

SOLAR ENERGY AND BUILDING PHYSICS LABORATORY

LABORATOIRE D'ÉNERGIE SOLAIRE ET DE PHYSIQUE
DU BÂTIMENT



Activity Report 2009



ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Innovations for Renewable Energy Use in the Built Environment

Solar Energy and Building Physics Laboratory (LESO-PB)

Swiss Federal Institute of Technology (EPFL)

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EPFL Solar Energy and Building Physics Laboratory (LESO-PB)

ACTIVITY REPORT 2009

The Solar Energy and Building Physics Laboratory (LESO-PB) works at the forefront of research and technological development in renewable energy, building science and urban physics. It is part of the Civil Engineering Institute (IIC) of the School of Architecture, Civil and Environmental Engineering (ENAC) of the Swiss Federal Institute of Technology (EPFL) in Lausanne, Switzerland. Placed under the responsibility of Prof. Dr Jean-Louis Scartezzini and four group leaders, the laboratory counts about 50 scientists, engineers and technicians. This report presents the teaching, research and dissemination activities for 2009.

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RESEARCH

INTRODUCTION

The research activities of the Solar Energy and Building Physics Laboratory focus on the development and implementation of energy efficient and renewable energy technologies in the built environment.

Basic and applied research is carried out in the following fields:

- Intensive use and perception of daylight
- Sustainable urban development
- Bio-mimetic building control
- Renewables integration in the urban environment
- Nanotechnology for solar energy conversion
- Computer modelling of complex systems

Research is carried out in the context of national and international collaboration with renowned academic institutions and industrial partners (National Research Programmes, European Framework Programmes, International Energy Agency). Results are widely published in refereed scientific journals and conferences.

2009 AWARDS AND DISTINCTIONS

Name	Prize, distinction	Year
MER Dr D. Robinson	Visiting Professor, Technical Research Centre of Finland	2009
MER Dr D. Robinson	EPFL – Promotion to Lecturer	2009
N. Cholet, Y. Gramegna	Asea Brown Boverly Award – Special Mention (MSc Thesis Supervisors: Prof. H. Gugger, Prof. J.-L. Scartezzini)	2009
F. Haldi, MER Dr D. Robinson	Best Paper Award – Building and Environment Journal	2009
F. Haldi	Best Student Paper Award, Building Simulation 2009 conference.	2009

DAYLIGHTING AND PERCEPTION

Group leader: Prof. J.-L. Scartezzini

Research associate: Dr Mirjam Münch

Postdoctoral researcher: Dr Jérôme Kämpf

PhD students: Apiparn Borisuit, Chantal Basurto, Friedrich Linhart



The anidolic daylighting façade of the LESO building

The daylighting and perception research group works on advanced systems for optimal use of daylight in buildings, with the aim to improve user comfort and health and reduce energy consumption.

The group has set up a sophisticated daylighting laboratory with, among other, a scanning sky simulator and an automated heliodon, which allow reproducing with very high precision all daylight conditions that exist around the world. Several anidolic (non-imaging) daylight systems have been developed and tested by the group. Furthermore, a bidirectional reflection and transmission goniophotometer based on digital imaging allows testing of the characteristics of complex fenestration systems.

Research on the impact of natural and artificial light on human chronobiology (circadian rhythms) is combined with technological advances in a holistic approach.

Published work relates to

- Anidolic Systems for collection and redirection of daylight within buildings
- Scanning sky simulator and Heliodon for the reproduction of any daylight conditions
- Bidirectional reflection and transmission goniophotometer based on CCD imaging techniques
- Daylighting and ergonomical test modules
- Diagnostic and monitoring equipments for lighting applications
- Daylighting design and analysis tools
- Green lighting: integrated daylighting and electric lighting systems

2009 Activities

The priority in 2009 was set on the deployment of a post-doctoral fellowship on “Daylighting and Perception” endowed by the Velux foundation. The post was attributed to Dr. Mirjam Münch, holder of a Doctorate in Neurosciences of Basel University, who joined the laboratory from Harvard Medical School (Boston, USA).

Current Projects

Daylighting Design and Visualisation Tools

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

The project is aiming to set up a daylighting design tool for the visualisation of the light redirecting properties of complex fenestration systems, which will be complemented by an advanced ray-tracing computer simulation algorithm.

Integrated Multifunctional Glazing for Dynamical Daylighting

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

The project is aiming to set the bases for an integrated multi-functional glazing for dynamic daylighting using novel microstructures which will redirect sunlight into office rooms.

Postdoctoral fellowship in Daylighting & Perception

Funding: VELUX Foundation

Duration: 2008-2012

This project is aiming to strengthen the education and research activities in the fields of building science and chronobiology. It is expected moreover to initiate innovating activities in relation to psycho-physiological aspects of daylight with an emphasis on human response factors, such as the perception of three-dimensional spaces and luminous environment.

Greenlighting – Integrated Daylighting and Electric Lighting (IEA Task 45)

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2005-2009

The aim of the Greenlighting project is the design and set-up of a high performance integrated daylighting and electric lighting system in order to achieve a 3 to 5 W/m² lighting power density offering optimal visual and non-visual lighting conditions for office rooms.

PhD theses published in this domain at LESO-PB

- *Comparing physical and virtual methods for daylight performance modelling including complex fenestration systems*, Anothai Thanachareonkit, EPFL PhD Thesis #4130 (2008)
- *Bayesian optimisation of visual comfort*, David Lindelof, EPFL PhD Thesis #3918 (2007)
- *Innovative Bidirectional Video-Goniophotometer for Advanced Fenestration Systems*, Maryline Andersen, EPFL PhD Thesis #2941 (2004) Prix Chorafas 2005
- *Méthode expérimentale d'évaluation des performances lumineuses de bâtiments*, Laurent Michel, EPFL PhD Thesis #2042 (1999)
- *Systèmes anidoliques d'éclairage naturel*, Gilles Courret, EPFL PhD Thesis #2026 (1999)
- *Application de la logique floue à l'aide à la décision en éclairage naturel*, Bernard Paule, EPFL PhD Thesis #1916 (1999)
- *Simulations numériques de systèmes d'éclairage naturel à pénétration latérale*, Raphaël Compagnon, EPFL PhD Thesis #1193 (1993)

SUSTAINABLE URBAN DEVELOPMENT

Group leader: MER Dr Darren Robinson

Postdoctoral researchers: Dr Philippe Leroux, Dr Jérôme Kaempf, Dr Frédéric Haldi

PhD students: Diane Perez, Urs Wilke, Olivier Pol



The relatively sustainable district of BO01 in Malmö, Sweden

The principal mission of this group is, through the simulation of physical processes, to better understand how to optimise the sustainability of **urban systems**, predominantly from environmental but also from social and economic perspectives.

Specific research interests include:

- Simulation and evaluation of resource fluxes (energy and matter) in urban systems
- Demand and supply side control of urban energy flows
- Urban microclimatology
- External environmental comfort and social wellbeing
- Stochastic modelling of human behaviour

Published work relates to

- Modelling and optimisation of urban energy fluxes
- Occupant behaviour and comfort
- Sustainable urban design
- Thermodynamics in the city
- Radiosity algorithms and internal illumination prediction

2009 Activities

This year witnessed the completion of PhD theses on the subjects of the modelling and optimisation of urban energy fluxes, multiscale urban climate modelling and the stochastic modelling of occupants' behaviour. We are approaching convergence now between these complementary works in the form of CitySim: software for modelling and optimising urban resource flows, accounting for occupants' presence and behaviour and the local radiant and climatic contexts. In 2010 our work will be heavily oriented towards the further refinement of CitySim and its application to problems of various scales, from a small City block to the entire city of Zurich as well as the completion of our book "Computer modelling for sustainable urban design".

Current Projects

IEA ECBCS Annex 51 – Energy Efficient Communities: Case Studies and Strategic Guidance for Urban decision Makers

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

Participation in IEA ECBCS Annex 51 “Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision makers”. Contributions of case study material to the relevant sub-tasks. Preparation of a chapter on Urban Modelling for a book to be published by the members of this Annex.

An Investigation of Strategies leading to a 2000W City using Bottom-up Models of Urban Energy Flows

Funding: Swiss National Science Foundation (SNSF)

Duration: 2009-2012

In this project we will develop a detailed spatially explicit model of the dynamic flows of energy and matter within a city due to transportation, the operation of buildings and the activities accommodated by them. This will involve the further development and integration of CitySim -- the most fully developed model available for explicit simulation of building-related energy flows in urban settlements --and MATSIM --a detailed transport micro-simulation model. Once integrated, calibrated and validated, it will be applied to the city of Zürich to produce new guidance for its development up until 2050, with a view to achieving a 2000W/capita city.

Innovative Planning and Management Instruments of Urban Energy Systems

Funding: EPFL Energy Center

Duration: 2009-2012

In this project we will work closely with municipalities, the EPFL Energy Centre as well as the Industrial Energy Systems Laboratory at EPFL to develop a new urban energy planning tool for use by municipalities. The purpose of this tool will be to support municipalities’ urban energy planning and investment decisions.

HOLISTIC - Holistic Optimisation Leading to Integration of Sustainable Technologies in Communities

Funding: European Union (EU) 6th Framework Program

Duration: 2007-2010

The HOLISTIC project aims to stimulate a paradigm shift in the use of energy within communities to more sustainable patterns. It will demonstrate how this transformation can be initiated in three typical communities, in Dundalk (IRE) Mödling (AU) and Neuchâtel (CH), by acting on every aspect of community life. The role of the LESO-PB within this 32MEuro European RTD project is to develop new software for optimising the energy performance of urban districts.

Evaluation and synthesis of current best practice in sustainable masterplanning

Funding: CIBSE/Ville de Lausanne

Duration: 2008-2009

During the summer of 2008 a selection of urban communities renowned for their sustainability were visited (Vesterbro in Copenhagen (DK), Bo01 in Malmö (S), Hammarby Sjöstad in Stockholm (S), Eco-Viikki in Helsinki (F), BedZed in London (UK) and Vauban in Freiburg (D)). Members of the urban planning team were interviewed as were residents of the communities in question, a photographic survey was conducted and documentation of the design and post-occupancy evaluation was collected. The objective was to identify strengths in sustainable masterplanning which should be repeated in future projects and weaknesses which should be avoided, considering social, economic and environmental perspectives. Comprehensive brochures describing each of the projects as well as results from their evaluation have been prepared, as has an article with a series of recommendations to support the future design and planning of sustainable communities.

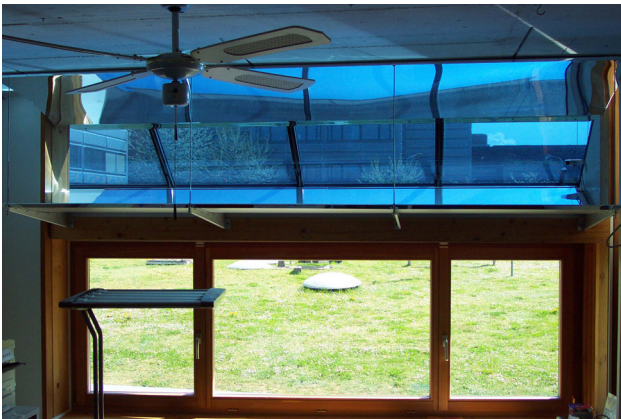
PhD theses published at LESO-PB in this domain

- *On the Modelling and Optimization of Urban Energy Fluxes*, J. Kaempf, EPFL PhD Thesis #4548 (2009)
- *Multiscale Modelling of Urban Climate*, A. Rasheed, EPFL PhD Thesis #4531 (2009)
- *Simulating occupant presence and behaviour in buildings*, Jessen Page, EPFL PhD Thesis #3900 (2007)

BIO-MIMETIC BUILDING CONTROL

Group leader: Dr Nicolas Morel

PhD students: David Daum, Nikos Zarkadis



Self-adaptive control system

Bio-mimetic control of building services (heating, cooling, ventilation, blinds, electric lighting) can simultaneously optimize energy use and indoor comfort (thermal, visual, air quality) through the use of advanced computer methodologies such as artificial neural networks, genetic algorithms, fuzzy logic, or advanced optimization algorithms. Our laboratory investigates control algorithms allowing at the same time:

- an optimal response to changing conditions (weather, building occupancy, lighting levels, thermal characteristics)
- a progressive adaptation to (possibly changing) building characteristics and to user preferences.

Research projects normally include two steps:

- development of innovative control algorithms, and evaluation with computer simulation tools
- testing under real situations, and evaluation of energy and comfort performances as well as acceptance by users. Most bio-mimetic controllers are evaluated in the LESO building, which represents a powerful tool for our group.

Published work relates to

- Self-adaptive integrated building control systems
- Blind and electric lighting control algorithms
- Advanced control of electrochromic glazing
- Genetic algorithms for adaptation to user preferences
- Fuzzy logic for implementing building physics expert knowledge into the control algorithms
- Artificial neural networks for adaptive models and various control systems (for instance thermal model of the building or weather evolution).

Activities 2009

After a successful research on the use of Genetic Algorithms for the adaptation of a blind and electric lighting controller using Fuzzy Logic to user preferences, this year has been devoted to the exploration of a new optimization algorithm for a Fuzzy Logic controller, allowing to simultaneously increase energy savings and user comfort. Furthermore, we have started to investigate the issue of an optimal control algorithm for electrochromic (EC) glazings, taking into account the relatively slow response (around 10 to 15 minutes) of the commercially available EC glazings. Both research projects are still ongoing; results will be available in 2010 for the first one and 2011 for the second one.

Current Projects in Biomimetic Building Control

Advanced Control of Electrochromic Glazing

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

Electrochromic (EC) glazings might be used as an alternative to conventional mobile solar shadings or solar protection glazings, which are not well suited to most weather conditions and as a rule not efficient enough against overheating. The EC glazings currently available have a radiation transmission variation range large enough to offer a good protection against overheating, although the protection against visual glare still remains to be improved. EC glazings have until now essentially been actuated manually by the users. Some elementary control schemes have also been proposed, but the time characteristics of these glazings have not been considered: EC glazings take some time to change from the dark state to the bleached state or inversely, typically 5 to 15 minutes. Therefore, a predictive algorithm, like those used for controlling building services, taking into account the thermal inertia, may bring some advantages with regard to user comfort (both thermal and visual). The project includes the development of an adequate control strategy, and the experimentation of this strategy in an office room of the LESO building, with real persons.

CCEM-SuRHiB: Sustainable Renovation of Historical Buildings

Funding: Swiss Competence Center for Energy and Mobility (CCEM)

Duration: 2009-2012

Historical buildings, if normally heated, cause relatively high energy consumption. As their façades need to be conserved, the thermal insulation of such buildings is difficult and risky. The moisture balance of walls has to be carefully considered besides the energy balance. Internal insulation that could effectively reduce thermal losses would hinder the drying process of walls. A careful risk assessment and robust guidelines have to be developed. A highly insulating light weight plaster finish based on aerogel particles, which insulates like polystyrene – inside or outside - but is open for moisture diffusion, is developed and tested in this project. Furthermore, appropriate heating systems and optimal solar integration are studied by LESO-PB.

CCEM Retrofit: Advanced Energy-Efficient Renovation of Buildings

Funding: Swiss Competence Center for Energy and Mobility (CCEM)

Duration: 2007-2010

CCEM Retrofit aims to improve the energy balance and comfort of buildings in the framework of renovation. In this context, the LESO-PB focuses on the optimization of a control algorithm for blinds and electric lighting implemented with Fuzzy Logic, using a new optimization technique based on Evolutionary Algorithms. The developed algorithm allows simultaneous optimizing of energy consumption and thermal comfort. Besides the algorithm development and simulation tests, the Laboratory also carries out measurements in two office rooms of the LESO building in order to assess the correct operation of the controller and to evaluate the acceptance by real users.

PhD theses published in this domain at LESO-PB

- *Bayesian optimisation of visual comfort*, David Lindelöf, EPFL PhD Thesis #3918 (2007)
- *Simulating occupant presence and behaviour in buildings*, Jessen Page, EPFL PhD Thesis #3900 (2007)
- *Using Genetic Algorithms to Take into Account User Wishes in an Advanced Building Control System*, Antoine Guillemin, EPFL PhD Thesis #2778 (2003)
- *Gestion bio-mimétique de l'énergie dans le bâtiment (NEUROBAT)*, Manuel Bauer, EPFL PhD Thesis #1792 (1998)

BUILDING INTEGRATION OF RENEWABLE ENERGIES

Group leader: Ing. EPFL Christian Roecker
 Postdoctoral researcher: Dr Maria Cristina Munari Probst
 PhD student: Raquel Peres Gagliano
 Research assistant: Marja Edelmann



Capteurs intégrés en façade (Sunny Woods, arch. Beat Kämpfen)

Many building surfaces are ideally suited for the use of solar energy, but high costs, technical and aesthetic considerations have long kept building owners and architects from using even a small part of this potential. This is why the research group "Renewables Integration into the Built Environment" addresses the issue of optimal architectural integration of photovoltaic and thermal solar systems.

Major progress has been made in photovoltaics integration in the framework of several international projects over the last years. Currently, the group focuses on the integration of solar thermal technology and is co-leading the new IEA Task 41 "Solar Energy and Architecture".

Published work relates to

- Façade integration of solar thermal systems
- Criteria for successful architectural integration of active solar systems (PV & ST)
- Façade and roof integration systems for photovoltaics (pilot installations / international exhibition and testing centre for integrated photovoltaics "Demosite")
- Ergonomic interface for simulation software and "wizard" expert system

2009 Activities

One important activity was the collaborative work with international colleagues to establish and launch a new IEA SHCP Task "Solar Energy and Architecture" (Task 41). The LESO-PB has taken the lead of Subtask A "Criteria for Architectural Integration".

Collaboration with EDF has been established leading to the financing of a PhD thesis "Architectural Solar Design for Collective Residential Buildings".

Work on a new architect specific interface for LESOSAI (building physics and solar thermal simulation software) has been started, implementing a "wizard" concept for data entry. The possibilities of implementing the coloured glasses for solar collectors have been further studied, in collaboration with the industry.

Architectural integration research and teaching work has been continued, in collaboration with several Swiss institutions (SUPSI, HSLU, Swissolar).

Current Projects

ECLEER – Architectural Solar Design for Collective Residential Buildings

Funding: Electricité de France (EDF)

Duration: 2009-2013

The goal of this project is to study the possibilities and propose solutions to use solar thermal energy in the field of collective residential buildings. One important option is to take the opportunity offered by retrofit work on existing buildings to combine it with the installation of a proposed innovative product.

Solar Energy and Architecture - IEA SHC Task 41

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

The main goal of the Task is to help achieving high quality architecture for buildings integrating solar energy systems, mainly by improving architects' qualifications and enhancing solar thermal manufacturers' awareness of building integration issues.

LESOSAI-POLYSUN – Computer Simulation Tool for Architects

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2010

The goals of this project are twofold:

- combine in one tool the building energy model and all passive and active “solar” gains, allowing the user to optimise his project by testing complete solar variants in the early design stage.
 - broaden the use of this tool within the architects community by enhancing the ergonomics of the user interface and reducing the amount of data input, providing default values for solar systems and building elements.
-

Coloured Solar Thermal Collectors

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2008-2010

Standard solar collectors are difficult to integrate into facades due to their dark and irregular absorber surfaces visible behind the front glass, and lack of corresponding dummy elements. This project proposes to use coloured interference filters on the front glass to solve the glass transparency problem, therefore enhancing the architectural “integrability” of the collectors and allowing the use of matching dummy elements.

CCEM – House 2000: Innovative Building Technologies for the 2000 Watt Society

Funding: Competence Center Energy and Mobility CCEM

Duration: 2007-2009

The innovative building technologies needed for the 2000 Watts Society concept launched by the Swiss Federal Council need to be brought together to be demonstrated. Coloured solar thermal collectors are expected to play an important role for building heating and cooling and are the part of the proposed technologies.

PhD theses published in this domain at LESO-PB

Architectural integration and design of solar thermal systems, Maria Cristina Munari Probst, EPFL Thesis 4258 (2008)

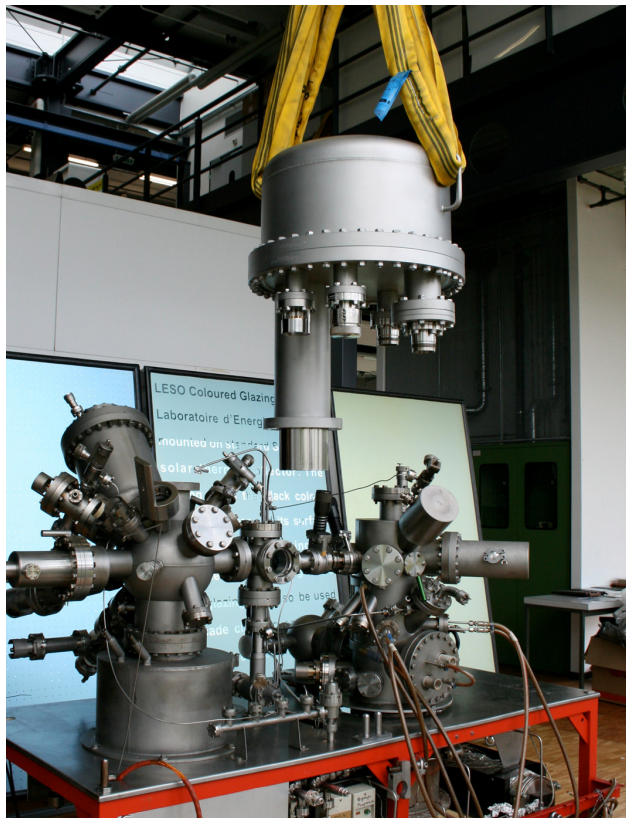
NANOTECHNOLOGY FOR SOLAR ENERGY CONVERSION

Group leader: Dr Andreas Schueler

Postdoctoral researchers: Dr Jonathan Castro, Dr Virginie Le Caër

PhD students: Martin Joly, Antonio Paone, Stefan Mertin

Research Assistant: Marina Gonzalez Lazo



Due to their fascinating optical and electronical properties, nanometer-scaled structures play an important role in solar energy conversion. The research group "Nanotechnology for Solar Energy Applications", develops and characterizes novel nanostructured materials for solar energy applications. The nanocomposite coatings consist typically of dielectric, semiconductor or metal nanocrystals embedded in a dielectric matrix. Applications include antireflection coatings on solar collector glazing, colored coatings with high solar transmittance for novel glazing of solar thermal facades, photoluminescent quantum dot solar concentrators for photovoltaic energy conversion and optical selective absorber coatings for thermal solar collectors and thermoelectric power generation.

The research group carries out fundamental research on novel nanocomposite materials and thin films materials and promotes the introduction of novel solar technologies through upscaling of the corresponding innovative manufacturing processes.

Published work relates to

- Coloured glazed thermal solar collectors
- Quantum dot solar concentrators
- Highly durable selective solar absorber coatings
- Novel thermochromic solar absorber coatings for overheating protection

2009 Activities

Major highlights from our activities include:

- the development of a clean low-cost process for the deposition of a novel selective absorber coating with good optical performance and excellent stability at elevated temperatures in air
- the deposition of novel switchable selective solar absorber coatings
- the development of novel surface treatments for ant-reflection of solar glazing
- the development of novel combinations of fluorescent materials for planar solar concentrators
- the concept and design of a new vacuum chamber for the plasma deposition of novel nanocomposite solar coatings
- the preparation of the installation of a UHV photoelectron spectrometer for the characterization of the electronic properties of novel nanocomposite solar coating

Current Projects

Technology Transfer of Coloured Solar Thermal Collectors

Funding: SwissINSO Trade & Invest Ltd

Duration: 2009-2012

At LESO, novel nanocomposite coatings on architectural glazing for solar active thermal facades have been developed within research funded by the Swiss Federal Office of Energy. The nanocomposite thin films are deposited by plasma assisted vacuum processes. The electronic and optical properties of the novel nanocomposite materials are thoroughly characterized. The transfer of the developed technology from science to market - including the upscaling of the processes to industrial production - is provided by LESO-PB. The novel glazing will allow a perfect architectural integration of solar thermal collectors into the building envelope thereby creating new possibilities for water and space heating as well as for solar cooling.

Advanced Switchable Selective Absorber Coating for Overheating Protection of Solar Thermal Collectors

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2011

Overheating and the resulting stagnation of solar thermal collectors is a common problem even in central European latitudes. During stagnation high temperatures lead to water evaporation, glycol degradation, and stresses in the collector with increasing vapor pressure. The occurring elevated temperatures lead to degradation of the materials that compose collector components such as sealing, thermal insulation, and also the selective absorber coating. A promising way to protect solar thermal systems without any mechanical device (e.g. for shading or for pressure release) is to provide them with a selective coating which exhibits a change in optical properties at a critical temperature T_c . Such « smart » solar collectors will allow a better dimensioning of solar thermal systems yielding a higher solar fraction without the inconvenience of overheating during summer. This project aims at the development of a novel generation of selective absorber coatings with thermochromic, "intelligent" properties.

Heat and Corrosion resistant nanocomposite selective Solar Absorber Coatings by Sol-gel Processing

Funding: Commission for Innovation and Technology (CTI)

Duration: 2008-2010

This project aims at the development of novel nanocomposite selective absorber coatings for solar thermal collectors. By the new production process, highly toxic CR(VI) shall be completely avoided. The novel coatings shall be absolutely chrome-free, more corrosion-resistant and more durable at elevated temperatures than existing products. Our approach is based on low-cost sol-gel techniques and will be suitable for up-scaling to industrial production.

Coloured Thermal Collectors – Nanosolar Technology Laboratory

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2008-2009

Construction of an advanced vacuum chamber for the plasma-deposition of novel nano-composite coatings, for solar energy applications such as coloured and thermochromic thermal solar collectors and improved switchable glazing. The installation will allow magnetron-cosputtering and deposition of multilayers with up to five magnetrons under high vacuum and ultra-high vacuum conditions.

Integrated Multifunctional Glazing for Dynamical Daylighting

Funding: Swiss Federal Office of Energy (SFOE)

Duration: 2009-2012

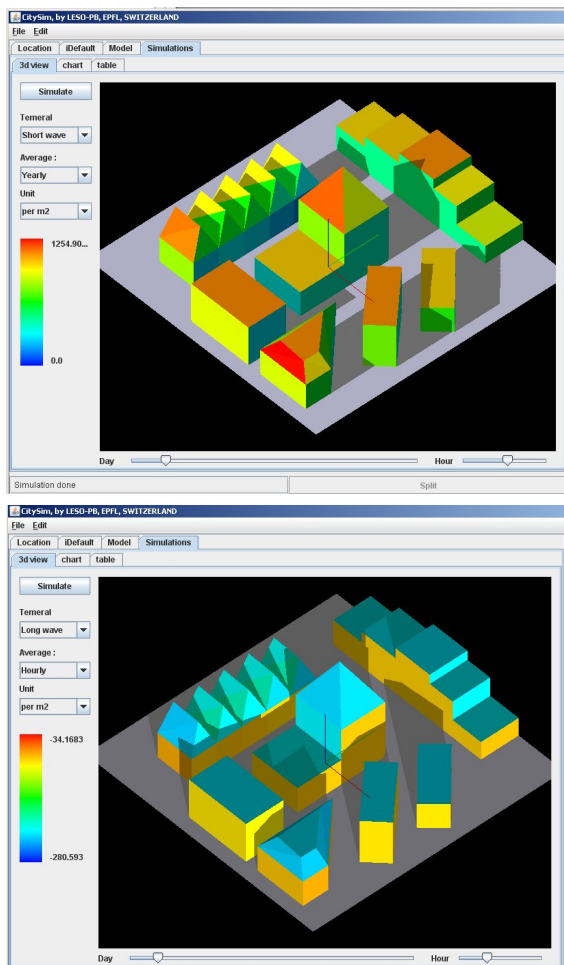
The project is aiming to set the bases for an integrated multi-functional glazing for dynamic daylighting using novel microstructures which will redirect sunlight into office rooms.

COMPUTER MODELLING OF COMPLEX SYSTEMS

Group leaders: Dr Darren Robinson

Postdoctoral researchers: Dr Jérôme Kaempf

PhD student: Urs Wilke



City Sim Model

By itself, building physics is concerned with rather elementary physics laws. But the construction, operation and demolition of a building are connected with many different aspects, and their interactions makes the complete system complex. The complexity is even increased when dealing with a whole district or a city instead of only one building.

This research domain includes two different aspects:

- modelling of building behaviour where non-deterministic aspects must be considered, such as user behaviour (occupancy, individual preferences relative to comfort, etc) or the stochastic nature of weather conditions;
- modelling of large groups of elementary buildings, where the complexity arises from the numerous interactions between the individual objects (buildings).

This domain is closely linked with the domain Sustainable Urban Development: notably, both domains cover the study of similar objects (urban districts or a whole city), and they are concerned with the modelling of similar phenomena (ecosystemic modelling, interaction with the environment).

Published work relates to

- Urban sustainable planning tools with 3D models (Suntool)

Activities 2009

Activities in 2009 were dedicated to the starting of a SNSF project dedicated to urban energy flow modelling involving the use of multi-agent modelling tools.

Current Projects

An Investigation of Strategies leading to a 2000W City using Bottom-up Models of Urban Energy Flows

Funding: Swiss National Science Foundation (SNSF)

Duration: 2009-2012

In this project we will develop a detailed spatially explicit model of the dynamic flows of energy and matter within a city due to transportation, the operation of buildings and the activities accommodated by them. This will involve the further development and integration of CitySim -- the most fully developed model available for explicit simulation of building-related energy flows in urban settlements --and MATSIM --a detailed transport micro-simulation model. The resulting platform should allow the simulation of all key physical urban resource flows. Once integrated, calibrated and validated, it will be applied to the city of Zürich to produce new guidance for its development up until 2050, with a view to achieving a 2000W/capita city.

EDUCATION AND TEACHING

COURSES AND STUDENT NUMBERS 2008/2009

Bachelor/Master Programmes

Course title	Lecturer	Students	Students numbers
Building Physics I	Prof. J.-L. Scartezzini	AR BA SEM1	211
Building Physics II	Dr A. Schueler	AR BA SEM2	185
Building Physics III	MER Dr Robinson	AR BA SEM3	133
Building Physics IV	Prof. J.-L. Scartezzini	AR BA SEM4	128
Building Physics V	Prof. J.-L. Scartezzini	AR BA SEM5	100
Building Physics VI	Prof. J.-L. Scartezzini	AR BA SEM6	107
Indoor Environment Quality	Prof. C.-A. Roulet	AR MA SEM1	23
Sustainable Urban Development, Infrastructures	Prof. J.-L. Scartezzini MER Dr D. Robinson	AR/GC/SIE BA SEM6 (ENAC Learning Units)	19
Energy within Buildings	Dr N. Morel	GC MA SEM1+3	43
Energy in the City	MER Dr D. Robinson MER Dr E. Gnansounou	AR/GC/SIE BA SEM4 (ENAC Weeks)	20
Monitoring within ENAC	Dr N. Morel	AR/GC/SIE BA SEM4 (ENAC Weeks)	18

PhD Projects

Project title	Name	Advisor	End	# EPFL-Thesis
Nanotechnology for Solar Energy Conversion	S. Mertin	Prof. J.-L. Scartezzini Dr A. Schueler	2013	N/A
Building integrated Solar energy Solutions for the Residential and Tertiary Sector	R. Peres Gagliano	Prof. J.-L. Scartezzini (Ch. Roecker)	2013	N/A
Thermochromic VO ₂ Films for "Smart" Solar Energy Applications	A. Paone	Prof. J.-L. Scartezzini Dr A. Schueler	2013	N/A
A Bottom-up Model of City Metabolism	U. Wilke	MER Dr D. Robinson	2013	N/A
Intensive Use and Perception of Daylight	A. Borisuit	Prof. J.-L. Scartezzini Dr M. Münch	2013	N/A
Urban resource Flow Modelling: from the Neighbourhood to the City	D. Perez	MER Dr D. Robinson	2013	N/A
Nanocomposite Thin Films for Solar Thermal Collectors	M. Joly	Prof. J.-L. Scartezzini Dr A. Schueler	2012	N/A
Evolutionary Optimization Algorithms for Biomimetic Building Control	D. Daum	Prof. J.-L. Scartezzini Dr N. Morel	2012	N/A
High Performance Integrated Daylighting and Electric Lighting Systems	F. Linhart	Prof. J.-L. Scartezzini	2010	N/A
Optimisation of Urban Form by the Evaluation of Solar Potential	M. Montavon	Prof. J.-L. Scartezzini	2010	N/A
On the Unification of Behavioural Modelling, Human Comfort and Energy Simulation	F. Haldi	MER Dr D. Robinson	2010	4587
On the Modelling and Optimization of Urban Energy Fluxes	J. Kaempf	Prof. J.-L. Scartezzini MER Dr D. Robinson	2009	4548
Multiscale Modelling of Urban Climate	A. Rasheed	MER Dr D. Robinson	2009	4531

Masters Projects

Title	Student/Institution	Year	Programme
Optimization and Fabrication of a Two-Dye Luminescent Solar Concentrator by Sol-Gel Dip Coating Process	C. Galantine (EPFL)	2009-2010	MSc Physics
Analysis of the Financial Cost, Environmental Effects and Quality of Swiss and Belgian Passive Houses	A.-S. Goudeseune (KU Leuven, Belgium)	2009-2010	MEng Arch.
Flexibilité d'un bâtiment au cours de sa durée de vie	M. Zimmermann (EPFL)	2009-2010	MSc Arch.
Intégration d'un bâtiment écologique autonome en centre ville	E. Moresi (EPFL)	2009-2010	MSc Arch.
Bilan thermique, comportement dynamique et améliorations d'une habitation unifamiliale	A. Allain, P. Jourdan (EPFL)	2009	MSc Civil Eng. (Diss. proj.)
Bilan énergétique d'un bâtiment, confort thermique et améliorations	V. Nidegger (EPFL)	2009	MSc Civil Eng. (Diss. proj.)
CIE Standard Skies in Switzerland: relative Occurrence and Impact on Daylighting System Performance	F. Alotto (Politecnico di Torino, Italy)	2008-2009	MSc Landscape Eng.

FOREIGN STUDENTS AND TRAINEES

LESO-PB Research Group	Student/Institution	Year	Programme
Nanostructured Inorganic thin Films for Solar Energy Conversion	A. Kostro	2009-2010	Post-grad intern
Nanostructured Inorganic thin Films for Solar Energy Conversion	S. Mertin	2009	Post-grad intern
Nanostructured Inorganic thin Films for Solar Energy Conversion	M. Pyton	2009	Civil Service
Nanostructured Inorganic thin Films for Solar Energy Conversion	G. Tornare	2009	BNF
Sustainable Urban Development	D. Angrula (IIT Bombay, India)	2009	Post-grad intern
Sustainable Urban Development	C. Quiroga (Master Sust. Arch.)	2009	Post-grad intern
Sustainable Urban Development	R. Jain (IIT Bombay, India)	2009	Post-grad intern
IT Support	E. Engstrom (ETML)	2009	Trainee
IT Support	S. Hausammann (ETML)	2009	Trainee
IT Support	Y. Fernandez	2009	Intern

VISITING PROFESSORS

Name/Institution	Year
S. Wittkopf, National University of Singapore	2009
G. Besuievsky, University of Gerona, Spain	2009

PUBLICATIONS 2009

Details see <http://infoscience.epfl.ch>.

REFEREED SCIENTIFIC JOURNALS

Birchler-Pedross A., Schröder C., Münch M., Knoblauch V., Blatter K., Schnitzler-Sack C., Witz-Justice A., Cajochen C., Subjective well-being is modulated by circadian phase, sleep pressure, age and gender
In *Journal of Biological Rhythms*, Vol. 24(3), pp 232-242 (2009)

Daum D., Deb K, Gupta S., Branke J. et al, Reliability-Based Optimization Using Evolutionary Algorithms
In *IEEE Transactions on Evolutionary Computation*, vol. 13, num. 5, p. 1054-1074 (2009)

Daum D., Morel N., Assessing the saving potential of blind controller via multi-objective optimization
In *Building Simulation*, vol. 2, num. 3, p.175-185 (2009)

Daum D., Morel N., Identifying important state variables for a blind controller
In *Building Environment*, vol. 45 num. 1-144, pp 887-900 (in press 2009)

Daum D., Morel N., Assessing the total energy impact of manual and optimized blind control in combination with different lighting schedules in a building simulation environment
In *Journal of Building Performance Simulation* (in press 2009)

Gruber D.P., Engel G., Sormann H., Schüler A., Papousek W., Modelling the absorption behaviour of solar thermal collector coatings utilizing graded α -C:H/TiC layers
In *Applied Optics*, vol.48, num. 8, p.1514-1519 (2009)

Haldi F., Robinson D., On the behaviour and adaptation of office occupants
In *Building and Environment*, Vol. 43, p. 2163-2177 (2009)

Haldi F., Robinson D., Interactions with window openings by office occupants
In *Building and Environment*, Vol. 44, num. 12, p. 2378-2395 (2009)

Kämpf J., Wetter M., Robinson D.
A hybrid CMA-ES and DE optimisation algorithm with application to solar energy potential
In *Applied Soft Computing*, vol. 2, num. 9, p.738-745 (2009)

Kämpf J., Montavon M., Bunyesc J., Bolliger R., Robinson D., Optimisation of buildings' daylight availability
In *Solar Energy* (in press 2009)

Kämpf J., Robinson D., Optimisation of building form for solar energy utilisation using constrained evolutionary algorithms
In *Energy and Buildings* (in press 2009)

Lindelöf D., A fast daylight model suitable for embedded controllers
In *Solar Energy*, vol. 83, num. 1, p.57-68 (2009)

Linhart F., Scartezzini J.-L., Minimizing lighting power density in office rooms equipped with Anidolic Daylighting Systems
In *Solar Energy* (in press 2009)

REFEREED SCIENTIFIC CONFERENCES

Daum D., Morel N., Coupling thermal simulation and multi-objective optimization for blind controller design

In CISBAT 2009 Proceedings, p. 377-382, Lausanne, September 2-3 (2009)

Davila Alotto F., Linhart F., Scartezzini J.-L., CIE Standard Skies in Switzerland: Relative Occurrence and Impact on Daylighting System Performance

In CISBAT 2009 Proceedings, p. 237-242, Lausanne, September 2-3 (2009)

Filchakova N., Robinson D., Thalmann P., A model of whole-city housing stock and its temporal evolution

In Proceedings Eleventh International IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Haldi F., Robinson D., A comprehensive stochastic model of window usage: theory and validation

In Proceedings Eleventh International IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Haldi F., Robinson D., A comprehensive stochastic model of blind usage: theory and validation

In Proceedings Eleventh International. IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Joly M., Python M., Antonetti Y., Rossy J.-P., Schüler A., Optical selective coating for solar absorbers

In CISBAT 2009 Proceedings, p. 23-29, Lausanne, September 2-3 (2009)

Kämpf J., Robinson D., Optimisation of urban energy demand using an evolutionary algorithm

In Proceedings Eleventh International. IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Linhart F., Scartezzini J.-L., Münch M., Daylight Exposure and Circadian Efficiency in Office Rooms Equipped with Anidolic Daylighting Systems

In CISBAT 2009 Proceedings, p. 255-260, Lausanne, September 2-3 (2009)

Linhart F., Wittkopf S., Scartezzini J.-L., High Performance Integrated Lighting Systems: Recent Achievements within the Framework of the "Green Lighting" project

In CISBAT 2009 Proceedings, p. 219-224, Lausanne, September 2-3 (2009)

Linhart F., Wittkopf S., Münch M., Scartezzini J.-L.

Recent Research on Anidolic Daylighting Systems: Highly Reflective Coating Materials and Chronobiological Properties

In Proceedings of SPIE 2009, vol. 7421-7434, p. 74230K-1-74230K-15, San Diego, August 2-6 (2009)

Paone A., Joly M., Sanjines R., Romanyuk A., Scartezzini J.-L., Schüler A.

Thermochromic films of VO₂ for "smart" solar energy applications

In CISBAT 2009 Proceedings, p. 29-34, Lausanne, September 2-3 (2009)

Paone A., Joly M., Sanjines R., Romanyuk A., Scartezzini J.-L., Schüler A.

Thermochromic films of VO₂ for "smart" solar energy applications

In Proceedings of SPIE 2009, vol. 7410-74100F, San Diego, August 2-6 (2009)

Rasheed A., Robinson D., Multiscale modelling of the urban climate

In Proceedings Eleventh International IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009).

Rasheed A., Robinson D., On the effects of Complex Urban Geometries on Mesoscale Modeling

In Proceedings Eleventh International IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Robinson D., Haldi F., Kämpf J., Leroux P., Perez D., Rasheed A., Wilke U., From the neighbourhood to the city: resource flow modelling for urban sustainability, In CISBAT 2009 Proceedings, p. 445-450, Lausanne, September 2-3 (2009).

Robinson D., Quiroga C., Sustainable masterplanning in practice: evaluation and synthesis
In CISBAT 2009 Proceedings, p.397-402, Lausanne, September 2-3 (2009)

Robinson D., Haldi F., Kämpf J., Leroux P., Perez D., Rasheed A., Wilke U., City-Sim: Comprehensive micro-simulation of resource flows for sustainable urban planning, In Proceedings Eleventh International IBPSA Conference Building Simulation, Glasgow, July 27-30 (2009)

Roecker C., Munari Probst M.C., Witzig A., Foradini F., Simulation tool for architects, In CISBAT 2009 Proceedings, p. 677-682, Lausanne, September 2-3 (2009)

PHD THESES

Haldi F., On the unification of behavioural modelling, human comfort and energy simulation in buildings
PhD Thesis EPFL, Nr 4587 (2009-2010)

Kämpf J., On the modelling and optimisation of urban energy fluxes
PhD Thesis EPFL, Nr 4548 (2009)

Rasheed A., Multiscale modelling of urban climate
PhD Thesis EPFL, Nr 4531 (2009)

BOOKS

Robinson D. , Integrated resource flow modelling of the urban built environment
In: Hensen, J.L.M. and Lamberts, R. (Ed's), Building Performance Simulation for Design and Operation,
Taylor & Francis: London (in press) (2009)

Scartezzini J.-L., Proceedings CISBAT 2009, International Conference Renewables in a Changing Climate
– From Nano to Urban Scale,
718 p., Lausanne, EPFL, 2-3 September (2009)

INVITED PRESENTATIONS

Scartezzini J.-L., Construire entre Ombre et Lumière

Keynote Speaker, EPFL Innovation Day 2009, Lausanne, 18 November 2009.

Scartezzini J.-L., Stadtplanung, Sonnenenergienutzung und Energieeffizienz

Invited Speaker, OcCC – Anpassung an den Klimawandel: Handlungsbedarf für Forschung und Praxis, Bern, 13 November 2009.

Scartezzini J.-L., Photobiological Impact of Day- and Electric Light achieved by Non-Imaging Optics

Invited Speaker, SAIC International Non-Imaging Workshop, La Jolla/San Diego (USA), 1 August 2009.

Scartezzini J.-L., Sustainable Buildings: Main Players of Sustainable Campus

Keynote Speaker, International Sustainable Campus Network – Global University Leaders Forum, Lausanne, 10-12 June 2009.

Scartezzini J.-L., Sustainable Buildings: from Nano to Urban Scale

Invited Speaker, Alliance - Renewable Energy Day, Lausanne, 3 June 2009.

Scartezzini J.-L., R&D Activities at the Solar Energy and Building Physics Laboratory

Invited Speaker, ENAC Professional Associations Meeting, Lausanne, 29 April 2009.

Scartezzini J.-L., Vision and Challenges for Sustainable Building Design and Performance

Keynote Speaker, National University of Singapore – MFPV International Workshop, Singapore, 2-3 April 2009.

Scartezzini J.-L., R&D Activities in Building Energy Efficiency at LESO-PB/EPFL

Invited Speaker, Executive Board of Siemens Company, Zug, 9 March 2009.

Scartezzini J.-L., R&D Activities in Solar Photovoltaic Energy at LESO-PB/EPFL

Invited Speaker, Visit of Spanish Minister of Science and Technology, Lausanne, 26 January 2009.

Munari Probst M.C., UiSol Urban integration of solar systems

Invited Lecturer, University of Mendrisio, 30 November 2009

Munari Probst M.C., Acceptability of building integrated solar systems

Invited Speaker, Building Integrated Solar Network BISOL, Zurich, 18 August 2009

Munari Probst M.C., Building integration of solar thermal and coloured panels

Invited Speaker, Graz, 23 April 2009

Munari Probst M.C., Architecture et énergie solaire: une maison solaire passive dans la région du Léman,

Invited Lecturer, SET-Routes Inside Lectures CERN, Geneva, 20 April 2009

Munari Probst M.C., Facilitate the acceptance of solar installations in the built environment

Invited Speaker, Building Integrated Solar Network BISOL, Lucerne, 23 March 2009

Munari Probst M.C., Intégration architecturale et design de systèmes solaires thermiques

Invited Speaker, Journée Schweizer "Construire pour le futur", Geneva, February 2009

Münch M.,

Invited Speaker Schweizer Lichtgesellschaft (SLG) Annual Meeting: Licht und Gesundheit, Lucerne (Switzerland), November 2009

Münch M., The built environment and the human response to (day-)light

Invited Speaker, Symposium "Chronobiology and Architecture" at the annual meeting of the Society for Light Treatment and Biological Rhythms (SLTBR) Berlin, Germany, June 2009

- Münch M., EEG spectra in healthy older adults across all circadian phases during NREM sleep
Keynote Speaker, Annual meeting of the Swiss Society for Sleep Research, Sleep Medicine and Chronobiology (SSSSC), March 2009
- Münch M., Sleep and rhythms in humans
Invited Speaker, Vision & Cognition Seminar, Laboratory of Cognitive Neuroscience & Laboratory of Psychophysics, Brain-Mind Institute, Swiss Federal Institute of Technology, Lausanne (Host: Prof. M. Herzog), March 2009
- Münch M., Licht und Architektur – eine chronobiologische Sichtweise
Invited Speaker, Meeting “Future Light” (Fh Luzern) Bern, Switzerland (Host D. Ernst), March 2009
- Robinson, D., Complexity, sustainability and the City,
Invited Lecturer, University of Michigan, November 2009
- Robinson, D., Sustainable urban neighbourhoods – past and future perspectives,
Invited Lecturer, Université de Liège, 28th October 2009
- Robinson, D., Vers les quartiers durables,
Invited Speaker, Eco-Habitat, CREM, Martigny, 7th October 2009
- Robinson, D., Urban scale simulation,
Invited Lecturer, University of Pennsylvania, May 2009.
- Robinson, D., Size, shape and the sustainability of cities,
Invited Panellist, Alliance for Global Sustainability – Annual Meeting, ETH Zurich (Switzerland), Jan. 2009
- Schüler A., Nanostructured thin films for solar energy applications,
Invited Lecturer, IMT Neuchâtel, 26th March 2009
- Schüler A., Advanced nanostructured coatings for solar energy conversion: Large opportunities for small structures,
Keynote Speaker, CISBAT 2009, International Scientific Conference, 2-3 September 2009
- Schüler A., Optische Nanokomposit-Beschichtungen für Solarenergie-Anwendungen und Gebäudeintegration von Solarenergie-Systemen,
Invited Speaker, Innovationsgruppe Plusenergiehaus, ETH Zürich, September 16th, 2009
- Schüler A., Nanotechnology for solar energy conversion,
Invited Speaker, SIBF – EPFL Renewable Energy Conference, Lausanne, October 4th, 2009
- Schüler A., Solar Buildings : From Nano to Urban Scale,
Keynote Speaker, Solar Summits Freiburg, 14 - 16 October 2009
- Schüler A., Advanced nanostructured coatings for innovative solar facade glazing,
Invited Speaker, SwissINSO Open House at EPFL, November 3rd, 2009

CONFERENCES AND LECTURES

CISBAT 2009

The 2009 edition of the international conference CISBAT invited specialists from academic institutions and industry to meet, present and discuss the latest research and development in advanced sustainable technologies for the built environment. The focus lay on the following topics:

- Nanotechnology for solar energy conversion (solar nanotechnologies)
- Sustainable building envelopes (ecobuildings)
- Hybrid and passive cooling (natural ventilation)
- Daylighting and electric lighting (green lighting)
- Indoor environment quality and health (global comfort)
- Advanced building control systems (biomimetic strategies)
- Urban ecology and metabolism (material and energy flows)
- Building and urban integration of renewables (electricity, heating and cooling)
- Decentralised energy production and interactive distribution (polygeneration)
- Information technologies and software (computer simulation)

Over 200 participants from 30 countries participated in the two-day event.

CISBAT is a cycle of international conferences related to Solar Energy and Sustainability in the Built Environment. Conferences are organised every two years by the Solar Energy and Building Physics Laboratory and part funded by the Swiss Federal Office of Energy.

LESO LUNCHTIME LECTURES

Title	Lecturer	Date
Simulation of Optical Properties of Si Wire Cells	Pietro Peter Altermatt, Inst. Solar Energy Research Hamelin, Germany	06.11.2009
Hardware Accelerated Daylight Illumination Method for Interactive Visualization	Prof. Gonzalo Besuievsky, University of Gerona, Spain	25.09.2009
Multiscale Modelling of the Urban Climate	Adil Rasheed, LESO-PB, EPFL	10.07.2009
Optimisation of Energy Fluxes from Building to Urban Scale	Jérôme Kaempf, LESO-PB, EPFL	05.06.2009
Innovative Thin Film Coatings for Sun Protection Glasses to Avoid Overheating During Summer	Dr. Iris Mack, University of Basel	01.05.2009
Couches Minces Nanocomposites pour Capteurs Solaires Thermiques	Martin Joly, LESO-PB, EPFL	06.03.2009
Design and Performance of a Zero Energy Building at NUS	Prof. Stephen Wittkopf, National University of Singapore	06.02.2009

REPRESENTATION

EPFL INTERNAL

Name	Function, Organisation	Start	End
Prof. J.-L. Scartezzini	Member of Search Committee (TTAP Sustainable Building Technology)	2009	-
Prof. J.-L. Scartezzini	Member of ENAC Academic Promotion Committee	2009	-
Prof. J.-L. Scartezzini	Head of CISBAT 2009 Editorial Committee	2009	2011
Prof. J.-L. Scartezzini	Member of Working Group on Excellence in Doctoral Education	2008	2010
Prof. J.-L. Scartezzini	Member of Search Committee (TTAP Sustainable Energy)	2005	2009
Prof. J.-L. Scartezzini	Head of Institute (ICARE)	2002	2009
Prof. J.-L. Scartezzini	Head of Doctoral Programme (EDEN)	2002	2009
Prof. J.-L. Scartezzini	Member of EPFL Doctoral Committee	2002	2009
MER Dr D. Robinson	Member of CISBAT 2009 Scientific Committee	2009	2011
MER Dr D. Robinson	ENAC Faculty Council	2008	-
MER Dr D. Robinson	Co-director of Master of Advanced Studies Architecture and Sustainable Development (co-organized with University of Toulouse (France))	2007	-
MER Dr D. Robinson	Member of Doctoral Programme Committee (EDEN)	2005	2009
Dr. A. Schueler	Member of CISBAT 2009 Scientific Committee	2009	2011
Dr. A. Schueler	Administrator of Doctoral Programme (EDEN)	2006	2009
Dr N. Morel	Member of CISBAT 2009 Scientific Committee	2009	2011
Dr N. Morel	ENAC Faculty Council	2006	-
P. Loesch	ENAC Faculty Council	2006	-
C. Roecker	Member of CISBAT 2009 Scientific Committee	2009	2011
C. Roecker	Member of ESOPP Pilot Committee	2008	-
C. Roecker	Member of ESOPP Scientific Committee	2008	-

EPFL EXTERNAL

Name	Organisation, Function	Start	End
Prof. J.-L. Scartezzini	European Centre and Laboratories for Energy Efficiency Research (ECLEER), Member of Advisory Board	2009	-
Prof. J.-L. Scartezzini	The Open Construction & Building Technology Journal , Member of Editorial Advisory Board	2009	-
Prof. J.-L. Scartezzini	Journal of Building Physics, Associate Editor	2009	-
Prof. J.-L. Scartezzini	IPCC Working Group III – Mitigation, Scoping Meeting for Renewable Energy, Expert Reviewer	2008	2010
Prof. J.-L. Scartezzini	World Economic Forum (WEF), Global Agenda Council on Sustainable Energy, Member of Experts Panel	2008	-
Prof. J.-L. Scartezzini	Qatar National Research Fund (QNRF), National Priorities Research Program (NRRP), Peer Reviewer	2007	-
Prof. J.-L. Scartezzini	Swiss Competence Centre for Energy and Mobility (CCEM-CH), Research, Committee Chair	2005	-
Prof. J.-L. Scartezzini	International Council for Research and Innovation in Building and Construction, EPFL Representative	2004	-

REPRESENTATION EPFL EXTERNAL (cont'd)

Prof. J.-L. Scartezzini	European Renewable Energy Research Centres Agency (EUREC), College of Members, EPFL Representative	2004	-
Prof. J.-L. Scartezzini	Ministère de la Région Wallonne, Direction générale des Technologies, de la Recherche et de l'Energie (DGTRE), Membre du Comité d'Experts	2003	-
Prof. J.-L. Scartezzini	Solar Energy International Journal, Associate Editor	2000	-
MER Dr D. Robinson	"Journal of Building Performance Simulation", published by Taylor and Francis, Editorial Board Member	2009	-
MER Dr D. Robinson	On-line journal "Sustainability", published by MDPI, Editorial Board Member	2009	-
MER Dr D. Robinson	National Science Foundation of Portugal programme "Architecture and Urban Studies", Member of Evaluation Committee	2009	-
MER Dr D. Robinson	EcoParc, Neuchâtel, Board Member	2009	-
MER Dr D. Robinson	e-sim (IBPSA-Canada) national conference, 2010, Scientific Committee Member	2009	2010
MER Dr D. Robinson	SB10, Sustainable Building Conference, Scientific Committee Member	2009	2010
MER Dr D. Robinson	ECCE Symposium, 2009, Scientific Committee Member	2009	2009
MER Dr D. Robinson	1 st Swiss Building and Urban Simulation Conf: BUS09, Scientific Committee Member	2009	2009
MER Dr D. Robinson	Building Simulation 2009, BUS 2009, Session Conference Chair	2009	2009
MER Dr D. Robinson	Building Simulation 2009, BUS 2009, Session Conference Chair	2009	2009
MER Dr D. Robinson	French national research agency (ANR) programme "Villes Durables", Member of Evaluation Committee	2008	-
MER Dr D. Robinson	Swiss Chapter of Int. Building Performance Simulation Association: IBPSA-CH, Founding Board Member	2006	-
Dr N. Morel	National Competence Center for Energy and Mobility (CCEM-CH) Retrofit & House 2000 projects, Member of Steering Committee		
Dr A. Schueler	Journal „Solid State Sciences“: special issue Nanomaterials and Nanotechnology on carbon-based nanostructured composite films (vol 11, 10/2009), Guest Editor	2009	2009
C. Roecker	National Competence Centre for Energy and Mobility (CCEM-CH), House 2000, Member of Steering Committee	2007	-
C. Roecker Dr M.-C. Munari Probst	Subtask leaders Task 41 IEA		

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