Non-Equilibrium Statistical Physics of Collective Fiberboids

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Inspired by the ability of filamentous viruses to actively roll on surfaces, over the past years we have created biomimetic table-top self-rolling analogues. These so called fiberboids, can be simply generated in a home experiment, e.g. by placing a dry spaghetti onto a hot stove surface: the spaghetti filament starts to rapidly roll across the surface, acting as a single-wheeled heat engine transferring energy between two heat baths (hot plate to cooler air). Upon closer inspection, the seemingly simple actively rolling filaments exhibit very complex individual and collective collision and binary direction switching dynamics akin to a form of yet to be explored statistical mechanics. The filaments can be trapped in confining potentials, perturbed and probed with external forces, assigned simple tasks or can engage in competitive collective interactions ("games") showing "moshing" and "crowdsurfing" dynamics similar to living systems like human crowds. The goal of this PhD thesis is to experimentally investigate and theoretically explain the collective statistical dynamics observed in systems of fiberboids and draw parallels to their natural counterparts.

The environment: M3 is a team of inspired Soft, Active & Biological Mater physicists who love what they do and enjoy doing it together, currently co-supervising 5 PhD students within the team.

We are looking for a dynamic out-of-the-box-thinker, with interest in experimental and theoretical soft matter physics, active systems or biophysics, equipped with curiosity, courage and persistence to make new and surprising things become reality. Prior basic skills in image/data analysis and python scripting are useful, but not madatory. If you are interested, do not hesitate and contact us.

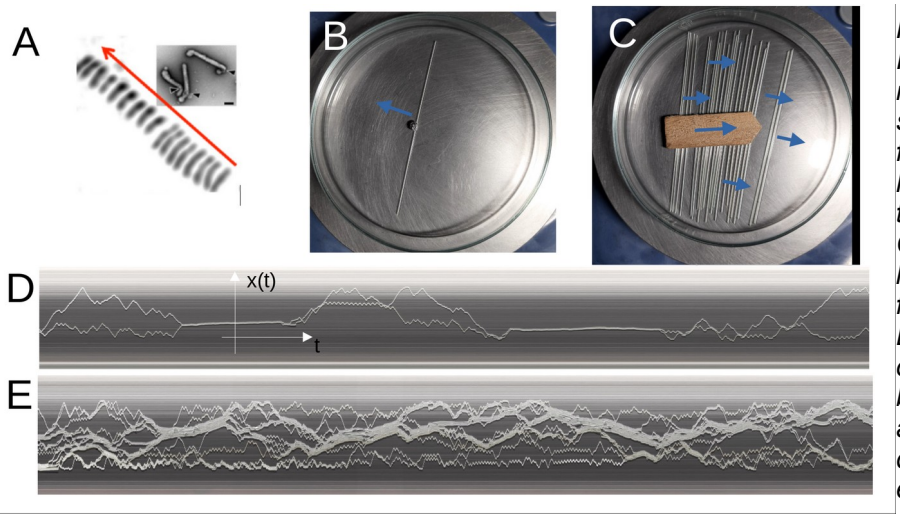

Figure: A) Filamentous Influenza viruses actively roll across sugar coated surfaces. B) A nylon fiberboid rolling along a hot surface and transporting a cargo. C) Collective transport of larger objects by an fiberboid ensemble. D) Space-time dynamics of binary collisions between two fiberboids and E) collective dynamics of a larger ensemble.

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