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## BAM05 : Fluid transports in living organisms

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### Content:

Fluid transport in living organisms encompasses a remarkable diversity of mechanisms combining active pumping, osmotic regulation, and hydraulic pressures to sustain life. From the pulsatile circulation of blood and lymph in animals, to sap transport in plants, to cerebrospinal fluid flow in the central nervous system, these systems operate under complex interactions between pressure gradients, tissue elasticity, and network geometry. At cellular and tissue scales, transport involves a delicate balance between advection and diffusion, while tissue mechanics often impose poroelastic constraints that couple fluid movement to deformation. Environmental interactions, such as evapotranspiration, rehydration after drought, or homeostatic tissue hydration further modulates flows. At larger scales, transport is often organized through actively reconfigurable networks, vascular, fungal, or cellular, where connectivity and geometry critically determine flow efficiency, robustness, and emergent behaviors. Understanding these processes raises fundamental questions from a physics perspective and suggests novel strategies for biomimetic design based on physical principles.

This mini-colloquium falls within the topics of the GDR MNF (Micro and NanoFluidics), GDR PhyP (Plant Biophysics and Biomechanics), GDR MECABIO Santé and GDR MePhy (Mechanics and Physics of Complex Systems).

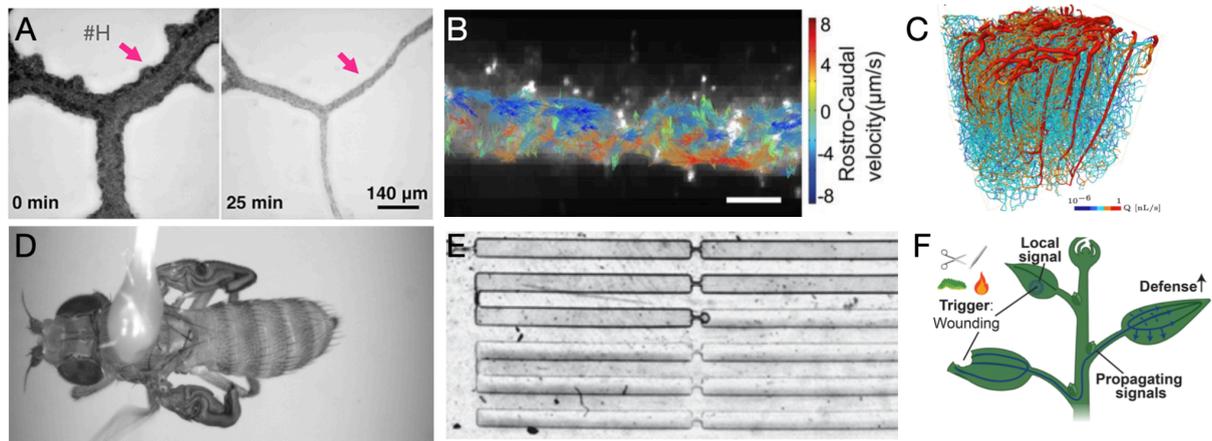


Figure: (A) Actively reconfigurable transport networks in *Physarum* [1] (B) Bidirectional flow in cerebrospinal fluid [2] (C) Dysfunction of cerebral microvascular transport [3] (D) Hydraulic wing deployment in insects [4] (E) Embolism propagation in biomimetic vascular networks [5] (F) Long-range hydromechanical signaling in plants [6]

### References:

- [1] S. Marbach et al. Vein fate determined by flow-based but time-delayed integration of network architecture. *Elife* (2023)
- [2] O. Thouvenin et al. Origin and role of the cerebrospinal fluid bidirectional flow in the central canal *Elife* (2020)
- [3] F. Goirand et al. Network-driven anomalous transport is a fundamental component of brain microvascular dysfunction. *Nature Communications* (2021)
- [4] S. Hadjaje et al. Mechanics of *Drosophila* wing deployment. *Nature Communications* (2024)
- [5] L. Keiser et al. Embolism propagation in *Adiantum* leaves and in a biomimetic system with constrictions. *Interface* (2024)
- [6] V. Bacheva et al. A unified framework for hydromechanical signaling can explain transmission of local and long-distance signals in plants. *PNAS* (2025)