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Self-assembly of spherical magnetic colloids

COMPUTE retreat 2012

Alexei Abrikossov

What is a colloid?

"A colloid is a substance microscopically dispersed evenly throughout another substance.[1]" - Wikipedia

"A colloid is a mixture of one substance spread out evenly inside another substance. They can be in two different phases or states of matter." - Wikipedia Simple English

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Examples off colloids

- Milk
- Paint,Ink
- Foam
- Pollen
- Hair spray
- Styrofoam

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Image: Wikipedia

The colloid particle

- ”Big Particle” 1 nm to 1 µm in diameter
- Easier to see than atoms and molecules
- Brownian motion
- Can be designed
- Lots of different shapes

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Self-assembly of colloids

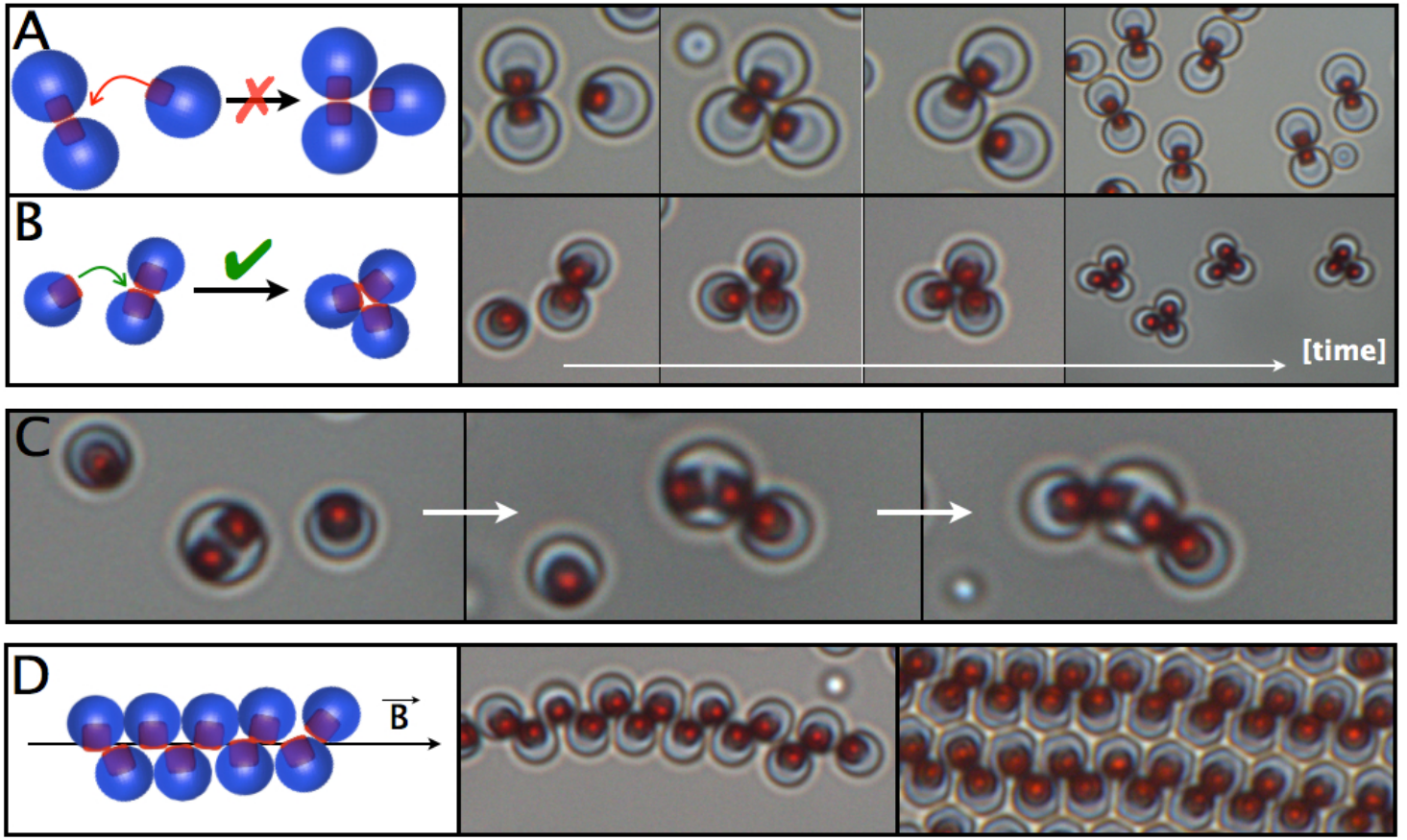

Image: S. Sacanna

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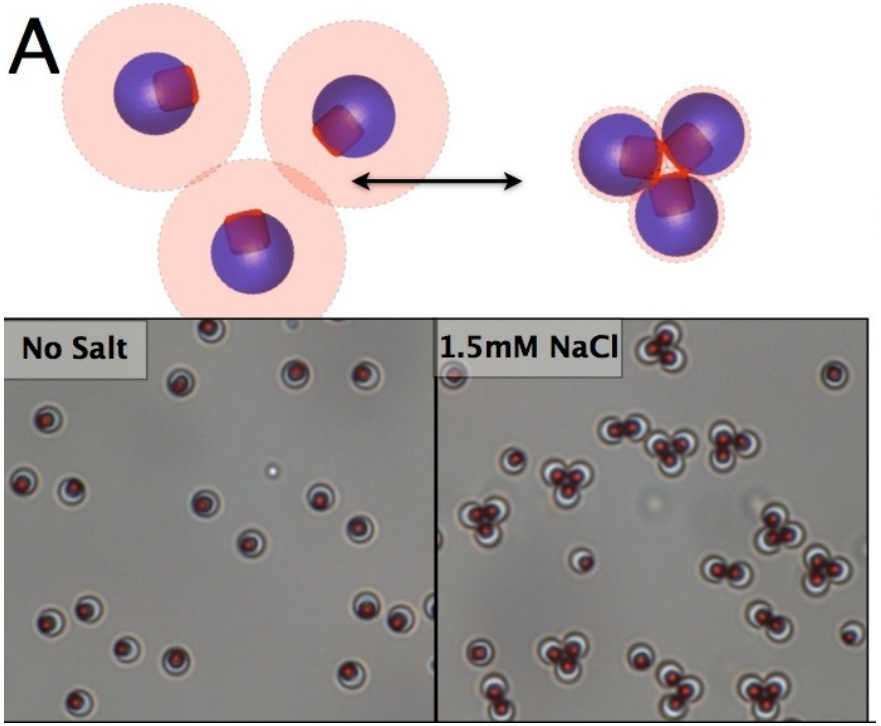
Model for Simulations



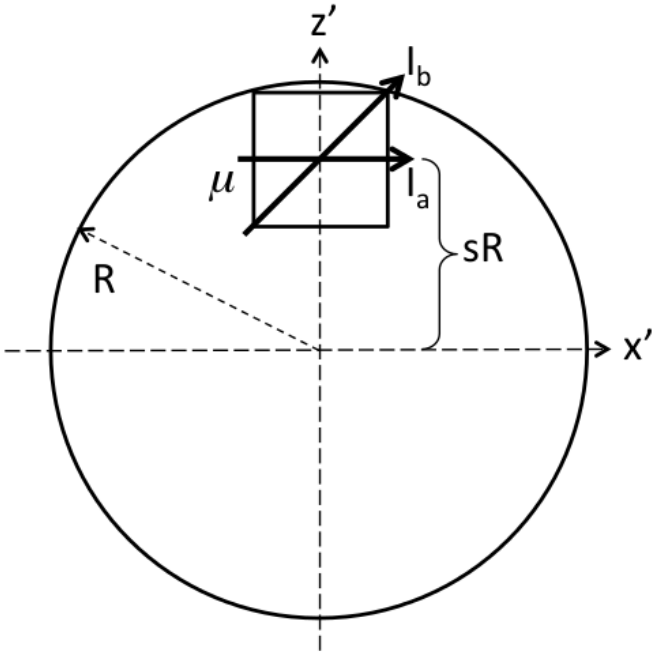
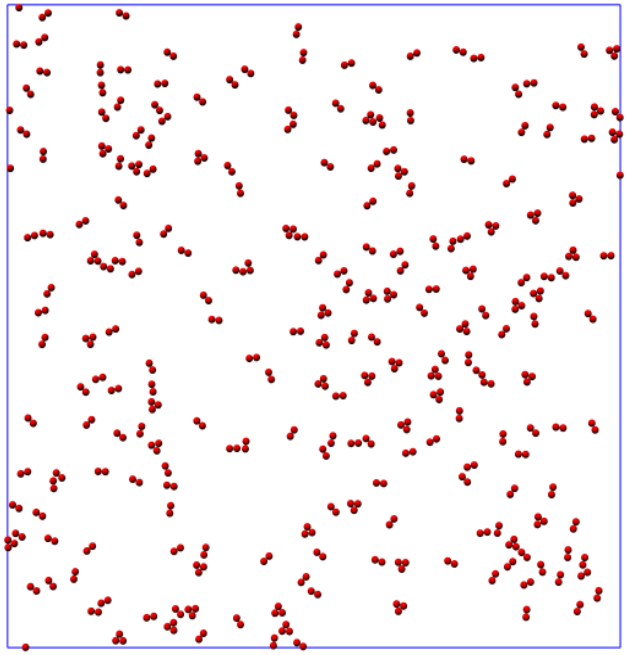


Image left: S. Sacanna Image right: Per Linse

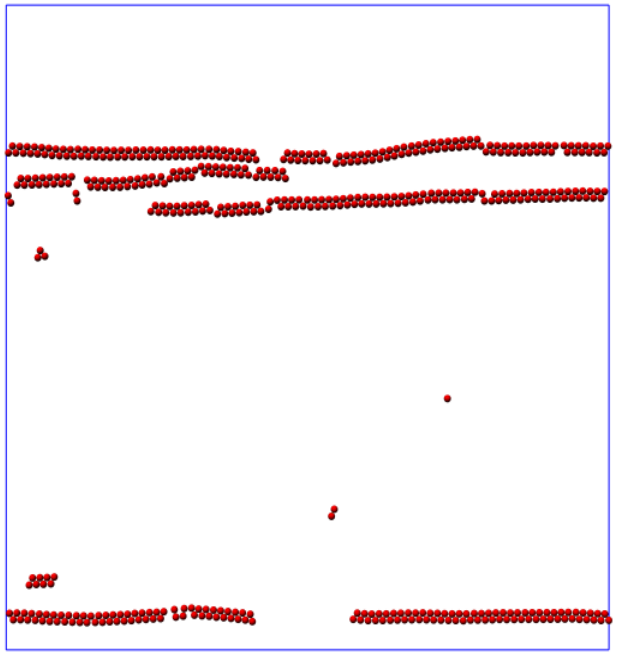
The use of Monte Carlo

- Equilibrium properties
- Trial moves
- Cluster moves

Results



Without an external field



With an external field

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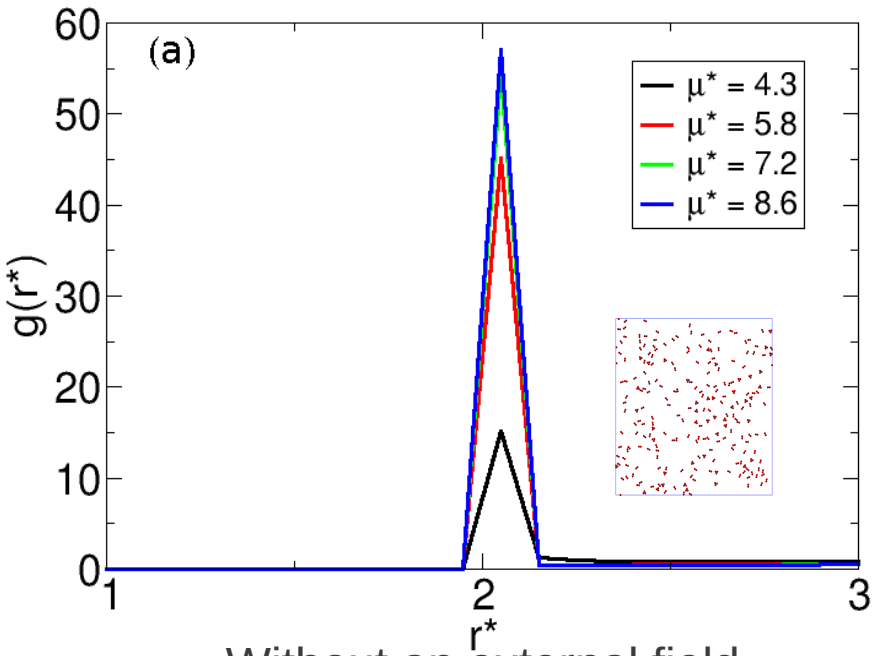
Radial distribution function



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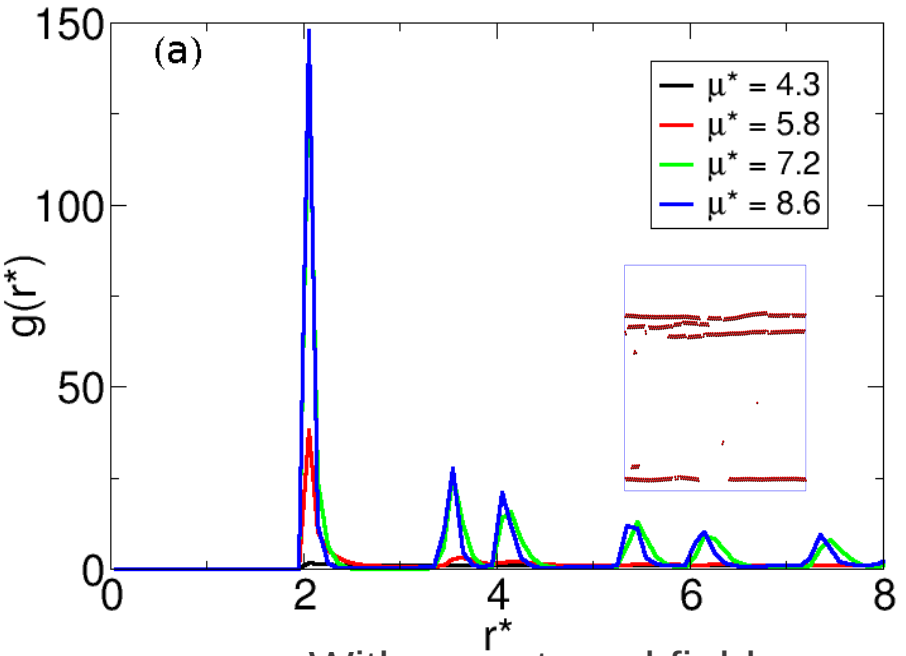

With an external field

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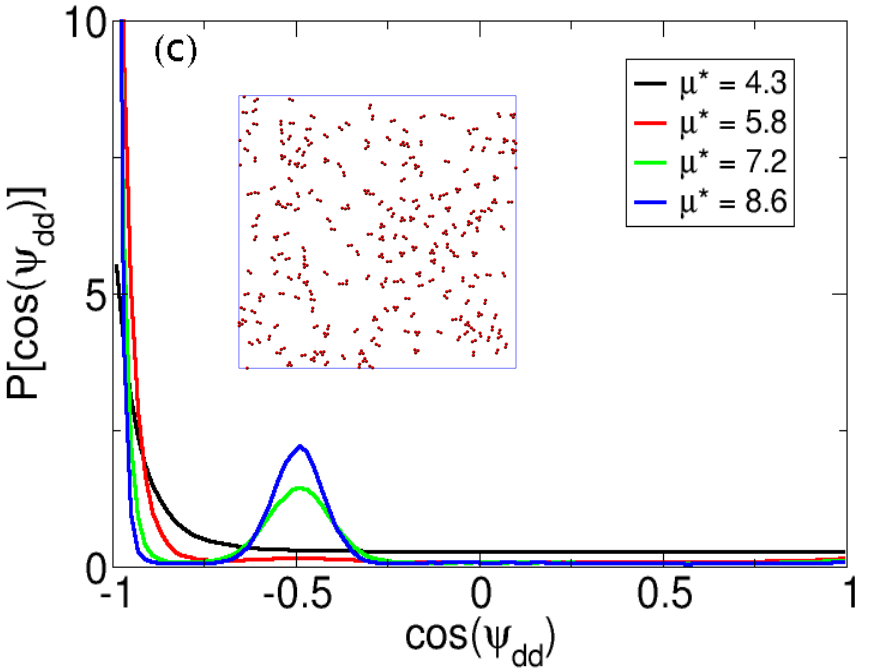
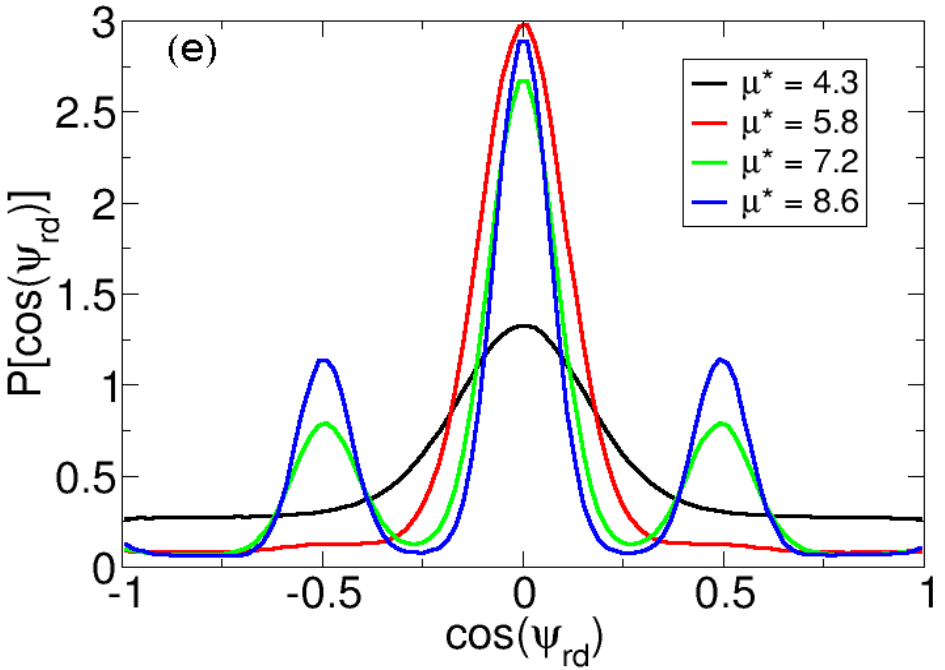
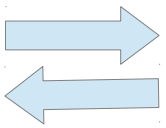
Angular distribution function

Without an external field







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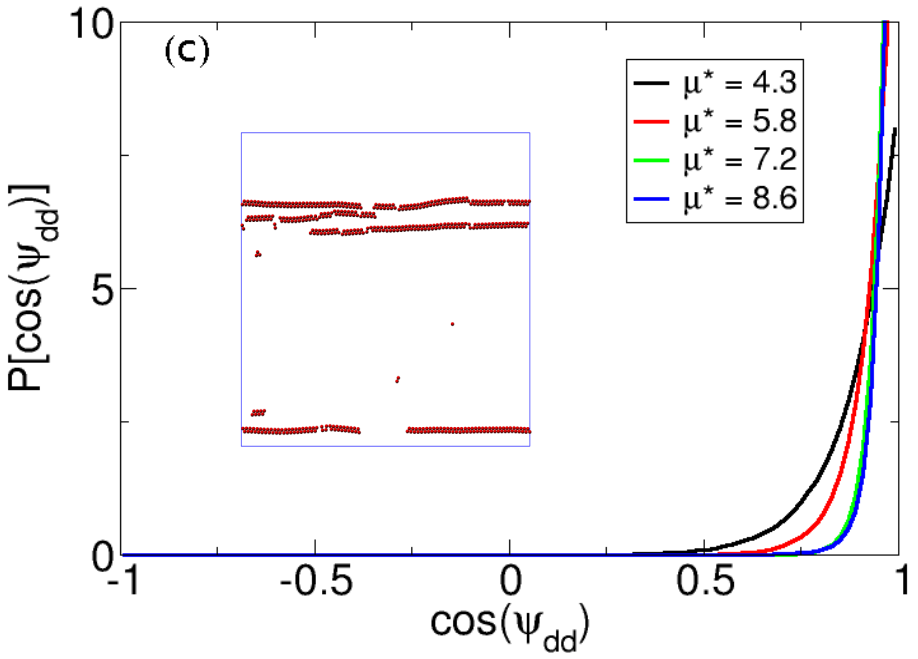
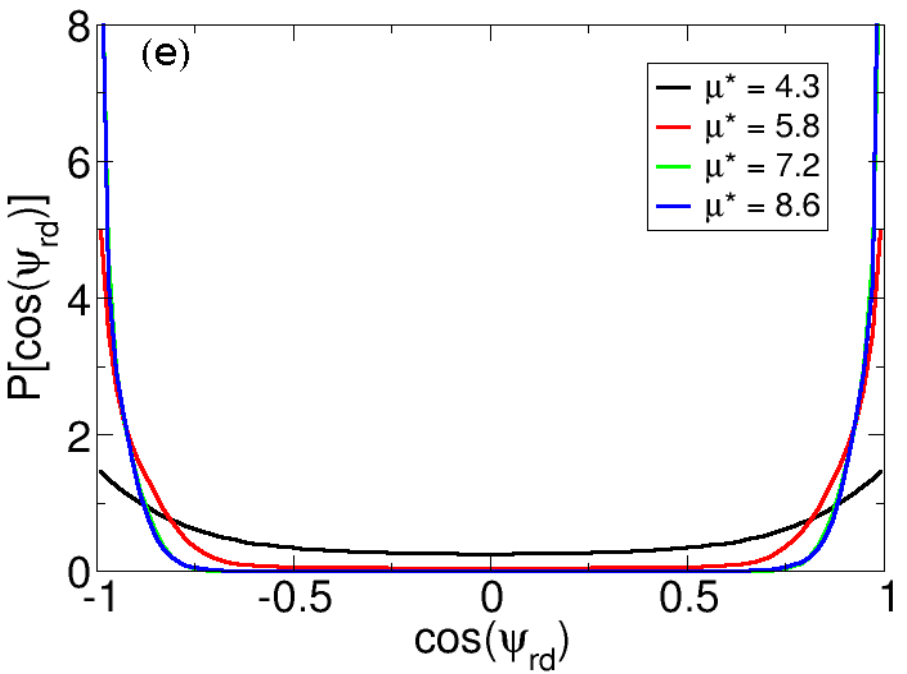
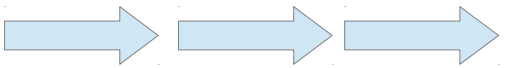
Angular distribution function

With an external field







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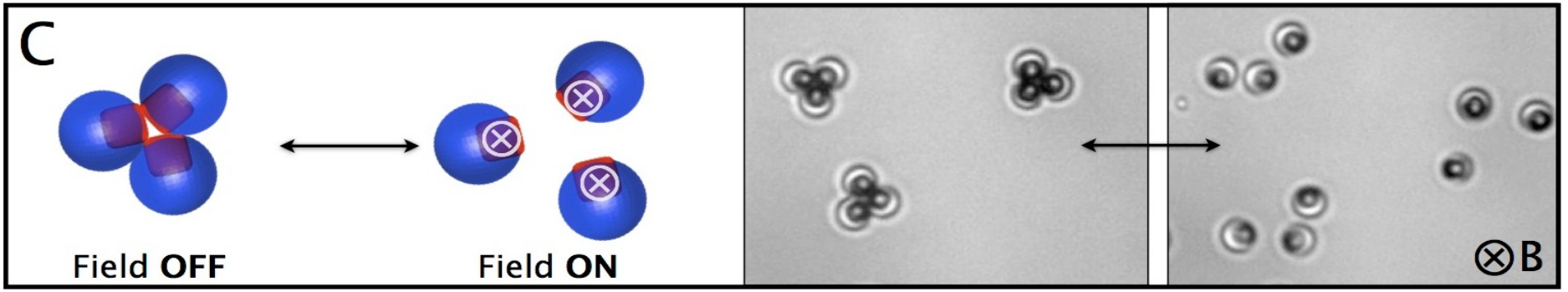
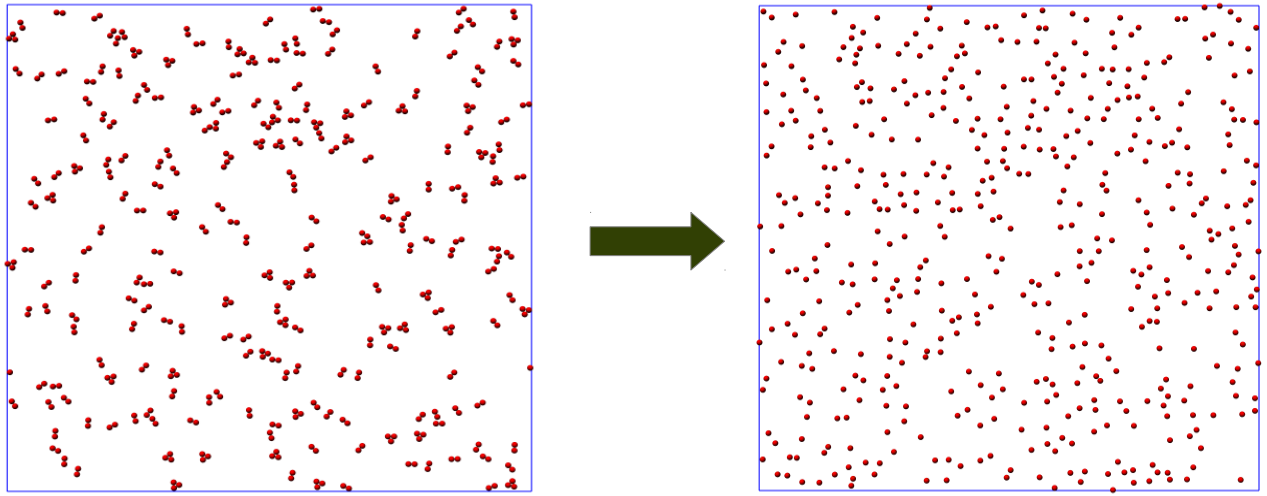
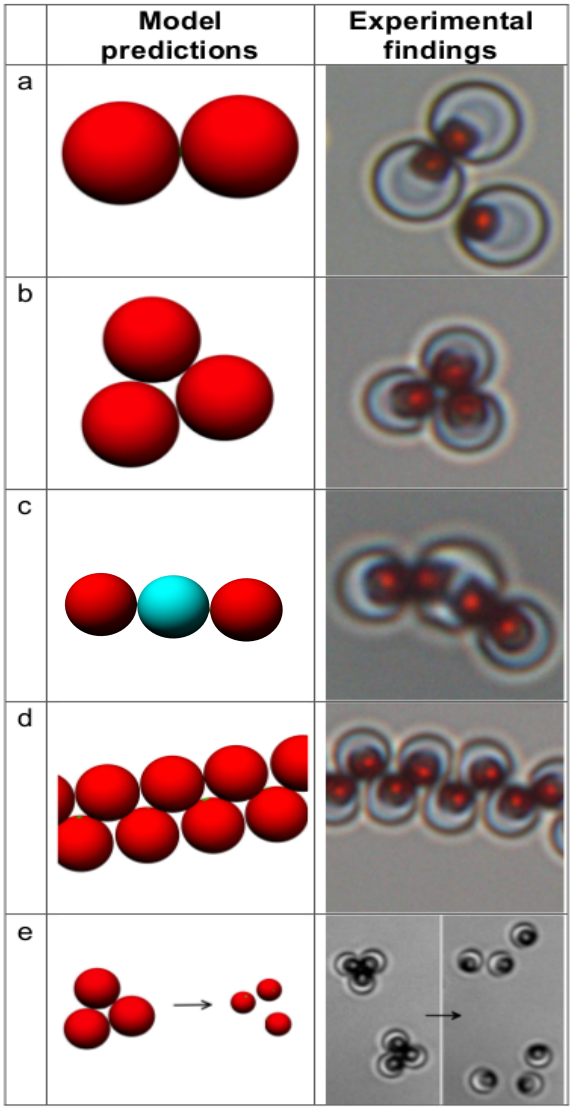
Perpendicular field





Top image: S.Sacanna

Experiments vs Simulations



a) Dimer

b) Trimer

c) Two dipole particle

d) Zipper chain formation in an external field

e) Break up of a trimer in an external perpendicular field

Image experimental part: S.Sacanna

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Conclusion

- Colloid self-assembly is a big and interesting area of research with many potential applications

- Relatively “simple” models are able to describe the systems studied

- By using computer simulations we are able to understand the experiments better

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Acknowledgments

Stefano Sacanna and Per Linse
Swedish Research Council (VR)
Organizing Molecular Matter (OMM)