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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-14.org/program
Chairmen's Message

On behalf of the conference committees, it is an honour to welcome you to the 14th International Conference on Concentrator Photovoltaic Systems (CPV-14) in Puertollano, Spain. In the last decades, Concentrator Photovoltaic technology has demonstrated its ability to be a “short cut” to market for new achievements or breakthroughs in the development of high efficiency solar cells, and CPV holds the records for the highest efficiencies ever achieved by any solar technology at the cell, module, and system levels. Field experiences not only show outstanding high performance, but also that CPV technology is highly reliable and comparable to standard PV. This series of conferences started in 2002 with the objective of providing a platform for the exchange of information and experiences in the CPV field and has become the premier technical conference in the areas of high- and low-concentration PV components, modules, and tracker-based PV systems. The conference brings together students, academics, technologists, and financiers to engage in discussion of state-of-the-art CPV components, trackers, and installations.

Puertollano is one of the main industrial cities of Castilla-La Mancha, a landscape known worldwide as the backdrop for Cervante's Don Quixote de la Mancha. This area is an example of transition from an economy highly dependent on fossil fuels to a land of opportunities for renewable energies. The economy of Puertollano was based on coal mining and petrol refining, but it was transformed into the City of Energy in last decades. Curiously, the palace of congress La Central was an old thermoelectric plant, built in 1917 and recently reconverted for use as a conference center.

Thus, our conference topic fits well into the city's transformation. We recommend to reserve some time and enjoy the attractive places such as the Mining Museum or the Sour Fountain. We invite you to enjoy the Spanish cuisine in the traditional bars and taverns where you can try typical dishes like migas, gachas de harina de pitos, tiznao, among others. And of course, to taste a wonderful array of flavours in the form of tapas.

You may also consider visiting the ISFOC headquarters, laboratories and CPV power plants in operation since 2008. We offer a visit to ISFOC together with the National Center of Hydrogen, CNH2, focused on hydrogen and fuel cell technologies.

As in previous editions of the CPV Conferences, the proceedings of CPV-14 will be published open access by the American Institute of Physics (www.aip.org). The submitted papers will be reviewed and selected to be published, indexed, and are citable through the AIP website and a digital object identifier (DOI).

We wish you a profitable and successful conference and an enjoyable stay in Puertollano.

Prof. Ignacio Antón
Scientific Chair of CPV-14
Instituto de Energía Solar –
Universidad Politécnica de Madrid

Óscar de la Rubia
Conference Host of CPV-14
ISFOC – Institute for Concentration Photovoltaics Systems
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Maxim Shvarts, Ioffe Institute, Russia
Gerald Siefer, Fraunhofer ISE, Germany
Guido Vallerotto, Universidad Politécnica de Madrid, Spain
Marta Victoria, Universidad Politécnica de Madrid, Spain
Philippe Voarino, CEA, France
Clement Weick, CEA, France
Monday, April 16, 2018

08:00 - 09:00  Registration

09:00 - 09:10  Introduction & Welcome
Opening CPV-14
Ignacio Antón, Instituto de Energía Solar - UPM
Welcome from Conference Host
Óscar de la Rubia, ISFOC

09:10 - 10:30  Session 1: Introductory Session
Chairs: Myles Steiner (NREL), Iván García (IES-UPM)

09:10  Analysis of the Performance of an On-Axis Mirror Module Design Compared to a Flatcon® Module
Maike Wiesenfarth¹, Sebastian Gamisch¹, Marc Steiner¹, Peter Jacob¹, Andreas W. Bett¹
¹ Fraunhofer ISE

09:30  Long Term Power Prediction Model for CPV Plants
Mousaab Benhammane¹, Grégoire Pichenot¹, Mathieu Baudrit¹, Gilles Notton²
¹ CEA - INES; ² Laboratory SPE – University of Corsica

09:50  Six-Junction Concentrator Solar Cells
John Geisz¹, Myles Steiner¹, Kevin Schulte¹, Ryan France¹, William McMahon¹, Daniel Friedman¹
¹ National Renewable Energy Laboratory (NREL)

10:10  Standardization of the CPV Technology in 2018 – Where are We Going to Go?
Kenji Araki¹, Carlos Algora², Gerald Siefer¹, Kensuke Nishioka¹, Ralf Leutz¹, Sam Carter⁶, Shitao Wang¹, Stephen Askins², Liang Ji⁸, George Kelly⁹
¹ Toyota Technological Institute; ² Instituto de Energía Solar - UPM; ³ Fraunhofer ISE; ⁴ University of Miyazaki; ⁵ Æolip - Leutz Optics and Illumination UG; ⁶ RayGen Resources Pty Ltd; ⁷ Research Institute of Arctech Solar; ⁸ UL LLC; ⁹ Sunset Technology

10:30 - 11:05  Coffee Break
Monday, April 16

11:05 - Welcome Session
11:40  Chairs: Ignacio Antón (IES-UPM), Óscar de la Rubia (ISFOC)
Welcome Speeches from Representatives of Puertollano and Castilla-La Mancha

11:40 - Session 2: CPV Systems (I)
13:20  Chairs: Andreas Bett (Fraunhofer ISE), Karin Hinzer (University of Ottawa)

11:40  Analysis of Ecosole HCPV System Performances During Two Operation Years
Carmine Cancro¹, Aniello Borriello¹, Gabriele Ciniglio¹, Sergio Ferlito¹, Giorgio Graditi¹, Gianni Leanza¹, Angelo Merola¹, Francesco Pascarella¹
¹ ENEA

12:00  High and Low Concentration Systems at the Atacama Desert in Chile
Elias Urrejola¹, Sebastian Falkenberg¹
¹ ENGIE Laborelec Chile

12:20  On-Sun Testing of a 100-Shingled-Cell Dense Receiver Array at ~50 W/cm² using Overlapped Single-Axis Foci
Richard Norman¹, Etienne Leveille¹, Boussairi Bouzazi¹, Brad Siskavich², Jean-Francois Dufault¹, Osvaldo Arenas¹, Richard Ares¹, Vincent Aimez¹, Luc Frechette¹
¹ University of Sherbrooke; ² xVI Technologies Inc.

12:40  REhnu Dish Based CPV: Performance and Reliability Improvements Based on Field Experience
Nicholas Didato¹, Roger Angel¹, Peter Strittmatter¹, Thomas Stalcup¹, Frank Sodari¹
¹ REhnu Inc.

13:00  Long-Term Data Analysis. Feedback from ISFOC CPV Plants
María Martínez¹, Daniel Sánchez¹, Gustavo Calvo-Parra¹, Cesáreo Alamillo¹, Eduardo Gil¹, Angel Hipólito¹, Fernando de Gregorio¹, Oscar de la Rubia¹
¹ ISFOC

13:20 - Lunch Break
14:40 - 16:20  |  Session 3: Solar Cells for CPV (I)  
Chairs: Matthew Lumb (Naval Research Laboratory), Rosalinda van Leest (AZUR SPACE)

14:40  |  On the Use of Graphene as a Transparent Electrode to Reduce the Series Resistance of High Concentrator Solar Cells  
Laura Barrutia Poncela¹, Mario Ochoa¹, Iván Lombardero¹, Tomás Palacios¹, Ignacio Rey-Stolle¹, Carlos Algara¹  
¹ Instituto de Energía Solar - UPM; ² Massachusetts Institute of Technology

15:00  |  Reverse Heterojunction Top Cells for High Current Density Solar Cell Operation  
Myles Steiner¹, Emmett Perl¹, Ryan France¹, Kevin Schulte¹, Daniel Friedman¹, John Geisz¹  
¹ National Renewable Energy Laboratory (NREL)

15:20  |  Development of InGaAs(P) Solar Cells for 5+J Stacked Multijunction Architectures  
Kenneth Schmieder¹, Matthew Lumb², Mitchell Bennett³, Eric Armour⁴, Ziggy Pulwin⁴, Jesse Frant⁴, Robert Walters¹  
¹ US Naval Research Laboratory; ² George Washington University; ³ Sotera Defense Solutions; ⁴ Veeco MOCVD

15:40  |  MOVPE SiGeSn Development for the Next Generation 4-Junction Solar Cells  
Gianluca Timo¹, Nicola Armani¹, Giovanni Abagnale¹, Marco Calicchio¹, Bernd Schineller²  
¹ RSE; ² AIXTRON

16:00  |  Dual Technological Procedure for Multijunction Solar Cells: InGaAs Subcell Epitaxial Lift-Off Combined with InP Wafer Recycling  
François Chancerel¹, Philippe Regreney¹, Jean-Louis Leclercq¹, Abdelatif Jaouad¹, Maïté Volatier¹, Maxime Dannon¹, Simon Fafard¹, Michel Gendry¹, Vincent Aimez²  
¹ University of Sherbrooke; ² Institut des Nanotechnologies de Lyon (INL - CNRS UMR-5270)

16:20 - 17:00  |  Coffee Break
Session 4: Tracking and Reliability

17:00 - 18:20
Chairs: Kenji Araki (Toyota Technological Institute), Luc Fréchette (University of Sherbrooke)

17:00
Tracking-Integrated CPV4ALL System Installation and Analysis of Mirror Tolerance Manufacturing
Sarah Bernardis¹, Philippe Voarino¹, Jaudia Gouffa-Folliet¹, Harmen Rooms², Marnick Van de Zande³, Peter Penning³, Mathieu Baudrit²
¹ CEA; ² TNO, Solar Research Solliance; ³ SunCycle Technology BV

17:20
Influence of Concentration and Solar Cell Size on the Warranty Time of Concentrator Triple Junction Solar Cells
Manuel Vazquez¹, Neftali Nunez¹, Julen Tamayo-Arriola², Vincenzo Orlando¹, Olga Alburquerque¹, Antonio Fernandez¹, Carlos Algora¹
¹ Instituto de Energía Solar - UPM; ² Instituto de Sistemas Optoelectrónicos y Microtecnología - UPM

17:40
Design and Analysis of Performance of a DC Power Optimizer for HCPV Systems within CPV Match Project
Ricardo Alonso¹, Ainhoa Pereda¹, E. Bilbao², J.A. Cortajarena², Iñigo Vidaurrazaga¹, Eduardo Roman¹
¹ TECNALIA; ² Engineering School of Gipuzkoa (UPV-EHU)

18:00
Modelling and Experimental Validation of Passive Tracking System for HCPV
Stephen Askins¹, Jaime Caselles², Emmanuele Chiappori³, Francisco Martín⁴, Ignacio Antón⁵
¹ Instituto de Energía Solar - UPM; ² SolaRays Energy; ³ Independent Contractor; ⁴ Solar Added Value, SL
Tuesday, April 17, 2018

09:00 - 10:40  Session 5: Solar Cells for CPV (II)

Chairs: John Geisz (NREL), Svetlana Levina (Ioffe Institute)

09:00  Lowering Perimeter Recombination Losses in Micro-Concentrator Solar Cells: A Simulation Study
Mario Ochoa¹, Iván García¹, Ignacio Rey-Stolle¹, Carlos Algora¹
¹ Instituto de Energía Solar - UPM

09:20  Assessing the Suitability of Metal-Wrap-Through Solar Cells for Low-Concentration PV Systems
César Domínguez¹, Gonzalo Puertas¹, Alberto Sanchidrián², Rafael Cascón², María Martínez², Daniel Sánchez², Pablo Noriega¹, Norman Jost¹, Ignacio Antón¹
¹ Instituto de Energía Solar - UPM; ² Escuela Técnica Superior de Ingeniería y Diseño Industrial; ³ ISFOC; ⁴ Abengoa Solar New Technologies S.A

09:40  Front-Contacted Multijunction Micro Solar Cells: Fabrication and Characterization
Pierre Albert¹, Abdelatif Jaouad¹, Maxime Darnon¹, Clément Laucher¹, Christopher E. Valdivia², Maïté Volatier¹, Yannick Deshayes³, Karin Hinzer², Laurent Bechou¹, Vincent Aimez¹
¹ University of Sherbrooke; ² University of Ottawa; ³ Université de Bordeaux

10:00  Subcell Segmentation: A Novel Method to Current Match Multi-Junction Solar Cells
Christopher Valdivia¹, Karin Hinzer¹
¹ University of Ottawa

10:20  Current Localization in Heterostructures of Multijunction Solar Cells: Causes for Arising and Diagnostics Potential
Maxim Shvarts¹, Alexander Gudovskikh², Nikolay Kalyuzhnyy³, Sergey Mintairov¹, Viktor Emelyanov⁴
¹ Ioffe Institute; ² St. Petersburg Academic University

10:40 - 11:20  Coffee Break
11:20 - 11:40 Invited Talk
Chair: Carlos Algora (IES-UPM)

Operation & Maintenance - The Key for Reliable Performance in a CPV Power Plant
Johannes Wüllner, Fraunhofer ISE

Johannes Wüllner studied environmental engineering in Trier, Germany, and received his degree with distinction in industrial engineering from the Environmental Campus in Birkenfeld. His professional career started in 2007 at Concentrix Solar in the system engineering and covered a key role in developing the first industrial scale CPV system. He was substantially supporting the system development of Concentrix to become, under the new name of Soltec Solar, one of the global players in CPV power plants. After 9 years in the CPV business he moved to South Africa to set up his own company, focusing on operation and maintenance for renewable power plants, including a 44MWp CPV power plant. Since December 2017 he is leading the group for applied research in energy storage system at Fraunhofer ISE in Freiburg, Germany.

11:40 - 13:20 Poster Session

The poster numbers are based on topics:
A High and Low Concentration Systems - Performance, Maintenance, Field Experiences, Testing
B Concentrating Optics - Materials, Designs, Characterization
C Measurement Equipment for CPV Characterization Indoors and Outdoors
D Tracking and Control
E Concentrator Solar Cells and Solar Cell Assemblies - Low and High Concentration Cells, New Designs, Characterization
F Modeling, Performance and Energy Prediction for Modules or Systems
G Novel Concepts in CPV
H Reliability, Accelerated Testing of Components and Systems
I Codes, Standards, Markets and Policies
J Hybridization of CPV with Other Technologies
A-01 Elaboration of Affordable Luminescent Solar Concentrators
Ayaulym Alseitova
L.N. Gumilyov Eurasian National University

A-02 Design and Indoor Testing of 3D Cross Compound Parabolic Concentrator for LCPV System
Mazin AL-Shidhani
Cardiff University

A-03 Fluid-Based Spectrally Selective Filters for Building Integrated Direct Immersed PVT Concentrating Solar Systems
Daniel Chemisana¹, Eduardo F. Fernández², Alberto Riverola¹, Alexandre Moreno¹
¹ University of Lleida; ² University of Jaén

A-04 NoDustPV Project: Development and Testing of Anti-Soiling Coatings
Angel Hipólito¹, María Martínez¹, Oscar de la Rubia¹, Mónica Della Pirriera², Ana Milena Cruz², Elena Torralba-Calleja², Pau Bosch-Jimenez², Beatriz Cantos², Lorenzo Bautista Perez², Alba Álvarez³
¹ ISFOC; ² Leitat; ³ Solartys

A-05 Energetic Simulation of a Dielectric Photovoltaic-Thermal Concentrator
Alexandre Moreno¹, Alberto Riverola¹, Daniel Chemisana¹
¹ University of Lleida

A-06 Alternative Techniques for Temperature Control and Automated Dust Cleaning in CPV Installations
Tabare Pagliano
IREVO Foundation

A-07 Application of HCPV Systems in Polygenerative Systems
Filippo Paredes¹, Fabio Maria Montagnino³
¹ Consorzio Arca

B-01 A Strategy to Ensure the Correct Thickness of Optical Couplers in Concentrating Photovoltaic Systems
Intissar Benhouma¹, Marta Victoria²
¹ National Engineering School of Gabes, University of Gabes; ² Instituto de Energía Solar - UPM
B-02 Indoor Characterisation and Comparison with Optical Modelling of Fresnel-Based High-CPV Units Equipped with Secondary Optics
Juan Pablo Ferrer
Universidad de Jaén

B-03 Optical Optimization for a Concentrated Photovoltaic Module
Ray Y. Lin¹, Sheng Hui Chen², Guei Shen Zeng³, David WW Dai¹
¹ TaiCrystal International Technologies Co., Ltd.; ² National Central University

B-04 Design Method for Nonimaging Solar PV Concentrators Using Genetic Algorithms
Daria Freier¹, Roberto Ramirez-Iniguez¹, Carlos Gamio¹, Firdaus Muhammad-Sukki²
¹ Glasgow Caledonian University; ² Robert Gordon University

B-05 Low Temperature Annealed Pd/Ge/Ti Metal Systems for Concentrator Inverted Metamorphic Solar Cells
Manuel Hinojosa¹, Ivan García¹, Luis Cifuentes¹, Ivan Lombardero¹
¹ Instituto de Energía Solar - UPM

B-06 Experimental Installation for Optical Characterization of Fresnel Lens Concentrators
Evgeniy Filimonov¹, Svetlana Levina¹, Maxim Shvarts¹
Presented by Svetlana Levina¹
¹ Ioffe Institute

C-01 Multijunction Solar Cells with Pronounced Optical Coupling: Single Wavelength Laser Biasing Approach at Quantum Efficiency Measurements
Svetlana Levina¹, Evgeniy Filimonov¹, Maxim Shvarts¹
¹ Ioffe Institute

C-02 From Component to Multijunction Solar Cells for Spectral Monitoring
Ignacio Antón¹, Norman Jost¹, Stephen Askins¹, Rubén Núñez¹, Luis J. San José¹, Guido Vallerotto¹, Rebeca Herrero¹, Marta Victoria¹, César Domínguez¹, Gabriel Sala¹
¹ Instituto de Energía Solar - UPM

C-03 Low Cost Solar Simulator for Concentrating CPV Cells Characterizations
Carmine Cancro¹, Aniello Borriello¹, Giorgio Graditi¹, Angelo Merola¹, Antonio Romano¹
¹ ENEA
C-04  Evaluation of the Direct Normal Irradiance Retrieval with a Rotating Shadow Band EKO Grating Spectroradiometer

Mario Po¹, Kees Hoogendijk¹, Will Beuttell¹, Shibayama Kazunori¹, Eiji Takeushi¹

¹ EKO

D-01  Analyses of the Performance of Locally Developed High Concentrator Photovoltaic System Upon Climate Conditions

Merouan Belkasmi¹, Mensah K Anaty², Khalid Bouziane², Mohamed Akherraz³

¹ International University of Rabat; ² UIR; ³ EMI

D-02  Design Strategy for Low-Power Consumption in Solar Trackers

Diego Alonso Flores-Hernández¹, Sergio Palomino-Resendiz², Alberto Luviano-Juárez³, Norma Lozada-Castillo³, Jorge Isaac Chairez-Oria⁴, Ignacio Antón⁵

Presented by Sergio Palomino-Resendiz²

¹ Centro de Innovación y Desarrollo Tecnológico en Cómputo – IPN; ² Unidad Profesional Interdisciplinaria en Ingeniería y Tecnologías Avanzadas – IPN; ³ Escuela Superior de Ingeniería Mecánica y Eléctrica – IPN; ⁴ Unidad Profesional Interdisciplinaria de Biotecnología – IPN; ⁵ Instituto de Energía Solar - UPM

D-03  Comparative Analysis of Aerodynamic Properties for Different Types of Solar Trackers

Alexander Chekalin¹, Viacheslav Andreev¹, Yuri Ascheulov¹, Yuri Chumakov¹, Sergei Kognovitski¹, Viacheslav Linnas¹

¹ Ioffe Institute; ² Peter the Great St. Petersburg Polytechnic University

E-01  Investigation of Solar Cell Overheating under Radiation of Ultrahigh Intensity

Alexander Chekalin¹, Nikolai Davidyuk², Nikolai Sadchikov³, Dmitry Malevskiy¹, Pavel Pokrovskiy¹

¹ Ioffe Institute; ² St. Petersburg Academic University

E-02  GaInNASb-Based Four Junction Solar Cells on GaAs and Ge Substrates

Arto Aho¹, Riku Isoaho¹, Marianna Raapana¹, Ville Polojarvi¹, Lauri Hytönen¹, Timo Aho¹, Antti Tukiainen¹, Mircea Guina¹

¹ Optoelectronics Research Centre / Tampere University of Technology
E-03  III-V/Ge Multijunction Solar Cell with Through Cell Via Contacts Fabrication

Mathieu de Lafontaine¹, Clément Laucher¹, Maxime Darnon¹, Abdelatif Jaoud¹, Malik Volatier¹, Erwine Pargou², Simon Fafard¹, Vincent Aimé¹

¹ University of Sherbrooke; ² Laboratoire des Technologies de la Microélectronique (LTM)

E-04  Loss Analysis for Single Junction Concentrator Solar Cells

Ned Ekins-Daukes³, A. Pusch³, A. Soeriyadi³

¹ Imperial College London; ² UNSW

E-05  Epitaxial Ge Nanopillar Solar Cells Grown by Metalorganic Chemical Vapor Deposition

Kangho Kim¹, Youngjo Kim², Nguyen Dinh Lam³, Won-Kyu Park²

¹ Ajou University; ² Korea Advanced Nano Fab; ³ Hanoi National University of Education

E-06  Investigation of Silicon Wafers Thermal Degradation by Photoluminescence Decay Measurements

Dmitry Kudryashov

St. Petersburg Academic University

E-07  Investigation of MBE Grown III-V Phosphide Semiconductor for Multijunction Cell

Amadéo Michaud¹, Lorenzo Mancini², François Jomard¹, Jean-Christophe Harmand², Jara Fernandez Martin¹, Ahmed Ben Slimane³, Stéphane Collin²

¹ Total New Energies; ² C2N; ³ GEMAC; ⁴ Institut Photovoltaïque d’Ile de France

E-08  Solar Cell Heating by Incident Radiation: Overheat Temperature and IV-Curve Correction

Mikhail Mintairov³, Valery Evstropov³, Svetlana Levina³, Sergey Mintairov³, Maxim Shvarts¹, Nikolay Kalyuzhnyy²

¹ Submicron Heterostructures for Microelectronics, Research & Engineering Center, RAS; ² Ioffe Institute

E-09  Optical and Electrical Properties of Superlattice and Photonic Metamorphic Structures for High-Performance Solar Cells

Viktor Emelyanov², Nikolay Kalyuzhnyy¹, Sergey Mintairov³, Maxim Shvarts¹

Presented by Mikhail Mintairov²

¹ Ioffe Institute; ² Submicron Heterostructures for Microelectronics
E-10  Investigation of Epitaxial Lift-Off Using the <001> Etching Directions in Inverted Three-Junction Solar Cells

Hwa Sub Oh
Korea Photonics Technology Institute

E-11  Module Interconnection for the Three-Terminal Heterojunction Bipolar Transistor Solar Cell

Marius Zehender1, Elisa Antolín1, Pablo García-Linares1, Irene Artacho1, Ilhigo Ramiro1, Juan Villa1, Antonio Marti1
1 Universidad Politécnica de Madrid; 2 Instituto de Energía Solar - UPM

E-12  High Efficiency Low Concentrator Silicon Solar Cells with Innovative Ag-Free Multi-Wire Metallization

Maxim Shvarts1, Tatyana Kost2, Alla Chebotareva2
1 Ioffe Institute; 2 Lomonosov Moscow State University, SINP

E-13  Output Parameters of Photovoltaic Cells at Ultrahigh Radiant Fluxes

Alexander Panchak1, Pavel Pokrovskiy1, Maxim Shvarts1
Presented by Maxim Shvarts1
1 Ioffe Institute

F-01  Output Energy Predictions for Hybrid Concentrator III-V / Planar Thin-Film Modules

Maxim Shvarts1, Viktor Emelyanov1, Ekaterina Aronova1
1 Ioffe Institute

F-02  Soiling and Abrasion Losses in CPV

Jaione Bengochea1, Ana Rosa Lagunas1, Ignacio Manero1, Miguel Murillo1, Aitor Barrenetxea1
1 National Renewable Energy Centre

F-03  Electricity Enhancement and Thermal Energy Production from Concentrated Photovoltaic Integrated with 3-Layered Microchannel Heat Sink

Idris Al-Siyabi1, Sourav Khanna1, Senthilarasu Sundaram1, Tapas Mallick1
Presented by Mazin AL-Shidhani2
1 University of Exeter; 2 Cardiff University
F-04 Photovoltaic System Integrated with Phase Change Material for South West UK Climate
Sourav Khanna¹, K S Reddy², Tapas K Mallick¹
Presented by Mazin AL-Shidhani³
¹ University of Exeter; ² Indian Institute of Technology Madras; ³ Cardiff University

F-05 Modelling SMRs by Means of Standardized Component Cells
Ruben Nunez¹, Ignacio Antón¹, Rebeca Herrero¹, Marta Victoria¹, César Domínguez¹, Stephen Askins¹, Norman Jost¹, Luis Javier San Jose¹
² Instituto de Energía Solar - UPM

F-06 Validation of the Binning Technique for Yearly Energy Yield Calculations Using Random Bandgap Combinations
Jose M. Ripalda¹, Jeronimo Buencuerpo¹, Ivan García²
¹ MN CSIC; ² Instituto de Energía Solar - UPM

F-07 Analysis on Fluctuation of Atmospheric Parameters and its Impact on Performance of CPVs
Kenji Araki¹, Yasuyuki Ota², Kan-Hua Lee¹, Takumi Sakai², Kensuke Nishioka², Masafumi Yamaguchi¹
¹ Toyota Technological Institute; ² University of Miyazaki

G-01 Possibility of the Static LCPV to Mechanical-Stack III-V//Si Module
Kenji Araki¹, Kan-Hua Lee¹, Masafumi Yamaguchi¹
¹ Toyota Technological Institute

G-02 Can Remote Epitaxy Make Cheap Multijunctions? Technical and Economic Considerations of a New III-V Manufacturing Process
Harry Apostoleris¹, Matteo Chiesa¹, Ibraheem Almansouri³
¹ Khalifa University of Science and Technology

G-03 Permanent Bonding Process for Thin Multijunction Solar Cell Integration
Clément Laucher¹, Clément Colin¹, Franck Melul¹, Mathieu de Lafontaine¹, Maïté Volatier¹, Maxime Darnon¹, Vincent Aimez¹, Abdelatif Jaouad¹
² University of Sherbrooke
Evaluation of Microlens Efficiency for Solar Micro-Concentrators

Fausta Loffredo¹, Fulvia Villani¹, Carmine Cancro¹, Giuseppe Nenna¹, Aniello Borriello¹, Riccardo Micsioscia¹, Carla Minarini¹, Franco Roca¹
¹ENEA

Trough-Lens-Cone Optics with Microcell Arrays: High Efficiency at Low Cost

Richard Norman¹, Brad Siskavich², Simon Fafard¹, Laurent Bechou¹, Richard Ares¹, Vincent Aimez¹, Luc Frechette¹
¹University of Sherbrooke; ²xVI Technologies Inc.

Development of a Novel Concentrating Photovoltaic Prototype Based on Solar Spectrum Splitting Technology

Michele Tonezzer¹, Paolo Bernardoni¹, Donato Vincenzi¹, Paolo Decarli², Silvio Fugattini³, Micol Boschetti¹
¹University of Ferrara; ²Trentino Rainbow Energy

Understanding the Effect of Shunt Resistances in Multijunction Solar Cells and its Application to Reliability Analysis

Ivan Lombardero¹, Carlos Algora¹
¹Instituto de Energía Solar - UPM

Technical Specification IEC TS 62989 ED 1 – Primary Optics for Concentrator Photovoltaic Systems

Ralf Leutz¹, David Miller², Philippe Voirino³, Marta Victoria⁴, Steve Scott⁵, Peter Nitz⁶, René Kogler⁶, Hideto Kasai⁸, Rebeca Herrero⁶, César Domínguez⁶, Sam Carter⁶, Stephen Askins⁹, Thomas Arndt⁷, Thorsten Hornung⁶
¹leopil - Leutz Optics and Illumination UG; ²National Renewable Energy Laboratory (NREL); ³CEA - INES; ⁴Instituto de Energía Solar - UPM; ⁵Reflexite; ⁶Fraunhofer ISE; ⁷Evonik Industries AG; ⁸Kuraray Co., Ltd.; ⁹RayGen Resources Pty Ltd

InGaAs Metamorphic Laser (λ=1064 nm) Power Converters with Over 44% Efficiency

Nikolay Kalyuzhnyy¹, Viktor Emelyanov¹, Sergey Mintairov¹, Maxim Shvarts¹
¹Ioffe Institute

InGaAs/GaAs Reciever for Infrared (λ=1064 nm) Laser Power Conversion

Vladimir Khvostikov¹, Nikolay Kalyuzhnyy¹, Sergey Mintairov¹, Natalia Potapovich¹, Svetlana Sorokina¹
Presented by Nikolay Kalyuzhnyy¹
¹Ioffe Institute
J-03  Analysis of Direct Normal Irradiation for CPVT System in South Korea

Seong Hyun Kang¹, Yong Hyun Kim², Jeong Eun Choi¹, Seong Jegarl¹, Seung Pil Moon¹
¹ Korea Electric Power Cooperation; ² Korea Photonics Technology Institute

J-04  The High Energy Efficiency for the CPVT System with the Double Concentrate Reflector and Dual Heat Exchange Technology

Yong Hyun Kim¹, Nam Hwang¹, Ku-rak Jung¹, Hangju Ko¹, Seunghyun Kang², Seung Pil Moon³
Presented by Nikolay Kalyuzhnyy¹
¹ Korea Photonics Technology Institute; ² Korea Electric Power Cooperation; ³ Korea Power Cooperation

J-05  Addressing Secondary Optical Element Misalignment of Concentrator Photovoltaic-Thermoelectric Hybrid Receivers, via Multispectral Computer Vision, Artificial Neural Networks, Deep Learning and a Thermoelectric-Enhanced Spectral Emissivity Map Correction Technique

Matthew H. Rolley¹, Tracy K. N Sweet¹
¹ Cardiff University

J-06  Experimental Comparison of a III:V Triple-Junction Concentrator Photovoltaic-Thermoelectric (CPV-TE) Hybrid Module with Commercial CPV and Flat Plate Silicon Modules

Matthew H. Rolley¹, Tracy K. N Sweet¹, Luka Eerens¹, Juan Pablo Ferrer-Rodríguez², Eduardo F. Fernández²
¹ Cardiff University; ² University of Jaén

J-07  EnerShade - A Low Concentration PV and Thermal Hybrid System as Building Integration Solution

Daniel Sánchez¹, Eduardo Gil¹, María Martínez¹, Cesáreo Alamillo¹, Gustavo Calvo-Parra¹, Oscar de la Rubia¹
¹ ISFOC

J-08  On the Efficiency of Hybrid PV/CSP Systems

Joya Zeitouny¹, Alexis Vossier¹, Eugene Katz², Alain Dollet¹, Gilles Flamant¹, Jeffrey Gordon²
¹ PROMES-CNRS; ² Ben-Gurion University of the Negev

13:20 - 14:40  Lunch Break
14:40 - 16:00  Session 6: Concentrating Optics
Chairs: Ignacio Rey-Stolle (IES-UPM), Daniel Chemisana (University of Lleida)

14:40  CPV Generator with Dish Reflector and Fly's Eye Receiver
Justin Hyatt
Steward Observatory The University of Arizona

15:00  A Comparative Study of Four Secondary Optical Elements for CPV Systems
Sarah El Himer¹, Ali Ahaitouf¹, Sara El-Yahiaoui¹, Abdallah Mechaqrane¹, Abdallah Ougazzaden²
¹ Université Sidi Mohammed Ben Abdellah; ² Georgia Tech-Lorraine

15:20  Electrically Influence of Temperature on an Off Axis Mirrors by Means of METHOD with Two Reflective Receivers with 3J Solar Cells
Philippe Voarino¹, Romain Couderc¹, Arnaud Ritou¹, Paolo Vagliasindi², Loris Todesco², Rolando Parmesani², Mathieu Baudrit¹
¹ CEA; ² ASSE S.r.l

15:40  Improvements in the Manufacturing Process of Achromatic Doublet on Glass (ADG) Fresnel Lens
Guido Vallerotto¹, Marta Victoria¹, Stephen Askins¹, Ignacio Antòn¹, Gabriel Sala¹
¹ Instituto de Energía Solar - UPM

16:00 - 16:20  Industry Session

16:00  Presentation Andaltec
16:05  Presentation AZUR SPACE
16:10  Presentation BSQ Solar
16:15  Presentation Sumitomo Electric

16:20 - 17:00  Coffee Break

17:00 - 18:20  Session 7: Modules and Measurements (I)
Chairs: Gerald Siefer (Fraunhofer ISE), Rebeca Herrera (IES-UPM)
17:00 Computer Vision Algorithm for Relative Misalignments Estimation in CPV Modules
Luis Javier San José¹, Ignacio Antón¹, Rebeca Herrero¹
¹ Instituto de Energía Solar - UPM

17:20 Impact of the Temperature Dependence of CPV Optics Transmittance on the Current Mismatch of Multi-Junction Norman Jost¹, Ignacio Antón¹, César Dominguez¹, Marta Victoria¹, Ruben Nuñez¹, Rebecca Herrero¹, Stephen Askins¹
¹ Instituto de Energía Solar - UPM

17:40 Dense Array CPV Receivers: Impact of the Cooling Device on the Net PV Output for Different Illumination Profiles
Jerome Barrau¹, Gerard Laguna¹, Montse Vilarrubí¹, Alvaro Fernández², Gonzalo Sisó¹, Joan Rosell¹, Manel Ibañez¹, Josep Ila¹, Ferran Badia¹, Luc Fréchette², Maxime Daron², Louis Michel Collin², Alain Dollet³
¹ University of Lleida; ² University of Sherbrooke; ³ PROMES-CNRS

18:00 How Will CPV Deliver on its Original Promise? A Pathway to High Efficiency at Competitive Cost
Harry Apostoleris¹, Marco Stefancich², Ibraheem Almansouri¹, Matteo Chiesa¹
¹ Khalifa University of Science and Technology; ² Dubai Electricity and Water Authority

19:00 Conference Dinner (see page 25 for more information)

Wednesday, April 18, 2018

09:00 - 10:40 Session 8: CPV Systems (II)
Chairs: Alain Dollet (CNRS - PROMES), Maike Wiesenfarth (Fraunhofer ISE)

09:00 ALCHEMI – A Low Cost, High Efficiency, Optoelectronic HCPV Module for 1000x Operation
Geoffrey Duggan¹
Presented by Andrew Johnson²
¹ Fullsun Photovoltaics Limited; ² IQE PLC

09:20 Central Receiver Photovoltaics - A New Generation of Solar Power
John Lasich
RayGen Resources Pty Ltd
09:40 Maintenance of CPV Plants, How Much Does it Cost?
Eduardo Gil¹, Cesar Alamillo¹
¹ ISFOC

10:00 MEGASOL: A First Feedback from a 2.2 MWp CPV Plant
Mousaab Benhammane¹, Philippe Voarino¹, Alexandre Mignonac², Grégoire Pichenot¹, Mathieu Baudrit¹, Gilles Notton³
¹ CEA - INES; ² CEA Tech; ³ Laboratory SPE – University of Corsica

10:20 Set-Up and Evaluation of 53 kW Concentrated Solar PV in India
Gerald Siefer¹, Soumen Sardar², Shashank Ojha², Jaspal Singh², Vishal Singh², Jatinder Singh Chandok², Marc Steiner¹, Alexander Wekkeli²
¹ Fraunhofer ISE; ² NETRA NTPC Limited

10:40 - 11:20 Coffee Break

11:20 - Invited Talk
Chair: Marc Steiner (Fraunhofer ISE)

11:40 Light Plastic Integrated Micro CPV Module: PIC
Michihiko Takase¹, Masaharu Terauchi¹, Nobuhiko Hayashi¹, Hikaru Nishitani¹, Takuji Inohara¹, Youichirou Aya¹, Shutetsu Kanayama¹, Bunji Mizuno¹
¹ Panasonic Corporation

Michihiko Takase studied vacuum deposition processes in Hyogo, Japan, and received his master's degree of engineering from Himeji Institute of Technology. His professional career started in 1992 at Panasonic and engaged in developing of ultra-low energy ion doping and plasma doping process for an ultra-fine CMOS and vacuum process of a plasma display panel. As lecturer of ultra-shallow junction, he was invited to Semiconductor Research Seminar sponsored by Prof. J. Nishizawa in 2000. He was also in charge of starting up and improving the yield of the mass productions of plasma display, micro wave, and so on. He is a project manager of CPV which is supported by NEDO as a Japanese national project.
11:40 - 13:20  Session 9: Modules and Measurements (II)  
Chairs: Maxim Shvarts (Ioffe Institute), Sarah Bernardis (CEA)  

11:40  4-Terminal CPV Module Capable of Converting Global Normal Irradiance Into Electricity  
Juan Francisco Martinez Sanchez1, Marc Steiner1, Maike Wiesenfarth1, Frank Dimroth1  
1 Fraunhofer ISE  

12:00  Achieving Wide-Acceptance Angle and High On-Axis Performance Static Low-Concentration Module Using Hybrid Lens Arrays  
Kan-Hua Lee1, Kenji Araki1, Nobuaki Kojima1, Masafumi Yamaguchi1  
1 Toyota Technological Institute  

12:20  Investigating the Spectral Nature of Soiling and its Impact on Multi-Junction CPV Systems  
Eduardo F. Fernández1, Leonardo Micheli2, Florencia Almonacid1, Matthew Muller2  
1 Universidad de Jaén; 2 National Renewable Energy Laboratory (NREL)  

12:40  Influence of Ground Cover Ratio on Optimum Inverter Size in CPV Plants  
Pedro M. Rodrigo1, Eduardo F. Fernández2, Florencia M. Almonacid2, Pedro J. Pérez-Higuera2  
1 Universidad Panamericana; 2 University of Jaén  

13:00  CPV for Space  
Matthew Lumb1, Brent Fisher2, Kenneth Schmieder3, Phillip Jenkins4, Robert Walters4  
1 George Washington University; 2 Formerly of Semprius Inc.; 3 Naval Research Laboratory; 4 US Naval Research Laboratory  

13:20 - 14:40  Lunch Break
Session 10: CPV Hybrid Systems and Concepts
Chair: Ned Ekins-Daukes (UNSW)

14:40 - 15:00
Progress in Agriculture Photovoltaic Leveraging CPV
Jan Ingenhoff¹, Luqing Liu¹, Wen Liu¹, Fangzin Zhang¹, Ming Li¹, Dahan Qiang¹, Xinyi Zhang², Zili He², Quinglang Ou²
¹ Institute of Advanced Technology of University of Science and Technology of China; ² USTC - University of Science and Technology

15:00 - 15:20
Cost-Competitiveness of Hybrid III-V-Si Concentrator Photovoltaic Systems
Kan-Hua Lee¹, Kenji Araki¹, Nobuaki Kojima¹, Masafumi Yamaguchi¹
¹ Toyota Technological Institute

15:20 - 15:40
Hybrid Photovoltaic and Thermoelectric Module for CPV-T with Heat Exchange Applications
Ryo Tamaki¹, Takeshi Toyoda², Yoichi Tamura², Akinari Matoba², Toshiharu Minamikawa², Misato Imai³, Masayuki Tokuda³, Megumi Masui³, Yoshitaka Okada¹
¹ RCAST, The University of Tokyo; ² Industrial Research Institute of Ishikawa; ³ ACTREE Corporation

15:40 - 16:00
InGaP/Ge and GaAs/Ge Double-Junction Solar Cells for Thermal-CPV Hybrid Energy Systems
Boussairi Bouzazi¹, Artur Turala¹, Richard Arès¹, Simon Fafard¹, Vincent Aimez¹
¹ University of Sherbrooke

16:00 - 16:30
Closing Session

Closing
Ignacio Antón, Instituto de Energía Solar - UPM

Conference Wrap-up
Myles Steiner, National Renewable Energy Laboratory (NREL)

Announcement CPV-15
Ali Ahaitouf, Université Sidi Mohammed Ben Abdellah

16:30 - 19:00
Technical Tour
Conference Dinner

The CPV-14 Conference Dinner will take place at the restaurant EL MESTO, a winery and olive mill located in the outskirts of Puertollano where dinner guests will indulge themselves, enjoying and tasting the most traditional food and drinks of Castilla-La Mancha.

**Date:** Tuesday, April 17  
**Fee:** 55 € incl. VAT (pre-registration is required)  
**Location:** Restaurante EL MESTO  
Calle Ucrania, 2 (1.647,15 km)  
13500 Puertollano

**Schedule:**  
Bus transfer will be available. Buses will leave from 18:45 in front of the conference venue.  
19:00 Visit Olive Mill and Winery  
20:00 Conference Dinner  
from 21:30 Buses will return to Puertollano

Technical Tour

The CPV-14 Technical Tour will take place on Wednesday, April 18 after the closing session and will cover the Centro Nacional del Hidrógeno (National Hydrogen Center), as well as the ISFOC facilities  

**Date:** Wednesday, April 18  
**Start time:** Approx. 16:30. The bus will leave after the closing session in front of the conference venue.  
**Return:** Approx. 19:00 to Puertollano  
**Fee:** € 28 incl. VAT (the tour is already fully booked)
General Information

Registration

Each participant has to register in person at the registration desk to collect a conference bag and 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 8:00.

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.

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 8:00.

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 freely 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-14.org. The login and password sent to you during registration will be required to gain access to the download area.

Contact Participants

CPV-14 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 receive e-mails 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.

WiFi Access

WiFi access will be available free of charge in the large exhibition room. Please see signs on-site for login details.
The listed companies and institutions have supported the 14th International Conference on Concentrator Photovoltaic Systems. Through their generous contributions they have made this conference a success in presenting a great opportunity to share knowledge and push the boundaries of solar science. We thank our Sponsors.