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<th>Time</th>
<th>Monday March 25, 2019</th>
<th>Tuesday March 26, 2019</th>
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<tr>
<td>08:00</td>
<td>Concentrator Cells</td>
<td>Optics for CPV</td>
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<td>10:00</td>
<td>Coffee Break</td>
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<td>10:30</td>
<td>Invited Speaker</td>
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<td>11:00</td>
<td>Sponsor Presentations</td>
<td>Panel discussion on trending CPV applications</td>
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<td>12:00</td>
<td>Registration &amp; Media Upload</td>
<td>Lunch</td>
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<tr>
<td>13:00</td>
<td>Welcome / Introduction</td>
<td>Lunch</td>
<td>Lunch</td>
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<td>13:15</td>
<td>Plenary</td>
<td>Applications on the Rise</td>
<td>Hybrid Architectures</td>
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<td>15:15</td>
<td>Coffee Break</td>
<td>Coffee Break</td>
<td>Closing Session</td>
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<td>15:30</td>
<td>Progress on CPV modules</td>
<td>CPV Systems &amp; Field Experience</td>
<td>Technical Tour 1</td>
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<td>17:30</td>
<td>Poster Session</td>
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<td>18:00</td>
<td>Bus to Dinner</td>
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<td>Conference Dinner</td>
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<td>19:00</td>
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To get the latest version of the scientific program on your cell phone please scan the QR-code or enter the URL: https://cms.cpv-15.org/program/
Chairmen’s Message

Since the story of CPV-x conferences started in 2002, a long way of development has been covered and there is still some to go. The PV environment is changing very fast, as is the CPV environment. Some may see uncertainty where others see great potential. However, there is one thing that is reliable in the CPV world: its strong community.

On behalf of the Chair Committee, it is our honor to welcome you to the 15th International Conference on Concentrator Photovoltaic Systems (CPV-15) in Fes.

For the first time in its history, the CPV-15 conference is being held on the African continent. Morocco is the first country hosting this event as it is one of the leaders in renewable energies in Africa, and therefore is one of the most obvious choices of location for CPV. This high DNI country became CPV industry’s center of interest a few years ago. In 2016, Morocco hosted the COP22 as a testimony of its involvement in the international commitment for a better environment and has adopted a clear and non-reversible policy of development of renewable energies in Morocco (PV, wind and hydro-energy).

Two specialized agencies have been set up, IRESEN and Masen, to sustain the development and deployment of renewable energies.

The host region, Fes-Meknes, houses two public and two private universities. It is an agricultural, sunny and very touristic region. At Fes, the University Sidi Mohammed Ben Abdellah welcomes the CPV-15 conference. It is one of the huge universities in the country and decided, among the priorities and strategic researches axis, to put a pole of sustainable development and renewable energies. The Laboratory for Renewable Energies and Smart Systems, led by Prof. Ali Ahaitouf, is one of the players in this pole and he is developing some projects on CPV systems.
The city of Fes welcomes participants with the well-known Moroccan hospitality in the ancestral traditions inherited from civilizations that passed through it and lived there. Fes is one of the five imperial cities, known as the spiritual capital of the kingdom. Also at Fes, there is Al Quaraouiyine University, the oldest existing, continually operating and the first degree-awarding educational institution in the world according to UNESCO.

This is the global landscape in which the CPV-15 conference takes place. Highlights of the conference will include presentations on state-of-the-art CPV components, trackers, and installations.

Welcome to CPV-15! We wish you a successful conference and an enjoyable stay in Fes!

Mathieu Baudrit
Scientific Chair of CPV-15
Sono Motors, Munich

Prof. Ali Ahaitouf
Conference Chair of CPV-15
Faculté des Sciences et Techniques
Université Sidi Mohammed Ben Abdellah, Fès
Committees

Scientific Chair
Mathieu Baudrit, Sono Motors, Germany

Conference Chair
Ali Ahaitouf, Université Sidi Mohammed Ben Abdellah, Morocco

Chair Committee
Chair Committee Chair:
Andreas Bett, Fraunhofer ISE, Germany

Mathieu Baudrit, Sono Motors, Germany
Karin Hinzler, University of Ottawa, Canada
Ignacio Antón, Universidad Politécnica de Madrid, Spain
Ali Ahaitouf, Université Sidi Mohammed Ben Abdellah, Morocco

Technical Program Committee

Program Chair:
César Domínguez, Universidad Politécnica de Madrid, Spain

Ali Ahaitouf, Université Sidi Mohammed Ben Abdellah, Morocco
Carlos Algara, Universidad Politécnica de Madrid, Spain
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Kenji Araki, Toyota Technological Institute, Japan
Nicholas Ekins-Daukes, UNSW, Australia
Simon Fafard, University of Sherbrooke, Canada
Iván García, Universidad Politécnica de Madrid, Spain
John Geisz, NREL, USA
Tian Gu, MIT, USA
Karin Hinzler, University of Ottawa, Canada
Sarah Kurtz, UC Merced, USA
Ignacio Luque-Heredia, BSQ Solar, Spain
Ignacio Rey-Stolle, Universidad Politécnica de Madrid, Spain
Marta Victoria, University of Aarhus, Denmark
Maike Wiesenfarth, Fraunhofer ISE, Germany
Publication Committee

Chair of Publication Committee:
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Romain Cariou, CEA, France
Rafael Cervantes, BSQ Solar, Spain
John Cook, University of Ottawa, Canada
Alain Dollet, PROMES, France
Eduardo F. Fernández, University of Jaen, Spain
Ryan France, NREL, USA
Rebeca Herrero, Universidad Politécnica de Madrid, Spain
John Lasich, RayGen, Australia
Ralf Leutz, Leopil, Germany
María Martínez, ISFOC, Spain
Kensuke Nishioka, University of Miyazaki, Japan
Maxim Shvarts, Ioffe Institute, Russia
Gerald Siefer, Fraunhofer ISE, Germany
Marc Steiner, Fraunhofer ISE, Germany
Guido Vallerotto, Universidad Politécnica de Madrid, Spain
Marta Victoria, Universidad Politécnica de Madrid, Spain
Philippe Voarino, CEA, France

Local Organizing Committee

Ali Ahaitouf, FST de Fès, Morocco
Najia Es-Sbai, FST de Fès, Morocco
Abdallah Mechaqrane, FST de Fès, Morocco
Mohammed Jorio, FST de Fès, Morocco
Fatima Errahimi, FST de Fès, Morocco
Saad Bennani Dosse, ENSA de Fès, Morocco
Anass Mansouri, ENSA de Fès, Morocco
Lakhrissi Iounes, ENSA de Fès, Morocco
Saad Bennani Dosse, ENSA de Fès, Morocco
Monday, March 25, 2019

from Registration & Media Upload 11:00

13:00 - Welcome / Introduction
13:15

13:15 - Session 1: Plenary
15:15 Chairs: Andreas W. Bett (Fraunhofer Institute for Solar Energy Systems ISE) and Ignacio Antón (Instituto de Energía Solar - UPM)

13:15 50% or Bust: Status of Six-Junction Concentrator Solar Cells
John Geisz1, Myles Steiner1, Kevin Schulte1, Ryan France1, Daniel Friedman1
1 National Renewable Energy Laboratory (NREL)

13:45 Recent Progress of Multi-Junction Solar Cell Development for CPV Applications at AZUR SPACE
Daniel Fuhrmann1, Rosalinda van Leest1, Alexander Frey1, Matthias Meusel1, Gerald Siefer2, Kasimir Reichmuth2
Presented by Werner Bensch1
1 Azur Space Solar Power GmbH; 2 Fraunhofer ISE

14:15 FLATCON® CPV Module Technology: New Design Development Based on the Evaluation of 10 Years of Outdoor Measurement Data
Maike Wiesenfarth1, Marc Steiner1, Tobias Dörsam1, Gerald Siefer1, Frank Dimroth1, Peter Nitz2, Andreas W. Bett1
1 Fraunhofer ISE

14:45 Towards Industrialization of Planar Microtracking Photovoltaic Panels
Gaël Nardin1, Alvaro F. Aguilar1, Laetitia Anglade1, Florian Gerlich1, Mathieu Ackermann1, Laurent Coulot1, Delphine Petri2, Jacques Levrat2, Antonin Faes2, Jonathan Champlaud2, Nicolas Badel1, Julien Brossard2, Gabriel Christmann2, Matthieu Despeisse2
1 Insolight SA; 2 CSEM PV-center

15:15 - Coffee Break
15:45
15:45 - 17:30  **Session 2: Progress on CPV Modules**

**Chairs:** Maxim Shvarts (Ioffe Institute) and María Martínez (ISFOC)

15:45  **Outdoor Experimental Characterization of Novel High-Efficiency High Concentrator Photovoltaic (HCPV) Modules Using Achromatic Doublet on Glass (ADG) Fresnel Lenses as Primary Optics**

*Guido Valerotto*¹, Maike Wiesenfarth², Marta Victoria¹, Marc Steiner², Ignacio Antón¹, Norman Jost¹, Steve Askins², Gabriel Sala¹

¹ *Instituto de Energía Solar (IES-UPM); ² Fraunhofer ISE*

16:02  **High Performance Concentrator for Thin and Lightweight CPV Modules**

*Michihiko Takase*¹, Nobuhiko Hayashi¹, Shuteu Kanayam¹, Bunji Mizuno¹

¹ *Connected Solutions Company, Panasonic*

16:19  **C3PV: Mass Produced EFA Receivers for a Franchised Module Technology**

*Ruediger Loeckenhoff*¹, Werner Bensch¹, Achim Endress¹

¹ *Azur Space Solar Power GmbH*

16:36  **How CPV Can Go Below $1/W Installed**

*Roger Angel*¹, Nicholas Didato², Peter Strittmatter², Ryker Eads¹

¹ *Presented by Ryker Eads*

¹ *University of Arizona; ² REhnu Inc.*

16:53  **Update on Project ALCHEMI – A Low Cost HCPV Module for 1000 Sun Operation**

*Andrew Johnson*

*IQE plc*

17:10  **Trade-Offs and Optimizations in Trough-Lens-Cone Optics for High Efficiency at Very Low Cost**

*Richard Norman*¹, Etienne Leveille¹, William Cloutier¹, Luc. G. Frechette¹, Vincent Aimez¹

¹ *Université de Sherbrooke*
17:30 - 19:00

**Poster Session**

The poster numbers are based on topics:

A Characterization Methods & Measurement Equipment for CPV

B Concentrating Optics: Materials, Performances & Designs

C High and Low Concentration Modules Performances

D Modelling, Performance and Energy Prediction for CPV Modules & Systems

E Novel Concepts of CPV and its Hybridization with Other Technologies

F Solar Cells and Solar Cell Assemblies for Low and High Concentration Systems

A-1 Simple and Accurate Indoor Calibration of Component Solar Cells

**Romain Couderc**, Philippe Voarino

*CEA-INES*

A-2 Minority Charge Carrier Lifetime Estimation for Multijunction Structures of PV Converters

**Viktor Emelyanov**, Nikolay Kalyuzhnyy, Svetlana Levina, Maxim Shvarts

*Presented by Nikolay Kalyuzhnyy*

*Ioffe Institute*

A-3 Characterization of Ultra High Power Laser Beam PV Converters

**Vladimir Khvostikov**

*Presented by Maxim Shvarts*

*Ioffe Institute*

A-4 GaAs Subcell of Triple-Junction Solar Cells with Hybrid Quantum Objects: Temperature Photovoltaic Characteristics

**Mikhail Mintairov**, Valery Evtropov, Sergey Mintairov, Maxim Shvarts, Nikolay Kalyuzhnyy

*Ioffe Institute*

A-5 Temperature Drift of PV Parameters in High-Power Laser Converters

**Alexander Panchak**, Mariia Nakhimovich, Pavel Pokrovskiy, Valeri Larionov, Dmitriy Malevskiy, Maxim Shvarts

*Ioffe Institute*
A-6 Accurate and Low Cost Sun Pointing Detector Unit for Concentrator Photovoltaic Applications

**Alessandro Minuto**¹, Gianluca Timò²

¹ RSE

B-1 Indoor Characterization of Two Secondary Optics with Fresnel Lens: Pyramid and Cone

**Sara El-Yahyaoui**¹, **Ali Ahaitouf**¹, **Sarah El Himer**², **Abdallah Mechaqane**¹, **Jean Paul Salvestrini**¹, **Abdallah Ougazzaden**³

¹ **Université Sidi Mohammed Ben Abdellah**; ² **Institut de Recherche en Energie Solaire et Energies Nouvelles**; ³ **Georgia Tech - CNRS UMI 2958**

B-2 Optimization of an Ultra-High CPV Cassegrain-Koehler Unit with 2000 x Concentration Ratio

**Juan Pablo Ferrer**¹, **Eduardo F. Fernández**¹, **Florencia Almonacid**¹, **Diego L. Talavera**¹, **Pedro Pérez-Higueras**¹

Presented by **Eduardo F. Fernández**¹

¹ **University of Jaén**

B-3 Spectral Selective PVT Solar Concentrator for Building Integration

**Daniel Chemisana**¹, **Alberto Riverola**¹, **Alexandre Moreno**¹, **Alejandro Solans**¹

¹ **University of Lleida**

C-1 Optimum Design of V-Trough Solar Concentrator for Photovoltaic Applications

**Mohammad Alnajideen**

Cardiff University

C-2 Fabrication and Experimental Investigation of a Direct Immersed PVT Concentrator for Building Integration

**Daniel Chemisana**¹, **Alberto Riverola**¹, **Alejandro Solans**¹, **Alexandre Moreno**¹

¹ **University of Lleida**

C-3 High and Low Concentration Modules Performances

**Tajudeen Sani**

Federal University Dutse

D-1 Aerodynamics for CPV: Investigating the Efficiency of Using Air Fairings on Solar Trackers

**Alexander Chekalin**¹, **Viacheslav Andreev**¹, **Yuri Ascheulov**³, **Yuri Chumakov**²

Presented by **Vitali Kalinovsky**³

¹ Ioffe Institute; ² Peter the Great St. Petersburg Polytechnic University
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<th>Authors</th>
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<td>D-2</td>
<td>Numerical Simulation of Parabolic Trough and Dish Solar Concentrator: Photovoltaic Application</td>
<td>Syham Kadri¹, Mouad Seghir¹, Kenza Djermane¹</td>
<td>University of Béchar</td>
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<td>D-3</td>
<td>Fins Integrated Phase Change Material for the Electrical Enhancement of Photovoltaic System for South West UK Climate</td>
<td>Sourav Khanna¹, K. S. Reddy², Tapas Mallick³</td>
<td>University of Portsmouth; Indian Institute of Technology Madras; University of Exeter</td>
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<td>D-4</td>
<td>Impact of Soiling on the IV Characteristics of CPV Modules</td>
<td>Leonardo Micheli¹, Jesus Montes-Romero¹, Marios Theristis², Juan de la Casa¹, George E. Georgiou², Florencia Almonacid³, Eduardo F. Fernández¹</td>
<td>University of Jaén; University of Cyprus</td>
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<td>E-1</td>
<td>Experimental Characterisation of an Absorptive/Reflective Crossed CPC PV/T System</td>
<td>Abdullah Alamoudi¹, Firdaus Muhammad-Sukki³, Radhakrishna Prabhu¹, Nazmi Sellami²</td>
<td>Robert Gordon University</td>
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<td>E-2</td>
<td>GaSb Photovoltaic Cells for Laser Power Conversion</td>
<td>Vladimir Khvostikov¹, Svetlana Sorokina¹, Maxim Shvarts¹, Olga Khvostikova¹, Natalia Potapovich¹, Vladimir Khvostikov¹</td>
<td>Presented by Maxim Shvarts¹</td>
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<td>F-1</td>
<td>Nanofluid Cooling Optimization of High Concentration Photovoltaic Panels</td>
<td>Kenza Djermane¹, Syham Kadri¹</td>
<td>University of Béchar</td>
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<tr>
<td>F-2</td>
<td>Nanopyramid-based Absorber to Boost the Efficiency of InGaN Solar Cells</td>
<td>Walid El Huni¹, Yacine Halfaya¹, Soufiane Karrakchou¹, Taha Ayari¹, Suresh Sundaram¹, Simon Gautier², Paul L. Voss³, Jean Paul Salvestrini¹, Abdallah Ougazzaden¹</td>
<td>Georgia Tech - CNRS UMI 295B; Institut Lafayette</td>
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F-3 Thermophysical Properties of a Soldered Contact of a Concentrator Solar Cell with a Heat Removing Basement
Vitali Kalinovsky¹, Aleksey Glazov¹, Vitali Kalinovsky¹, Evgeny Kontrosh¹, Aleksey Nashchekin¹, Kyrill Muratikov²
¹ Ioffe Institute

F-4 Strategies for the CVD-Preparation of Single-Domain Si(100) and Ge(100) Surfaces
Agnieszka Paszuk¹
Presented by Thomas Hannappel¹
¹ Technische Universität Ilmenau

F-5 Characterization and Impact of Non-Uniformity on Multi-Junction Solar Cells (MJSC) Caused by Concentrator Optics
Jose Manuel Saura García¹, Eduardo Fernández Fernández², Daniel Chemisana Villegas²
Presented by Eduardo F. Fernández²
¹ University of Lleida; ² University of Jaén

F-6 Bifacial Low Concentrator Silicon Solar Cells with Al-Alloyed BSF and Ag-Free Multi-Wire Metallization
Maxim Shvarts¹, Alla Chebotareva², Tatiana Kost²
¹ Ioffe Institute; ² Lomonosov Moscow State University

F-7 Finite Element Analysis of Cooling Mechanism by Flat Heat-Sinks in Ultra-High CPV Systems
Alvaro Valera
Presented by Eduardo F. Fernández
University of Jaén
Tuesday, March 26, 2019

from 07:30

08:00 - 10:00 Session 3: Concentrator Cells

Chairs: John Geisz (NREL) and Gianluca Timò (RSE)

08:00 Self Powered Light-Induced Plating for CPV Solar Cells
Clément Laucher¹, Gwenaëlle Hamon¹, Artur Turala¹, Etienne Paradis¹, Maïté Volatier¹, Maxime Darnon¹, Vincent Aimez¹, Abdelatif Jaouad¹
Presented by Gwenaëlle Hamon¹
¹Université de Sherbrooke

08:17 In Situ Quantification of the As/P Content in GaAsP Graded Buffers for III-V-on-Si Tandems During MOVPE
Oliver Supplie¹, Alexander Heinisch¹, Agnieszka Paszuk¹, Masakazu Sugiyama², Thomas Hannappel¹
Presented by Thomas Hannappel¹
¹Technische Universität Ilmenau; ²University of Tokyo

08:34 High-Efficiency Vertical-Tunnel-Junction (VTJ) Solar Cells up to 10000 Suns
Eduardo F. Fernández¹, Natalia Seoane², Florencia Almonacid¹, Antonio J. García-Loureiro¹
¹University of Jaén; ²University of Santiago de Compostela

08:51 IEC 62787: „Concentrator Photovoltaic (CPV) Solar Cells and Cell-On-Carrier (CoC) Assemblies – Qualification“
Carlos Algora¹, Neftali Nuñez¹, Manuel Vazquez³, Roland Schilling³, Kenji Araki³
¹Instituto de Energía Solar (IES-UPM); ²Azur Space Solar Power GmbH; ³Toyota Technological Institute

09:08 High-Voltage Low-Current Multijunction Monolithic Interconnected Microcells
Pierre Albert¹, Abdelatif Jaouad¹, Maxime Darnon¹, Maïté Volatier¹, Yannick Deshayes², Christopher Valdivia¹, Karin Hinzer³, Laurent Bechou², Vincent Aimez¹
¹Université de Sherbrooke; ²Laboratoire de l’Intégration du Matériaux au Système (IMS); ³SUNLAB

09:25 Light Budget in Multijunction Solar Cells at Temperature Tuning
Svetlana Levina¹, Maxim Shvarts¹, Evgeniy Filimonov¹, Viktor Emelyanov¹
¹Ioffe Institute
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<tr>
<td>09:42</td>
<td><strong>Assessment of the Energy Yield Gain in High CPV Systems Using Graphene-Enhanced Multijunction Solar Cells</strong>&lt;br&gt;Ignacio Rey-Stolle¹, Laura Barrutia¹, Iván García¹, Iván Lombardero¹, Carlos Algora¹&lt;br&gt;¹ Instituto de Energía Solar (IES-UPM)</td>
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<td>10:00</td>
<td>Coffee Break</td>
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<td>10:30</td>
<td><strong>Invited Speaker</strong>&lt;br&gt;Chair: Karin Hinzer (University of Ottawa)</td>
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<td>10:30</td>
<td>Integrated Micro-Scale Concentrating Photovoltaics: a Path Towards High-Performance, Low-Cost Solar Power&lt;br&gt;Tian Gu, Massachusetts Institute of Technology</td>
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Dr. Tian Gu is a Research Scientist at Materials Research Laboratory and Department of Materials Science and Engineering at MIT. His primary research interests involve integrated photonics, nano-optics and photonic materials, focusing on the areas of photovoltaics, metasurface optics, on-chip spectroscopic sensing, data communications, flexible photonics, and 2D materials integrated photonics. He is a recipient of the R&D 100 Award and the TechConnect National Innovation Award.

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<td>Presentation BSQ Solar</td>
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<td>Presentation IRESEN</td>
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<td>Presentation Masen</td>
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<td>Presentation STACE</td>
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13:30 - 15:30  **Session 4: Applications on the Rise**

**Chairs:** Frank Dimroth (Fraunhofer ISE) and Vincent Aimez (University of Sherbrooke)

13:30  A High-Concentration Photovoltaic System to Maximize Solar Resource Utilization in Dual Use with Agriculture

*Harry Apostoleris*, Matteo Chiesa

*1 Khalifa University of Science and Technology*

13:47  Microconcentration for Space Applications: A 7.6X TIR Design

*Philippe Voarino*, Arnaud Ritou, Caroline Seraine, Marlène Roux, Romain Couderc

*Presented by Romain Couderc*

14:04  Thermal and Resistive Loss in InGaAs Metamorphic Laser ($\lambda = 1064$ nm) Power Converters with Over 45% Efficiency

*Nikolay Kalyuzhnyy*, Valeriy Evtropov, Viktor Emelyanov, Sergey Mintairov, Mikhail Mintairov, Maxim Shvarts

*1 Ioffe Institute*

14:21  Hydrogen Generation Using CPV Technologies: Comparative Techno-Economic Study

*Rafika Boudries*

*CDER*

14:38  CPV System with Cylindrical Tubes and Strips of Solar Cells

*Sang-Moo Shin*, Yu-Bin Shin

*1 Samsung Engineering; 2 Handong Global University*

14:55  Standardization of the CPV Technology in 2019 – Path to the New CPV Technologies

*Kenji Araki*

*Toyota Technological Institute*

15:30 - 16:00  Coffee Break

16:00 - 18:00  **Session 5: CPV Systems and Field Experience**

**Chairs:** Gabriel Sala (Instituto de Energía Solar - UPM) and Florencia Almonacid (University of Jaén)
16:00 CPVIndia – Energy Yield Forecasting with PVsyst

Marc Steiner¹, Gerald Siefer¹, Alexander Wekkeli¹, Soumen Sardar², Shashank Ojha³, Jaspal Singh⁴, Vishal Singh⁴, Jatinder Singh Chandok²

¹ Fraunhofer ISE; ² NETRA NTPC

16:17 Improvement of the Spectral Sensitivity of CPV by Enhancing Luminescence Coupling and Fine-Tuning to the Bottom-Bandgap Matched to Local Atmospheric Conditions

Kenji Araki¹, Yasuyuki Ota², Kan-Hua Lee¹, Kensuke Nishioka², Masafumi Yamaguchi³

¹ Toyota Technological Institute; ² University of Miyazaki

16:34 TwinFocus® New Installation Data

Marco Nardello¹, Sandro Centro¹

¹ Atemenergia srl

16:51 Susceptibility of CPV Optical Materials to Abrasion

Jaione Bengoechea¹, Eugenia Zugasti¹, María Jesús Rodríguez¹, Ana Rosa Lagunas¹

¹ National Renewable Energy Centre (CENER)

17:08 Towards Routine Measurement and Calculation of Spectrally Corrected DNI for CPV Systems

Viktar Tatsiankou¹, Henry Schriemer¹, Karin Hinzer¹, Richard Beal²

¹ University of Ottawa; ² Spectrafy

17:25 On-Tracker Relative Misalignments Estimation in CPV Modules Through Image Processing

Luis Javier San José¹, Rebeca Herrero¹, Ignacio Antón¹, Gabriel Sala¹

¹ Instituto de Energía Solar (IES-UPM)

17:42 Verification Tests for the Refinancing of a CPV Plant in Operation - Difficulties Associated with the Size of the CPV Modules

M. Martinez¹, D. Sanchez¹, G. Calvo-Parra¹, E. Gil¹, O. de la Rubia¹, J. Leloux², C. Labeyrie³, N. Chaperon³, J. Andrade³

¹ ISFOC; ² Universidad Politécnica de Madrid; ³ Neoen

18:30 Bus to Dinner

19:00 - 22:00 Conference Dinner (see page 24 for more information)

The Conference Dinner is sponsored by Umicore. Thank You!
Wednesday, March 27, 2019

from 07:30 Registration & Media Upload

08:00 - 10:00 Session 6: Optics for CPV
Chairs: Ralf Leutz (Leutl - Leutz Optics and Illumination) and Marc Steiner (Fraunhofer ISE)

08:00 Optical Element Design for the Retrofit of the World's First Concentrator Photovoltaic (CPV) System

**Hussam Khonkar**, Fahad Alharbi, Abdulaziz Alyahyah, David C. Miller

1 King Abdulaziz City for Science and Technology; 2 National Renewable Energy Laboratory (NREL)

08:17 High-Concentration Wide-Angle Tracking Integration with Stacked Lens Arrays

**Håkon Jarand Dugstad Johnsen**, Jan Torgersen, Astrid Aksnes

1 Norwegian University of Science and Technology

08:34 Optical Design for a Fly's Eye CPV System with Large, On-Axis Dish Solar Concentrator

**Roger Angel**, Justin Hyatt, Ryker W. Eads

Presented by Ryker Eads

1 University of Arizona; 2 Steward Observatory, University of Arizona

08:51 A Solar Concentrator Based on Photonic Angular Selectivity

**Harry Apostoleris**, Duncan Wheeler, Yichen Shen, Thomas Cooper, Svetlana Boriskina, Matteo Chiesa, Marin Soljacic

1 Khalifa University of Science and Technology; 2 Massachusetts Institute of Technology; 3 York University

09:08 Compromise Solutions for Design and Technology of Fresnel Lenses as Sunlight Concentrators

**Maxim Shvarts**, Viktor Emelyanov, Mariia Nakhimovich, Andrey Soluyanov

1 Ioffe Institute

09:25 Spectral Analysis of Chromatic Aberration in Fresnel Lenses

**Evgeniy Filimonov**, Svetlana Levina, Maxim Shvarts

Presented by Svetlana Levina

1 Ioffe Institute
11:00 - 12:00  Panel Discussion on Trending CPV Applications

Panelists:
Kenji Araki (Toyota Technological Institute)
Andreas W. Bett (Fraunhofer ISE)
Frank Dimroth (Fraunhofer ISE)
Karin Hinzler (University of Ottawa)
Ignacio Luque-Heredia (BSQ Solar)
Why and How Does Car-Roof PV Create 50 GW/Year of New Installations? Also, Why is a Static CPV Suitable to this Application?

Kenji Araki1, Daisuke Sato2, Taizo Matsuda3, Kan-Hua Lee4, Noboru Yamada5, Masafumi Yamaguchi6

1 Toyota Technological Institute; 2 Nagaoka University of Technology; 3 Toyota Motor Corporation

Discussion
Objective of the panel: identifying the main challenges and opportunities for CPV in the near future, e.g. by showing the way to new applications and markets where CPV can add a strong value, like high-efficiency or space-constrained applications.

During the panel discussion, we will use an interactive Q&A and polling platform called Slido. To participate, simply open a browser on any laptop, tablet or smartphone, go to slido.com and enter the event code #CPV-15.

11:00 - 11:17
11:17 - 12:00 Lunch Break
12:00 - 13:30 Session 7: Hybrid Architectures
13:30 - 14:04

13:30 - 15:30 Session 7: Hybrid Architectures
Chairs: Maike Wiesenfarth (Fraunhofer ISE) and Gwenaëlle Hamon (University of Sherbrooke)

13:30 Demonstration of the Performance Static Low-Concentration Module Using Hybrid Lens Arrays
Kan-Hua Lee1, Kenji Araki1, Daisuke Sato2, Noboru Yamada4, Masafumi Yamaguchi6

Presented by Kenji Araki1
1 Toyota Technological Institute; 2 Nagaoka University of Technology

13:47 PVSITES: An Alliance of Low-Concentration PV with a New Building-Integrated Module Design
Paul Messaoudi
CEA LITEN

14:04 CPV Module Based on a Hybrid Solar Cell
Vitali Kalinovsky1, Evgeny Kontrosh1, Alena Andreeva1, Evgeniya Ionova1, Alexandra Malevskaya1, Vyacheslav Andreev1, Valeri Zalesskiy2, Viktoriya Malutina-Bronskaia3, Alla Lemeshevskaya3, Vladimir Kuzoro4, Vladimir Khalimanovich4, Marina Zayceva5

1 Ioffe Institute; 2 SSPA “Optics, Optoelectronics and Laser Technology”; 3 2STC “Belmikrosystemy” of the JSC “Integral”; 4 Academician M.F. Reshetnev Information Satellite Systems; 5 Space Systems Research Institute

Wednesday, March 27
14:21   Fluorescent Photonic Crystal Fibers Trapping Light in a Luminescent Solar Concentrator

Olivier Besida

CEA

14:38   Development and Investigation of Linear Fresnel Lens for Concentrator Space Solar Arrays

Vitali Kalinovsky¹, Evgeniya Ionova¹, Alena Andreeva¹, Evgeny Kontrosh¹, Vyacheslav Andreev¹

¹ Ioffe Institute

14:55   Prototype Optical Modelling Procedure and Outdoor Characterization of an Embedded Topaz Crossed Compound Parabolic Concentrator for Integrated Photovoltaic Windows

Katie Shanks¹, Ashley Knowles², Adam Brierly³, Hasan Baig¹, Yanyi Sun⁴, Yupeng Wu⁴, Tapas Mallick⁵

Presented by Hasan Baig¹

¹ University of Exeter; ² Yorkshire Photonics; ³ Brinell Vision; ⁴ Nottingham University; ⁵ Environment and Sustainability Institute

15:30 - 16:00   Closing Session

16:00 - 19:00   Technical Tour University (see page 25 for more information)
IEC TC82 WG7 Spring Meeting, March 28 – 29, 2019

The IEC TC82 WG7 meeting will be held on March 28 – 29, just after the CPV-15 conference. It is open to engineers and scientists in CPV, tracker and car-roof PV technologies as observers. It is not a closed-door meeting.

If you would like to join the meeting and contribute to the international standardization of these technologies, please contact Dr. Kenji Araki (cpvkenjiaraki@toyota-ti.ac.jp) in advance for registration.

Meeting venue
Just as CPV-15, the meeting takes place at the Faculté des Sciences et Techniques, Route d'Immouzzer, Fes, Morocco. The meeting room will be „La salle des réunions au décanat“ (= “the meeting room at the dean's office“). When you enter the campus through the main gate, the décanat/ dean's office is the first building on the right. The meeting room is upstairs, on the first floor.

Timetable and agenda

<table>
<thead>
<tr>
<th>March 28</th>
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<tbody>
<tr>
<td>08:00 – 08:30</td>
<td>Meeting room and web connection set-up</td>
<td>K. Araki</td>
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<tr>
<td>08:30 – 10:00</td>
<td><strong>CPV module and system, WG7 scope, summary of the past meetings, and next meeting place</strong></td>
<td>K. Araki</td>
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<tr>
<td></td>
<td>Summary of the past meetings</td>
<td>S. Askins</td>
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<td>WG7 scope (new scope is submitted to TC82)</td>
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<td>Update of the CPV module safety standard</td>
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<td>Solar simulator</td>
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<td>Active cooling system, Hybrid system</td>
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<td>10:00 – 10:15</td>
<td>Break</td>
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<td>10:15 – 12:00</td>
<td><strong>CPV cell and receiver</strong></td>
<td>C. Algora</td>
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<td>CPV cell/receiver/COC qualification</td>
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<td>COC+SOE or receiver qualification</td>
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<tr>
<td>12:00 – 13:30</td>
<td>Lunch break</td>
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<td>13:30 – 15:00</td>
<td><strong>Tracker IS (International standards)</strong></td>
<td>B. Wang</td>
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<td></td>
<td>Tracker qualification</td>
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<td></td>
<td>Tracker safety standards</td>
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<td>15:00 – 15:15</td>
<td>Break</td>
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<tr>
<td>15:15 – 18:00</td>
<td><strong>Tracker technical documents without pass/fail criteria</strong></td>
<td>B. Wang</td>
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<td>Tracker availability</td>
<td>K. Araki</td>
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<td>Tracker design guideline.</td>
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<td>March 29</td>
<td>Car-roof PV standardization overview and summary of the past meeting, relation to the standardization body of the car industries, etc.,</td>
<td>K. Araki</td>
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<td>08:30 – 10:00</td>
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<td>10:00 – 10:15</td>
<td>Break</td>
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<td>10:15 – 12:00</td>
<td>Curved PV issue (STC)</td>
<td>K. Araki</td>
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<tr>
<td>12:00 – 13:30</td>
<td>Lunch Break</td>
<td>K. Araki</td>
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<tr>
<td>13:30 – 15:00</td>
<td>Performance modeling (SOC)</td>
<td>K. Araki</td>
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Conference Dinner

The Conference Dinner will take place in Palais Sheherazade in the traditional Medina of Fes. This 19th-century Arabo-Andalousian palace includes a lush garden with century-old palm trees, and a panoramic terrace offering a serene atmosphere overlooking the ancient medina.

**Date:** Tuesday, March 26

**Schedule:** 18:30 Bus transfer from the conference venue  
19:00 Conference Dinner  
After the dinner, please organize your return trip to your hotel independently. Since most hotels are closer to the dinner venue than to the conference venue, there will be no bus transfer back.

**Fee:** 55 € (Pre-registration is required)

**Location:** Palais Sheherazade & Spa  
23 Arsat Bennis Douh, Medina  
30000 Fès  
Morocco  

The dinner is sponsored by: umicore  
Electro-Optic Materials
Technical Tours

Technical Tour 1: Innovation City & CPV lab of USMBA, Fez

The CPV-15 Technical Tour will take place on Wednesday, March 27, 2019, after the closing session (around 16:00). We will visit Innovation City Fez (“La Cité de l’Innovation de Fès”) and the CPV lab of the Faculty of Sciences and Technology of University Sidi Mohammed Ben Abdellah.

Innovation City Fez was set up by the University Sidi Mohammed Ben Abdellah to offer its laboratories a common platform for material characterization and qualification. Also, it is dedicated to hosting start-ups and incubating innovative projects. Another mission is to promote the culture of entrepreneurship and to bring the university enterprises closer together by working on common interest projects.

Highlights among the equipment include:
- Infrared spectroscopy
- X-ray diffraction
- Thermal analyzer
- Raman spectroscopy
- Scanning electron microscope

At the CPV lab, we will visit the optical setup dedicated to optical elements testing. A solar simulator as well as some optical elements are available for indoor tests. Some experimental setups to bring together primary and secondary optical elements are currently under manufacturing and may be available during the conference. The aim of this tour is also to launch discussion among the local hosts and the participants about future collaboration and knowledge sharing. For late registrations, please contact the registration desk.

Technical Tour 2: NOOR Solar Power Complex, Ouarzazate, offered by Masen

Please note that for this tour, early pre-registration was required and new registrations cannot be accepted anymore.

Masen is kindly offering you to take a free tour at NOOR (near Ouarzazate, 600 km travel distance from Fes). It will take place on Friday, March 29, from 9:30 - ca. 14:00. It will start at Masen’s visitors centre with an introduction. The tour will include a visit to:
- the NOOR I – III CSP plants
- the R&D platform (including the Masen & Sumitomo CPV platform)
- the Belvedere look-out at the visitors centre

Meeting point in Ouarzazate will be on Friday, March 29, 9:00 at the main entrance of Hotel Le Berbère Palace, Quartier Mansour Eddahbi 55, Ouarzazate, where you will be picked up by Masen. Water will be provided during the tour at NOOR. Please bring your own food.

Important: Please don’t forget to bring your passport in order to get access to the site!

Participants should organize their travel to Ouarzazate and accommodation on their own. Please note that there are no direct flights between Fez and Ouarzazate, but there are connections via Casablanca.
General Information

Registration

Each participant has to register in person at the registration desk to collect their name badge before attending any sessions. Please make sure to wear your badge for admission to all sessions and side events. Participants who have lost their badge should report to the registration desk.

Registration times are during conference hours, starting at 11:00 on Monday, March 25, and at 7:30 on the other two days.

Posters

Please mount your poster before the start of the poster session. Do not remove your poster until the end of the conference. Posters are an important part of the scientific program and should be displayed the whole time.

All poster authors are welcome to submit a PDF file of their poster for presentation in the Download Area. Poster PDFs can be uploaded on-site at the Media Upload Desk.

Please remove your poster before you leave. Remaining posters will be discarded.

Speaker Information

All presentations must be handed in at the Media Upload Desk, one hour before your session. You will not be able to display your presentation directly from your laptop computer or USB flash drive. Our technical support team will welcome you at the Media Upload Desk during all conference days, starting at 11:00 on Monday, March 25, and at 7:30 on the other two days.

Please meet your session chair(s) inside the conference room at least 10 minutes prior to the beginning of your oral session to acquaint yourself with the technical equipment.

Certificate of Attendance

A certificate of attendance for participants will only be available on-site at the registration desk and cannot be issued after the conference.

Conference Proceedings

The proceedings will be published open access with AIP, the American Institute of Physics (www.aip.org) after the conference, covering papers with sufficient scientific quality. This collaboration will provide optimum visibility of the proceedings and ensure that the authors’ publications remain traceable and citable. Final online papers will be accessible on the AIP website and contain an ISBN number for each volume as well as individual DOI numbers for each paper.

List of Participants

Registered participants may download a list of participants on the conference website, www.cpv-15.org. The login and password sent to you during registration will be required to gain access to the download area.

Contact Participants

CPV-15 offers a contact opportunity for conference participants in its internal Download Area. Login with your password and contact other participants by e-mail.

All participants who want to use the contact feature can confirm their admission to send and receive e-mails to and from other conference participants in the Download Area. The first contact will occur indirectly via the conference system in the Download Area. No personal data will be handed out.

Interactive Panel Discussion

For the panel discussion, we will use a Q&A and polling platform called Slido. To participate, simply open a browser on any laptop, tablet or smartphone, go to slido.com and enter the event code #CPV-15. Alternatively, please scan the QR code:

WiFi Access

WiFi access will be available free of charge. Please see signs on-site for login details.
The listed companies and institutions have supported the 15th International Conference on Concentrator Photovoltaic Systems. Through their generous contributions they have made this conference a success in fostering a great opportunity to share knowledge and push the boundaries of solar science. **We thank our Sponsors.**