Our latest publication in Cell:

**Cell**

Compromised nuclear envelope integrity drives TREX1-dependent DNA damage and tumor cell invasion

**Graphical abstract**

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**In brief**

Extreme nuclear deformations in dense microenvironments lead to repeated nuclear envelope rupture followed by TREX1-dependent chronic DNA damage. This triggers a partial EMT in malignant cells which might underlie tumor progression.
Link to the article

Our latest publication in Science:

The nucleus acts as a ruler tailoring cell responses to spatial constraints

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Our team studies different processes happening in the cell: cell migration, cell volume/mass regulation, cell division. We are interested by processes involving the cytoskeleton, organelles and their relation with mechanosensitivity. We develop and use innovative tools based on nano and micro-fabrication techniques, to control and modulate the main physical and chemical parameters of the cell micro-environment.

These tools are coupled with high quality quantitative microscopy, and used alongside molecular and cell biology techniques, to obtain a quantitative description of the cell behavior. As well as highlighting new basic concepts about cell behavior, our multidisciplinary approach leads to the development of novel tools with potential applications in biomedical research.

The focus of our current research is how cells proliferate and migrate when space is limited. We want to understand how cells (immune cells and cancer cells) can produce efficient motion under confinement and squeeze through small holes. We also want to understand how physical constrains affect dividing cells. Our current project on cell proliferation under external constrains has been awarded an ERC Consolidator grant (2013-2018). M. Piel is author of more than 100 publications (H index 52) with more than 10400 citations. He holds four patents, and is a co-
Techniques and tools we created and use:

- **Micropatterning**: We have demonstrated that micro-patterns of extra-cellular matrix molecules are able to determine the polarity and division axis of cultured cells ([see publication](#)). This discovery was patented and licensed to a start-up company (CYTOO, created in 2008) and we have kept developing this technology.

- **Microchannels**: We use microfabricated channels ([see method publication](#)) to study cell migration and to mimic the micro-environment of the cell in the body. See poster below.

- **Confinement devices**: We developed tools to confine the cell to very low height and we have exploited them to understand how mechanical constrains affect cell division and migration.

- **Cell volume measurement**: We published a technique to measure precisely the cell volume with exclusion fluorescence ([see publication](#)) and showed that mammalian cells swell during mitosis ([see publication](#)).
Members of the team:

- **Larisa Venkova** (postdoctoral researcher): Cell volume regulation in response to deformations.

- **Nishit Srivastava** (postdoctoral researcher): Cell growth and size homeostasis with single-cell mass and volume measurements.

- **Guilherme Nader** (postdoctoral researcher): Probing the consequences of the loss of nuclear envelope integrity caused by nuclear deformation in confined microenvironments.

- **Theresa Jakuszeit** (postdoctoral researcher)

Subgroup: **MOTILE** (Mechanobiology Of Trans-Migration in Leukocytes) team headed by Pablo Vargas

Since 2016, **Pablo Vargas** is part of the team as a permanent researcher (CR1 INSERM). His main interests are in understanding the mechanics behind the efficient migration of cells between distant organs. To do that, his group is using leukocytes specialized for migration in complex microenvironments.

- **Mathieu Deygas** (postdoctoral researcher): Integration of biochemical signals during migration in 3D microenvironments.
Students both in our team and in another team:

- **Alexandra Zak** (postdoctoral researcher): Probing the cortex of the cell with magnetic tools, with the team of **Olivia Du Roure** (ESPCI).

- **Zahraa Al Raies** (PhD student): The role of nuclear envelope integrity in aging, with the team of **Ana-Maria Lennon-Duménil** (U932/INSERM/Institut Curie).

- **Alice Williart** (PhD student): Impact of mechanical state of nuclear envelope on HIV infection. In collaboration with the team of **Nicolas Manel** (U932/INSERM/Institut Curie).

Key publications

Year of publication 2020

The nucleus acts as a ruler tailoring cell responses to spatial constraints.
*Science (New York, N.Y.)*: [DOI: eaba2894](#)

Year of publication 2019

Clotilde Cadart, Larisa Venkova, Pierre Recho, Marco Cosentino Lagomarsino, Matthieu Piel (2019 Aug 19)
The physics of cell-size regulation across timescales

Hélène D Moreau, Carles Blanch-Mercader, Rafaele Attia, Mathieu Maurin, Zahraa Alraies, Doriane Sanséau, Odile Malbec, Maria-Graciela Delgado, Philippe Bousso, Jean-François Joanny, Raphaël Voituriez, Matthieu Piel, Ana-Maria Lennon-Duménil (2019 Apr 16)
Macropinocytosis Overcomes Directional Bias in Dendritic Cells Due to Hydraulic Resistance and Facilitates Space Exploration.
*Developmental cell*: 171-188.e5 : [DOI: S1534-5807(19)30235-7](#)

Year of publication 2018

Adhesion to nanofibers drives cell membrane remodeling through one-dimensional wetting.
*Nature communications*: 4450 : [DOI: 10.1038/s41467-018-06948-x](#)

Clotilde Cadart, Sylvain Monnier, Jacopo Grilli, Pablo J Sáez, Nishit Srivastava, Rafaele Attia, Emmanuel Terriac, Buzz Baum, Marco Cosentino-Lagomarsino, Matthieu Piel (2018 Aug 18)
Size control in mammalian cells involves modulation of both growth rate and cell cycle duration.
*Nature communications*: 3275 : [DOI: 10.1038/s41467-018-05393-0](#)

Diversification of human plasmacytoid predendritic cells in response to a single stimulus
*Nature Immunology*: 19(1) : 63-75 : [DOI: 10.1038/s41590-017-0012-z](#)