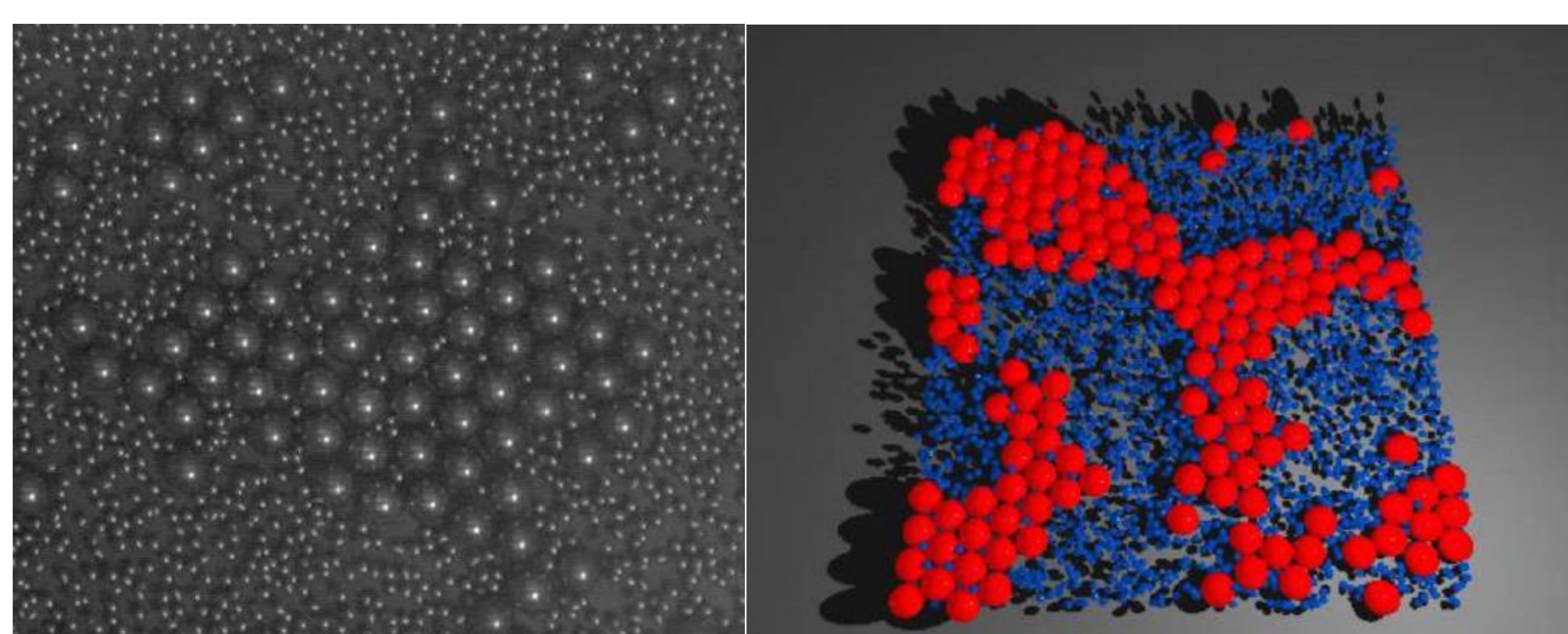
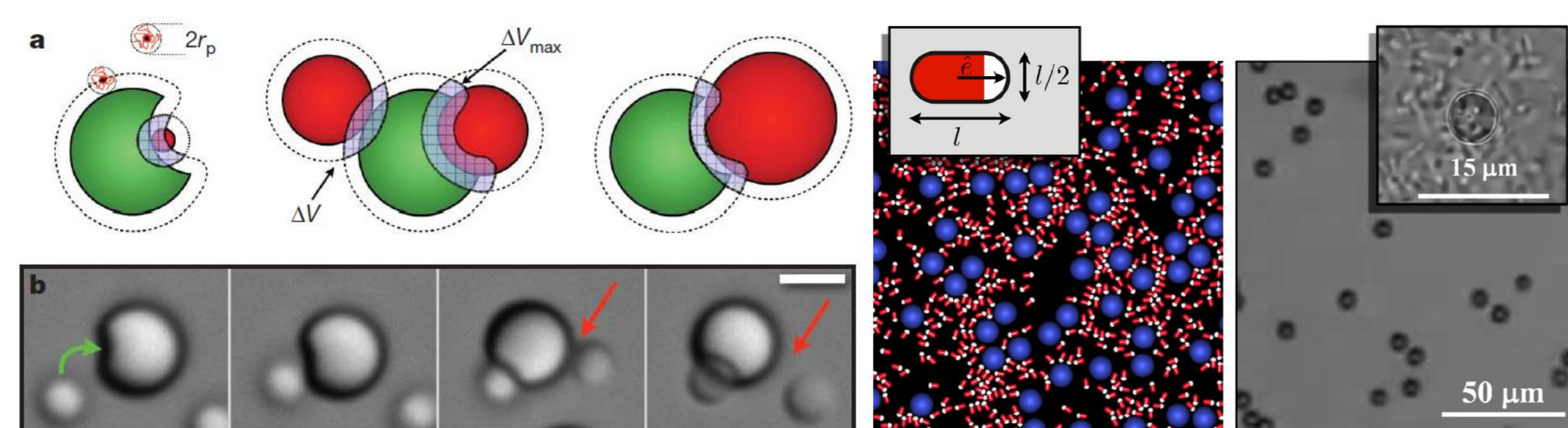


## Abstract

Previous experiments have shown that colloidal particles interact with each other via depletion forces in the presence of passive depletant particles. Numerical and experimental work have shown that this depletion interaction is attractive in nature, and can also be observed in a bath of passive bidisperse granular media. The effect of having an active bath to such interaction is not fully known. We performed experiments that focus on the interaction of macroscopic disks immersed in a quasi-2D bath of vertically vibrated self-propelled rods acting as depletant. We will present results on the depletion-like interaction due to the active bath.

## Motivation

Depletion interactions are observed between colloidal particles in the presence of passive and active depletants. [1,2]

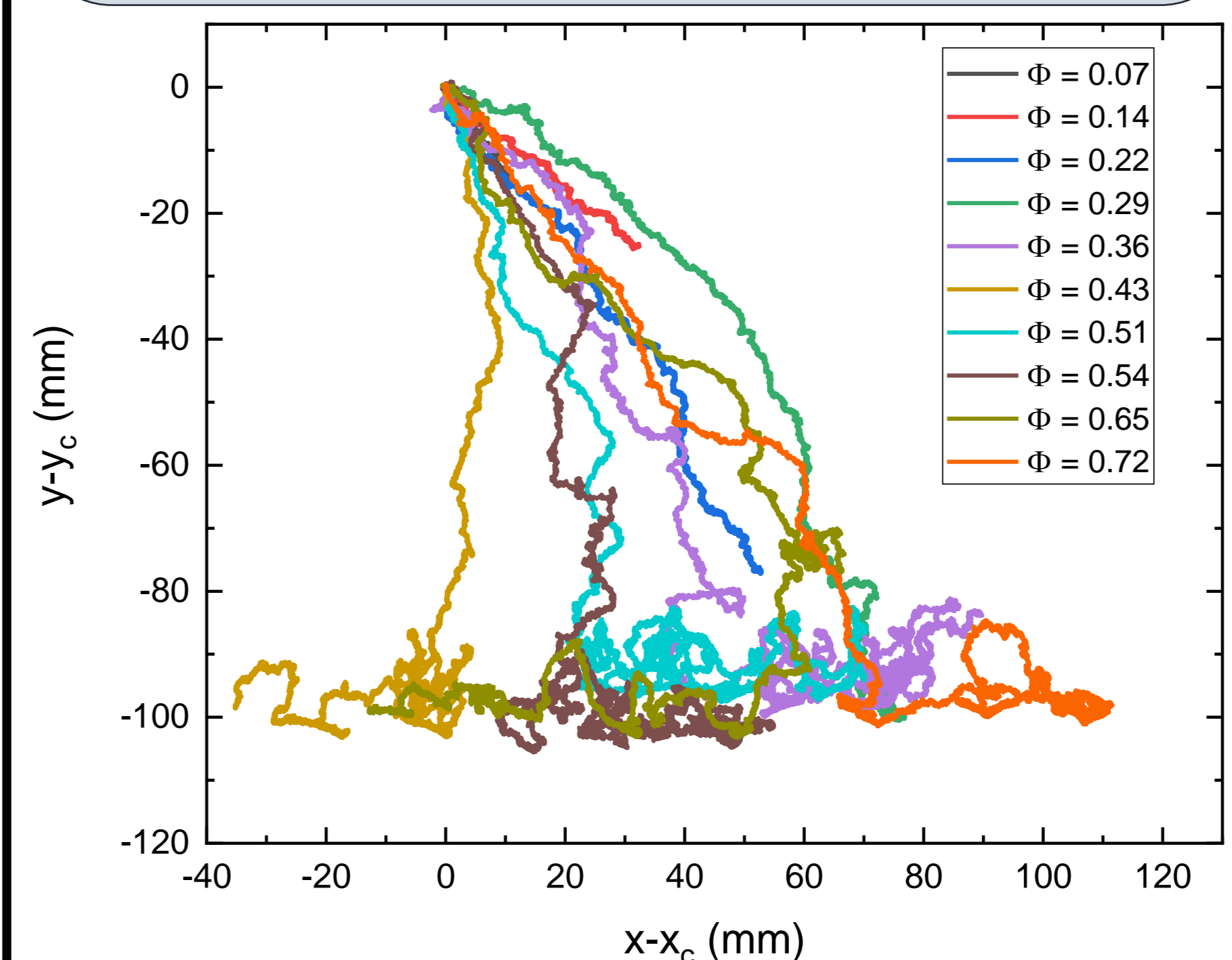


An interaction similar to depletion is reported in a bath of vertically driven bidisperse granular media [3].

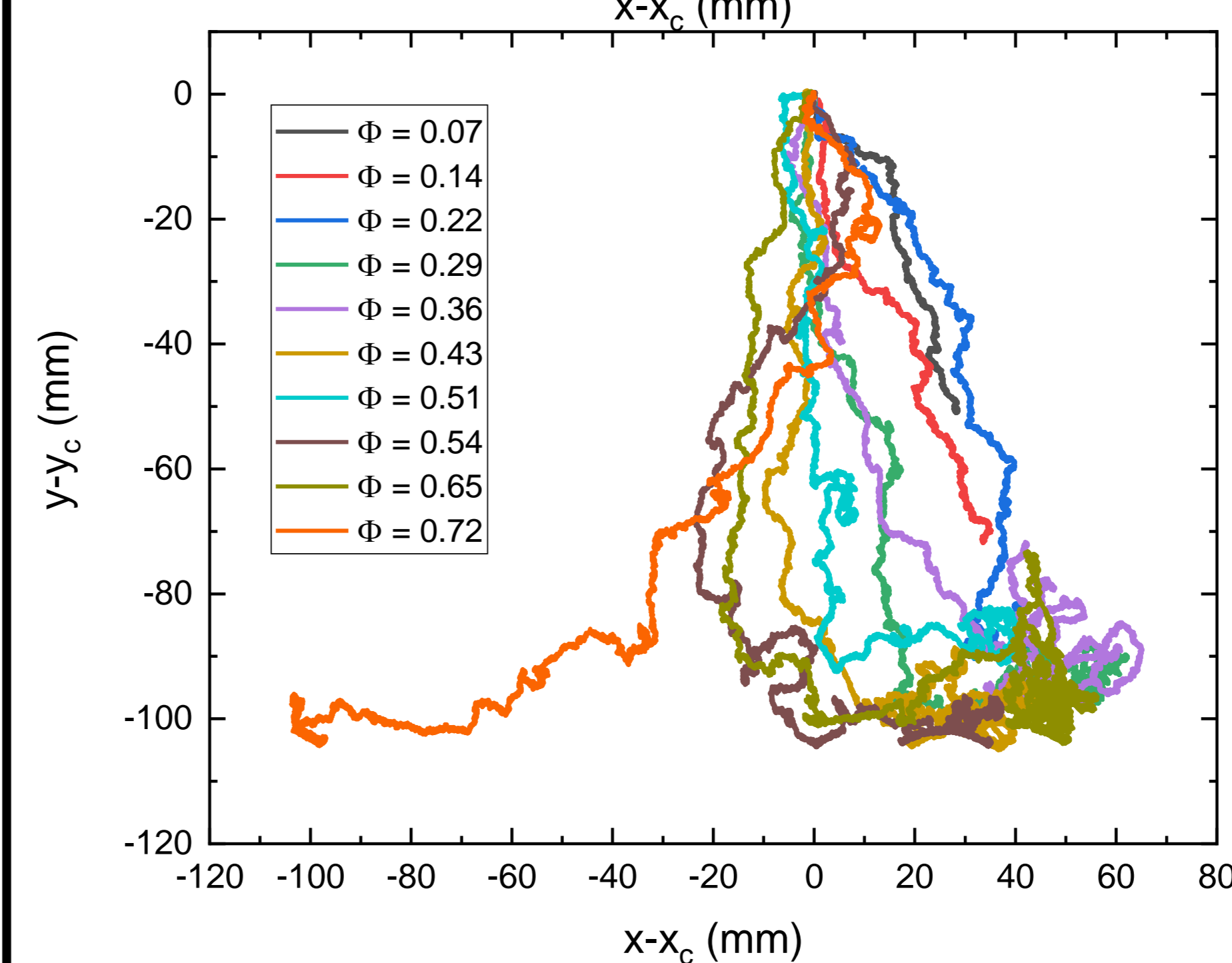
Depletion effects in an active granular bath are not yet fully known.

## Initial Results

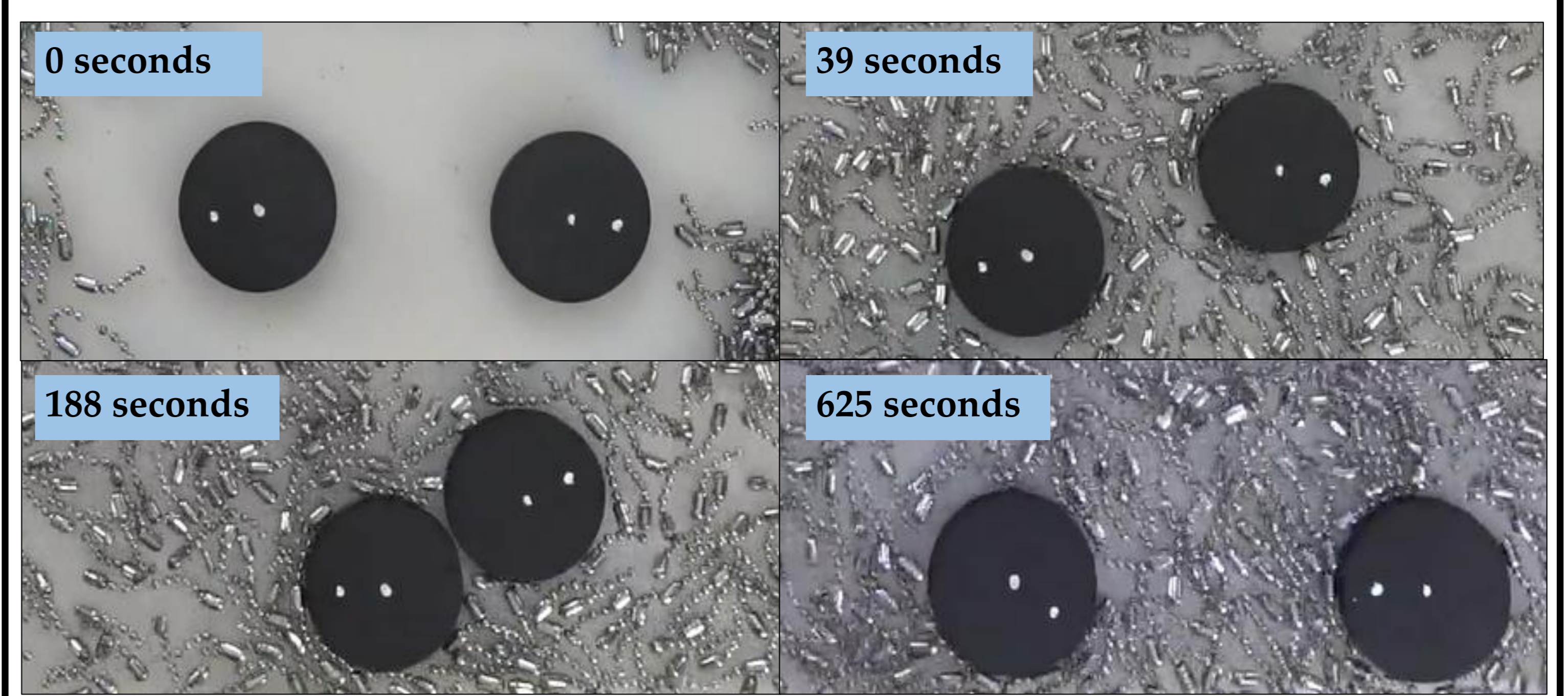
### Probe trajectories



Trajectories of the left probe (top) and right probe (bottom) with respect to their body centers for varied area fraction  $\Phi$

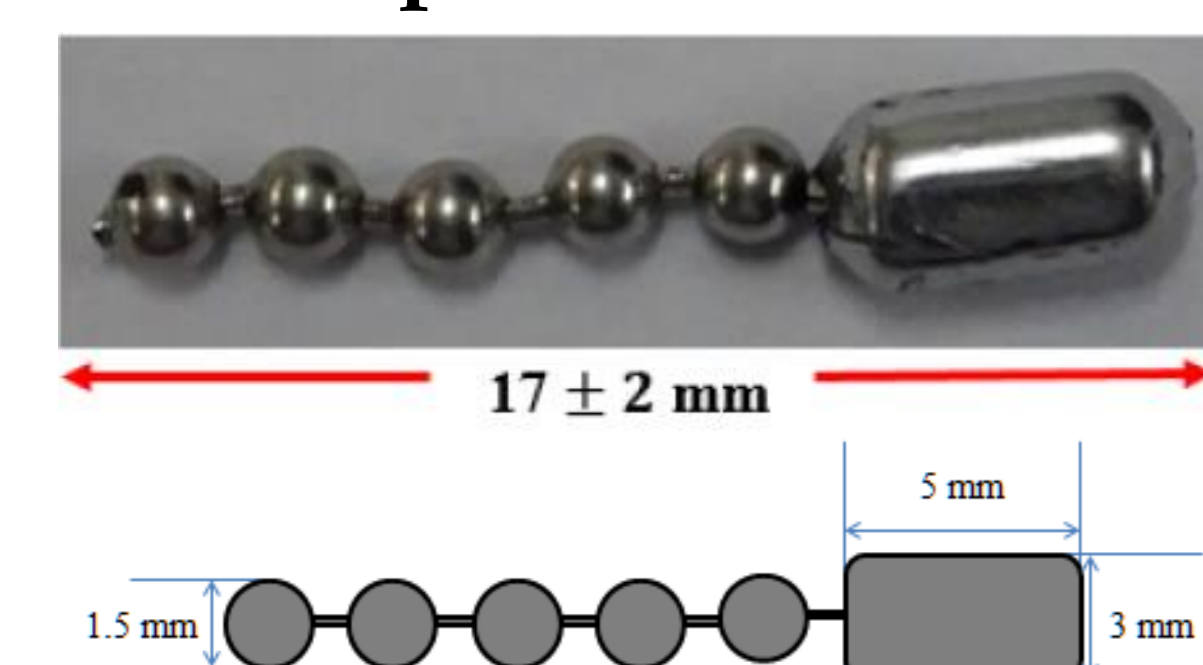


The probes are observed to be driven by the active granular bath towards each other, a phenomenon similar to passive particles in the presence of a depletant.

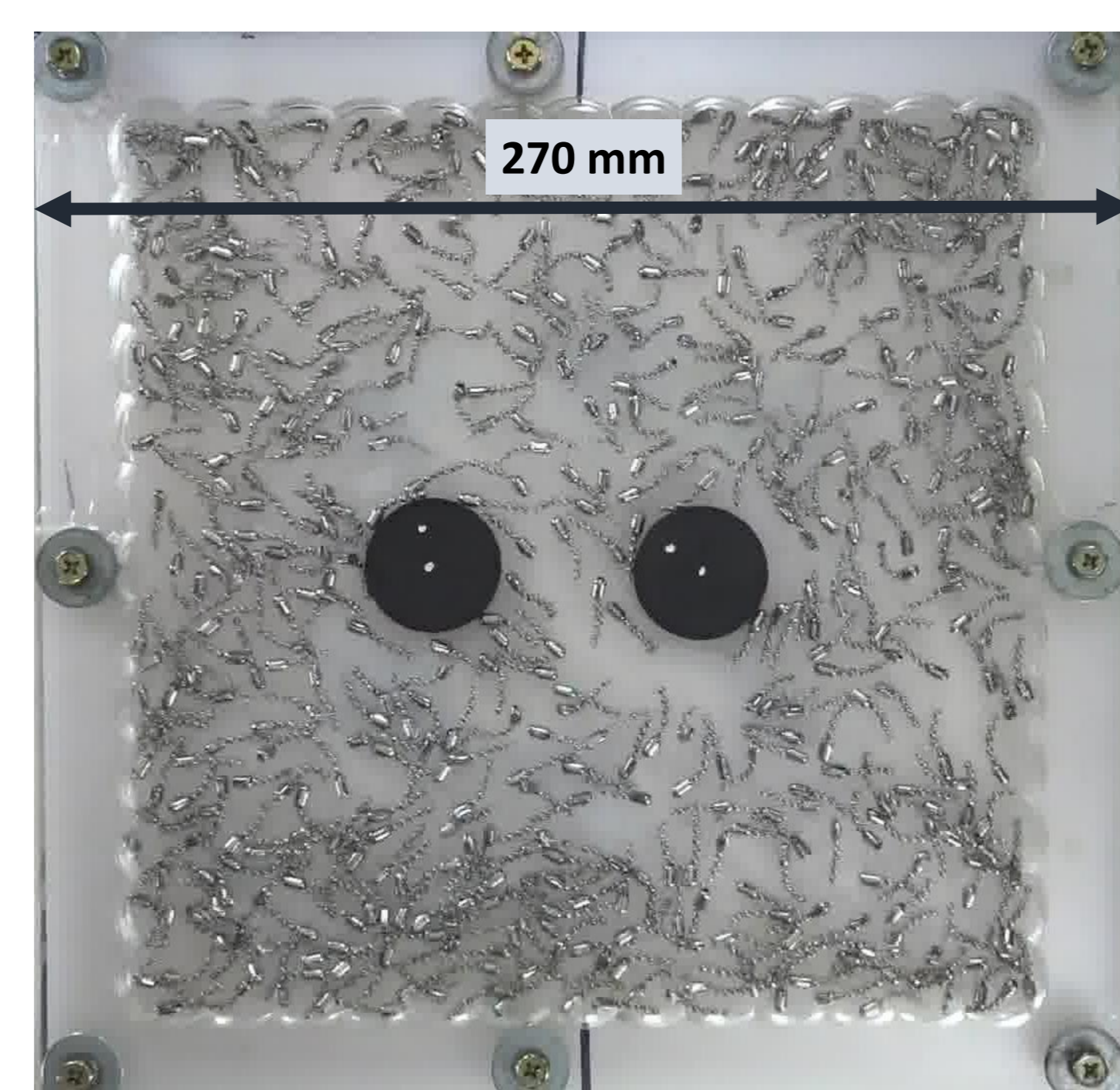


## Experimental Setup and Methodology

### Self-Propelled Rod (SPR)



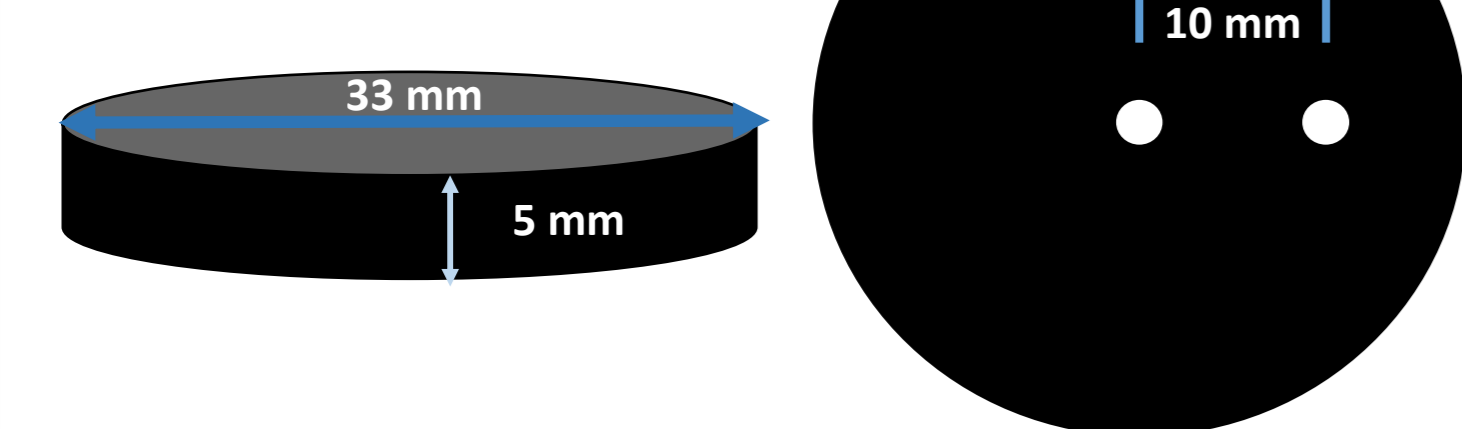
### Experimental Compartment with the circular probe particles in the SPR bath (Top View)



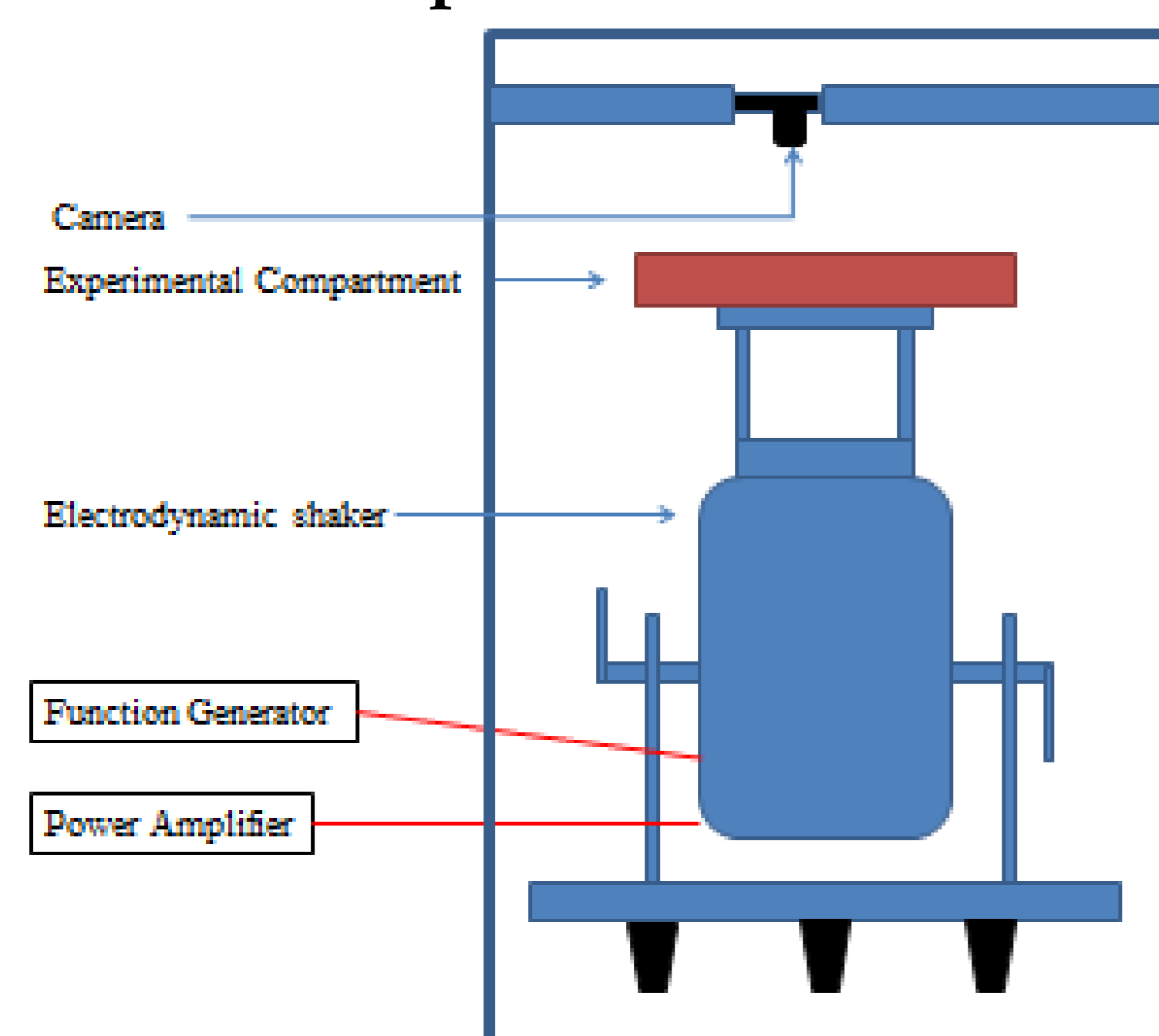
$$\text{Area Fraction } \Phi = \frac{NA_{SPR}}{A_C - 2A_{probe}}$$

$N$  = number of SPR in the compartment  
 $A_{SPR}$  = surface area of one SPR  
 $A_C$  = area of experimental compartment  
 $A_{probe}$  = area of one circular probe particle

### Circular Probe Particle



### Experimental Setup: Schematic Representation



1. Set the parameters [ $A$ ,  $f$ , gain (in terms of power output)]
2. Load  $N$  number of particles
3. Capture experiment (in the form of a .mp4 video) via digital camera
4. Convert .mp4 video into .avi video using Any Video Converter (AVC)
5. Convert the .avi video into an image sequence using ImageJ
6. Analyze data using a ready-made code
  - Track the  $(x,y)$ -trajectory of the probes
  - Obtain the MSD

### Experiment Protocol

## Summary

- At lower area fraction, depletion effects are not observed.
- At some concentration and within a certain time interval, depletion effects are observed and is attractive in nature.
- At higher area fraction, the interaction becomes repulsive as more SPRs crowd between the probe particles.

## References

- [1] Sacanna, S., Irvine, W., Chaikin, P. *et al.* Lock and key colloids. *Nature* **464**, 575–578 (2010).
- [2] Angelani, L., Maggi, C. *et al.* Effective interactions between colloidal particles suspended in a bath of swimming cells. *Phys Rev Lett.* **107** (2011).
- [3] Melby P, Prevost A, Egoif DA, Urbach JS. Depletion force in a bidisperse granular layer. *Phys Rev E Stat Nonlin Soft Matter Phys.* 2007 Nov; **76**(5 Pt 1):051307

## Acknowledgement

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