira Castello, Jochen Kronjaeger
National Physical Laboratory, United Kingdom

Poster	5025	Self-Lasing Technique for Controlling the Gain of Bi-Directional EDFA Used for Optical Frequency Transfer
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Shukree Wassin, Wei Huang, Elvira Castello, Jochen Kronjaeger
National Physical Laboratory, United Kingdom

Poster	5108	GLONASS Time and the Accuracy of Positioning and Timing by GLONASS Signals in 2021
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Andrei Druzhin, Tatiana Primakina, Aleksandr Feoktistov
Russian Institute of Radionavigation and Time, Russia

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Session BIP-9 – 26/04 08:40 – 10:20

Posters 2, Virtual (G6)

Location: Poster Area 6

Session chair: John McFerran, UWA

Poster	5032	Progress on the Evaluation of the Blackbody Radiation Shift Uncertainty of NRC's Strontium Ion Clock
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Bin Jian², Pierre Dube², Miroslav Dolezal¹

¹Czech Metrology Institute, Czech Rep., ²National Research Council Canada, Canada

Poster	5033	Optical Frequency Division with a Comb Based on Difference Frequency Generation
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Sebastian Mueller, Reinhard Unterreitmayr, Thomas Puppe, Rafal Wilk
TOPTICA Photonics AG, Germany

Poster	5037	Measurement of Molecular Iodine Hyperfine Transition Near 554 nm
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Yiting Chen, Jianwei Zhang, Jize Han, Nongchao Xin, Shengnan Miao, Haoran Qin, Lijun Wang
Tsinghua University, China

Poster	5057	Progress Towards a Cs-Limited Uncertainty at $\pm 3 \times 10^{-16}$ of the Absolute Frequency Measurement of NMJ-J-YbI
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Takumi Kobayashi¹, Daisuke Akamatsu², Kazumoto Hosaka¹, Yusuke Hisai², Akiko Nishiyama¹, Akio Kawasaki¹, Masato Wada¹, Hajime Inaba¹, Takehiko Tanabe¹, Feng-Lei Hong², Masami Yasuda¹

¹National Metrology Institute of Japan, National Institute of Advanced Industrial Science & Technology, Japan, ²YNU, Japan

Poster	5075	Progress Towards Development of a Transportable Sr+ Ion Optical Clock at NRC
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Kosuke Kato, Pierre Dubé
National Research Council Canada, Canada

Poster	5082	Application of Velocity Grating Spectrum in Calcium-Beam Optical Clock
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Duo Pan, Tianyu Liu, Haosen Shang, Tiantian Shi, Jingbiao Chen
Peking University, China

Click on the paper title to view the corresponding paper file.

Poster	5084	Dual-Frequency Faraday Laser with THz Frequency Separation
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Jianxiang Miao, Jia Zhang, Tiantian Shi, Duo Pan, Jingbiao Chen
Peking University, China

Poster	5092	Doubly-Locked Dual-Frequency Faraday Laser for Absolute Frequency Measurement
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Jianxiang Miao, Jia Zhang, Tiantian Shi, Duo Pan, Jingbiao Chen
Peking University, China

Poster	5107	Blackbody Radiation and Lattice Light Shift in Sr
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Christian Lisdat, Soren Dorschner, Ingo Nosske, Uwe Sterr
Physikalisch-Technische Bundesanstalt, Germany

Poster	5181	Multi-Branch Fiber Frequency Comb for Precision Frequency Measurement of Molecular Transitions
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Mingkun Li², Pan Zhang², Bingjie Rao², Lulu Yan², Yanyan Zhang¹, Haifeng Jiang⁴,
Shougang Zhang³

¹Key Laboratory of Time and Frequency Primary Standards, National Time Service Center, CAS, China, ²National Time Service Center, Chinese Academy of Sciences, China,

³University of Chinese Academy of Sciences, National Time Service Center, CAS, China,

⁴University of Science and Technology of China, National Time Service Center, CAS, China

Poster	5182	An Er:fiber Femtosecond Optical Frequency Comb for Measurement of the D1 Line in Cold 6Li Atoms
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Bingjie Rao², Pan Zhang², Mingkun Li², Lulu Yan², Xiguang Yang², Xin Chen², Shougang Zhang³, Haifeng Jiang⁴, Yanyan Zhang¹

¹Key Laboratory of Time and Frequency Primary Standards, National Time Service Center, CAS, China, ²National Time Service Center, Chinese Academy of Sciences, China,

³University of Chinese Academy of Sciences, National Time Service Center, CAS, China,

⁴University of Science and Technology of China, National Time Service Center, CAS, China

Poster	5189	Progress on a Compact Ultra-Stable Laser System for Photonic Microwave Generation
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Yani Zuo, Shaoyang Dai, Shiyang Cao, Fei Meng, Fasong Zheng, Weiliang Chen, Kun Liu, Tianchu Li, Fang Fang
National Institute of Metrology, China, China

Click on the paper title to view the corresponding paper file.

Poster	5215	Traceable Characterization of THz Electric Fields by Precision Spectroscopy of Cold Trapped HD ⁺ Ions
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Florin Lucian Constantin
CNRS, France

Poster	5253	Frequency Comb Development at the NRC
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Claude Marceau, Scott Beattie, Marina Gertsolf
National Research Council Canada, Canada

Poster	5196	The iqClock Industry Clock Demonstrator - a Progress Update
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Markus Gellesch⁷, Yogeshwar Kale⁷, Abhilash Jha⁷, Alok Singh⁷, Jonathan M. Jones⁷, Qiushuo Sun⁷, Richard Barron⁷, Manan Jain⁷, Vijay Singh⁷, Kai Bongs⁷, Yeshpal Singh⁷, Pierre Thoumany⁵, Filippo Bregolin⁵, Florian Tauser⁵, Rafal Wilk⁵, Juergen Stuhler⁵, Joe Popple⁴, Stephen Bardell⁴, Bhavesh Patel⁴, Naveen Betadur⁴, Karen Munyard⁴, Ole Kock⁴, Ben Hammond⁴, Patrick Bowen³, Peter Morten Moselund³, Poul Varming³, Anthony Flavin², Marco Menchetti¹, Andrew Lord¹, Iqclock Consortium⁶
¹BT, United Kingdom, ²Chronos Technology, United Kingdom, ³NKT Photonics, Denmark, ⁴Teledyne e2v, United Kingdom, ⁵TOPTICA Photonics AG, Germany, ⁶University of Amsterdam, Netherlands, ⁷University of Birmingham, United Kingdom

Poster	5229	Blue-Detuned Optical Lattice for Sr Long-Range Interactions
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Shengnan Zhang, Balsant Tiwari, Sandhya Ganesh, Preetam Ramchurn, Kai Bongs, Yeshpal Singh
University of Birmingham, United Kingdom

Poster	5173	A Field-Deployable Optical Clockwork in the Visible Spectrum Capable of Supporting Instabilities Below 1X10 ⁻¹⁷
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Henry Timmers, Andrew Attar, Bennett Sodergren, Star Fassler, Evan Barnes, Saeid Rostami, Kurt Vogel, Kevin Knabe
Vescent Photonics, United States

Poster	5191	Recent Progress of Mercury Lattice Clock in SIOM
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Qixin Liu, Ye Zhang, Zexin Yu, Jianfang Sun, Zhen Xu
SIOM, China

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Session B2L-1 – 26/04 10:50 – 12:30

G2: Optical Oscillators

Location: Room 1

Session chair: Olivier Llopis, LAAS-CNRS, Université de Toulouse

10:50	5062	Parametric Study on the Phase Noise of an Optoelectronic Oscillator Submitted to Vibrations
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Pierre Travers², Yohann Léguillon², François Louf¹, Pierre-Alain Boucard¹, Loic Morvan³, Daniel Dolfi⁴, Vincent Crozatier³

¹Laboratoire de Mécanique et Technologie, France, ²Thales Land and Air Systems, France, ³Thales Research & Technology, France, ⁴Thales Research and Technology, France

11:10	5013	A CPT-Based Cs Cell Self-Sustained Microwave Oscillator
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Rodolphe Boudot², Moustafa Abdel Hafiz¹, Michael Petersen¹, Enrico Rubiola¹, Claudio Calosso³

¹FEMTO-ST Institute, France, ²FEMTO-ST Institute, CNRS, France, ³INRiM - Istituto Nazionale di Ricerca Metrologica, Italy

11:30	5137	Influence of the Optical Amplifier on Optoelectronic Oscillator with Optical Gain
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Guillaume Dangoisse³, Perrine Berger³, Vincent Crozatier³, Frederic van Dijk¹, Christophe Caillaud¹, Michael Verdun², Nadège Le Grand², Xavier Prat², Guillaume Canat²

¹III-V Lab, France, ²Lumibird, France, ³Thales Research & Technology, France

11:50	5203	Numerical Study of a COEO Device Versus Loop Chromatic Dispersion and Detuning
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Alexis Bougaud, Olivier Llopis, Arnaud Fernandez
LAAS, France

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Session B2L-2 – 26/04 10:50 – 12:30

G6: Spectroscopy & Applications

Location: Room 2

Session chair: Ronald Holzwarth, MenloSystems

10:50	5264	High Precision, SI-Traceable, Mid-Infrared Molecular Spectroscopy
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Nicolas Cahuzac¹, Yuhao Liu¹, Marylise Saffre¹, Etienne Cantin², Olivier Lopez², Dang Bao An Tran¹, Rosa Santagata¹, Mathieu Manceau¹, Anne Amy-Klein², Benoit Darquie¹, Mads Tonnes³, Benjamin Pointard³, Michel Abgrall³, Luca Lorini³, Yann Le Coq³, Rodolphe Le Targat³, Hector Alvarez-Martinez⁵, Dan Xu⁴, Paul-Eric Pottie³
¹Laboratoire de physique des lasers, France, ²Laboratoire de Physique des Lasers, Université Sorbonne Paris Nord, CNRS, France, ³LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ⁴Observatoire de Paris, France, ⁵Real Instituto y Observatorio de la Armada, Spain

11:10	5256	Towards an Active Frequency Reference Driven by a Thermal Beam of 88Sr Atoms
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Francesca Fama¹, Camila Beli Silva¹, Sheng Zhou¹, Mikkel Tang², Stefan Alaric Schaffer¹, Shayne Bennetts¹, Florian Schreck¹
¹University of Amsterdam, Netherlands, ²University of Copenhagen, Denmark

11:30	5031	Constraining Variations in Fundamental Constants Using a Network of Clocks
-------	------	--

Adam Parsons², Marco Schioppo², Jacob Tunesi², Ian Hill², Billy Robertson², Alexandra Tofful², Richard Hendricks², Anne Curtis², R.C. Thompson¹, Krzysztof Szymaniec², Helen S. Margolis², Rachel Godun²
¹Imperial College London, United Kingdom, ²National Physical Laboratory, United Kingdom

11:50	5247	New Absolute Frequency Measurement of the Improved 171Yb Optical Lattice Clock at INRiM
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Irene Goti³, Stefano Condio², Matias Risaro¹, Cecilia Clivati¹, Michele Gozzelino¹, Giovanni A. Costanzo³, Filippo Levi¹, Marco Pizzocaro¹, Davide Calonico¹
¹INRiM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRiM – Istituto Nazionale di Ricerca Metrologica / Politecnico di Torino, Italy, ³INRiM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy

Session B2L-3 – 26/04 10:50 – 12:30

G5: Optical Timebases & Applications

Location: Room 3

Session chair: Dirk Piester, PTB

10:50	5080	Benefit of Optical Clocks for Geodesy
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Jurgen Muller

Leibniz University Hannover, Germany

11:30	5192	Reassessment of Lab-Side Uncertainties for High-Precision Optical Clock Contributions to Tai
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Nils Nemitz, Hidekazu Hachisu, Nozomi Ohtsubo, Hiroyuki Ito, Tetsuya Ido

National Institute of Information and Communications Technology, Japan

11:50	5213	Testing a Robust Algorithm for Optical Time Scales Generation
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Valerio Formichella¹, Giovanna Signorile¹, Marco Pizzocaro¹, Irene Goti³, Stefano Condio², Cecilia Clivati¹, Matias Risaro¹, Filippo Levi¹, Davide Calonico¹, Ilaria Sesia¹, Lorenzo Galleani⁴

¹INRiM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRiM – Istituto Nazionale di Ricerca Metrologica / Politecnico di Torino, Italy, ³INRiM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy, ⁴Politecnico di Torino, Italy

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Session B3L-1 – 26/04 14:00 – 16:00

G2: MEMS, OCXO & Frequency Divider

Location: Room 1

Session chair: Magnus Danielson, Net Insight

14:00	5248	Design Challenges for MEMS Resonator-Based High Performance Oscillators in Commercial Applications
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John Clark, Pierre Guebels, Andrew R. Brown, Seungbae Lee, Wanling Pan
Microchip, United States

14:40	5276	Time-Temperature Superposition Based Accelerated Aging Method for Packaged MEMS Resonators
-------	------	--

Jeronimo Segovia-Fernandez, Yutaka Suzuki, Mahmud Chowdhury, Javier Rojas, Ernest Yen
Texas Instruments, United States

15:00	5277	A Thermal-Stress FEM to Predict Aging in Packaged MEMS Resonators
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Jeronimo Segovia-Fernandez, Yutaka Suzuki, Mahmud Chowdhury, Javier Rojas, Ernest Yen
Texas Instruments, United States

15:20	5177	30 GHz Regenerative Frequency Divide-by-3
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Archita Hati¹, Marco Pomponio², Connor Humiston², John Lettang², Craig Nelson¹
¹National Institute of Standards and Technology, United States, ²National Institute of Standards and Technology and University of Colorado Boulder, Italy, ²National Institute of Standards and Technology and University of Colorado Boulder, United States

15:40	5185	Ultra-Stable Oscillator Stabilization Using an Artificial Neural Network
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Olukayode Okusaga², John Hamilton², Trey Schmidt¹, Samuel Reynolds², Jefferey Garstecki², Gregory Weaver²
¹Johns Hopkins APL, United States, ²Johns Hopkins Applied Physics Laboratory, United States

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Session B3L-2 – 26/04 14:00 – 16:00

G6: Combs

Location: Room 2

Session chair: Tara Fortier, NIST

14:00	5023	Transfer Oscillator Technique for Generation of 10 GHz Low-Noise Microwaves with High Accuracy
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Nicholas Nardelli², Tara Fortier¹, Marco Pomponio², Esther Baumann², Craig Nelson¹, Thomas Schibli², Archita Hati¹

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

14:40	5183	Broadband Nonlinear Wavelength Conversion with Integrated Microresonators
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Jennifer Black¹, Su-Peng Yu², Zachary Newman², David Carlson², Jizhao Zang¹, Scott Papp¹

¹National Institute of Standards and Technology, United States, ²NIST, United States

15:00	5161	300 GHz Wave Generated with a Dissipative Kerr Soliton Divider
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Antoine Rolland

IMRA America, Inc., United States

15:20	5126	Shaped Supercontinuum for Precision Frequency Transfer
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Kevin Lee, Antoine Rolland, Peng Li, Jie Jiang, Martin Fermann

IMRA America, Inc., United States

15:40	5104	Response Function of Homodyne Wavelength Difference Stabilization
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James Cahill³, Tanvir Mahmood¹, Patrick Sykes³, Curtis Menyuk², Weimin Zhou³

¹CCDC ARL, United States, ²UMBC, United States, ³US CCDC Army Research Laboratory, United States

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Session B3L-3 – 26/04 14:00 – 16:00

G5: Optical Time Transfer I

Location: Room 3

Session chair: Anne Amy Klein, LPL

14:00	5036	Photon Efficient Optical Time Transfer
Emily Caldwell ¹ , Laura Sinclair ¹ , William Swann ¹ , Nate Newbury ¹ , Benjamin Stuhl ³ , Jean-Daniel Deschênes ²		
¹ National Institute of Standards and Technology, United States, ² Octosig Consulting, United States, ³ Space Dynamics Laboratory, National Institute of Standards and Technology, United States		
14:40	5060	Free Space Optical Link for Frequency Comparison and Chronometric Geodesy
Nicolas Maron ² , Francois-Xavi Esnault ¹ , Thomas Leveque ¹ , Peter Wolf ²		
¹ Centre National d'Études Spatiales, France, ² LNE-SYRTE, Observatoire de Paris - Université PSL, CNRS, Sorbonne Université, France		
15:00	5279	Estimation Architectures for Precise Time and Frequency Transfer in a LEO Constellation
Christopher Flood ² , Penina Axelrad ² , Andrew J. Metcalf ¹ , Benjamin K. Stuhl ¹		
¹ Air Force Research Lab, United States, ² University of Colorado Boulder, United States		
15:20	5157	How to Implement Mutual Network Synchronization in the Presence of Large Cross-Coupling Delays
Lucas Wetzel ¹ , Dimitrios Prousalis ¹ , Rabia Riaz ² , Christian Hoyer ² , Niko Joram ² , Frank Ellinger ² , Frank Julicher ¹		
¹ Max Planck Institute for the Physics of Complex Systems, Germany, ² Technische Universität Dresden, Germany		
15:40	5154	Wireless PTP Transmission with FWA Technology
Marco Sellone ² , Filippo Levi ² , Alberto Mura ² , Davide Calonico ² , Stefano Zanolli ¹ , Gabriele Balzano ¹		
¹ HAL Service, Italy, ² INRiM - Istituto Nazionale di Ricerca Metrologica, Italy		

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Session B4L-1 – 26/04 16:20 – 18:00

G1/4 Joint

Location: Room 1

Session chair: Valentina Zega, Politecnico di Milano, Italy

16:20	5169	Microwave-Optical Transduction Using High Overtone Bulk Acoustic Resonances
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Terence Blesin¹, Anat Siddharth¹, Hao Tian², Rui Ning Wang¹, Alaina Attanasio², Sunil Bhav², Tobias Kippenberg¹

¹École Polytechnique Fédérale de Lausanne, Switzerland, ²Purdue University, United States

16:40	5284	Self-Aligned Single-Electrode Actuation of Tangential and Wineglass Modes
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Ozan Erturk³, Sunil Bhav³, Kilian Shambaugh², Sang-Goo Lee¹

¹Bule Photonics, Korea, ²Polytec Inc., United States, ³Purdue University, United States

17:00	5283	AlScN-on-SiC Thin-Film Micromachined Resonant Transducers Operating in High-Temperature Environment Up to 600°C
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Wen Sui², Haoran Wang², Jaesung Lee², Afzaal Qamar³, Mina Rais-Zadeh¹, Philip X.-L. Feng²

¹NASA Jet Propulsion Laboratory, California Institute of Technology, United States,

²University of Florida, United States, ³University of Michigan Ann Arbor, United States

17:20	5172	Multi-Level Analog Programmable Graphene Resistive Memory with Fractional Channel Ferroelectric Switching in Hafnium Zirconium Oxide
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Ved Gund, Benyamin Davaji, Shubham Jadhav, Hyunjea Lee, Debdeep Jena, Huili Grace Xing, Amit Lal

Cornell University, United States

17:40	5295	Turnover Temperature in Lateral-Field-Excited Thin-Film Lithium Tantalate Contour Resonators
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Yasaman Majd, Hamideh Kermani, Parvin Akhkandi, Garrett Goodale, Reza Abdolvand
University of Central Florida, United States

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Session B4L-2 – 26/04 16:20 – 18:00

G6: Clocks & Combs

Location: Room 2

Session chair: Tanja Mehlstaebler, PTB

16:20	5302	Simple Millimeter Wave Generation with Stability Tied to a Self-Referenced Frequency Comb
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Alexander Lind², Eugene Tsao³, Franklyn Quinlan¹, Scott Diddams²

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

³NIST, United States

16:40	5202	Quantum Nondemolition Detection for Strontium Optical Lattice Clock
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Haosen Shang, Miguel-Angel Cifuentes Marin, Yannick Foucault, Rodolphe Le Targat, Jerome Lodewyck

LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France

17:00	5255	Advancing Optical Lattice Clock Performance with Enhanced Quantum Control Techniques
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Chun-Chia Chen¹, Jacob Siegel¹, Xiaogang Zhang¹, William McGrew¹, Youssef Hassan¹, Kyle Beloy¹, Andrew Ludlow²

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

17:20	5303	Tweezer Clocks: A New Platform for Quantum Metrology
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Adam Kaufman

JILA, National Institute of Standards and Technology and University of Colorado Boulder, United States

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Session B4L-3 – 26/04 16:20 – 18:00

G3: Timekeeping Clocks

Location: Room 3

Session chair: François-Xavier Esnault, CNES

16:20	5146	Cold-Atom-Based Commercial Microwave Clocks at 1X10-15 Relative Instability Over More Than a Month
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Bruno Pelle¹, Luc Archambault¹, Bruno Desruelle¹, Arnaud Landragin²

¹iXblue, France, ²SYRTE, Observatoire de Paris, France

17:00	5050	Normalised Detection of Clock States by Cold Atom Recapture Method
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Samuel Walby³, Martin Knapp³, Josh Whale¹, Andrew Wilson¹, Richard Hendricks¹, Christopher Foot², Krzysztof Szymaniec¹

¹National Physical Laboratory, United Kingdom, ²University of Oxford, United Kingdom,

³University of Oxford / National Physical Laboratory, United Kingdom

17:20	5262	Reevaluating the Collisional Shift of the NRC-FCs2 Primary Frequency Standard
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Scott Beattie, Bin Jian, Marina Gertsolf

National Research Council Canada, Canada

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Session CIL-1 – 27/04 08:40 – 10:20

G3: Cell Standards

Location: Room 1

Session chair: Gaetano Miletì, Université de Neuchâtel

08:40	5035	LaLI-POP: Lamp and Laser Integrated Pulsed-Optically Pumped Atomic Clock
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Michael Huang, Arielle Little, James Camparo
Aerospace Corporation, United States

09:00	5168	Multipole Moments of the CPT Density Matrix in Polarization Modulation Conditions
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Zachary Warren, James Camparo
Aerospace Corporation, United States

09:20	5110	Frequency-Doubled Laser System at 780 nm for Pulsed Vapor-Cell Clocks
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Michele Gozzelino, Salvatore Micalizio, Elio Bertacco, Filippo Levi, Claudio Calosso
INRiM - Istituto Nazionale di Ricerca Metrologica, Italy

09:40	5121	Versatile Microfabricated Alkali Vapor Cells Using Local Sealing
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Vincent Maurice⁵, Clement Carle², Shervin Keshavarzi², Ravinder Chutani⁴, Samuel Queste², Ludovic Gauthier-Manuel¹, Jean-Marc Cote², Remy Vicarini¹, Rodolphe Boudot³, Nicolas Passilly²

¹FEMTO-ST, France, ²FEMTO-ST Institute, France, ³FEMTO-ST Institute, CNRS, France, ⁴IEMN, France, ⁵IEMN - Centrale Lille, France

10:00	5176	New Approaches for Cost Reduction in Microfabricated Atomic Clocks
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Motoaki Hara¹, Yuichiro Yano¹, Satoshi Shinada¹, Zhijian Zhao², Masaya Toda², Hiroyuki Ito³, Takahito Ono², Tetsuya Ido¹

¹National Institute of Information and Communications Technology, Japan, ²Tohoku University, Japan, ³Tokyo Institute of Technology, Japan

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Session CIL-2 – 27/04 08:40 – 10:20

G6: Techniques & Theory

Location: Room 2

Session chair: Murray Barrett, NUS

08:40	5195	Low-Noise Near-Ultraviolet Photonic Integrated Lasers
Anat Siddharth ¹ , Thomas Wunderer ² , Grigory Lihachev ¹ , Andrey Voloshin ¹ , Camille Haller ¹ , Rui Ning Wang ¹ , Marke Teepe ² , Zhihong Yang ² , Junqiu Liu ¹ , Johann Riemensberger ¹ , Nicolas Grandjean ¹ , Noble Johnson ² , Tobias Kippenberg ¹		
¹ École Polytechnique Fédérale de Lausanne, Switzerland, ² Palo Alto Research Center, United States		
09:00	5209	Towards the Development of a Compact-Monolithic Iodine Frequency Stabilized Laser Setup for Ground Tests of LISA Payload
Alexis Mehlman ⁴ , David Holleville ² , Michel Lours ³ , Rodolphe Le Targat ³ , Sébastien Bize ³ , Ouali Acef ³ , Aurelien Boutin ¹ , Karine Lepage ¹ , Ludovic Fulop ¹		
¹ ixblue, France, ² LNE-SYRTE, Observatoire de Paris, France, ³ LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ⁴ SYRTE Laboratory, Observatoire de Paris/ixblue, France		
09:20	5144	Improving the Signal/Noise Ratio on Optical Comb-Based Frequency Measurements Using a Track&Hold Amplifier
Matias Risaro ² , Paolo Savio ¹ , Davide Calonico ² , Filippo Levi ² , Cecilia Clivati ²		
¹ Fondazione LINKS, Italy, ² INRiM – Istituto Nazionale di Ricerca Metrologica, Italy		
09:40	5040	Atomic Structure Calculations for the Intercombination and Clock Levels in Hg and Cd
Jesse Schelfhout, John McFerran		
University of Western Australia, Australia		
10:00	5218	Spectroscopic Effects Nonlinear in Atomic Density Caused by the Free Motion of Atoms in a Gas
Valeriy Yudin ² , Alexey Taichenachev ¹ , Maksim Basalae ³ , Oleg Prudnikov ² , Sergey Bagayev ¹		
¹ Institute of Laser Physics SB RAS, Russia, ² Institute of Laser Physics, Novosibirsk State University, Russia, ³ Novosibirsk State University, Russia		

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Session CIL-3 – 27/04 08:40 – 10:20

G5: Traceability & the SI Second

Location: Room 3

Session chair: Per Olof Hedekvist, RISE

08:40	5304	Roadmap Towards the Redefinition of the Si Second
Noel Dimarcq CNRS -Université Cote d'Azur - Observatoire Cote d'Azur, France		

09:20	5113	Current Activity of the Consultative Committee for Time and Frequency to Address the Needs of Time and Frequency Metrology and its Applications
Noel Dimarcq ² , Patrizia Tavella ¹ ¹ BIPM Bureau International des Poids et Mesures, France, ² CNRS -Université Cote d'Azur -Observatoire Cote d'Azur, France		

09:40	5088	Traceability to UTC from GNSS Measurements
Pascale Defraigne ⁵ , Pierre Uhrich ¹ , Joseph Achkar ¹ , Andreas Bauch ⁴ , Judah Levine ² , Michael Wouters ³ ¹ LNE-SYRTE, Observatoire de Paris - Université PSL, CNRS, Sorbonne Université, France, ² National Institute of Standards and Technology, United States, ³ National Measurement Institute, Australia, ⁴ Physikalisch-Technische Bundesanstalt, Germany, ⁵ Royal Observatory of Belgium, Belgium		

10:00	5136	Selected Aspects of Traceability and Uncertainty of Frequency Measurements with Counters
Dirk Piester, Egle Staliuniene, Andreas Bauch Physikalisch-Technische Bundesanstalt, Germany		

Session C2L-1 – 27/04 10:50 – 12:30

G3: Fundamental Physics & Precision Metrology

Location: Room 1

Session chair: Sebastien Bize, SYRTE

10:50	5305	Long-Lived Spin Squeezing in a Metrologically Relevant Regime
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Jose Alberto De La Paz Espinosa², Carlos Leonardo Garrido Alzar², Meng-Zi Huang¹, Alice Sinatra¹, Jakob Reichel¹

¹ENS-Université PSL, CNRS, Sorbonne Université, France, ²LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France

11:30	5244	Test of the Sagnac Effect by Accurate Measurements with a Dual-Axis Cold-Atom Gyroscope
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Mohamed Guessoum³, Romain Gautier², Quentin Bouton², Leonid Sidorenkov¹, Arnaud Landragin⁴, Remi Geiger²

¹LNE-SYRTE, Observatoire de Paris – Université PSL, CNRS, Sorbonne Université, France, ²SYRTE, France, ³SYRTE – Observatoire de Paris, France, ⁴SYRTE, Observatoire de Paris, France

11:50	5147	Ultra-High Precision Laser Spectroscopy of Antihydrogen
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Janko Nauta
Swansea University, United Kingdom

12:10	5297	Precision Metrology with Photons, Phonons and Spins
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Michael Tobar, Jeremy Bourhill, William Campbell, Elrina Hartman, Eugene Ivanov, Maxim Goryachev, Benjamin McAllister, Aaron Quiskamp, Catriona Thomson, Alexey Veryaskin, Zijun Zhao
University of Western Australia, Australia

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Session C2L-2 – 27/04 10:50 – 12:30

G4: Resonant Sensors & Energy Harvesters

Location: Room 2

Session chair: Jérôme Juillard, CentraleSupélec

10:50	5063	H2MEMS Project: Resonant MEMS for Detection of Hydrogen Release in Radioactive Waste Disposal Facility
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Isabelle Dufour⁴, Luis Iglesias Hernandez⁴, Priyadarshini Shanmugam⁵, Jean-Francois Michaud⁵, Laurent Colin⁵, Daniel Alquier⁵, Dominique Certon⁵, Maria-Dolores Manrique-Juarez³, Thierry Leichle³, Fabrice Mathieu³, Laurent Mazon³, Liviu Nicu³, Luan Nguyen², Sébastien Chenot², Marc Portail², Johan Bertrand¹
¹Andra, France, ²CNRS-CRHEA, France, ³CNRS-LAAS, France, ⁴Université de Bordeaux, France, ⁵Université de Tours, France

11:30	5138	Electrostatic Frequency Tuning of a Quatrefoil Suspension Gyroscope
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Madan Parajuli², Guillermo Sobreviela¹, Ashwin Seshia²
¹Silicon Microgravity, United Kingdom, ²University of Cambridge, United Kingdom

11:50	5249	A Highly Sensitive Magnetic Field SAW Sensor on Metglas
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Prince Mengue¹, Omar Elmazria¹, Baptiste Paulmier¹, Anna Maria Friedel¹, Sebastien Petit-Watelot¹, Thomas Hauet¹, Sergei Zhgoon², Daniel Lacour¹, Michel Hehn¹, Sami Hage-Ali¹
¹Institut Jean Lamour, France, ²National Research University "MPEI", Russia

12:10	5134	Planar Grin Lenses for MEMS Energy Harvesters: Macroscopic Proof of Concept
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Valentina Zega, Marco Antonacci, Attilio Frangi, Alberto Corigliano, Emanuele Riva
 Politecnico di Milano, Italy

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Session C2L-3 – 27/04 10:50 – 12:30

G5: Optical Time Transfer II

Location: Room 3

Session chair: Laura Sinclair, NIST

10:50	5197	One Year of WR Link Operation Between Two UTC(k)
Pierre Waller ¹ , Cedric Plantard ¹ , Erik Dierikx ² , Yan Xie ² ¹ ESA/ESTEC, Netherlands, ² VSL, Netherlands		
11:10	5100	Fiber Optic Time Transfer from UTC(k) to a VLBI Antenna in a Coherent Communication Network
Per Olof Hedekvist ¹ , Sven-Christian Ebenhag ¹ , Carsten Rieck ¹ , Magnus Bergroth ² ¹ RISE Research Institutes of Sweden AB, Sweden, ² SUNET, Sweden		
11:30	5120	A Pulsed-Optical Frequency and Timing Distribution System for Deep Space Antennas
Kemal Shafak ¹ , Anan Dail, Franz. X. Kaertner ¹ , Benjamin Rudin ⁴ , Florian Emaury ⁴ , Oliver Lange ³ , Werner Lange ³ , Sinda Mejri ² ¹ Cycle GmbH, Germany, ² European Space Agency, Germany, ³ Lange-Electronic GmbH, Germany, ⁴ Menhir Photonics AG, Switzerland		
11:50	5242	Long Distance Free Space Optical Time and Frequency Transfer: Towards Satellite-Ground Link at 10-18 Instability
Qi Shen ² , Jian-Yu Guan ² , Lei Hou ² , Ting Zeng ² , Min Li ² , Jin-Jian Han ² , Meng-Zhe Lian ² , Yan-Wei Chen ² , Yuan Cao ² , Zhao-Hui Li ¹ , Jin-Cai Wu ¹ , Jian-Jun Jia ¹ , Sheng-Kai Liao ² , Ji-Gang Ren ² , Juan Yin ² , Cheng-Zhi Peng ² , Haifeng Jiang ³ , Qiang Zhang ² , Jian-Wei Pan ² ¹ Key Laboratory of Space Active Opto-Electronic Technology, Shanghai Institute of Technical Physics, China, ² University of Science and Technology of China, China, ³ University of Science and Technology of China, National Time Service Center, CAS, China		

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Session C3L-1 – 27/04 14:00 – 16:00

G1: Aluminum Scandium Nitride Devices

Location: Room 1

Session chair: Azadeh Ansari, Georgia Institute of Technology

14:00	5159	X-Band Multi-Frequency 30% Compound ScAlN Microacoustic Resonators and Filters for 5G-Advanced and 6G Applications
-------	------	--

Gabriel Giribaldi, Michele Pirro, Bernard Herrera Soukup, Meruyert Assylbekova, Giuseppe Michetti, Luca Colombo, Matthew Conte, Matteo Rinaldi
Northeastern University, United States

14:20	5289	Frequency Reprogrammable Al _{0.7} Sc _{0.3} N Acoustic Delay Line with Up to 13.5 % Bandwidth
-------	------	--

Onurcan Kaya, Xuanyi Zhao, Cristian Cassella
Northeastern University, United States

14:40	5184	High-Performance SAW Resonators at 3 GHz Using AlScN on a 4H-SiC Substrate
-------	------	--

Xingyu Du, Zichen Tang, Chloe Leblanc, Deep Jariwala, Roy H. Olsson III
University of Pennsylvania, United States

15:00	5156	Improving Thermal Linearity and Quality Factor of Al _{0.72} Sc _{0.28} N Contour Mode Resonators Using Acoustic Metamaterials Based Lateral Anchors
-------	------	--

Xuanyi Zhao, Onurcan Kaya, Michele Pirro, Sungho Kang, Cristian Cassella
Northeastern University, United States

15:20	5291	A 7 GHz – 13.4 GHz Complementary-Switchable Thickness-Extensional Bulk Acoustic Resonator Using Laminated Ferroelectric Sc _{0.28} Al _{0.72} N
-------	------	---

Dicheng Mo, Shaurya Dabas, Sushant Rassay, Roozbeh Tabrizian
University of Florida, United States

15:40	5281	Intrinsically Tunable Laminated Ferroelectric Sc _{0.28} Al _{0.72} N Extensional Resonator Based on Local Polarization Switching
-------	------	---

Shaurya Dabas, Dicheng Mo, Sushant Rassay, Roozbeh Tabrizian
University of Florida, United States

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Session C3L-2 – 27/04 14:00 – 16:00

G6: Clocks II

Location: Room 2

Session chair: Uwe Sterr, PTB

14:00	5158	Optical Frequency Ratios Between a Highly Charged Ion Clock and a $^{171}\text{Yb}^+$ Clock
-------	------	---

Steven King², Lukas Spiess², Alexander Wilzewski², Peter Micke², Tobias Leopold², Erik Benkler², Richard Lange², Nils Huntemann², Piet Schmidt³, Jose Crespo Lopez-Urrutia¹
¹Max-Planck-Institut für Kernphysik, Germany, ²Physikalisch-Technische Bundesanstalt, Germany, ³Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany

14:40	5245	First Measurements with a Portable Yb Optical Lattice Clock
-------	------	---

Wesley Brand, Robert Fasano, Yun-Jhih Chen, Richard Fox, Andrew Ludlow National Institute of Standards and Technology and University of Colorado Boulder, United States

15:00	5288	Compact and Portable Cavity-Stabilized Laser with Broadband EOM Feedback for Low Phase Noise
-------	------	--

Megan Kelleher³, Charles McLemore³, Dahyeon Lee³, Scott Diddams², Franklyn Quinlan¹
¹National Institute of Standards and Technology, United States, ²National Institute of Standards and Technology and University of Colorado, Boulder, United States, ³University of Colorado Boulder, United States

15:20	5164	Two-Color Grating Magneto-Optical Trap for Narrow-Line Laser Cooling
-------	------	--

Saskia Anna Bondza², Christian Lisdat², Stefanie Kroker², Tobias Leopold¹
¹Deutsches Luft- und Raumfahrtzentrum, Germany, ²Physikalisch-Technische Bundesanstalt, Germany

15:40	5054	Absolute Frequency Measurement of the Sr^+ Ion Optical Clock with a Fourfold Uncertainty Reduction
-------	------	---

Pierre Dubé, Bin Jian, Marina Gertszvolf
National Research Council Canada, Canada

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Session C3L-3 – 27/04 14:00 – 16:00

G3: Chip-scale Atomic Clocks

Location: Room 3

Session chair: John Kitching, NIST

14:00	5011	Chip Scale Rubidium Oscillator for Space Application
Serge Grop ² , Jacques Haesler ¹ , Joseph Gouloumet ² , Sylvain Karlen ¹ , Davide Grassani ¹ , Vito Genna ² , Christian Schori ² , Laurent Balet ¹ , Benjamin Gallinet ¹ , Fabien Droz ¹ , Steve Lecomte ¹		
¹ CSEM SA, Switzerland, ² Orolia Switzerland, Switzerland		
14:20	5014	Tackling Light-Shifts in a Microcell Atomic Clock with Symmetric Auto-Balanced Ramsey Sequence
Clement Carle ¹ , Moustafa Abdel Hafiz ¹ , Nicolas Passilly ¹ , Jean-Marie Danet ⁴ , Claudio Calosso ³ , Rodolphe Boudot ²		
¹ FEMTO-ST Institute, France, ² FEMTO-ST Institute, CNRS, France, ³ INRiM - Istituto Nazionale di Ricerca Metrologica, Italy, ⁴ SYRLINKS, France		
14:40	5119	Adapting a Flat-Form Factor Miniature Atomic Clock to a Commercial Package: Preliminary Characterization
Davide Grassani ¹ , Laurent Balet ¹ , Olivia Hefti ² , Sylvain Karlen ¹ , Fabien Droz ¹ , Joseph Gouloumet ³ , Serge Grop ³ , Christian Schori ³ , Jacques Haesler ¹ , Steve Lecomte ¹		
¹ CSEM SA, Switzerland, ² CSEM/PSI, Switzerland, ³ Orolia Switzerland, Switzerland		
15:00	5097	Long-Term Instability of a Pulsed Optically Pumped Micro-Cell Rubidium Frequency Standard
Etienne Batori ³ , Christoph Affolderbach ³ , Florian Gruet ³ , Matthieu Pellaton ³ , Gaetano Mileti ³ , Yuanyan Su ¹ , Maddalena Violetti ² , Anja K. Skrivervik ¹		
¹ École Polytechnique Fédérale de Lausanne, Switzerland, ² Toscana Life Sciences, école Polytechnique Fédérale de Lausanne, Switzerland, ³ Université de Neuchatel, Switzerland		
15:20	5074	Low Phase Noise Low Power Atomic Clocks
Peter Cash, Igor Kosvin, Hoklay Park, Matt Stanczyk, Mike F. Wacker		
Microchip Technology, United States		

15:40	5151	Miniature Atomic Clock Driven by an Application Specific Integrated Circuit (ASIC)
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Yves-Julien Regamey, David Ruffieux, Sylvain Karlen, Jacques Haesler, Steve Lecomte

CSEM SA, Switzerland

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Session D1L-1 – 28/04 08:40 – 10:20

G1: RF Acoustic Techniques & Devices

Location: Room 1

Session chair: Alexandre Reinhardt, CEA

08:40	5087	Conception of Wide Band Surface Acoustic Waves Filter in L-Band Based on Lithium Niobate Substrate
Alexandre Clairet ¹ , Thierry Laroche ¹ , Eric Michoulier ¹ , Bruno Lelong ² , Jean-Michel Hode ² , Florent Bernard ¹ , Emilie Courjon ¹ , Sylvain Ballandras ¹ ¹ FrecIn sys, France, ² Thales DMS, France		
09:00	5058	Self-Excitation in Electrostatically Actuated Non-Identical Coupled Curved Microbeams
Lior Medina ¹ , Ashwin Seshia ² ¹ Tel-Aviv University, Israel, ² University of Cambridge, United Kingdom		
09:20	5238	Transverse Mode Suppression Based on Optimized Tilted Transducer for NS-SAW Resonator
Shuxian Wu ¹ , Ming Li ³ , Feng Xu ¹ , Feihong Bao ¹ , Gongbin Tang ² , Jie Zou ¹ ¹ Fudan University, China, ² Institute of Novel Semiconductors, Shandong University, China, ³ Shandong University, China		
09:40	5004	Study on the Spurious Modes in FBAR Resonators with Quasi-Free Edges
Chin-Yu Chang ¹ , Yan-Ming Huang ¹ , Tzu-Hsuan Hsu ¹ , Yung-Hsiang Chen ² , Rakesh Chand ³ , Yelehanka Pradeep ³ , Yens Ho ² , Ming-Huang Li ¹ , Weileun Fang ¹ , Sheng-Shian Li ¹ ¹ National Tsing Hua University, Taiwan, ² Vanguard International Semiconductor Corporation, Taiwan, ³ Vanguard International Semiconductor Corporation Singapore PTE. Ltd., Singapore		

Session DIL-2 – 28/04 08:40 – 10:20

G3/6 Joint: Ion Clocks

Location: Room 2

Session chair: Rachel Godun, NPL

08:40	5129	An Ensemble of Prototype Yb+ Microwave Ion Clocks
Daniel Thrasher, Peter Schwindt, Brendan Gunning, Erik Skogan, Ganapathi Subramania, Mary Crawford, Yuan-Yu Jau		
Sandia National Laboratories, United States		

09:00	5122	Evaluation of a Sympathetically Cooled In+ Ion Clock
Tanja E. Mehlstübler ² , Tabea Nordmann ¹ , Jonas Keller ¹ , Jan Kiethe ¹ , Hartmut Nimrod Hausser ¹ , Leon Schomburg ¹ , Hongli Liu ³ , Nishant Bhatt ¹ , Richard Lange ¹ , Nils Huntemann ¹ , Ekkehard Peik ¹ , Erik Benkler ¹ , Sören Dörscher ¹ , R. Schwarz ¹ , Christian Lisdat ¹		
¹ Physikalisch-Technische Bundesanstalt, Germany, ² Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany, ³ PTB Physikalisch-Technische Bundesanstalt, Germany		

09:20	5101	27Al+ Clock at PTB – Recent Improvements on the Error Budget
Johannes Kramer ⁴ , Fabian Dawel ³ , Marek Hild ² , Steven King ² , Nicolas Spethmann ² , Piet Schmidt ³ , Miroslav Dolezal ¹		
¹ Czech Metrology Institute, Czech Rep., ² Physikalisch-Technische Bundesanstalt, Germany, ³ Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany, ⁴ PTB Braunschweig, Germany		

09:40	5165	Tailored Optical Clock Transition in 40Ca+
Lennart Pelzer ⁴ , Kai Dietze ⁴ , Johannes Kramer ⁴ , Fabian Dawel ⁴ , Ludwig Krinner ⁴ , Nicolas Spethmann ³ , Piet Schmidt ⁴ , Victor Jose Martinez-Lahuerta ² , Klemens Hammerer ² , Nati Aharon ¹ , Alex Retzker ¹		
¹ Hebrew University of Jerusalem, Israel, ² Leibniz Universität Hannover, Germany, ³ Physikalisch-Technische Bundesanstalt, Germany, ⁴ Physikalisch-Technische Bundesanstalt and Leibniz Universität Hannover, Germany		

10:00	5030	A High-Performance Sympathetically-Cooled Cd+ Microwave Frequency Standard
Haoran Qin, Jize Han, Nongchao Xin, Shengnan Miao, Yiting Chen, Jianwei Zhang, Lijun Wang Tsinghua University, China		

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Session DIL-3 – 28/04 08:40 – 10:20

G5: Timescales

Location: Room 3

Session chair: Gerard Petit, Time Department, BIPM

08:40	5069	A New Way to Set the Maximum Weight in the Weighting Algorithm of UTC
-------	------	---

James Milton², Gianna Panfilo¹

¹BIPM Bureau International des Poids et Mesures, France, ²University of Edinburgh, United Kingdom

09:00	5099	Improvements to the UTC(NPL) Steering Protocol – On-Demand Estimation of Time Offset from UTC
-------	------	---

Josh Whale, Richard Hendricks, Adam Peverell, Krzysztof Szymaniec, Peter Whibberley, Conway Langham, Elizabeth Laier English
National Physical Laboratory, United Kingdom

09:20	5171	Design of a Robust and Precise Timing Facility for the European Navigation Satellite System
-------	------	---

Johann Furthner, Laura Agazzi, Pia Kindl, Thomas Schilling, Markus Schmitt
German Aerospace Center (DLR), Germany

09:40	5076	A Total Imputation Algorithm That Fills Gaps in Time Series Measurements for ADEV and Phase Noise Characterizations of Power-Law Noise Models
-------	------	---

David Howe¹, Chloe Champagne², Noah Schlossberger³

¹National Institute of Standards and Technology and University of Colorado Boulder, United States, ²Naval Research Lab, Wash DC, United States, ³University of Colorado Boulder, United States

10:00	5212	Mixing UTCr and Cesium Fountain Measurements for the Generation of UTC(IT)
-------	------	--

Valerio Formichella¹, Giovanna Signorile¹, Tung Than Thai¹, Michele Gozzelino¹, Ilaria Sesia¹, Filippo Levi¹, Giovanni A. Costanzo²

¹INRiM – Istituto Nazionale di Ricerca Metrologica, Italy, ²INRiM – Istituto Nazionale di Ricerca Metrologica and Politecnico di Torino, Italy

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Session D2L-1 – 28/04 10:50 – 12:30

G2: Oscillators & Measurements

Location: Room 1

Session chair: Enrico Rubiola, FEMTO-ST, Besançon

10:50	5225	Photonic Microwave Generator as Quantum-Enabled Local Oscillator for Radars
-------	------	---

Maximilian Bradler¹, Maurice Lessing¹, Benjamin Sprenger¹, Marc Fischer¹, Michele Giunta¹, Ronald Holzwarth¹, Jonathan M. Jones², Darren Griffiths², Jithin Kannanthara², Mike Antoniou², Chris Baker², Mohammed Jahangir², Yeshpal Singh², Kai Bongs²
¹Menlo Systems GmbH, Germany, ²University of Birmingham, United Kingdom

11:30	5200	Miniaturized High-Reliability Lasers for Quantum Technologies
-------	------	---

Rachel Cannon², Sean Dyer³, Erling Riis³, James McGilligan³, Paul Griffin³, Douglas Bremner¹, Una Marvel¹
¹Alter Technology TÜV Nord UK Ltd, United Kingdom, ²Alter Technology TÜV Nord UK Ltd/University of Strathclyde, United Kingdom, ³University of Strathclyde, United Kingdom

11:50	5274	The Cool Oscillator Energy-Mode Model for Advanced Performance Analysis and Prediction
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Michael Underhill
Underhill Research, United Kingdom

12:10	5230	Comparison Between Cross-Spectrum and Spectrum Average Generalized to Q-Devices
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Antoine Baudiquez², Eric Lantz¹, Enrico Rubiola², François Vernotte²
¹Femto-ST, France, ²FEMTO-ST Institute, Italy, ²FEMTO-ST Institute, France

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Session D2L-2 – 28/04 10:50 – 12:30

G6: Stable Lasers

Location: Room 2

Session chair: Rodolphe Le Targat, SYRTE

10:50	5096	Noise Contributions in Crystalline Mirror Coatings
Jialiang Yu ² , Thomas Legero ² , Fritz Riehle ² , Chun Yu Ma ² , Sofia Herbers ² , Daniele Nicolodi ² , Dhruv Kedar ¹ , Eric Oelker ³ , Jun Ye ¹ , Uwe Sterr ²		
¹ JILA, NIST and university of Colorado, United States, ² Physikalisch-Technische Bundesanstalt, Germany, ³ University of Glasgow, United Kingdom		
11:30	5067	Towards a 4X10 ⁻¹⁷ Fractional Frequency Instability Laser Based on a Room Temperature Optical Cavity
Marco Schioppo, Jacob Tunesi, Anthony Harwood, Helen S. Margolis		
National Physical Laboratory, United Kingdom		
11:50	5091	Multi-Spectral Hole Probing for Laser Frequency Stabilization
Michael Hartman ³ , Shuo Zhang ² , Xiuji Lin ³ , Rodolphe Le Targat ² , Philippe Goldner ¹ , Bess Fang ³ , Signe Seidelin ⁴ , Yann Le Coq ²		
¹ Chimie ParisTech, France, ² LNE-SYRTE, Observatoire de Paris - Université PSL, CNRS, Sor-bonne Université, France, ³ SYRTE, France, ⁴ Université Grenoble Alpes, France		
12:10	5214	Ultrastable Laser System for Sr Lattice Clocks
Manuel Brekenfeld ¹ , Benjamin Rauf ¹ , Sarah Saint-Jalm ¹ , Maurice Lessing ¹ , Andreas Fricke ¹ , Benjamin Sprenger ¹ , Marc Fischer ¹ , Michele Giunta ¹ , Ronald Holzwarth ¹ , Gar-Wing Truong ² , Seth B. Catano-Lopez ² , Garrett D. Cole ²		
¹ Menlo Systems GmbH, Germany, ² Thorlabs Crystalline Solutions, United States		

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Session D2L-3 – 28/04 10:50 – 12:30

G5: Microwave Satellite Time Transfer

Location: Room 3

Session chair: Pascale Defraigne, ORB

10:50	5070	CNES Accurate Monitoring of GNSS Time Scales Based on Absolute Calibration
-------	------	--

Jerome Delporte, David Valat
CNES, France

11:10	5117	Continuous IPPP Links for UTC
-------	------	-------------------------------

G rard Petit, Frederic Meynadier, Aur lie Harmegnies, Camille Parra
BIPM Bureau International des Poids et Mesures, France

11:30	5049	Inventory of Error Sources Limiting GNSS-Based Frequency Transfer
-------	------	---

Ahmed Elmaghraby, Thomas Krawinkel, Steffen Schoen
Leibniz Universit t Hannover, Germany

11:50	5208	Understanding TWSTFT Diurnals
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Frederic Meynadier¹, Carsten Rieck³, Kenneth Jaldehag²
¹BIPM Bureau International des Poids et Mesures, France, ²RISE, Sweden, ³RISE Research Institutes of Sweden AB, Sweden

12:10	5034	GNSS Time Transfer Exploiting High-Gain Antennas
-------	------	--

Esteban Garbin³, Ricardo Piriz³, Francisco Gonzalez¹, Erik Schoenemann¹, Daniel Garcia⁴, Cedric Plantard¹, Florian Reckeweg¹, Pierre Waller²
¹ESA, Netherlands, ¹ESA, Germany, ²ESA/ESTEC, Netherlands, ³GMV, Spain, ⁴Prodetel, Spain



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