Université Joseph Fourier

Summer Bachelor Program
Summer Bachelor Program

6 weeks from June to mid July
- Scientific course (30h or 60h)
- French language (36h)
- Lab/industry visits
- Cultural visits
- Interaction with French science students

First session in June 2012 free of tuition fee
# Summer Bachelor Program

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## Introduction to Physical computing

**Title**
Introduction to Physical computing

**Instructor**
Didier.donsez@imag.fr

**Organisation**
60 h Lecture / tutorials / lab and company visits

**Prerequisites**
Basics in programming and electronics

**Topic**
Computer Science and instrumentation: Physical computing focuses on interactions with the physical world using a variety of sensors and actuators that are controlled by microcontrollers and computers. This module introduces the technical aspects of development with the Arduino platform [http://air.imag.fr/](http://air.imag.fr/).
### Introduction to Physical Computing

**Electronics: what you should know to start Physical computing:**
- Definitions, principles and examples
- Microcontroller, sensors and actuators, simple programming language
- Arduino project
- Practicals: elementary and basic circuits

**Robotics: building an autonomous mobile robot**
- Guiding and moving programming (hard and soft aspects)
- Motor driving, collision prevention
- Communication protocol between robots
- Practicals: building the robot
- [http://air.imag.fr/mediawiki/index.php/Magician_Chassis](http://air.imag.fr/mediawiki/index.php/Magician_Chassis)

**Introduction to Fablab:**
- Digital construction (CAD / CAM)
- Designing / cutting / adapting of robot chassis
- Construction

**Visits:**
- Schneider Electric Home project,
- LIG Domus, CCSTI's fablab,
- Orange Labs' thinging fablab
## Physics

<table>
<thead>
<tr>
<th>Title</th>
<th>Introduction to large scale facilities: probing matter with neutron and synchrotron radiation</th>
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</thead>
<tbody>
<tr>
<td>Instructor</td>
<td><a href="mailto:Beatrice.grenier@ill.fr">Beatrice.grenier@ill.fr</a></td>
</tr>
<tr>
<td>Organisation</td>
<td>60 h Lecture / tutorials / lab work / ESRF and ILL visit</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Wave propagation and interferences, background in quantum mechanics is useful</td>
</tr>
<tr>
<td>Topic</td>
<td>Introduction to crystallography and other neutron and synchrotron techniques. Application to the study of structure in condensed matter and in other domains such as biology, industry, …</td>
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</table>
Introduction to large scale facilities: probing matter with neutron and synchrotron radiation

**CRYSTALLOGRAPHY**
- Crystallography in Direct Space
- Diffraction - Crystallography in Reciprocal Space
- X-ray and neutron diffraction by a crystal

**NEUTRON SCATTERRING**
- Neutrons: What for and How ? comparison to X-rays
- Instrumentation and experimental results:
  - Diffraction, Small angle neutron scattering, Liquid scattering, Reflectivity (examples will be given in condensed matter physics, biology, industry, …)

**SYNCHROTRON SCATTERING AND ABSORPTION**
- X-rays and their interaction with matter
- Synchrotron radiation
- Refraction and reflection from interfaces
- Kinematical diffraction
- Scattering from a surface, Scattering from a helix
- Photoelectric absorption
- Imaging

**Lab-works**
- X-rays - Debye-Scherrer, X-rays - Fluorescence, Neutron - Laue diffraction, Synchrotron - EXAFS
- ILL and ESRF visits
### Maths

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<tbody>
<tr>
<td>Instructor</td>
<td><a href="mailto:Bernard.Ycart@imag.fr">Bernard.Ycart@imag.fr</a></td>
</tr>
<tr>
<td>Organisation</td>
<td>30 h Lecture / tutorials</td>
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<td>Prerequisites</td>
<td>Basics in set theory and elementary calculus including infinite series, partial differentiation, and multiple integration. Some exposure to rudimentary linear algebra (e.g., matrices and determinants) is useful.</td>
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<tr>
<td>Topic</td>
<td>Basics in mathematical probability, discrete and continuous random variables, expectation and variance, random vectors, laws of large numbers and central limit theorem.</td>
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<td><strong>Random experiments</strong></td>
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<td>Events, axioms of probability, probability measurements, conditional probability, independence, random variables, distribution function, expectation, variance, modeling, pseudo-random generators, simulation.</td>
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**Discrete random variables**
Bernoulli, binomial, geometric, Poisson, hypergeometric, negative binomial. Applications in biology

**Continuous random variables**
Uniform, exponential, normal. Change of variables, simulation. Applications in biology, reliability, physics, chemistry.

**Random vectors**
Covariance and correlation, multidimensional density, change of variables, characteristic function. Gaussian vectors, applications to statistics

**Limit theorems**
Law of large numbers, central limit theorem

**Birth-death processes**
Summer Bachelor Program

June 4 - July 13, 2012

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- French language (36h)
- Lab/industry visits
- Cultural visits
- Interaction with French science students

Academic coordinator:
Sophie.de-Brion-Ravel@ujf-grenoble.fr