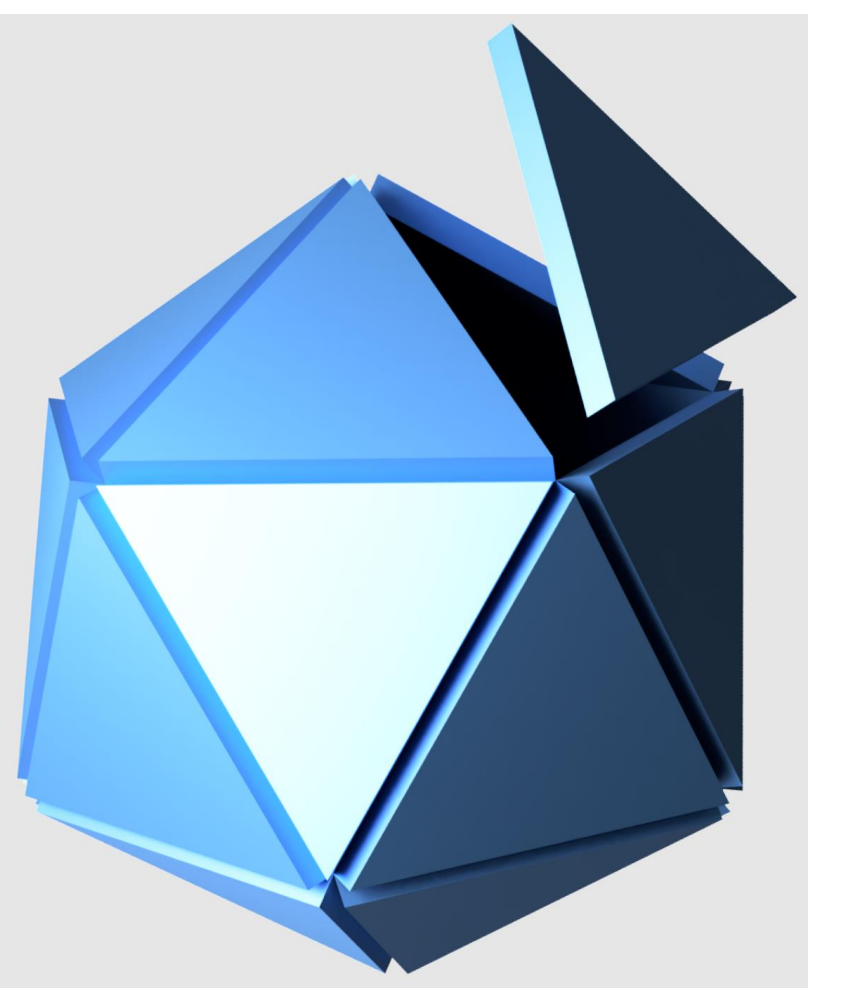


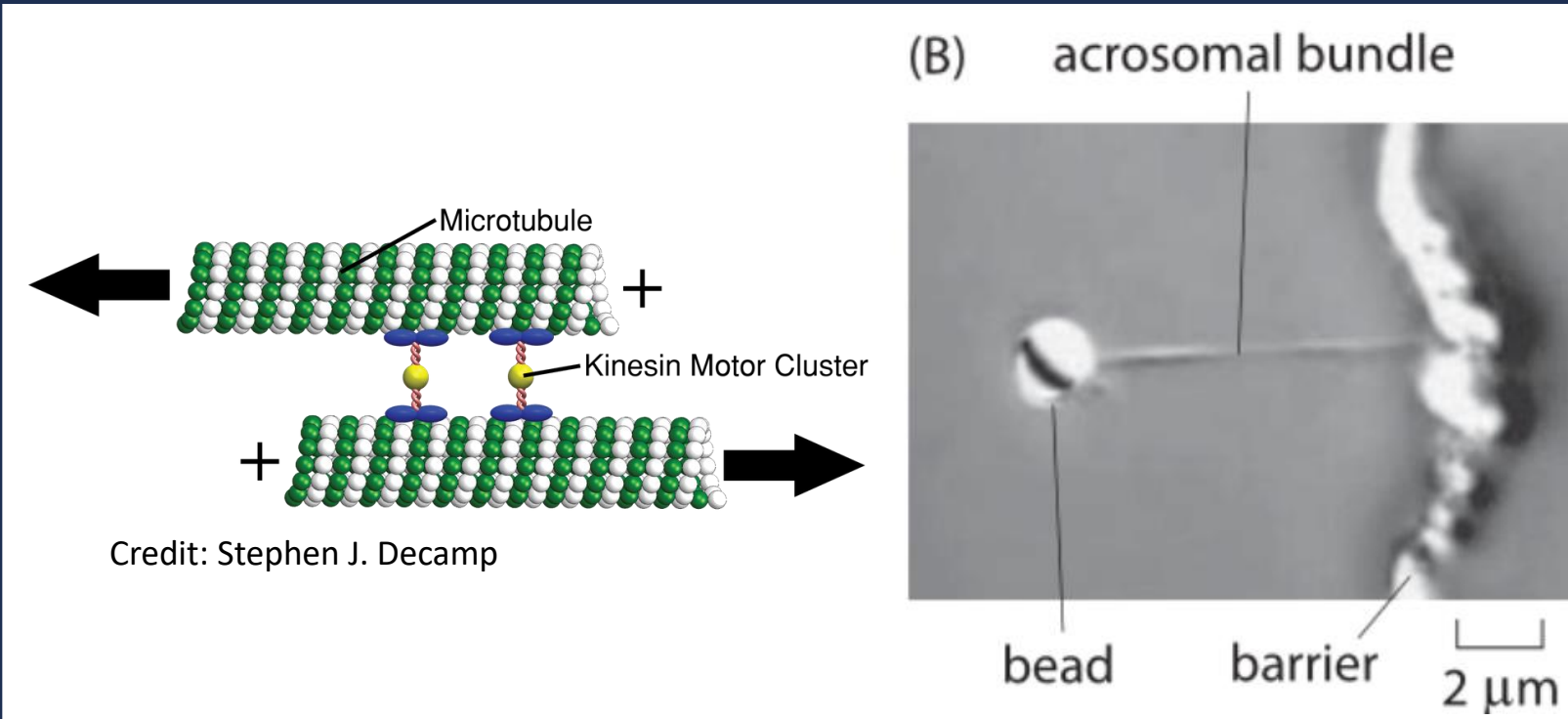
# Emergent behavior in motile beads driven by actin polymerization

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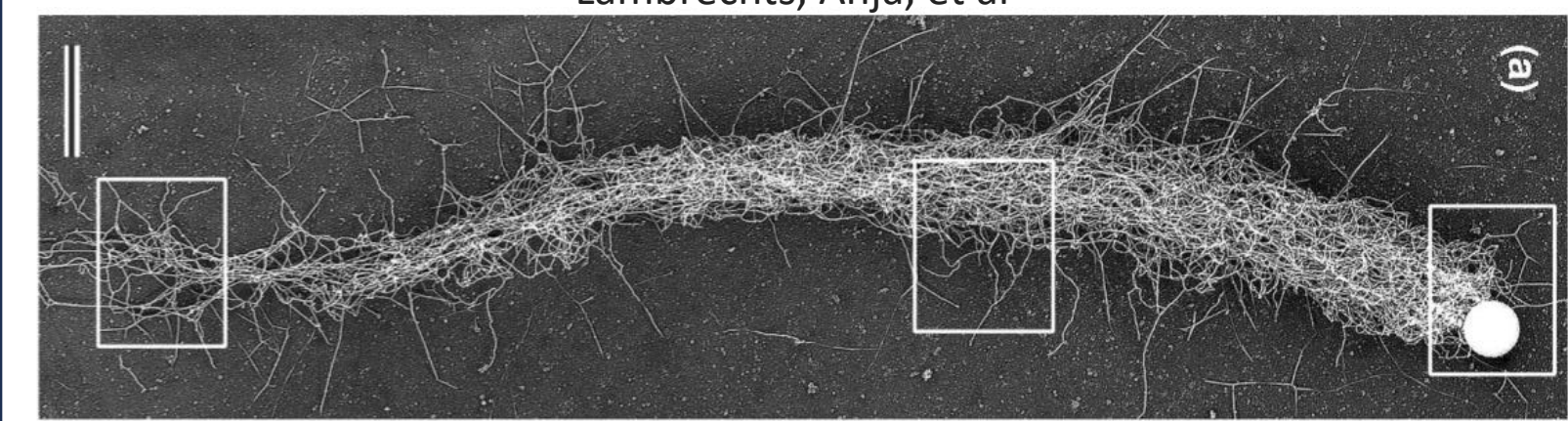
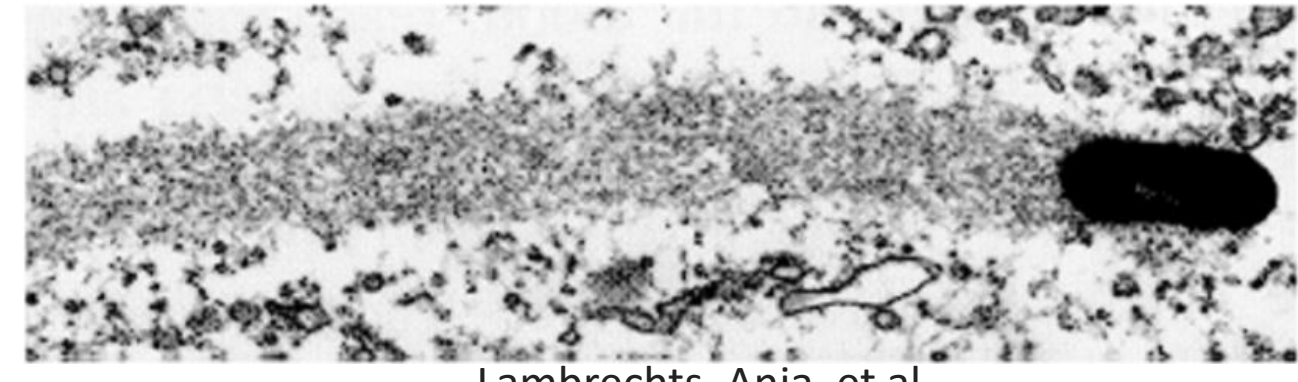


## Introduction



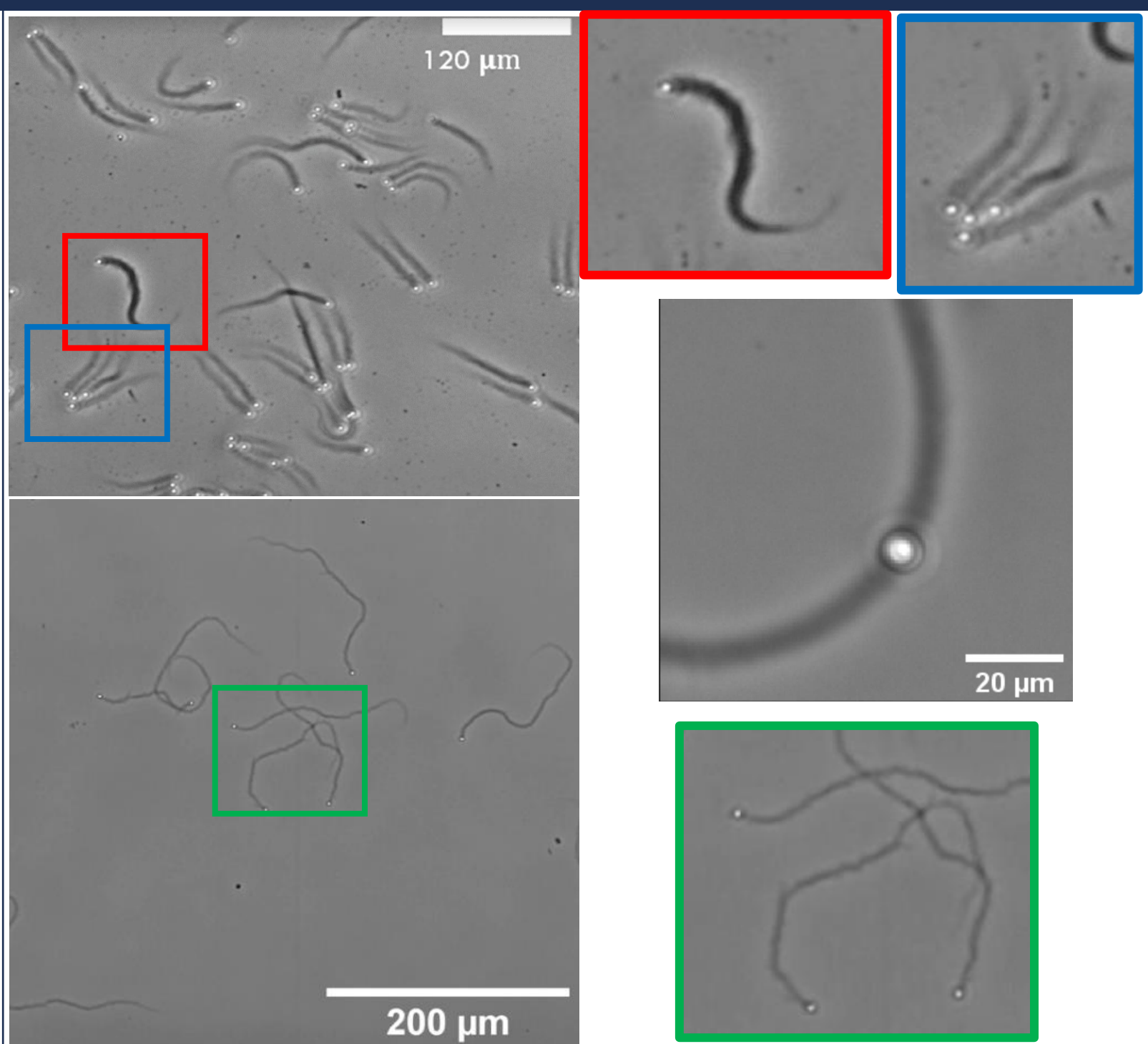
Much bioinspired active matter we see in our MRSEC is based on the force generation by molecular motors driving biopolymers. (Upper left) Here we see clustered kinesin motors walking along two antiparallel microtubules creating extensile motion. While this is a rich experimental system, the cytoskeleton is capable of producing force by polymerization of biopolymers alone. (Upper right) A bead hosts a polymerizing filament that grows towards a barrier. Through a Brownian ratchet type interaction, the filament further grows, exerting a force to deform the barrier.

With this in mind, we set out to design a new class of polymerization based active matter.



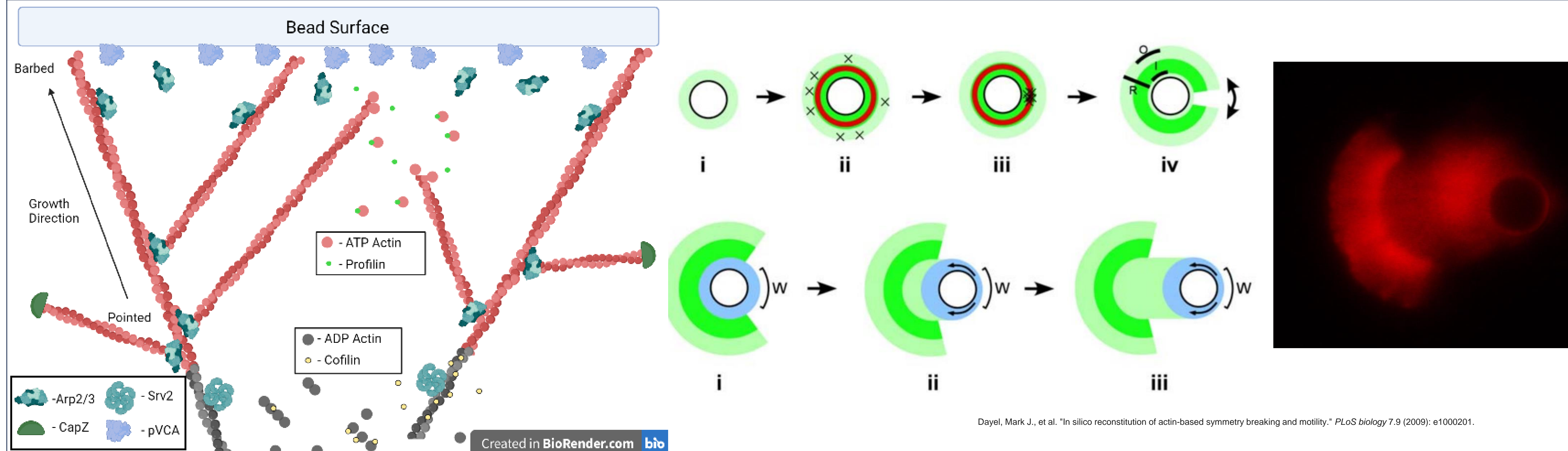
For inspiration we again turn to nature. (Top) The pathogen *Listeria* utilizes the polymerization of actin filaments in host cells to provide motility, creating an actin comet tail in the process. (Bottom) Others have been able to reproduce motility via actin comet tails *in vitro*.

## Bead motility behavior

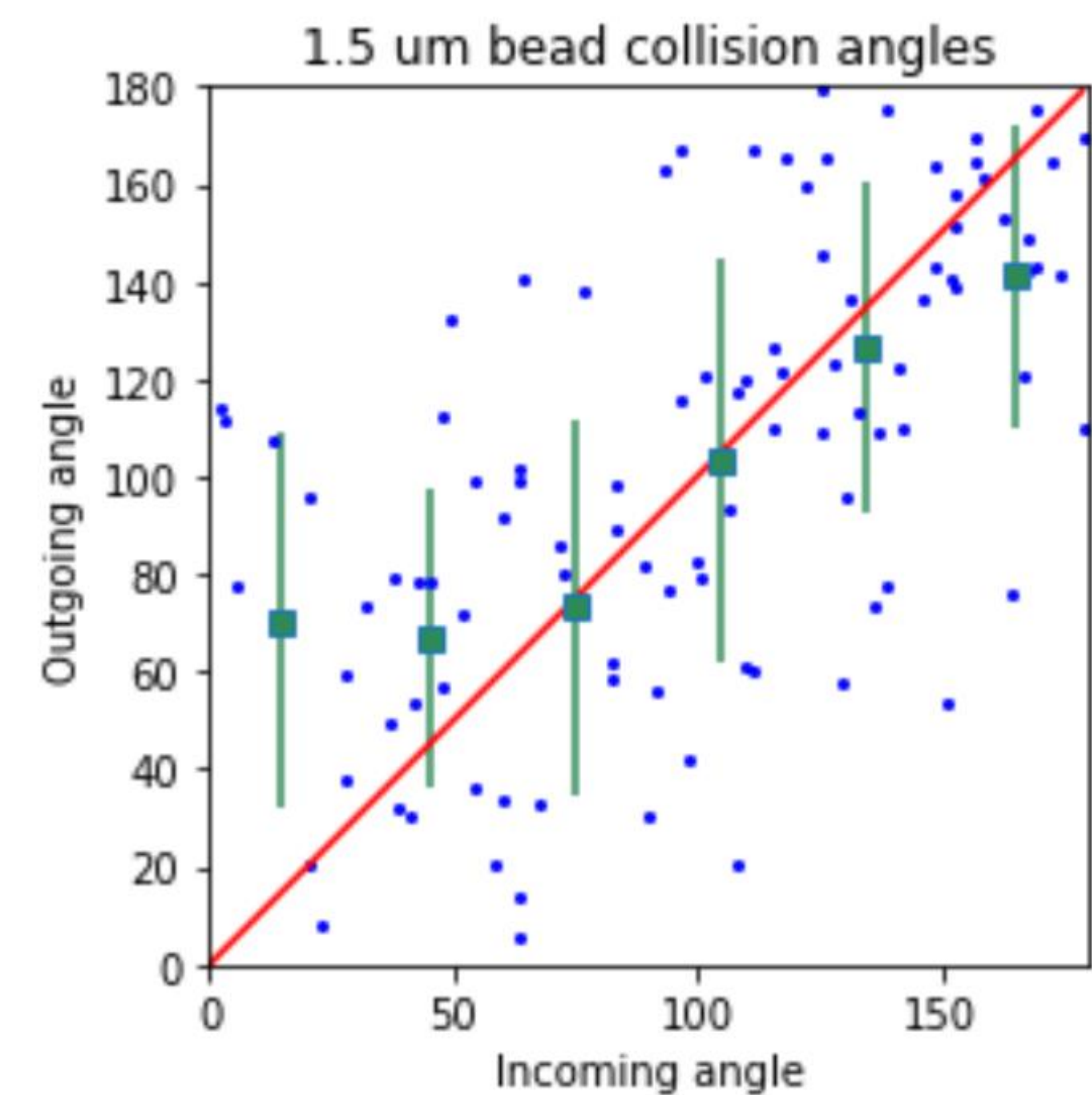
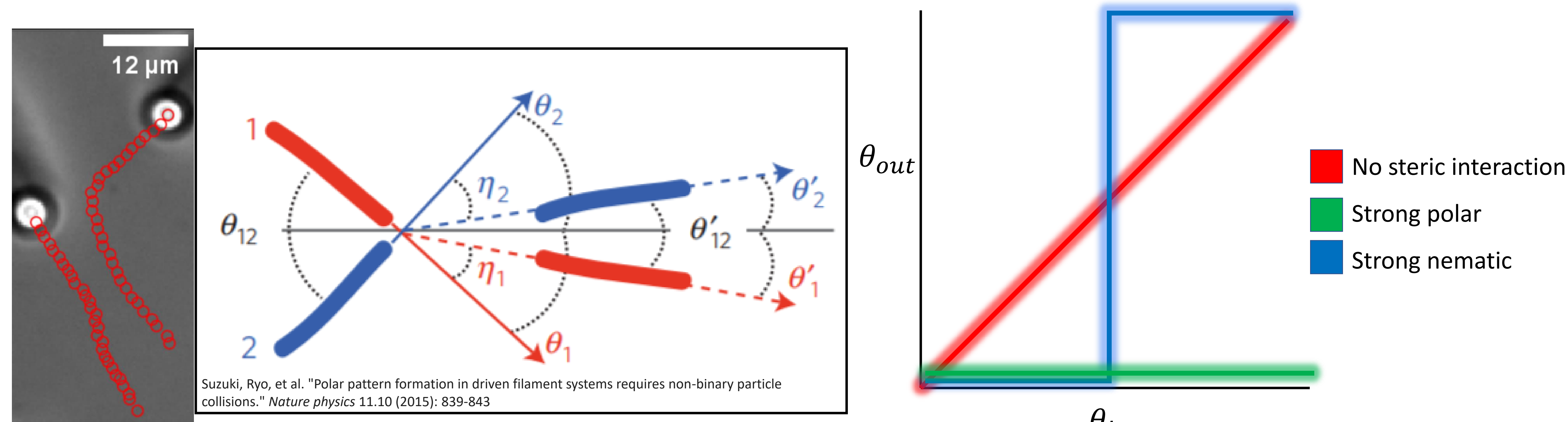


**Behavior of motile beads.** The top left panel shows a broad phase contrast image of 6 μm beads propelled by actin comet tails. The red and blue panels show 6 μm beads on their own and in flocks, respectively. The green panel shows 1.5 μm beads that do not exhibit flocking behavior. The image in between shows a 6 μm bead with two tails.

## Biochemical System & Force Generation

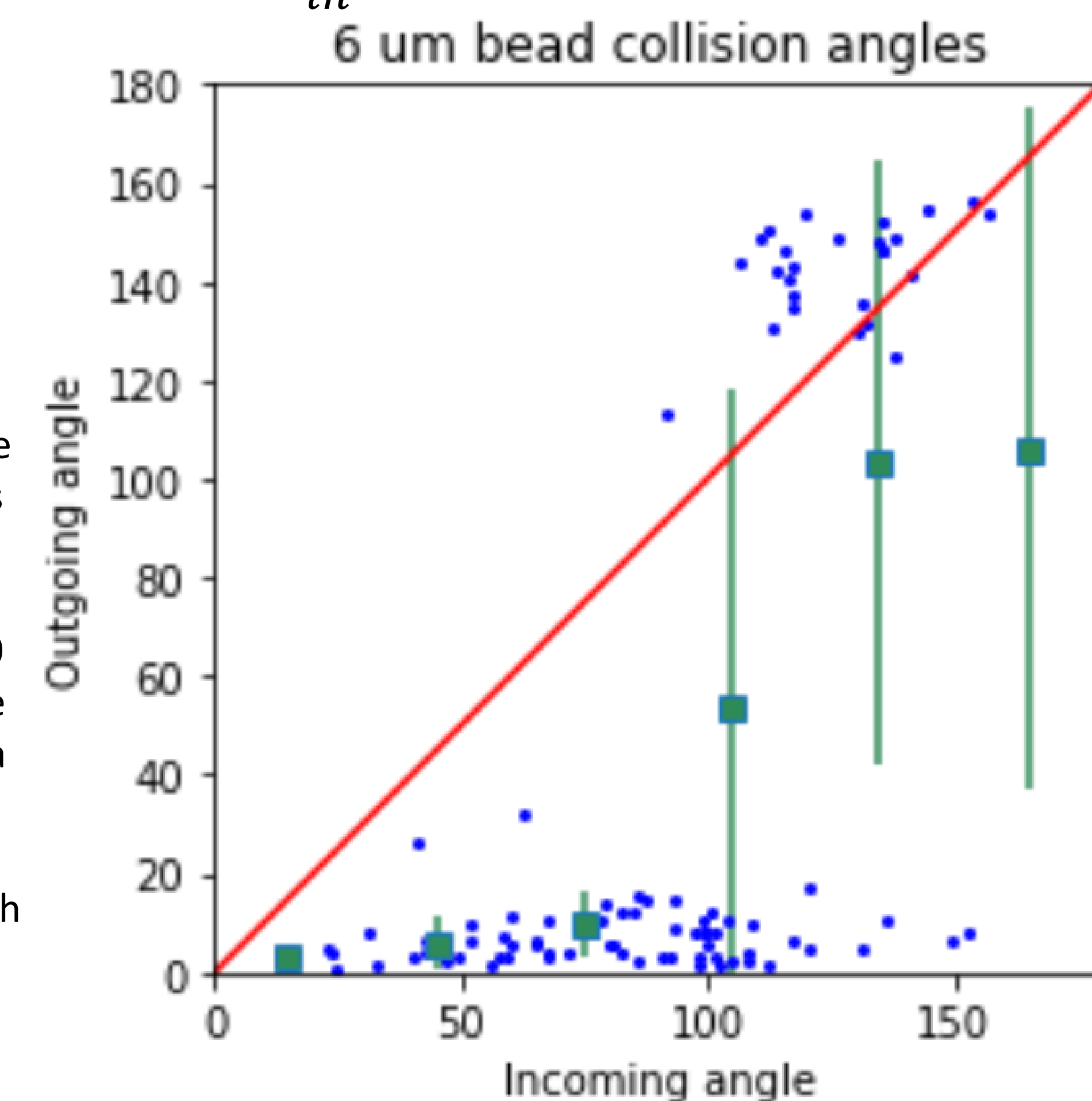


## Binary Collision Statistics

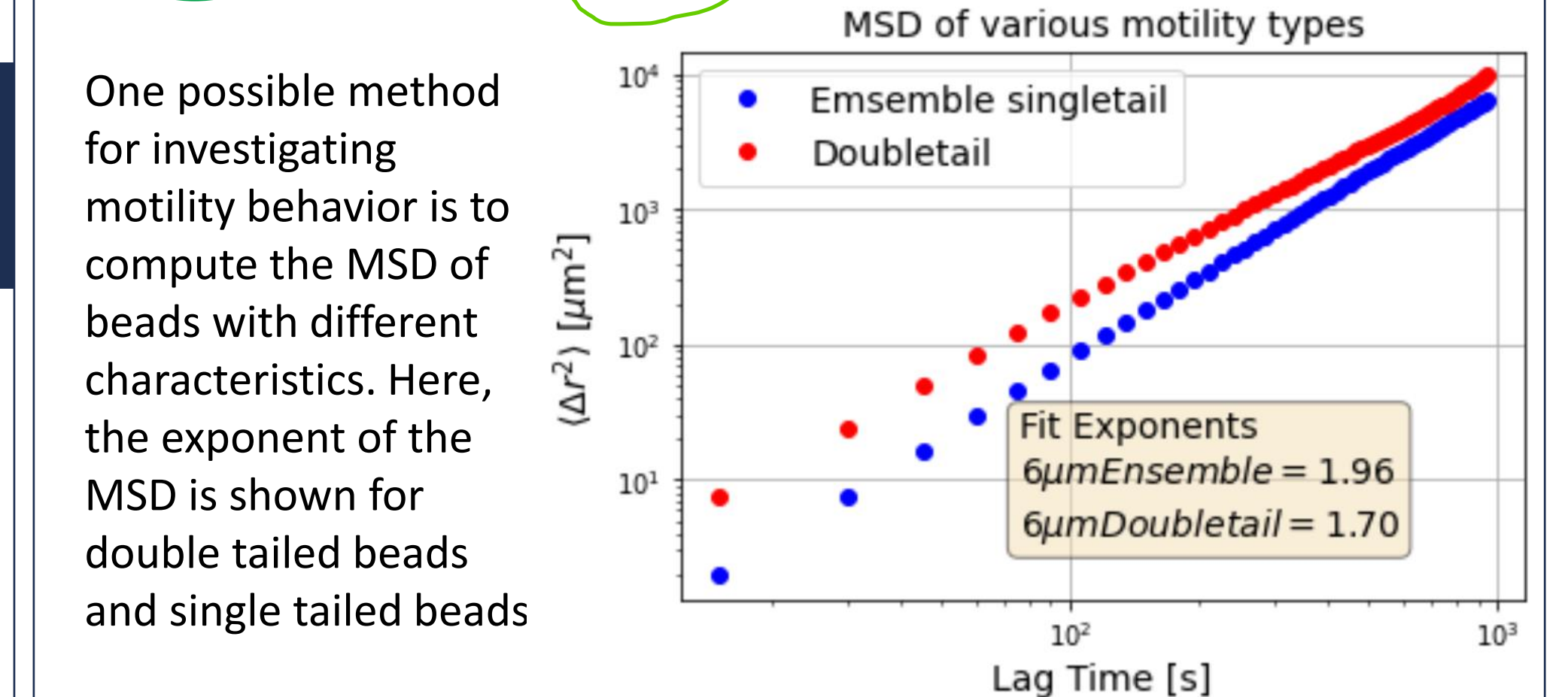
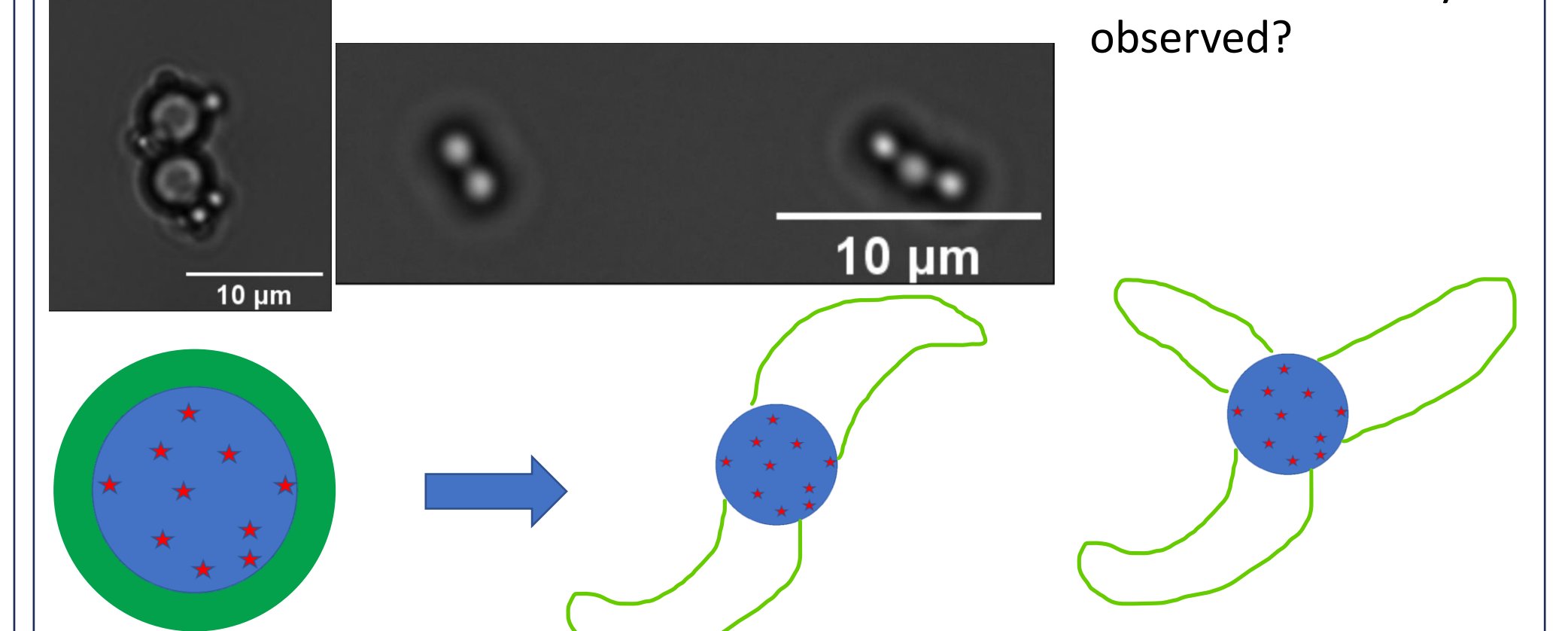
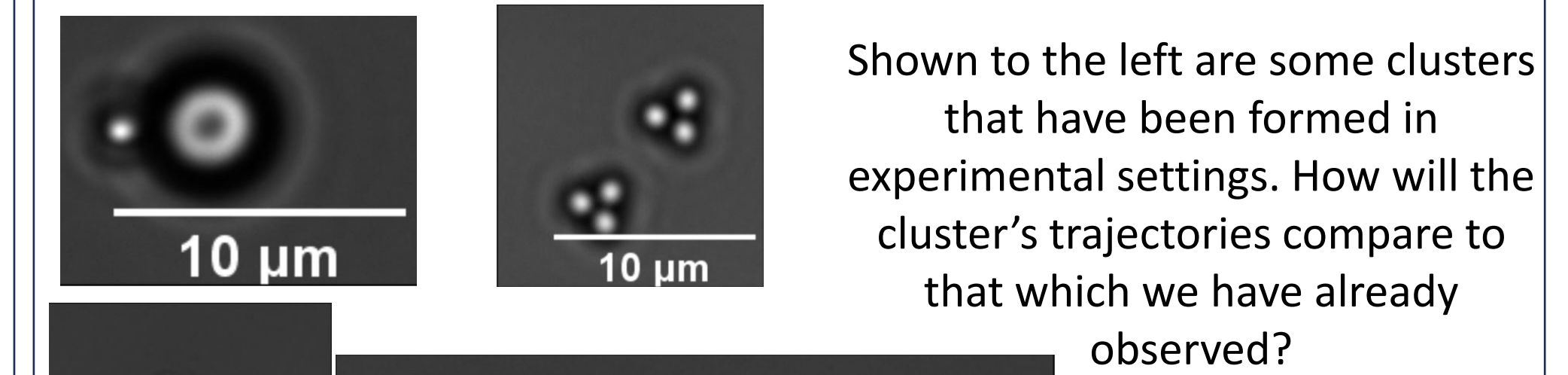


Left: Binary collision data for ~100 collisions between 1.5 μm beads. The data is grouped around the red line which denotes  $\theta_{in} = \theta_{out}$  indicating a lack of bead-bead interaction further supported by the running averages of collision angles above the plot.

Right: Binary collision data for ~100 collisions between 6 μm beads. The bottom grouping of data indicates a majority polar interaction in this system where for most  $\theta_{in}, \theta_{out} = 0$ . The above grouping have very high  $\theta_{in}$ , and allows us to conclude that this is largely a polar interaction.



## Future Directions



## References

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