



Depuis 80 ans, nos connaissances  
bâtissent de nouveaux mondes



## SFERA-III

# 1st Summer School & Doctoral Colloquium

September, 9th- 13th, 2019

CNRS- PROMES, Odeillo, France



## FULL PROGRAM



THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020  
RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO 823802

# Summer School

## “Thermal energy storage systems, solar fields and new cycles for future CSP plants”

### Chairs

Alain Ferrière, CNRS-PROMES  
Diogo Canavarro, University of Evora

### Program

#### Day 1 : Monday, September 9th, 2019

- 8:15 am Registrations
- 9:30 am Welcome address by Alain Dollet (CNRS)  
Introduction of the School, by Alain Ferrière (CNRS) & Diogo Canavarro (Univ. Evora)
- 9:45 am Introductory talk, by Alain Ferrière (CNRS)  
“The CSP technologies: market status and opportunities for R&D”
- 10:30 am Coffee break
- 11:00 am Thermal Energy Storage - Class 1, by Eduardo Zarza (CIEMAT)  
“TES for solar thermal power plants: introduction, commercial systems, integration issues and latent heat”
- 12:00 pm Thermal Energy Storage - Class 2, by Anna Chiara Tizzoni/Salvatore Sau (ENEA)  
“Novel molten salts for TES application in CSP plants”
- 12:30 pm Lunch at CNRS restaurant
- 2:30 pm Thermal Energy Storage - Case study, by Shahab Rohani (Fraunhofer ISE)  
“Lessons learned from a lab-scale thermochemical storage”
- 3:30 pm Coffee break
- 4:00 pm Thermal Energy Storage - Class 3, by Sylvie Rougé (CEA)  
“Thermochemical TES: challenges and issues”
- 4:45 pm Thermal Energy Storage - Class 4, by Pierre Garcia (CEA)  
“TES performance assessment”
- 5:30 pm Group picture
- 6:00 pm End of 1st day session
- 7:00 pm Get together buffet (offered by CNRS) in PROMES' premises

## **Day 2 : Tuesday, September 10th, 2019**

- 9:00 am      Introductory lecture, by Manuel Romero (IMDEA Energy)  
“Next generation of CSP plants: technology developments and market opportunities”
- 10:00 am      Coffee break
- 10:30 am      Collectors - Class 1, by Diogo Canavarro (Univ Evora)  
“New concepts of line focus and point focus collectors”
- 11:00 am      Collectors - Class 2, by Jose González-Aguilar (IMDEA Energy)  
“New concepts of heliostats for solar tower systems”
- 11:30 am      Collectors - Case study, by Shahab Rohani (Fraunhofer ISE)  
“A design tool for heliostat field layout”
- 12:30 pm      Lunch at CNRS restaurant
- 2:00 pm      Cycles - Introductory lecture, by Eduardo Zarza (CIEMAT)  
“Thermodynamic cycles for CSP plants: state-of-the-art and challenges”
- 3:30 pm      Cycles - Class 1, by Manuel Romero (IMDEA Energy)  
“sCO<sub>2</sub> cycles for CSP plants: challenges and issues”
- 4:00 pm      Coffee break
- 4:30 pm      Cycles - Class 2, by Daniel Benitez (DLR)  
“Hybrid CSP-PV plants: examples of configurations and simulation using Greenius”
- 5:30 pm:      End of 2nd day session

## **Day 3 : Wednesday, September 11th, 2019**

- 8:45 am      Transfer to Themis solar tower platform in Targasonne (group 1)  
Transfer to CNRS solar facilities in Odeillo (group 2)
- 9:00 am      Visit of Themis platform (group 1)/Visit of CNRS solar facilities (group2)
- 10:30 am      Coffee break and transfer to Odeillo/Targasonne
- 11:00 am      Visit of Themis platform (group 2)/Visit of CNRS solar facilities (group1)
- 12:30 pm      Lunch at CNRS restaurant
- 2:00 pm      End of the Summer School

Note: The visits are organized for both events (Summer School and Doctoral Colloquium)

# Doctoral Colloquium

(SFERA members only)

## Session Chairs

Alain Dollet, CNRS  
Sixto Malato, CIEMAT  
Robert Pitz-Paal, DLR  
Aldo Steinfeld, ETH-Z

## Program

### Day 1 : Wednesday, September 11th, 2019

- 8:45 am Transfer to Themis solar tower platform in Targasonne (group 1)  
Transfer to CNRS-PROMES solar facilities in Odeillo (group 2)
- 9:00 am Visit of Themis platform (group 1)/Visit of CNRS solar facilities (group2)
- 10:30 am Coffee break and transfer to Odeillo/Targasonne
- 11:00 am Visit of Themis platform (group 2)/Visit of CNRS solar facilities (group1)
- 12:30 pm Lunch at CNRS restaurant
- 13:45 pm Registrations
- 2:00 pm Departure for social activity: «Tree trail «(Parc Aventure, Font-Romeu L'hermitage).  
(Registered persons only).
- 6:00 pm Free time (hotel or city of Font-Romeu)
- 7:00 pm Departure for Llivia province
- 7:30 pm Get together dinner at Cal Rita Porta in Llivia (offered by CNRS)
- 9:30 pm Return to hotels in Font-Romeu

## **Day 2 : Thursday, September 12th, 2019**

### **Session 1: Energy storage & Solar fuels**

Chair: Aldo Steinfeld, ETH Zurich

- 9:00 am «The importance of Energy Storage (ES) in Isolated Islands. Cyprus Case Study»  
George Partasides, Constantinos Taliotis, Manuel Blanco, The Cyprus Institute
- 9:25 am «Modelling & Experimental Validation of a Thermochemical Energy Storage Reactor»  
Michael Wild, Aldo Steinfeld, ETH Zürich
- 9:50 am «Influence of mass flow rate on thermocline storage performance»  
Ségolène Vannerem, Quentin Falcoz, Pierre Neveu, CNRS/University of Perpignan
- 10:15 am «Thermal-energy storage system integration with focus on advanced adiabatic compressed air energy storage plants»  
Philipp Roos, Andreas Haselbacher, Aldo Steinfeld, ETH Zürich
- 10:40 am Coffee break
- 11:00 am «High-temperature thermochemical heat storage: development of materials and lab-scale packed-bed prototype»  
Marco Gigantino, Aldo Steinfeld, ETH Zurich
- 11:25 am «The solar refinery: techno-economic potential of producing carbon-based fuels with concentrated solar power»  
Andreas Rosenstiel, Martin Roeb, Nathalie Monnerie, Stefan Brendelberger, Christian Sattler, DLR -Institute of Solar Research
- 11:50 am «Performance Optimization of the CeO<sub>2</sub>-CH<sub>4</sub>-CO<sub>2</sub> Redox Cycle for Solar Fuel Production»  
Mario Zuber, Simon Ackermann, Philipp Furler, Aldo Steinfeld, ETH Zürich
- 12:15 pm «Solar-thermal oxygen pumping»  
Mathias Pein, Christos Agrafiotis, Martin Roeb, Christian Sattler, DLR
- 12:40 pm Lunch at CNRS restaurant

### **Session 2: Solar receivers**

Chair: Sixto Malato, CIEMAT

- 2:00 pm «Numerical Simulation of 3D-Shaped Volumetric Absorbers»  
Robin Tim Broeske, DLR
- 2:25 pm «Process Assistance System for a molten salt receiver based on dynamic simulation models and artificial neural networks»  
Christian Schwager, Peter Schwarzböz, Aachen University of Applied Sciences and DLR
- 2:50 pm «High-temperature solar volumetric air receiver: lab-scale testing and computational modeling»  
Vikas R. Patil, Aldo Steinfeld, ETH Zurich
- 3:15 pm «Test setup for the experimental evaluation of the convective heat transfer for nitrate salt in tubular solar receivers»  
Cathy Frantz, Reiner Buck, DLR
- 3:40 pm Coffee break

- 4:00 pm «Measurement of high solar irradiance on receivers in solar tower plants»  
M. Casanova, J. Ballestrín, R. Monterreal, J. Fernández, E. Setien, J. Rodríguez, CIEMAT
- 4:25 pm «Numerical Modelling of Particle Motion in Centrifugal Receiver»  
Serdar Hicdurmaz, Lars Amsbeck and Bernhard Hoffschmidt, DLR

### Session 3a: Solar field

Chair: Robert Pitz-Paal, DLR

- 4:50 pm «Deep Learning Algorithms for Heliostat Field Calibration»  
Max Pargmann and Daniel Maldonado, DLR
- 5:15 pm «Dynamic Wind Loads on Heliostats: Experimental Investigation and Development of Acceptance Tests Based on Artificial Excitation»  
Kristina Blume, Marc Röger, Robert Pitz-Paal, DLR
- 5:40 pm «Dynamic aimpoint management for performance enhancement in solar tower power plants»  
Laurin Oberkirsch, DLR
- 6:05 pm «Experimental and numerical evaluation of drift errors in a solar power tower facility with tilt-roll tracking-based heliostats»  
Alejandro Martínez Hernández, Iván Bravo Gonzalo, Manuel Romero and José Gonzalez-Aguilar, IMDEA Energy
- 6:30 pm End of 2nd day sessions

## **Day 3 : Friday, September 13th, 2019**

### Session 3b: Materials and durability

Chair: Robert Pitz-Paal, DLR

- 9:00 am «Elaboration, performance and durability analysis of selective coatings for CSP»  
D. Ngoue, A. Diop, A. Carling-Plaza, A. Grosjean, V. Pares, A. Soum-Glaude, S. Quozola, E. Hernandez, L. Thomas, CNRS and University of Perpignan
- 9:25 am «An effective simulation route for the ternary phase diagram:  $\text{NaNO}_3\text{-KNO}_3\text{-NaNO}_2$ »  
Tiziano Delise, University of Rome Tor Vergata and ENEA
- 9:50 am «Aging and durability studies of solar selective absorber coatings in air at high temperature»  
A. Carling-Plaza, M. Bichotte, A. Soum-Glaude, M.A. Keilany, L. Dubost and L. Thomas, CNRS/University of Perpignan and HEF-IREIS
- 10:15 am «Lifetime prediction of solar mirrors used in concentrating solar thermal energy»  
Francisco Buendía-Martínez, Aránzazu Fernández-García, Florian Sutter, Johannes Wette and Loreto Valenzuela, CIEMAT and DLR
- 10:40 am Coffee break

## Session 4: Hybrid and advanced solar processes

Chair: Alain Dollet, CNRS

- 11:00 am «Electrochemical wastewater treatments enhanced by combination with solar energy»  
I. Salmerón, G. Rivas, I. Oller, S. Malato, CIEMAT
- 11:25 am «Evaluation of a new solar photo-reactor for solar water disinfection»  
A. Martínez-García, I. Oller, P. Fernández-Ibáñez, M.I. Polo-López, CIEMAT and University of Ulster (UK)
- 11:50 am «Application of Advanced Integrated Technologies (Membrane and Photo-Oxidation Processes) for the Removal of CECs contained in Urban Wastewater»  
Dennis Deemter, Isabel Oller, Sixto Malato, Ana M. Amat. CIEMAT and Universitat Politècnica de València
- 12:15 pm Group picture
- 12:30 pm Buffet at CNRS restaurant with PROMES staff
- 2:00 pm «PV/CSP hybrid system»  
Dounia Ziyati, Alexis Vossier, Alain Dollet, CNRS
- 2:25 pm «Investigation of electrostatic precipitation to avoid particles deposition on a solar reactor window»  
Juan P. Rincon-Duarte, Stefania Tescari, Thomas Fend, Martin Roeb, Christian Sattler, DLR
- 2:50 pm Concluding remarks  
Alain Dollet, CNRS
- 3:00 pm **End of the Doctoral Colloquium**

## Transportation

A special bus will transport participants between Font-Romeu city centre and the meeting places  
Departure times from Font-Romeu (front of the «Casino», 46 Avenue Emmanuel Brousse) :  
Monday: 8:00 am, Tuesday: 8:30 am, Wednesday: 8:30 am and 7:00 pm, Thursday: 8:30 am,  
Friday: 8:30 am



## Meeting address

PROMES/CNRS laboratory, 7 rue du Four solaire, 66120 Odeillo

## Organizing committee

### PROMES CNRS

Alain Dollet  
Alain Ferrière  
Romie Lopez  
Alex Carling-Plaza (PhD student)  
Charlène Pellegrini (PhD student)  
Segolène Vannerem (PhD student)  
Donia Ziyati (PhD student)



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## University of Evora

Diogo Canavarro



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Solar Facilities for the European Research Area