DSCG liquid crystal's viscosity: Insight into the motility of bacteria in an anisotropic liquid environment

In this talk

- Anisotropic medium: DSCG liquid crystal
- Isotropic and anisotropic motility of flagellar bacteria (*E. coli)*
- Speed and orientation of bacteria in DSCG solution
- Viscosity of DSCG solution

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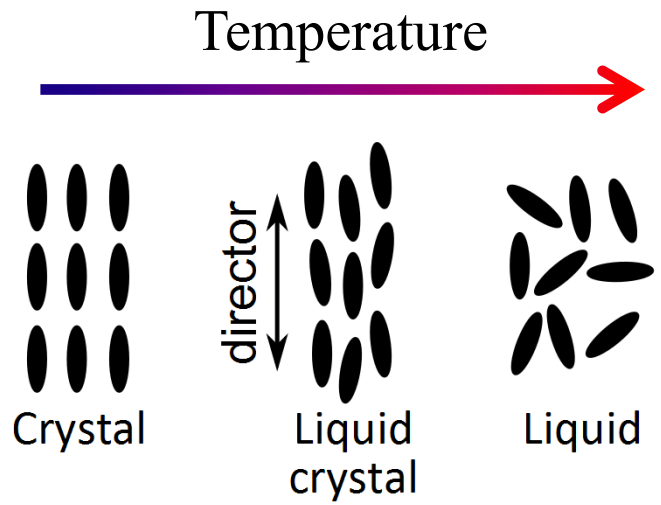
DSCG liquid crystal's viscosity: Insight into the motility of bacteria in an anisotropic liquid environment

- Anisotropic liquid environment:
  - Physical properties depend on the direction (as birefringence)
- Flagellar bacteria:
  - Bacteria that may swims in aqueous medium by rotating theirs flagella
- Why anisotropic motility:
  - Many biological tissues and media may be anisotropic (biofilms, enriched chitin soils...)
  - Difficult task: only few studies

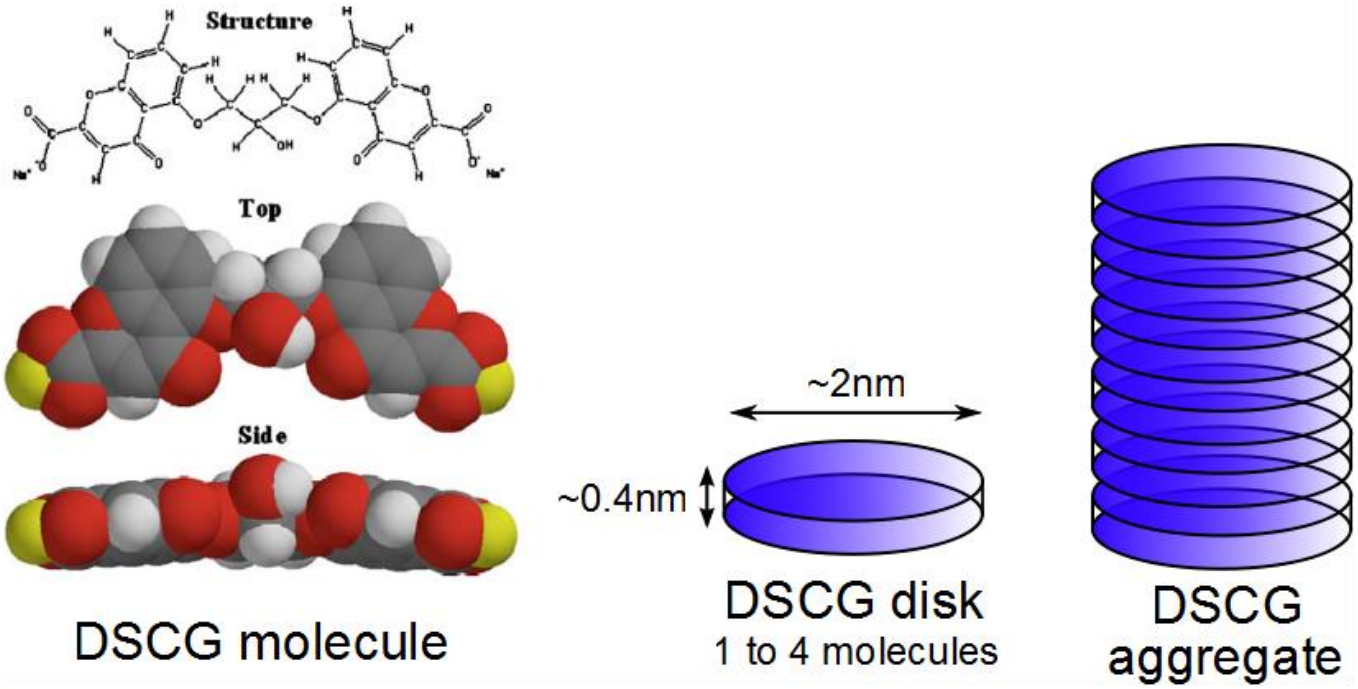
Anisotropic medium: nematic liquid crystal (LC)



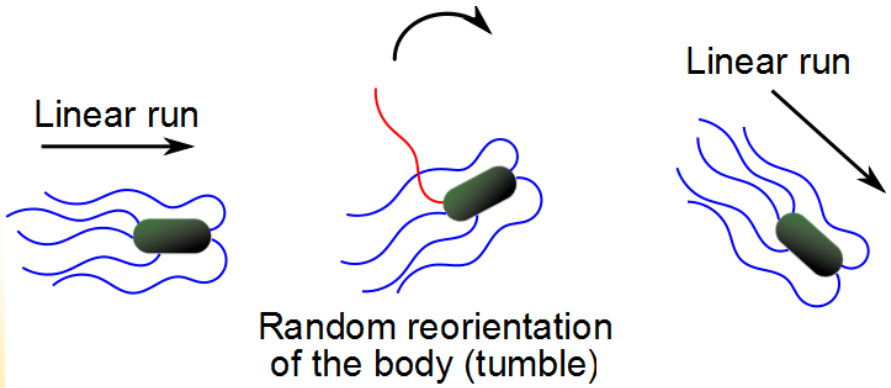
Order			
Orientational	X	X	
Positional	X		

Lyotropic LC: cromolyn sodium salt (DSCG)

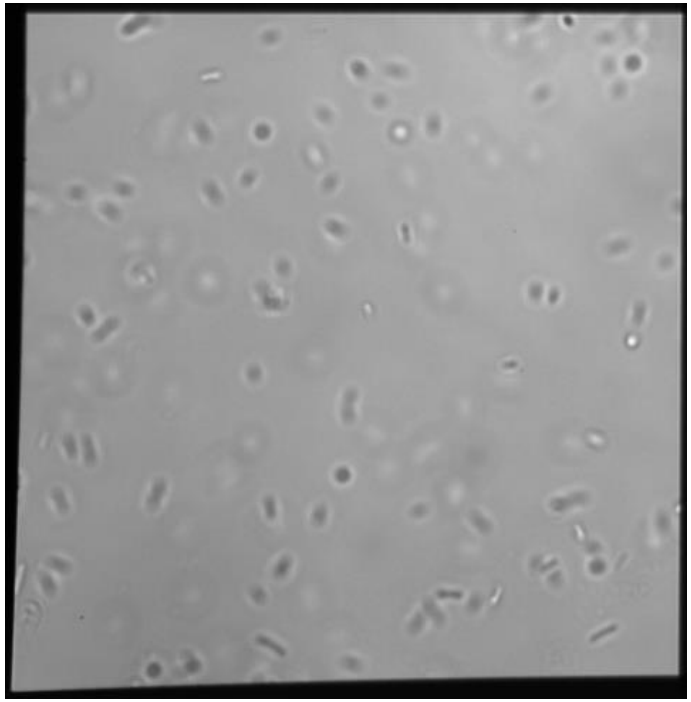
Yu. A. Nastishin and al.,
Physical Review E, November 2004.



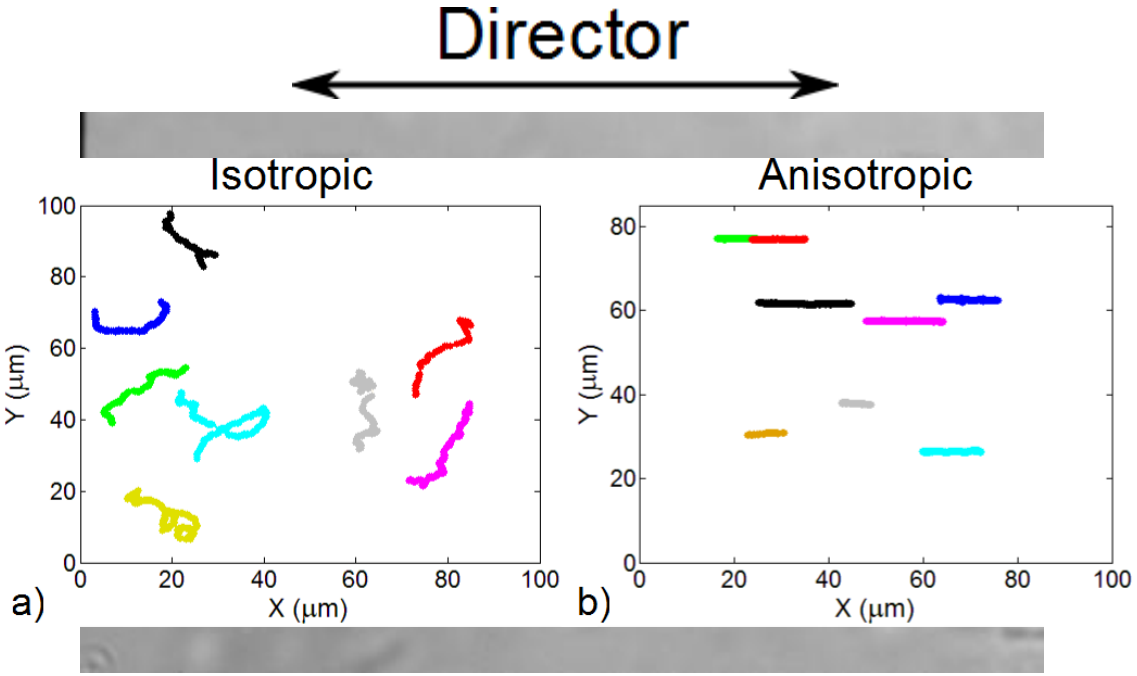
Isotropic motility of *bacteria*: runs and tumbles



Blue filaments: counterclockwise rotation
Red filament: clockwise rotation

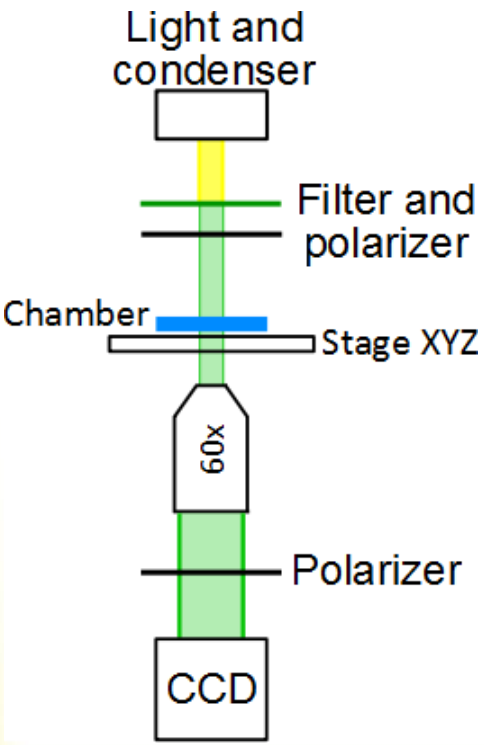


Anisotropic motility of flagellar bacteria (*E. coli*)

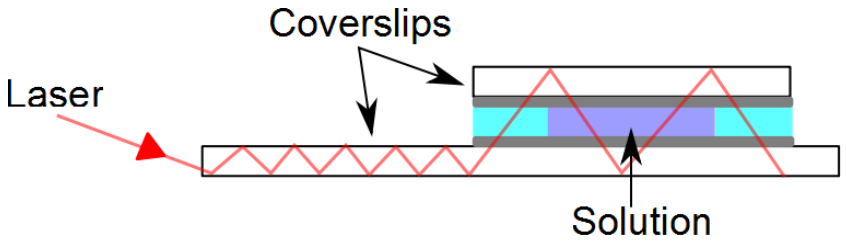


Experiments: montages

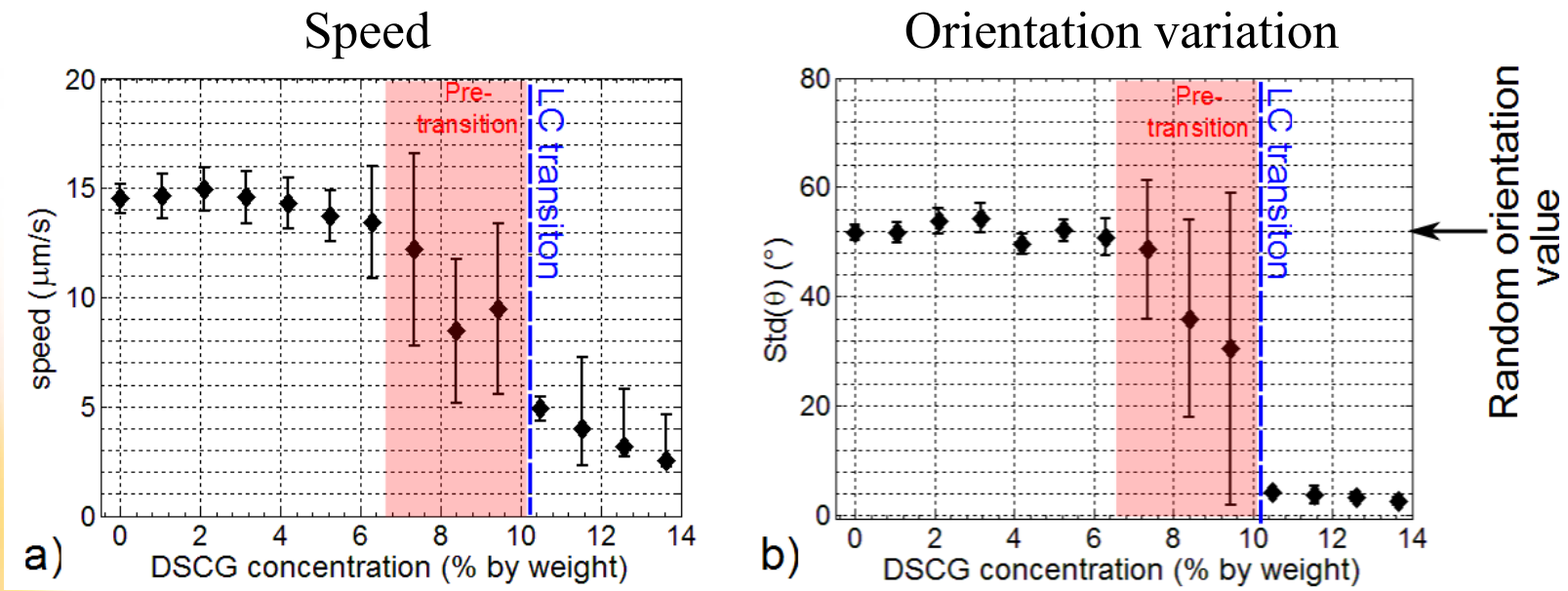
Microscope



Chamber and light-guided dark-field microscopy

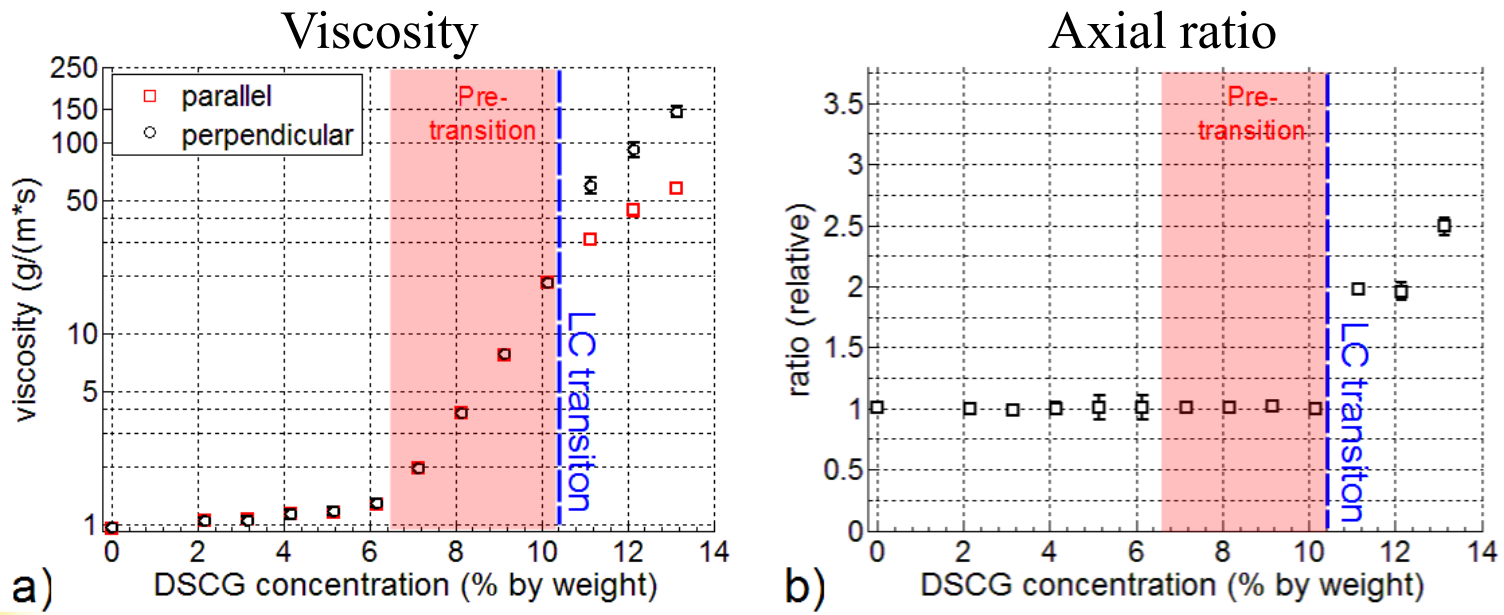


Results: bacterial motility



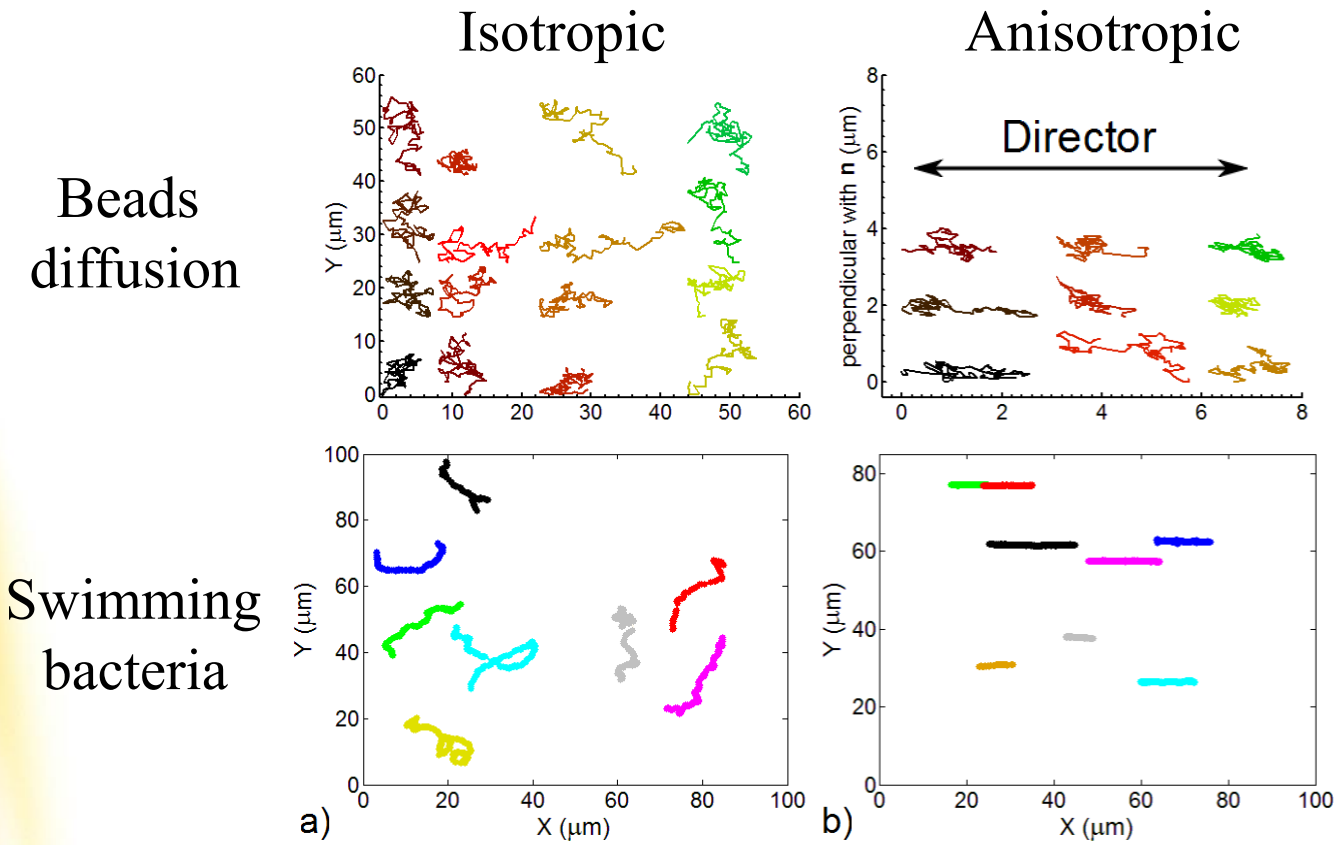
- **Purely isotropic phase:** as if there were no DSCG
- **Pretransitional phase:** sticky effect
- **Anisotropic phase:** decrease of speed and runs in the direction of the director

Results: viscosity measurements
(from diffusion of 0,2-2µm microspheres)



- **Purely isotropic phase:** little viscosity increase
- **Pretransitional phase:** exponential viscosity increase
- **Anisotropic phase:** anisotropic viscosity

Can we explain the anisotropic motility with the anisotropic viscosity?



Conclusion

- Bacteria behave very differently in anisotropic media
- Viscosity doesn't explain everything (active motility important)
- “New” pretransitional phase
  - Viscosity increase (aggregation – threshold)
  - Sticky effect
- New possibilities for controlling motion of microorganisms

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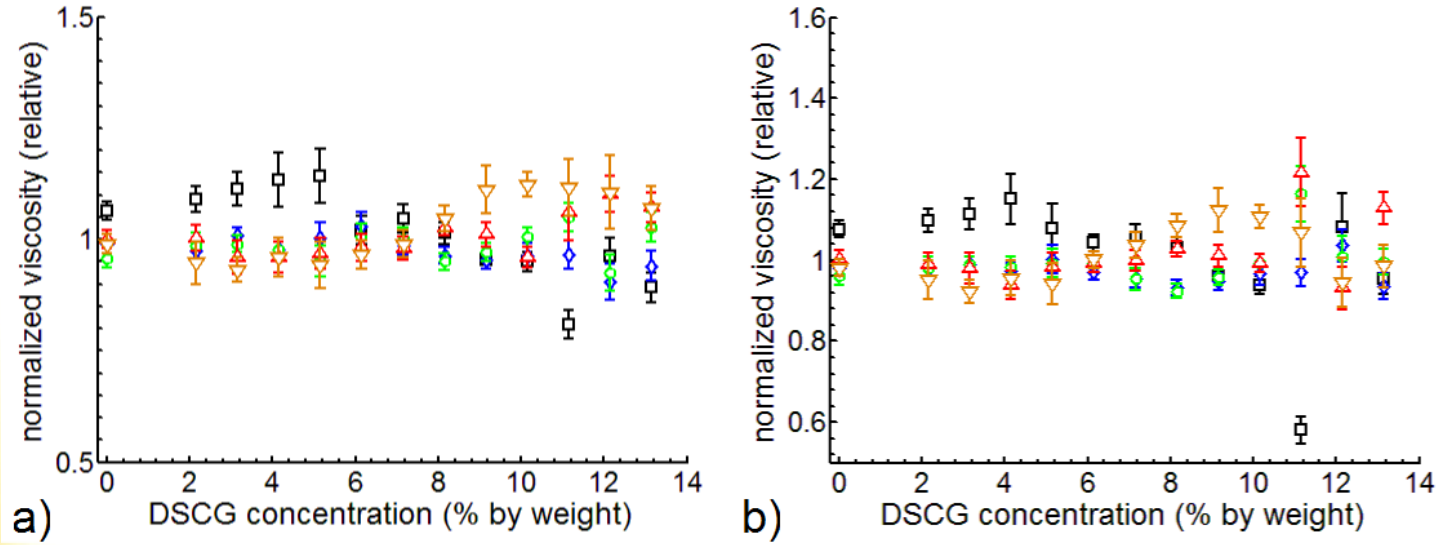
Viscosity dependency to the beads size



Propulsive force of bacteria