



European Summer Campus, Strasbourg: June 27 – July 5, 2010

“Metamaterials”

Why light bends the wrong way

Why things don't fall down

<http://esc.u-strasbg.fr/index.php>

Dear colleagues,

We would like to draw your attention to the ninth European Summer Campus (previously called Summer University) on the theme “**Metamaterials**”, Strasbourg, June 27 – July 5, 2010.

The European Summer Campus of the Université de Strasbourg is a prestigious and highly sponsored one week meeting of students from all over Europe. They attend lectures on some of the most recent research topics in physics presented by internationally known scientists. An important part of the programme consists in exploring the cultural and political heritage of the region of Alsace and Strasbourg, where the European Parliament and the Council of Europe are located.

In 2000 European Summer Universities were created by the French Minister of Education to develop the pan-European University space for undergraduate students and university staff. Mobility, not only of scientists but also of students, plays an increasingly important role in research, industry and the academic domain. Since 2009 this programme is called “European Summer Campus” (Campus Européen d'Eté).

We had extremely encouraging experiences during the last eight years (2002-2009) with Summer Universities focussed on the problems of our energy resources, an introduction to Nanoscience, Modern Optics, Quantum Mechanics, Astroparticle and Particle Physics, the Physics of Living Matter, Physics Probes and the Secrets of Nuclear Physics. The European Summer Campus 2010 is organised by the Physics Department of the Université de Strasbourg (UdS) in collaboration with the Karlsruhe Institute of Technology (KIT) and the Université de Haute Alsace (UHA) on the subject of “Metamaterials”, which will address the most recent developments in this new domain of physics and its impact on our society via the possibility of exciting applications in many fields.

Motivation for students

The idea of the 2010 European Summer Campus is to offer to the students an enthusiastic and pedagogical introduction to the most recent research subjects. The lectures will be given by researchers recognized internationally in their field.

The Scientific Programme

It will consist of 10-12 main lectures of 2x 45 minutes each, student workshops organised at several research laboratories, round table discussions and a poster session. The lectures will start on Monday morning, June 28 and will end on Saturday noon, July 3.



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Targeted Audience

The lectures are appropriate for students in physics having successfully completed three years of university studies.

Validation of the Summer Campus

All students have the possibility (optional) to validate their participation by passing an examination on Monday morning, June 5. It is suggested that home universities recognize the successful participation with 3 credit points (ECTS). Students in physics registered in the Master programme at the UdS can validate their participation as one of the optional courses of the second year (M2).

Housing and Transportation

Accommodation for students will be provided free of charge. Within the limits of our budget we can cover an important fraction of the travel expenses.

The European Summer Campus is now open for applications:

<http://esc.u-strasbg.fr/index.php>

We would very much appreciate if you could inform students at your university about this project and encourage and support them to attend the Summer Campus on Metamaterials.

With best regards,

On behalf of the organising committee:

Thierry Charitat, Dominique Dupuis, Cyriaque Genet, Ulrich Goerlach, Stefan Haacke, Pascal Hébraud, Charles Hirlimann, Zbigniew Kuznicki, Jean-Pierre Münch, Nicolas Rivier, Martin Wegener



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**Campus Européen d'Eté
European Summer Campus**

Metamaterials

***“Why light bends the wrong way”
“Why things don't fall down”***

SCIENTIFIC PROGRAMME

Metamaterials have physical properties (optical and/or mechanical) determined by their structure instead of their bulk chemical constituents. They can be natural (plant stem – made of soft material, cytoskeleton, biopolymers) but are mostly artificial. The recent realisation of metamaterials bending light the wrong way (with negative index of refraction) and the extraordinary physical properties of these materials (flat, perfect lenses free from resolution restrictions and, possibly, invisibility screen) have generated an extraordinary interest. Similarly, the photon sieve, a metallic plate with a regular array of holes, is much more than a super transparent material but a device storing and re-emitting electromagnetic energy. The concept of metamaterial (fold, arches or buttresses) has been used for centuries to redirect stresses in bridges or gothic cathedrals (“why things don't fall down”), to prevent the catastrophic growth of fractures or in the design of weaved tissues (clinging or hanging fabrics). Thus, the assembly of elements in a particular structure responsible for one or several physical properties has been developed by Darwinian evolution or by scientific endeavour. We will try to understand how and why.

Programme:

The main topics, which will be discussed at the European Summer Campus (ESC2010) are grouped into 7 modules:

1) Negative refraction (“Why light bends the wrong way”)

A composite material with resonances of the electric and magnetic fields in the same frequency range has a negative refractive index. It bends the light the wrong way, and constitutes a perfect lens that is flat with a resolution beyond the diffraction limit.

Course: Aloyse Degiron, Orsay

2) Photon sieve

Light incident on a metallic plate transpierced with a lattice of nano-sized holes is reemitted on the other side with extraordinary efficiency. The plate is much more “transparent” than the total geometric cross section of the holes. It is the lattice of holes that makes the material super transparent.

Course: Cyriaque Genet, Strasbourg

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3) Photonic crystals and photonic metamaterials

Both photonic crystals and metamaterials can be viewed as artificial materials with tailored optical properties. In addition to negative refractive indices, photonic metamaterials also allow for giant chiral effects, enhanced nonlinear optics, and for shaping optical space via transformation optics. Photonic crystals enable photonic band gaps and a tailored "electromagnetic vacuum". Theory (Kurt Busch) and experiment (Martin Wegener) will be covered. The visit to Karlsruhe also includes laboratory visits.

Course: K. Busch and M. Wegener, Karlsruhe; Visit of laboratory: M. Wegener

4) Structural metamaterials ("Why things don't fall down")

The manifold of available materials is not only an asset, it is also a challenge. This has led in recent years to the development of systematic material selection methods providing guidelines to select, for a given set of requirements, the best possible solutions. The first part of the course will deal with this manifold and with the material selection methods and software.

In spite of this huge manifold, the requirements are often contradictory, and for some of these contradictions there is no "single material solution". This has led to the development of hybrid materials, or "metamaterials" where material associations, geometry and topology provide new strategies to "expand the material world". The second part of the course will deal with these new developments in material science.

Course: Yves Bréchet, Grenoble

5) Soft metamaterials

Examples of soft metamaterials: Entropic elasticity, polymer melts, Casimir effect in vacuum and in polymers.

Course: Sergei Obukhov, Gainesville, FL

6) Cytoskeleton and motion of living cells

Stress-strain and rheology of living cells through the nonlinear elasticity of a network of semi flexible, sliding filaments

Course: B. Fabry, Erlangen

7) Elasticity of textile fabrics and yarns

Exploit shear strain and Poisson ratio of anisotropic structures. Haute Couture: Mlle Vionnet, "bias cut" vs. "square cut".

Small experiments and example classes.

Coordinated by Dominique Dupuis, ENSISA, UHA Mulhouse

Evening Lecture in common with the French Physical Society (SFP):

Sir John Pendry, Imperial College

Prelude

An introduction to several essential concepts, (origin of the refractive index, critical size for nucleation or fracture, stress and strain, etc.) will be given by one or several members of the local scientific committee.



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Workshops and experiments in different laboratories, guided visits:

We will demonstrate some aspects of metamaterials with small experiments taking place at the participating institutes or in the lecture hall (Elasticity of textile fabrics and yarns).

One full day at the Karlsruhe Institute of Technology, institute of applied physics June 30

It will consist of two lectures (experimental and theoretical aspects) on photonic metamaterials and crystals in the morning and of a visit of the laboratory in the afternoon.

Round table discussions: (to be confirmed)

- What is the smallest size of an object which can still be classified as a metamaterial?
- How many atoms will form a critical cluster for nucleation?
- Invisibility: is it science-fiction or can it become reality?
- Any similarities between electromagnetic and structural metamaterials?

Poster session

We offer to our students the possibility to present their research work or their university in an informal poster session at the beginning of the Summer Campus. The goal is to ease the process of first contacts; the posters will be displayed during the entire week.

Documentation:

The documents related to all lectures will be placed on our web-site as soon as they are available and video streams of all lectures will be distributed on DVD after the end of the Summer Campus.

The European Aspect

A guided visit to the architecturally and functionally impressive buildings of the Council of Europe combined with a presentation and a discussion with a representative of the Council will provide background information about the European Institutions in Strasbourg.

Social and Cultural Programme

Alsace is a region with rich cultural and historical legacy and its position along the border between France and Germany has made it an important economical focal point. Some excursions in Strasbourg and a trip to the countryside will introduce the participants to the cultural treasures and specialities of this region.



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Organisation

Application

The participants of the Summer Campus are expected to have at least 3 successfully completed years of physics universities studies but should in general not yet have started with their PhD thesis. Only a very limited number of students in the first year of their thesis will be admitted. Students are expected to follow actively all lectures and to seek frequent discussions with the lecturers. Sufficient knowledge in English to follow the lectures and to communicate with the lecturers and other students is mandatory.

Students, interested in participating at the European Summer Campus are asked to complete the on-line application form available on our Website indicated below, **before May 16th**. A letter of recommendation by a senior faculty member is required which should follow the structure of the template provided on our web page and be mailed directly to the Conference Secretary.

Students who do require an entrance **visa** to France (see below) should apply before May 10th in order to respect the delays of the visa procedure.

Due to the limited number of places available, applications will be selected on the basis of the letters of recommendation and also by the attempt to reach a balanced distribution of universities and countries. Early applications will be favoured and some students might be admitted already before the closing date.

Admitted candidates will be notified no later than May 30th

Place and Time

The European Summer Campus will take place at the Physics and Engineering Department of the University of Strasbourg very close to the city-centre.

Sunday, June 27 is reserved for arrival and registration.

The official language of the Summer University sessions is English. Participants are expected to be able to communicate fluently in this language.

Housing

Accommodations for participant students will be provided free of charge. Students will be housed in single rooms in the University residence of Strasbourg, close to the faculty.



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Transportation

Travel expenses of the participants will be covered within the limitations of our budget. In general this will be equivalent to 80-100% of the cost of a second class return trip by train or coach or an economy flight if necessary. Certain upper limits are however in place for each country. It is obligatory to request an approval by the organisers for the type of transportation you have chosen or it might be impossible to reimburse your expenses adequately. This is particularly important if you have to come by plane.

VISA

No entrance-visa is required to enter France for citizens of most European countries. **Please verify yourself sufficiently in advance, if a visa is necessary for you and inform yourself about the duration necessary to obtain one.** Do apply before May 10th and inform the organisers early enough, if there might be a time problem to obtain a visa.

All participants will receive an official invitation letter by the organizers.

How to get to Strasbourg

Useful information about Strasbourg and on how to get there can be found at

<http://www.strasbourg.fr/Strasbourgfr/FR>

<http://cms.strasbourg.fr/Strasbourgfr/GB>

<http://www.strasbourg.com/>



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Organizing committee

Chair:

Ulrich Goerlach, Prof., UdS, IPHC IN2P3-CNRS Strasbourg

Coordinator at KIT (Karlsruhe Institute of Technology):

Martin Wegener, Prof.

Coordinator at ENSISA:

Dominique Dupuis, Prof. (ENSISA, UHA)

Other members:

Thierry Charitat, MC (ICS)

Cyriaque Genet, CR (ISIS)

Stefan Haacke, Prof., (IPCMS, DON)

Pascal Hébraud, Chargé de Recherche, (IPCMS, DON)

Charles Hirlimann, Prof., (IPCMS, DSI)

Zbigniew Kuznicki, Prof., (LSP)

Nicolas Rivier, Prof., (IPCMS, DEMONS)

Jean-Pierre Münch, Prof., Director UFR Physique et Ingénierie

Secretariat: Annick Coulibaly and Monique Dell, UFR Physique et Ingénierie

Technical support:

Communication, Catherine Berger, IPHC

Informatics, Olivier Hunzinger, UFR

Video recording, Christophe Helfer and Nicolas Rudolf, IPHC

Website: Nicolas Busser, IPHC

Website:

For further information and the application form please consult our website at

<http://esc.u-strasbg.fr/index.php>



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