Seminario: La Física del Cáncer

Report of Contributions

https://indico.cern.ch/e/lafisicadelcancer

Contribution ID: **1** Type: **not specified**

”Stochastic fate choices during cancer initiation”

Tuesday 16 May 2017 09:30 (30 minutes)

Abstract: “The changes in cell dynamics after oncogenic mutation that lead to the development of tumours are currently unknown. Here, using skin epidermis as a model, we assessed the effect of oncogenic hedgehog signalling in distinct cell populations and their capacity to induce basal cell carcinoma, the most frequent cancer in humans. We found that only stem cells, and not progenitors, initiated tumour formation upon oncogenic hedgehog signalling, mirroring the homeostasis spatial organisation and hierarchy of the tissue. Modelling reveals that cancer initiation is a stochastic process in which cells continue to make random fate decisions as they do during normal homeostasis. Our work reveals that the capacity of oncogene-targeted cells to induce tumour formation is dependent not only on their long-term survival and expansion, but also on the specific clonal dynamics of the cancer cell
of origin.”

Short CV:
PhD in Biological Physics at the Institut Curie, co-advised by Jean-Francois Joanny and Jacques Prost. Completed with Highest Honors. 2010-2014. B.Sc. in Chemistry, B.Sc. and Masters in Physics with Highest Honors at the École Normale Supérieure of Paris and at the University Pierre et Marie Curie. 2006-2010. “Classes préparatoires” specialized in mathematics, Physics, and Chemistry, corresponding approximately to a two-year university diploma in those three disciplines. 2004–2006. French Baccalauréat with Highest Honors. 2004
Work Experience: Sir Henry Wellcome Fellow of the Wellcome Trust, based in the Gurdon Institute, Cambridge 2016-2020. Junior Research Fellow at Trinity College, University of Cambridge, and at the Cavendish Laboratory, working with Prof. Benjamin Simons. 2015-2019 Supervisions at Trinity College, University of Cambridge, of Part IB physics students (2 hours/week). 2015-2016 Short Postdoctoral Position in the Developmental Biology Department at the Institut Curie, under the supervision of Yohanns Bellaiche 2014 Visiting Scholar at Harvard University. I worked in the Experimental Soft Condensed Matter Group (David A. Weitz), and studied the properties of collective cell dynamics as a function of cell density 2008.
Publications Peer-reviewed papers - 19 accepted research Articles General public articles and interventions _ “Mathematical modelling in biology” (2015), interview with Arte (franco-german TV channel). _ “Cancer and Randomness ?” (2015), invited speaker in the “Science, Research, Society” forum organised by “Le Monde”, France’s leading newspaper _ “Cancer and Randomness ?” (2015), article in the French magazine “La Recherche” _ “Does cancer play dice?” (2015), article in “Le Monde”, France’s leading newspaper _ “Angelina Jolie and the return of Pascal’s wager” (2013), article in “Le Journal du Dimanche”. _ “Young smiles in research” (2011), radio interview on “France Culture”
Scientific distinctions _ 2015: Sir Henry Wellcome Fellowship from the Wellcome Trust _ 2014: Young Researcher Prize from the Bettencourt-Schuller Foundation. Junior Research Fellowship from Trinity College, Cambridge. _ 2010: PhD grant from the French Ministry of Research. Address : O2 Great Court, Trinity College, Cambridge, UK

Presenter: HANNEZO, Edouard

Contribution ID: **2** Type: **not specified**

”Defining the role of stem and progenitor cells during tumour initiation”

Tuesday 16 May 2017 09:00 (30 minutes)

Many cancers arise from tissues maintained by stem and progenitor cells that ultimately give rise to non-dividing terminally differentiated cells. However, little is known about the contribution of stem cells and committed progenitors to cancer initiation.
In this study we assess the role of stem cells and progenitor cells in cancer initiation. Using skin epidermis as a model, we studied the impact of oncogenic hedgehog signalling in stem cells and progenitor cell populations and their capacity to induce basal cell carcinoma (BCC), the most frequent cancer in humans. We found that only stem cells, and not progenitors, were competent to initiate tumour formation upon oncogenic hedgehog signalling. Interestingly, this difference was due to the hierarchical organization of tumour growth in oncogene-targeted stem cells, characterized by an increase of symmetric self-renewing divisions and a higher p53-dependent resistance to apoptosis, leading to rapid clonal expansion and progression into invasive tumours.

Short CV
Adriana Sánchez-Danés received her BSc in Biotechnology in 2007 (Awarded first of the class by the Universitat Autònoma de Barcelona and National Prize of Excellence for University Academic Achievement by the Spanish Ministry of Science and Education, 2007). She obtained her MSc in Biomedical Research in 2008 and a PhD in Biomedicine in 2012 from Universitat Pompeu Fabra (Barcelona). During her PhD, she focused on the generation of human dopaminergic neurons from induced pluripotent stem cells to model Parkinson's disease.
In August 2012, Adriana joined Prof. Cédric Blanpain Lab at the Université Libre de Bruxelles. Prof. Blanpain's group has made major contributions to the skin cancer field and focuses on elucidating the mechanisms regulating stem cell fate decision during development, tissue homeostasis and cancer. During her postdoc, Adriana has been studying the mechanisms involved in skin cancer initiation and progression. She is recipient of a FNRS Postdoctoral Fellowship to pursue her research.

Adriana.Sanchez.Danes@ulb.ac.be

Presenter: SANCHEZ DANES, Adriana

Contribution ID: **3** Type: **not specified**

”Mechanical guidance of collective cell migration and invasion”

Tuesday 16 May 2017 10:00 (30 minutes)

A broad range of biological processes such as morphogenesis, tissue regeneration, and cancer invasion depend on the collective migration of epithelial cells. Guidance of collective cell migration is commonly attributed to soluble or immobilized chemical gradients. I will present novel mechanisms of collective cellular guidance that are physical in origin rather than chemical. Firstly, I will focus on how the mechanical interaction between the tumor and its stroma guides cancer cell invasion. I will show that cancer associated fibroblasts exert a physical force on cancer cells that enables their collective invasion. In the second part of my talk I will focus on durotaxis, the ability of cells to follow gradients of extracellular matrix stiffness. Durotaxis is well established as a single cell phenomenon but whether it can direct the motion of cell collectives is unknown. I will show that durotaxis emerges in cell collectives even if isolated constituent cells are unable to durotax. Collective durotaxis applies to a broad variety of epithelial cell types and requires the action of myosin motors and the integrity of cell-cell junctions. Collective durotaxis is more efficient than any previous report of single cell durotaxis; it thus emerges as robust mechanism to direct collective cell migration in development and disease.

Short CV:
Xavier Trepat received a BSc in Physics in 2000 and a B.Sc in Engineering in 2001. In 2004 he obtained his PhD from the Medical School at the University of Barcelona. He then joined the Program in Molecular and Integrative Physiological Sciences at Harvard University as a postdoctoral researcher. In 2008 he became a Ramon y Cajal researcher at the University of Barcelona and the Institute for Bioengineering of Catalonia (IBEC), and in January 2011 he became an ICREA Research Professor. Trepat's research aims to understand how cells and tissues grow, move, invade and regenerate in a variety of processes in health and disease. To achieve this, he has developed and patented different technologies to measure cellular properties at the micro- and nanoscales. He has then applied these technologies to identify fundamental mechanisms in cell biology and biophysics.
Since his return to Spain from the USA in 2008, his research at the intersection between life and physical sciences has attracted ample support from the most prestigious funding agencies; Trepat is the one of the very few researchers in Europe ever to be awarded three grants from the European Research Council (ERC), one Starting, one Consolidator, and one Proof of Concept. He is also one of the few researchers –if not the only one –to ever publish his work as main author in five Nature family journals, namely Nature, Nature Physics, Nature Materials, Nature Methods, and Nature Cell Biology. The diversity of these journals captures the broad spectrum of topics in his laboratory. He has been awarded the Banc de Sabadell Award for Biomedical Research in 2015.

Presenter: TREPAT, Xavier

Contribution ID: **4** Type: **not specified**

”Physics-like modeling of brain tumors: Solitons, surface-driven phenomena, scaling laws and more.”

Tuesday 16 May 2017 10:50 (30 minutes)

In this talk I will describe how mathematical modeling of brain tumors inspired by physical phenomena can shed light on the dynamics of gliomas. I will describe novel therapies, imaging based biomarkers, counter-intuitive alternative treatment schedules, surface-driven phenomena and scaling laws. All of this phenomena will be discussed on the light of using mathematical (physics-like) modeling to raise concepts and hypothesis of clinical applicability.

Short CV:
Graduate in Physics and PhD in Quantum Optics (Complutense U). Associate professor (1997) and full professor (2002) in Applied Mathematics at the Mathematics Department of the University of Castilla-La Mancha. Director of the Institute of Applied Mathematics in Science and Engineering at the same university. He has published more than 130 ISI-indexed research papers with 4200 citations and has an H-index of 33. Currently he leads several national and international projects on the application of mathematical modeling to oncology with clinical applications.

Presenter: PÉREZ-GARCÍA, Víctor M.

Contribution ID: **5** Type: **not specified**

”Bioelectricity and Intercellular Communication in Model Multicellular Ensembles”

Tuesday 16 May 2017 11:20 (30 minutes)

Cancer research tends to focus on genes and biochemistry. However, bioelectricity and intercellular electrical coupling could also be significant. Experiments with model animals and cell culture assays suggest the instructive role of spatio-temporal maps of cell membrane potentials. These potentials regulate and are regulated by the ion channel proteins that transport signaling molecules, thus influencing the expression of growth genes. In particular, cell depolarization and tumorigenesis can be related but experimental procedures for the manipulation of specific ion channels have serious risks because the channels also control healthy tissues. The external modulation of cell potentials requires a precise spatial localization, which might be achieved by using nanoparticles, microwires, local transfer of exogenous channels, mRNA and miRNA, and optogenetics. However, the interplay between bioelectrical and biochemical networks is still unclear. We will describe simple but biologically-motivated theoretical approaches based on bioelectric concepts and weakly coupled cell lattice models.

Short CV:
Salvador Mafe received the M.Sc. (Extraordinary Award, 1984) and Ph.D. (Extraordinary Award, 1986) degrees in Physics from the Univ. of Valencia (UV). He was appointed Assoc. Prof. at the Univ. of Castilla-La Mancha (1988). He was a visiting scientist at the Helsinki Univ. of Technology, UCLA, MIT, and Tokyo Inst. of Technology. He has been Prof. of Applied Physics at UV since 1999 where he teaches Statistical Physics and Experimental Thermodynamics courses. His current research interests concern transport phenomena in nanostructures and the modeling of bioelectrical phenomena in multicellular ensembles. He is recipient of the “Tajima Prize”(International Society of Electrochemistry) and the “Investigadores Noveles”prize (Real Sociedad Española de Física).

Presenter: MAFE, Salvador

Contribution ID: **6** Type: **not specified**

”The dose-dense principle in cancer chemotherapy”

Tuesday 16 May 2017 12:30 (30 minutes)

Chemotherapy is a class of cancer treatment that uses drugs to kill cancer cells. A typical chemotherapeutic protocol consists of several drugs delivered in cycles of three weeks. We present mathematical analyses demonstrating the existence of a minimum time between cycles of chemotherapy for a protocol to be effective. A mathematical equation is derived, which relates such a minimum time with the variables that govern the kinetics of the tumor and those characterizing the chemotherapeutic treatment. Our results suggest that there are compelling arguments supporting the use of dose-dense protocols. Finally, we discuss the limitations of these protocols and suggest an alternative.

Presenter: G. LÓPEZ, Alvaro

Contribution ID: **7** Type: **not specified**

”Dynamics and Physics of Cancer: Tumor and Immune Cell Interactions”

Tuesday 16 May 2017 11:50 (30 minutes)

In this plenary talk we present our work in Dynamics and Physics of Cancer [1,2,3,4]. In particular, our study uses in silico experiments and mathematical analyses to characterize the transient and asymptotic dynamics of the cell-mediated immune response to tumor growth. An hybrid probabilistic cellular automaton model describing the spatio-temporal evolution of tumor growth and its interaction with the cell-mediated immune response is developed. The model parameters have been adjusted to an ordinary differential equation model, which has been previously validated [2] with in vivo experiments and chromium release assays. We utilize the cellular automaton model to investigate and discuss the capacity of the cytotoxic cells to sustain long periods of tumor mass dormancy, as commonly observed in recurrent metastatic disease. This is joint work with Alvaro G. López and Miguel A. F. Sanjuán (Spain).

Short CV:

• Natural de Cádiz, 23-01-1973
• NIF: 44033240Q
• Profesor Titular de Universidad de Física en la Universidad Rey Juan Carlos
• Licenciado en Ciencias Físicas por la UNED (2002)
• Doctor en Ciencias Físicas por la URJC (2007)
• Autor de más de 40 artículos de investigación indexados en el JCR
• Ponente en más de 50 conferencias nacionales e internacionales en EEUU, Rusia, Japón, Australia, Alemania, Italia, Francia, entre otros muchos.
• Investigador en 9 Proyectos de Investigación del Plan Nacional.
• Director de 4 Tesis Doctorales.
• Director de 60 Trabajos Fin de Carrera, Trabajos Fin de Máster y Trabajos Fin de Grado.
• Secretario Académico del Departamento de Física de la URJC desde su creación en el año 2006.
• Coordinador de las PAU en la Materia Física en la URJC.
• Coordinador de la línea de Investigación en Ciencias Experimentales de la Escuela Internacional de Doctorado de la URJC.
• Coordinador del Grado en Ciencias Experimentales en la URJC
• Investigador Visitante en la UPV, Universidad de Zaragoza, Istituto Nazionale di Ottica de Florencia (Italia), Technical University of Lublin (Polonia), Arizona State University (AZ, EEUU), entre otros muchos.

Presenter: SEOANE, Jesús

Contribution ID: **8** Type: **not specified**

Deep changes in radiology

Tuesday 16 May 2017 13:00 (30 minutes)

This talk explains how deep technologies of automatic learning will affect radiology. Deep learning algorithms, techniques of deep reinforcement learning and their possible application to radiology are discussed.

Short CV;
Emilio Soria Olivas holds a degree in Physics (1992), an extraordinary award and a PhD in electronic engineering (1997). He is currently a University professor in the Department of Electronic Engineering of the ETSE (University of Valencia) where he is a lecturer of biosignal processing and machine learning applied to medicine. He has published 80 papers in journals indexed by JCR and more than 200 contributions to national and international conferences as well as 20 book chapters. All these publications are related to advanced data analysis in Medicine. He has also participated in more than 30 projects with public / private funding for the development of data-based applications. Currently, he belongs to the IDAL research group (http;//idal.uv.es) of the University of Valencia

Presenter: SORIA, Emilio