

VALIDATION

Ces cours peuvent donner droit à des crédits ECTS, prière de se renseigner auprès de sa haute école de rattachement

 PHYSIQUE
THÉORIQUE

- 1. Gravitation and cosmology in brane-worlds** ■ **David Langlois**, Institut d'Astrophysique de Paris, France
 A few years ago, the idea of extra-dimensions went through a renewal with the possibility, suggested by developments in string theory, that ordinary matter is confined to a sub-space, called brane, embedded in a higher dimensional spacetime. A consequence of this hypothesis is that the "size" of these extra-dimensions could be much larger (even infinite) than previously thought. This course will present brane-world models and discuss their phenomenological consequences, mainly for gravity and cosmology. Self-gravitating branes in a five-dimensional bulk space-time. Productions of bulk gravitons by the brane. Inflation in the brane.
Les jeudis 19, 26 avril, 3, 10 mai 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 121
- 2. Statistical physics of complex networks: from living cells to the Internet** ■ **Sergei Maslov**, Brookhaven National Laboratory, USA
 Networks have recently emerged as a unifying theme of research on complex systems. An overview of some recent work in this field will be given, concentrating on:
 - propagation of signals and perturbations in networks with broad degree distribution;
 - detection of non-random topological patterns in networks;
 - the effect of communities/modules on the topology of networks and the algorithms for their detection.
 These general ideas will be illustrated using examples of both biological and information complex networks. In particular
 - protein interaction and regulatory networks in living cells,
 - rough physical backbone of the Internet - connections between different Autonomous Systems,
 - World Wide Web - the directed network of webpages connected by hyperlinks,
 will be described and analysed.
Les jeudis 24, 31 mai, 7, 14 juin 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 121, *sauf 24 mai: EPFL, Lausanne, salle BM2135*

 PHYSIQUE
NUCLÉAIRE &
CORPUSCULAIRE

- 1. Physique au-delà du Modèle Standard** ■ **Guido Altarelli**, Università di Roma Tre and CERN, Geneva
 The course will begin with a general introduction, to set the context, consisting of a coarse map of the status of particle physics at the start of the LHC. Then the limits of the SM and its conceptual and phenomenological problems will be addressed. An overview of possible forms of new physics at the TeV scale: supersymmetry, "little Higgs", extra space-time dimensions, composite Higgs will conclude the introduction. Then two specific chapters of new physics will be presented in detail, which represent the most realistic items: Grand Unified Theories and Neutrino Masses and Mixings.
Les jeudis 15, 22, 29 mars, 5, 19, 26 avril 2007 de 14h15 à 17h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 120
- 2. Les ondes gravitationnelles** ■ **Michele Maggiore**, Université de Genève
 Theoretical and experimental aspects of gravitational-wave physics.
 On the theoretical side: Definition and properties of gravitational waves (GWs). Generation of GWs from weak-field sources: Einstein quadrupole formula and multipole expansion. Gravitational backreaction and inspiral of compact binaries. Generation of GWs from strong-field sources: post-Newtonian expansion and relaxed Einstein equations. Observation of GWs from the change of orbital period in compact binaries: the Hulse-Taylor pulsar and the double pulsar.
 On the experimental side: Functioning principles of detectors. Resonant-mass detectors. Interferometric detectors: present (LIGO, Virgo), near future (advanced interferometers). The space interferometer LISA. Data analysis techniques for GW experiments.
Les jeudis 24, 31 mai, 7, 14 juin 2007 de 14h15 à 17h30 ■ EPFL, Lausanne, Centre Ouest, salle CO 123, *sauf 24 mai: EPFL, Lausanne, salle CM106*

 PHYSIQUE
DE LA MATIÈRE
CONDENSÉE

- 1. ARPES of cuprates and related correlated materials** ■ **Z.-X. Shen**, Stanford University, USA
 We will discuss the study of important current problems in material physics, with emphasis on complex oxides. The materials of interest are superconducting materials, magnetic materials, ferroelectric and other dielectric materials. In these lectures, we focus on the angle-resolved photoemission spectroscopy (ARPES) of strongly correlated electron systems, such as the high-temperature superconductors. ARPES is an especially powerful technique in determining the microscopic electronic structure of condensed matter systems, because it maps out the occupation density of electrons in momentum space. In turn, this information is also related to the single electron Green's function. Although our experimental measurements have a simple interpretation within the framework of one-electron band theory, we have been using this technique to study the more complex many-body physics of strongly correlated quantum systems.
Les jeudis 29 mars, 5 avril 2007, de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 121
- 2. Atomic-layer tailoring of high-Tc superconductors and related oxides** ■ **Ivan Bozovic**, Brookhaven National Laboratory, USA
 Using the 'next-generation' molecular beam epitaxy system, we have reproducibly synthesized thin films of LaSrCuO, BiSrCaCuO and BaKBiO with rms surface roughness in the range 0.2-0.5 nm. This technology has enabled fabrication of precise and uniform multilayers and superlattices, some of which contain barriers or HTS layers that are just one-unit-cell thick and yet have no pinholes over macroscopic areas. In turn, such heterostructures enable novel experiments that probe into the basic physics of HTS. For example, we have established that HTS and antiferromagnetic order phase separate on angstrom scale, while the pseudo-gap state apparently mixes with HTS on an anomalously large length scale ("Giant Proximity Effect").¹⁻⁴ In this talk, we will report on our most recent results with such cuprate and bismuthate heterostructures, including XRD, AFM, RHEED, TOF-ISARS, LEEM, high-resolution TEM, transport, Hall effect, high magnetic fields (33 T), photo-induced absorption spectroscopy, photoconductivity, and resonant (synchrotron) X-ray scattering. We will also discuss atomic-layer synthesis of "artificial" (i.e., metastable) superconductors with high-Tc (above liquid nitrogen temperature) and future prospects for other correlated materials.
Les jeudis 15, 22 mars 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 121
- 3. Cell motility as persistent random motion: Theories from experiments** ■ **Henrik Flyvbjerg**, Risø National Laboratory, Denmark
 In these lectures we present recent progress in understanding the cell motility, related to the research on functional genomics: the adhesion and growth of cells on specifically designed environments that supports the targeted nanotechnological design of biocompatible surfaces. Compatibility of invasive microorganisms are studied at the cell level and single cell test systems are developed for cytotoxicity screening of radionuclides towards cancer cells. Optical nanosensor particles are being developed for in vivo quantification of metabolic compounds and processes; this supports our advanced chemical analysis of quenched samples. Discussion of future prospects is also given.
Les jeudis 3, 10, 24, 31 mai 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 120, *sauf 24 mai: EPFL, Lausanne, salle BM2131*
- 4. Group Theory and its relevance/application to studies of molecular adsorbates** ■ **Neville Richardson**, University of St Andrews, U.K.
 This 4x3 hour graduate level course of lectures/workshops aims to provide a practical appreciation of the power of group theoretical methods in understanding the properties of well-defined, single crystal surfaces and, more specifically, the properties of molecules adsorbed on such surfaces. A particular focus will be on a symmetry-based description of electronic and vibrational transitions within the adsorbate and their links to important surface spectroscopies. The course will cover the following topics:
 Revision of group theory of isolated objects; (symmetry elements and operations properties of groups character tables reducible and irreducible representations symmetry adapted molecular orbitals group theoretical description of molecular vibrations); Symmetry rules governing electron excitation and emission in isolated molecules; Group theoretical description of molecular vibrations IR and Raman activity of molecular vibrations; Symmetry properties of 2D periodic systems (symmetry elements, Bravais Lattices, 2D space groups, site symmetries, factor group symmetries); Electronic structure of ordered arrays; Angle resolved photoemission from substrates and oriented molecules; Vibrational spectroscopy of molecular (adsorbates adsorption induced symmetry changes; surface selection rules; Determination of molecular orientation); Other surface spectroscopies (NEXAFS, X-ray emission etc) Chirality at surfaces
Les jeudis 5, 19, 26 avril, 3 mai 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 123
- 5. Electronic properties of colossal magnetoresistance CMR Oxides** ■ **Yoshinori Tokura**, University of Tokyo, Japan
 Complex (or correlated-electron) materials are on the frontier of materials physics because conventional solid-state theory is often unable to explain their frequently novel behavior, high-temperature superconductivity being a prime example. Among these materials are the manganese oxide compounds that exhibit the colossal magnetoresistance (CMR) effect. An American-Japanese collaboration working at the Advanced Light Source has shown that the quasiparticle concept, a pillar of current solid-state theory, does retain its validity in CMR oxides, but the peculiarities of the electronic structure result in rapid fluctuations at the nanometer length scale of separate conducting and insulating phases, fluctuations that appear to underlie the CMR effect. Various properties and physical mechanisms will be discussed at length.
Les jeudis 7, 14 juin 2007 de 14h15 à 18h00 ■ EPFL, Lausanne, Centre Ouest, salle CO 120

COURS DE BASE

- 1. Statistics for Physicists** ■ **Frederik James**, CERN, Genève
 A summary of the basic principles of probability and statistics, from both the Bayesian and Frequentist points of view. Application to problems encountered by physicists, including Monte Carlo calculations. The following chapters will be treated: Overview: the problems and the methods; Probability; Fundamental concepts and results of probability theory; Point estimation - bayesian; Interval estimation - bayesian; Point estimation - frequentist; Interval estimation - frequentist; Comparison of frequentist and bayesian intervals; Hypothesis testing - frequentist; Hypothesis testing - bayesian; Goodness-Of-Fit testing (GOF); Decision theory; The Monte Carlo method; Important applications and exercises.
Les jeudis 15, 22, 29 mars, 5, 19, 26 avril, 3, 10, 24, 31 mai, 7, 14 juin 2007 de 9h15 à 13h00. ■ EPFL, Lausanne Centre Ouest, salle CO 011, *sauf 24 mai: EPFL, Lausanne, salle MA31*

Les cours organisés dans le cadre du Troisième cycle de la physique en Suisse romande sont destinés aux candidats au doctorat, aux professeurs et chercheurs des instituts associés, aux maîtres de l'enseignement secondaire, ainsi qu'aux chercheurs de l'industrie. L'inscription se fait auprès de l'assistant à chaque leçon. Les informations concernant le Troisième cycle de physique sont disponibles à <http://www.cuso.ch> Le programme ci-dessus est sujet à modifications. Les changements sont indiqués sous <http://www.cuso.ch/3e-cycle/physique.html>