Elongated active particles in speckle fields

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Active particles, defined as units that autonomously extract energy from the environment to move or perform work, are ubiquitous in nature. Even though some interesting properties of these systems can be understood by approximating the particles as spheres, the shape of these particles has recently been highlighted as a key property to engineer their active motion [1,2,3]. The motion of these non-spherical active particles has been well characterized in homogeneous energy landscapes; however, real life active systems often find themselves in much more complex environments. Light speckle patterns can generate random energy landscapes introducing part of the complexity of real-life situations [4,5].

The role that the shape plays in the dynamics of active particles in complex environments remains to be explored. In this work, we study the dynamics of 3D printed elongated active particles in a speckle light field. The particles are coated with platinum on one end, creating an asymmetry that is exploited for activating the particles when illuminated with laser light. In this way, light plays a double role. It does not only generate a potential energy landscape, but also induces activation by thermophoresis when heating the platinum. We find that the properties of the particles' dynamics are strongly affected by parameters like their aspect ratio, the speckle grain size, and the intensity of the light. Furthermore, the particles' trajectories tend to generate a network where particles starting from different positions can end up following very similar paths (Fig 1).

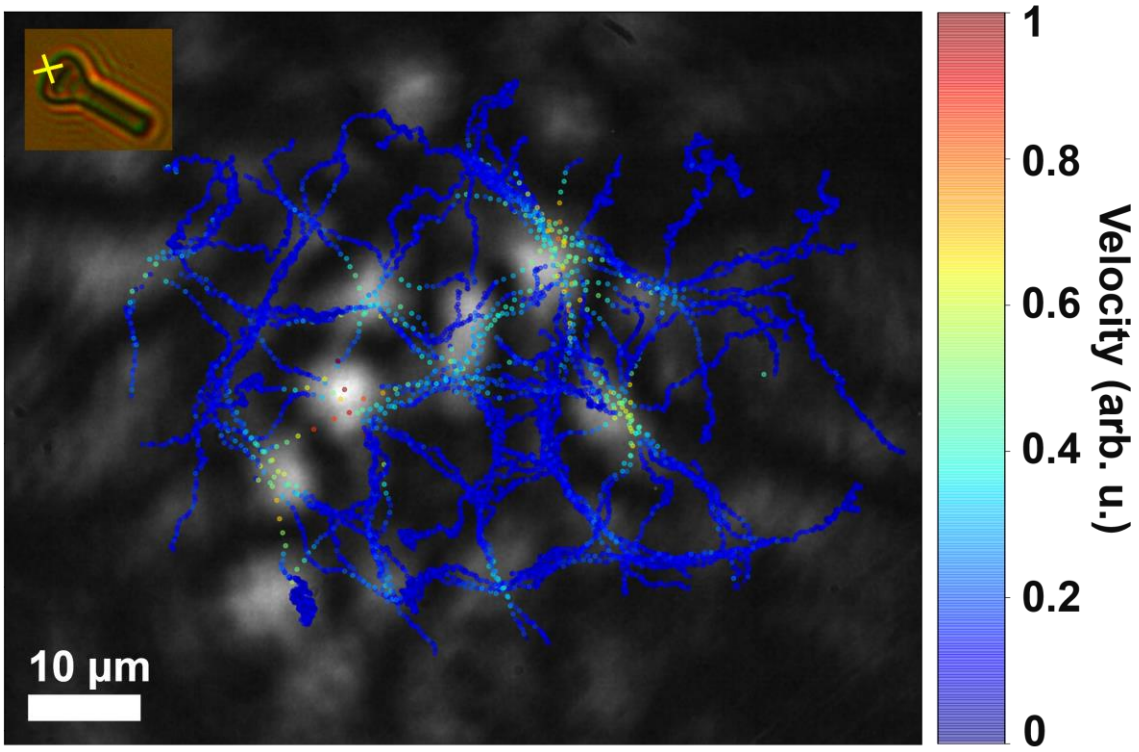

Fig 1: Trajectories of elongated active particles in a speckle field. The image in the top left corner shows the particle studied in this figure. The yellow cross corresponds to the platinum coated part. The positions of the center of this coated part are plotted for different initial positions. The color of the points represents the normalized velocity of the particle at that given point.

References

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