

“Doctoral Day” Programme—11 December 2020

Date and time: Friday 11 December, 08:50

Venue: <https://eu.bbcollab.com/guest/a93ed0f7d4ac4d84acac2747d197395c>

08:50-09:00.- **Welcome** (Joaquín Gómez Camacho, Programme Coordinator, Universidad de Sevilla; Antonio Prados Montaña, Academic Committee Member, Universidad de Sevilla)

09:00-10:00 Opening Talk

Enhancing transport by shaping barriers (beating activation energies)

Prof. Emmanuel Trizac

LPTMS, Université de Paris-Saclay-CNRS, Orsay, France



Abstract: Brownian escape is key to a wealth of physico-chemical processes, including polymer folding and information storage. The frequency of thermally activated energy barrier crossings is assumed to generally decrease exponentially with increasing barrier height. Here, we show theoretically and experimentally that higher, fine-tuned barrier profiles result in significantly enhanced escape rates, in breach of the intuition relying on the above scaling law, and address the corresponding conditions for maximum speed-up.



Emmanuel Trizac's Short CV:

Born in 1971, French nationality. LPTMS, Université de Paris-Saclay-CNRS.

2012-today: Director of LPTMS (Laboratoire de Physique Théorique et Modèles Statistiques, a joint CNRS-University Paris-Saclay unit with a staff of 50).

2008-2013: Member of “Institut Universitaire de France”.

2004-today: Professor (associate then full in 2011) in Paris-Sud/Paris-Saclay University. Invited senior investigator, University of California at San Diego (12 months, 2005-2006); invited professor, Department of Theoretical Physics, University of Barcelona (3 months, 2007).

1998-2004: Assistant professor in Paris-Sud University.

1991-1998: Postdoctoral fellow, FOM Institute for Atomic and Molecular Physics (Amsterdam, in the group of Daan Frenkel). PhD student in the Physics Laboratory of Ens Lyon under the supervision of Jean-Pierre Hansen. Graduate from Ecole normale supérieure of Lyon in 1994.

Research: statistical mechanics, soft matter, granular matter, complex fluids. 150 publications in international journals, plus 5 in educational journals and a dozen of proceedings. Supervision of 10 PhD students since 2001, and 11 post-docs.

Community service: Member of various committees in France or abroad (CNRS, HCERES, ANR, several Universities in Paris, evaluator for tenure case and promotion in Georgetown University). Member of the editorial board of the European Journal of Physics (2003-2012). Member of the Computational Physics Group of the European Physical Society (2006-2013). Member of the governing body of Institut Henri Poincaré in Paris (2010-2013). Member of the governing body on the doctoral school ‘Physique en Ile de France’ (supervising 400 PhD students), and of the ‘Laboratoire d’Excellence PALM’, a local funding agency for 700 researchers on Orsay-Saclay-Palaiseau campus (2012-2019). Member of the Scientific Council of Ecole normale supérieure in Paris (2019-2024).

Morning Session

Date and time: Friday 11 December, 10:00

Venue: <https://eu.bbcolllab.com/guest/a93ed0f7d4ac4d84acac2747d197395c>

Students' presentations

10:00-10:20.- Norberto Pérez Prieto, **“Spatial Delta Encoded Input Time-Multiplexed Neural Recording Analog Front-End”**

Abstract: In recent years, neural recording has become one of the most studied fields of neuroengineering due to its effectiveness in the treatment of neuronal diseases such as epilepsy, Parkinson's disease, or Alzheimer's disease. Herein, the number of implanted electrodes is largely increasing to provide more information about brain activity. Thus, the neural recording analog front-end, besides its low energy consumption, should minimize its area occupation and provide a compression method to reduce the bit rate of the transmitted signal. In this work, we present a neural recording analog front-end that employs input time-multiplexing to reduce the area per channel of the system and the spatial delta encoding technique to compress the neural signals.

10:20-10:40.- Ajay Vasudevan, **“Spiking Neural Networks: Applications and Challenges”**

Abstract: Spiking neural networks (SNN) which mimic natural neural networks closely are described as the third generation of neural networks. They have proven advantages in terms of latency and energy efficiency but lack behind state of the art conventional neural networks in performance for eg. in terms of classification accuracy for classification tasks. In this presentation, development of and results with supervised and unsupervised learning methods for SNNs for static and event based datasets will be presented.

10:40-11:00.- Juan Manuel Franco Patiño, **“Semi-inclusive neutrino-nucleus reactions”**

Abstract: Neutrino-oscillation experiments have been relying on inclusive neutrino-nucleus results to reconstruct the neutrino energy necessary in those oscillation experiments. Realistic theoretical models have been developed to explain inclusive neutrino-nucleus experiments, where only the final lepton is detected, but very harsh approximations are needed in order to extract the neutrino energy only from the final lepton variables. Future neutrino experiments will be able to detect the final lepton in coincidence with another particles, for instance an ejected nucleon, giving the opportunity to improve the reconstruction of the neutrino energy. An introduction to neutrino-nucleus reactions will be given in this presentation and results for inclusive and semi-inclusive processes will be presented showing the importance of the nuclear structure in the latter.

11:00-11:20.- COFFEE BREAK**11:20-11:40.-** Mojtaba Parsakordasiabi, **“A High-Resolution Low-Resource FPGA-based Time-to-Digital Converter Using a Combinational Counters Encoder”**

Abstract: Time-to-digital converters (TDCs) are a central component in systems based on time-interval measurement. Since time resolution is an important specification in different applications, high-resolution TDCs are on demand. On the other hand, the implementation of multi-channel TDCs requires low resource usage. In this presentation, we report a TDC implemented in a 28-nm FPGA. The proposed TDC utilizes low resources while reaching high measurement precision.

11:40-12:00.- Juan Alfonso Serrano Viseas, **“General fitting method for real-time cell-count experimental data processing”**

Abstract: This work reports a general method for extraction of cell-electrode electrical model parameters in cell culture (CC) assays. The presented approaches can be applied to CC assays based on electrical cell-substrate impedance spectroscopy (ECIS) technique for real-time supervision, providing the cell number per square centimeter, i.e., the cell density, as main result. The proposed method, a minimization of system equations, search, during the experiment, the optimum values of the electrical model parameters employed for the electrode-cell model. The results of this search enable a fast and efficient calculation of the involved cell-electrode model parameters and supply real-time information on the cell number. For the sake of experimental validation, we applied the proposed method to practical CCs in cell growth assays with a cell line of AA8 Chinese hamster ovarian fibroblasts and the Oscillation Based Test technique for bioimpedance measurements.

12:00-12:20.- Rubén Gómez Merchán, **“Why use asynchronous schemes in SPAD-based image sensors?”**

Abstract: Single Photon Avalanche Diodes (SPADs) are photodetectors able to generate measurable signals with a single photon impinging on their surface. This fact makes SPADs an interesting alternative for next-generation imagers, combining 2D and 3D imaging in the same device by measuring the Time of Flight (ToF). However, SPAD-based sensors have the need to perform per-pixel histograms in order to render a 3D image, which results in a large amount of output data. Thus, using asynchronous architectures could reduce that problem, since only pixels containing information would be readout. This presentation summarizes the main architectures used in SPAD imagers and the main limitations that appear when facing this problem.

Flash Talks

12:20-12:25 María de los Ángeles Millán Callado: [Exploring laser-driven neutrons for nuclear physics experiments and applications.](#)

12:25-12:30 Jesús González Rosa: [Study of neutrino inelastic scattering using scaling functions.](#)

12:30-12:35 Pablo Pérez Maroto: [Neutron capture on \$^{50}\text{Cr}\$ and \$^{53}\text{Cr}\$ at CERN n_TOF for criticality safety in nuclear reactors.](#)

12:35-12:40 Adrián García Osuna: [Study of SiC detectors for harsh environments.](#)

12:40-12:45 Antonio Patrón Castro: [Relaxation in fluids with non-linear drag: opening the door to strong memory effects.](#)

12:45-12:50 Alessio Mancini: [Electromagnetic and mechanical assessment of disrupting events in the SMART tokamak.](#)

Afternoon Session

Date and time: Friday December 11, 15:00-17:40

Venue: <https://eu.bbcollab.com/guest/a93ed0f7d4ac4d84acac2747d197395c>

Students' presentations

15:00-15:20.- Victoria Lérica Toro, **“Study of instrumental background in AMS”**

Abstract: In the application of the AMS technique, results need frequently to be corrected due to the background. There are two main background causes in the measurement procedure: background induced by the previous radiochemical treatment during sample preparation and instrumental background that occurs during the measurement. The background derived from the radiochemical procedure can be observed and quantified by performing so-called chemical blanks. The instrumental background is more complex to determine because there are several sources that cause it. The detailed background sources in the AMS measurement of ^{129}I are analysed in this work as well as the traditional method for background correction. As a result, a new background correction method is proposed.

15:20-15:40.- Paula de Navascués Garvín, **“Unraveling Reaction Mechanisms in Plasma-Assisted Ammonia Processes”**

Abstract: Current studies on ammonia synthesis by means of atmospheric pressure plasmas respond to the urgent need of developing less environmentally aggressive processes than the conventional Haber-Bosch catalytic reaction. Herein, we systematically study, from an experimental point of view, the plasma synthesis of ammonia and also the much less investigated reverse reaction (decomposition of ammonia into nitrogen and hydrogen). Experiments were carried out in a packed-bed plasma reactor, applying diagnosis techniques like isotope labelling with Mass Spectrometry or Optical Emission Spectroscopy, among others.

15:40-16:00.- Carlos Francisco Romero Madrid, **“Characterization of RMP-induced 3D equilibria with HINT2”**

Abstract: Implementation of a new magnetohydrodynamic (MHD) code to solve nonlinear 3D equilibrium response due to a 3D magnetic field created by resonant magnetic perturbations (RMPs) to ASDEX Upgrade geometry. Energetic particle losses and turbulent regions generated by magnetic islands will be characterized to deepen into the understanding of high-confinement mode (H-mode) of the plasma, and the instabilities related to this enhanced confinement, so-called edge localized modes (ELMs).

16:00-16:20.- David Palomeque Mangut, “**Integrated system for neural stimulation with wireless power supply**”

Abstract: We are developing an implantable integrated system for optogenetic and electrical stimulation of neural tissue. Both optogenetic and electrical stimulation are potential alternative therapeutic treatment to patients with severe neurological disorders, chronic pain, central nervous system injuries, etc.

This presentation will give a general overview of the topic to the attendees. Besides, I will talk about the design of two fundamental parts of the implant: the high-voltage step-up DC-DC converter and the high-voltage-tolerant current drivers.

16:20-16:40.- COFFEE BREAK

16:40-17:00.- Carlos Manuel Domínguez Matas, “**Rad-Hard design techniques for High-Speed High-Accuracy SAR-ADCs**”

Abstract: The main objective of this thesis is the research and development of radiation hardened techniques (at both physical and architectural/circuitry levels) for high-speed high-resolution data converters, with emphasis on the SAR ADC topology in extreme operation conditions (radiation, power supply and temperature). The target is to detect at real time any failure in critical applications including Single-event (SEE) radiation effects. This presentation will discuss the effect of the radiation on the CMOS monolithic circuit, how model this effect to be simulated using DFVII and the main strategies to harden the circuit against radiation.

17:00-17:20.- Salvatore Simone Perrotta, “**Cluster models of the ${}^6\text{Li} + \text{p} \rightarrow {}^3\text{He} + \alpha$ reaction at sub-Coulomb energies**”

Abstract: Modelling of elemental abundances in the Universe critically depends on the cross-section of a wide number of nuclear reactions of astrophysical interest, at very low collision energies ($\lesssim 100$ keV). Direct and indirect experimental measurements present an unexplained discrepancy for some such processes (“electron screening problem”), which may be due to a poor understanding of the nuclear reaction dynamics.

We approached the issue for the ${}^6\text{Li}(\text{p}, {}^3\text{He})\alpha$ reaction. We show that the indirect sub-Coulomb cross-section is very well described as a DBWA transfer within a di-cluster model for the reactants. Results of more complex models are also discussed.

17:20-17:40.- Javad Ahmadifarsani, [“An in-vitro neuromorphic system for interacting with the brain tissue”](#)

Abstract: In the in-vitro phase of HERMES project, several integrated-circuits (ICs) have been designed and fabricated to establish a real-time interaction with a brain slice. These ICs include an analog-front-end chip, a synaptic chip, a memristor chip, and a selector chip. In this presentation, the structures of the synaptic and the selector chips are explained. The pre-synaptic part is comprised of field-potential-to-spike converters, pulse extenders, and voltage switches. The post-synaptic part consists of current-attenuators and neuron circuits.

Flash Talks

17:40-17:45 María Teresa Rodríguez González: [Experimental measurement of the reaction cross section of \$\beta^+\$ emitters \$^{11}\text{C}\$ and \$^{13}\text{N}\$ in the West German Proton Therapy Center.](#)

17:45-17:50 José Rueda Rueda: [Imaging Neutral Particle Analyser, a new generation of fast-ion diagnostic.](#)

17:50-17:55 Hamidreza Erfanijazi: [Memory technologies with Multi-Scale time constants for neuromorphic architectures \(MeM-Scales\).](#)

17:55-18:00 Gabriel Galeote: [Neuroprosthetics for epilepsy treatment.](#)

TIMETABLE

| | Morning Session | | Afternoon Session |
|-------------|--|-------------|--------------------------------|
| 08:50-09:00 | Welcome | 13:00-15:00 | LUNCHTIME |
| 09:00-10:00 | Opening talk Emmanuel Trizac | | |
| | Students' presentations | | Students' presentations |
| 10:00-10:20 | Pérez | 15:00-15:20 | Lérida |
| 10:20-10:40 | Vasudevan | 15:20-15:40 | Navascués |
| 10:40-11:00 | Franco | 15:40-16:00 | Romero |
| 11:00-11:20 | COFFEE BREAK | 16:00-16:20 | Palomeque |
| 11:20-11:40 | Parsakordasiabi | 16:20-16:40 | COFFEE BREAK |
| 11:40-12:00 | Serrano | 16:40-17:00 | Domínguez |
| 12:00-12:20 | Gómez | 17:00-17:20 | Perrotta |
| 12:20-12:50 | FLASH TALKS | 17:20-17:40 | Ahmadifarsani |
| | | 17:40-18:00 | FLASH TALKS |