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Organizing space at the cellular scale using molecular lawnmowers

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Nature utilizes molecular machines to organize space at the cellular scale. A number of these machines operate via a mechanism known as a burnt bridges Brownian ratchet (BBR), where the machine consumes energy to form a spatial gradient of a substrate that drives motion. These 'lawnmowers' can be found in bacteria where they spatially segregate genetic material. Recent experimental work has shown that BBR systems can be designed and implemented in vitro to drive the motion of spherical particles along surfaces. In this talk I will present our modelling efforts to understand the complex dynamics of BBRs that have been observed both in vivo and in vitro. For in vivo BBRs I will show how cellular confinement and a competition for the substrate can aid the faithful spatial segregation of cargo. Lastly, for the spherical particle BBRs, I'll show how the chemical kinetics and elastic properties of the surface can be tuned to control the persistence and mode of motion, whether rolling or sliding. The varied dynamics of BBRs make them well suited to solve the vast assortment of transport problems that Nature provides.