

**Mardi 26 mars 2024 à 10h30**  
**Amphithéâtre Henri Benoît**

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## Soft and adaptive active systems: towards cell-mimetic microdevices

Bioinspired microdevices are the prelude to a great advance in biomedical technologies. However, there is a clear gap in fabricating prototypes of the size and complexity of cells [1]. Active colloids are an experimental paradigm to realize microrobots due to their ability to self-propel and perform simple tasks [2, 3], yet they fail to provide autonomous units due to their limited geometries and materials, and lack of autonomy. How can we push the experimental limits and realize bioinspired microscale devices? Here, I will demonstrate that using soft and adaptive building blocks is the key to a new generation of biomimetic active colloids. In particular, I will show our recent results on the fabrication of cell-like active assemblies using giant unilamellar vesicles (GUVs) under external actuation [4]. In contrast to the traditional active colloids, active GUVs present an excellent cell-model system, thanks to their membrane permeability and ability to enclose nano and micro-objects. We report on their run-and-tumble dynamics, reminiscent of bacteria dynamic patterns. We further explore their ability to deform and divided when applying external fields. The proposed cell-like architecture reveals exciting opportunities for the development of soft and adaptive active microdevices with in-built feedback via bottom-up approaches.

Fig 1. Fluorescence microscopy picture of phase-separated active Janus vesicle driven by AC electric field. The motion of the vesicle undergoes runs and tumbles, due to the transient mixing of the lipid domains.

[1] Nelson BJ, Kaliakatsos IK, Abbott JJ. Microrobots for minimally invasive medicine. *Annu. Rev. Biomed. Eng.* 15, 55 (2010)

[2] Alvarez, L.\*, Fernandez-Rodriguez M.A., Alegria A., Zhao, K., Kruger, M., Isa, L.\*, Reconfigurable Artificial Microswimmers with Internal Feedback. *Nature Communications*, 12, 4762 (2021)

[3] van Kesteren, S., Alvarez, L., Arrese-Igor, S., Alegria, A., Isa, L\*, Self-propelling colloidal finite state machines. *PNAS*, 120, e2213481120 (2023)

[4] Willems, V., Baron A., Matoz-Fernandez, D., Wolisberg, G., Dufresne, E., Alvarez, L\*. Phase-separation dependent active motion of Janus Vesicles. *ArXiv* (under review, 2023)

