BIOMAC–BP Seminar Series

Time: **April 29, 2026 (Wednesday)**
3 PM CET

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Bio:

Arnold Mathijssen completed his undergraduate at University College London (2012), his PhD with Julia Yeomans FRS at the University Oxford (2016), and a postdoc with Manu Prakash at Stanford University (2020). He is now a faculty member at the University of Pennsylvania and Associate Editor with Physics of Fluids. Arnold was awarded the *Sir Sam Edwards PhD Thesis Prize* by the UK Institute of Physics, the *'30 under 30'* Award by Scientific American, the *HFSP Cross-Disciplinary Fellowship*, the *Charles Kittel Award* by the American Physical Society, and the *Paul Sniegowski Award for Mentorship of Undergraduate Research*. Arnold is also a popular science communicator known for culinary fluid mechanics and the science of pour-over coffee, with coverage in The New York Times, The Guardian, CNN, FOX, USA Today, and Food & Wine Magazine.

Bacterial navigation in porous media

Bacteria often reside in porous media, such as soil and marine sediments, where complex geometries constrain and redirect their motion. Recent works have explored how bacteria can navigate in such environments composed of thousands of microchannels and pores. However, the roles of cell length and pore shape in navigating these environments remain poorly understood. Here, we investigate how cell morphology and pore architecture jointly determine bacterial spreading behavior. Using genetically engineered E. coli with tunable cell length, we performed single-cell tracking in microfluidic devices that mimic ordered and disordered porous structures. We find that elongated bacteria traverse ordered pore networks more effectively than short cells, exhibiting straighter paths, greater directional persistence, and enhanced exploration efficiency. In contrast, in disordered porous media, elongated bacteria become trapped in dead-end regions for extended periods, resulting in markedly reduced navigational efficiency. Together, these results reveal how cell shape and environmental geometry interact to govern bacterial transport. Moreover, we suggest a new mechanism for separating antimicrobial-resistant (AMR) bacteria from elongated susceptible cells in designer porous media.

References

[1] Gao D, Wang Z, Jain M, Mathijssen AJTM, and Tao R, "Selectric trapping of bacteria in porous media by cell length", arXiv:2512.17047

[2] Tao R, Théry A, Que S, Mathijssen AJTM, "Invasion of bacteria swimming upstream in microstructured devices", Newton 2(1): 100337 (2026) (journal cover)