# WELCOME TO THE 5th UNIGE


**Thursday 9th June 2022**
**Science III, Room A150**

Organized by the UNIGE PostDoc Association - APDU

POSTDOC DAY

# CONFERENCE BOOKLET

# PROGRAM

***8h30 - 9h10*** *Registration*

***9h10 - 9h20*** *Opening Remarks*

## *Part I - Who are your colleagues?*

***9h20 – 10h*** *Postdoc contributed talks*

**Quentin Vagne**: "A Theoretical framework to understand the physics of rotating cell doublets"

**Juan Manuel Garcia Arcos**: "Advected percolation in the actomyosin cortex drives amoeboid cell motility"

***10h – 10h45*** ***Keynote speaker – BIOLOGY***

***Rashmi Priya*** *- The Francis Crick Institute, London, UK*

*Multiscale organizational principles building the vertebrate heart*

***10h45 – 11h00*** *APDU Committee:*

**Nirvana Caballero** *(President)* **Manuela Leonardelli** *(Vice-President)*

***11h00 – 11h20*** *Coffee break* ☕

***11h20 – 11h40*** *Postdoc contributed talks*

**Aurélie Diman:** "Mechanism of preferential binding of SMC5/6 to extrachromosomal DNA in mammalian cells"

***11h40 – 12h25*** ***Keynote speaker – CHEMISTRY***

***Monica Carril*** *- Biophysics Institute CSIC-UPV/EHU, Bilbao, Spain*

*"Synthesis and uses of Fluorinated Nanoparticles"*

***12h25 – 13h35*** *Lunch*

**13h35 – 14h15** *Postdoc contributed talks*

**Claire Dessalles**: "Forces in a microvessel-on-chip, from system development to cellular response"

**Lionel Di Santo** "Genome-wide sequencing to understand the evolutionary history of Torrey pine (*Pinus torreyana*) with implications for species conservation"

**14h15 – 15h** ***Keynote speaker – PHYSICS***

***Sahand Rahi*** *- Laboratory of the Physics of Biological Systems EPFL, Lausanne*

*"How checkpoints Fail Optimally"*

**15h – 15h15** *Coffee break* ☕

## *Part II - Focus on your career*

**15h15 – 15h30** *Neringa Mannerheim, Life Science Switzerland (LS2)*

**15h30 – 17h30** *Invited panelists:*

***Caterina Tomba*** *- CNRS researcher at the Lyon Institute of Nanotechnology*

***Daniel Couto*** *- Application Scientist at Creoptix, Zürich*

***Massimo Caine*** *- Lecturer and UNIGE Communication Officer*

***Rachel Aronoff*** *- Association President Hackuarium, Lausanne*

**17h30** *Closing remarks - Best talk and image competition prize* 🏆

**18h00** *Aperó* 🍻 *in front of Science III*

# Career session

**Caterina Tomba**

PhD Institut Néel - PostDoc UNIGE - now CNRS researcher Institut des Nanotechnologies de Lyon

**Daniel Couto**

PhD University of East Anglia - PostDoc UNIGE - now Application Scientist at Creoptix

**Massimo Caine**

Now Lecturer and Communication Officer UNIGE

**Rachel Aronoff**

PhD University of Washington - Now president of Hackuarium (non-profit organisation)

# LIST OF POSTDOC CONTRIBUTED TALKS

## Forces in a microvessel-on-chip, from system development to cellular response

Calire A. Desalles[1], Arthur Boutillon[2], Clara Ramon-Lozano[3], Paul Salipante[4], Abdul I. Barakat[3], Avin Babataheri[3]

[1]*Department of Biochemistry, University of Geneva, CH-1211 Geneva, Switzerland;*
[2]*Laboratory for Optics and Biosciences, CNRS UMR7645, INSERM U1182, Institut Polytechnique de Paris, 91128 Palaiseau, France;*
[3]*Hydrodynamics Laboratory – CNRS UMR7646, Ecole Polytechnique, Palaiseau, France.*
[4]*Polymers and Complex Fluids Group, National Institute of Standards and Technology, 100 Bureau Drive, Gaithersburg, MD, USA.*

Cells in complex organisms are constantly subjected to tensile stresses due to tissue deformation. A prominent example of tension in the adult body is found in blood vessels that cyclically dilate as a result of the periodic pulsations of the heart. These traction forces are a key regulator of blood vessel development and stabilization, and abnormalities in the mechanical environment play critical roles in the development of vascular disease.

We developed a collagen hydrogel-based microvessel-on-chip that uses hydraulic actuation to generate controlled stretching of a confluent endothelial cell monolayer. Normal forces induced by the luminal pressure compress the surrounding soft hydrogel, dilate the channel, and create circumferential tension. Rigorous characterization of the system revealed the crucial role played by the poroelastic behavior of the hydrogel in determining the magnitudes of the strain and tension.

This novel device was used to investigate the response of endothelial cells as a connective tissue to static traction forces. Over the course of 24 hours, the monolayer underwent a anisotropic tissue elongation, driven by cell elongation and alignment in the direction of the stress. The adherens junctions remodeled towards comb-like configurations that enabled transendothelial actin cables. These collective structural responses were highly dynamic and depended on the presence of adherens junctions.

This organ-on-chip was also shown to be compatible with epithelial cell culture, which opens the possibility of investigating the role of anisotropic tension in the context of the gut, lungs or even during morphogenesis.

# Mechanism of preferential binding of SMC5/6 to extrachromosomal DNA in mammalian cells

Diman Aurélie, Bastien Baechler, Michel Strubin

*Department of Microbiology and Molecular Medicine, Faculty of Medicine, University of Geneva, Geneva, Switzerland*

*The essential SMC5/6 (Structural Maintenance of Chromosome) complex is a close relative of cohesin and condensin. SMC5/6 has well-recognized functions in homologous recombination-mediated DNA repair. However, the complex is likely to perform additional functions that remain to be discovered. Our lab has shown that the SMC5/6 complex, but not cohesin or condensin, acts as a host restriction factor against hepatitis B virus (HBV). The complex binds to the circular extrachromosomal HBV DNA genome, hindering viral transcription and consequently infection. Using different circular extrachromosomal reporter gene constructs, we showed that the SMC5/6 complex binds to and impedes the expression of any extrachromosomal DNA.*

*Recent reports have revealed that, in vitro, both the human and budding yeast Smc5/6 complexes recognize unusual DNA configurations, such as plectonemes and catenated DNA. However, it is still unknown whether SMC5/6 detects similar structures in mammalian cells and by which mechanisms. Our current results point towards a model where in mammalian cells, the helical tension generated by the transcriptional process itself, rather than chromatin composition, plays a role in the selective recognition of the extrachromosomal DNA template by SMC5/6. This model suggests that the SMC5/6 complex functions as a supercoiling and intertwining DNA sensor and acts as a new regulator of the transcriptional process.*

## Genome-wide sequencing to understand the evolutionary history of Torrey pine (*Pinus torreyana*) with implications for species conservation

Lionel N. Di Santo, Sean M. Hoban, Thomas L. Parchman, Jessica W. Wright, and Jill A. Hamilton

Understanding how different evolutionary processes have influenced the distribution of neutral and adaptive genetic variation both across space and time can be invaluable to informing conservation decisions necessary to preserve rare species' evolutionary potential. For species that may be candidates for genetic rescue, these data can be used to evaluate potential risks associated with management decisions. In this study, we focus on Torrey pine (Pinus torreyana Parry), a critically endangered pine, endemic to California. Torrey pine is an ideal system to evaluate the contribution of demographic history, gene flow, and natural selection to population differences that span unique island-mainland distributions. This species is restricted to only two populations, one mainland population in La Jolla, CA, and one island population on Santa Rosa Island, CA, one of the Channel Islands. The combination of small population size, extremely low genetic variation, and abiotic and biotic challenges associated with climate change indicate Torrey pine may have reduced evolutionary potential to adapt to change. Thus, Torrey pine could be a potential candidate for inter-population genetic rescue. Here, we used genomic data to tease apart the respective influence of neutral and adaptive processes on population genetic structure testing demographic models of population connectivity across time and space with contemporary genome scans. Overall, we observed extremely low genetic variation and a lack of population structure within the species. Demographic simulations indicate Torrey pine has likely consistently suffered from low population size while maintaining some level of gene between island and mainland populations following divergence. Interestingly, despite small population sizes and a lack of genetic diversity, we found no evidence of inbreeding within either population. However, despite a lack of population structure genome-wide, outlier analyses identified over 2000 candidate loci putatively under strong selection. These results suggest that genomic differences between island and mainland populations likely result from selection as opposed to spatial and temporal genetic drift or inbreeding. From a conservation perspective, extremely low genetic diversity within populations indicates that opportunities for within-species evolutionary rescue may be limited. Nonetheless, these results also suggest caution is necessary for implementation of conservation strategies such as genetic rescue. Gene flow between island and mainland populations could disrupt locally adapted gene complexes important to persistence in distinct island and mainland environments.

## Advected percolation in the actomyosin cortex drives amoeboid cell motility

Juan Manuel Garcia Arcos , Javier Espadas, Aurélien Roux

*Department of Biochemistry, University of Geneva, Geneva, Switzerland, NCCR for Chemical Biology, University of Geneva, Geneva, Switzerland*

Lipid bilayers are highly fluid. This unique property determines many of the mechanical properties of cellular membranes, in particular the fast equilibration of membrane tension on every point of their surface. Thus, at the size of single cells, no membrane tension gradient is theoretically expected to arise. Paradoxically, recent reports have shown that in migrating cells, a membrane tension gradient exists, and participate to the force dipole required for movement (Hetmanski et al., 2019; Lieber et al., 2015; Mueller et al., 2017). How this gradient is created and maintained in association to actin cellular dynamics and cell locomotion is unknown.
Here, we quantitatively characterize the establishment of membrane tension gradients and its role in force propagation in an in vitro system consisting of spreading supported lipid bilayers. We show preliminary data describing the relation between lipid flows and tension gradients using the Fluorescent Lipid Tension Reporter (FliptR), recently developed by the Roux et and Matile labs (Colom et al., 2018), and speculate about the applications in the study of migrating cells.

## A Theoretical framework to understand the physics of rotating cell doublets

Quentin Vagne, et al

TBA

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