# Self-Assembly
# Bio-molecules & Colloids

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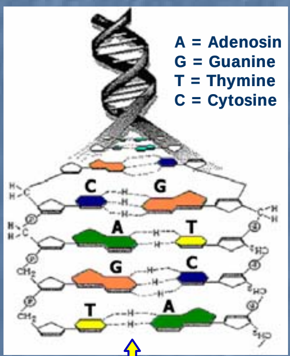
**BSS**

*Biological and Soft Systems*

## DNA as specific glue

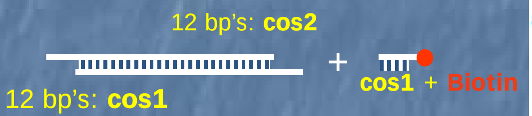
In my research group we use DNA-coated colloids to design novel types of nano-structured materials. The specificity of interactions between two complementary DNA strands makes it possible to "tune" the interactions between colloids with different DNA coatings. We use confocal microscopy and image-analysis software to study those systems.



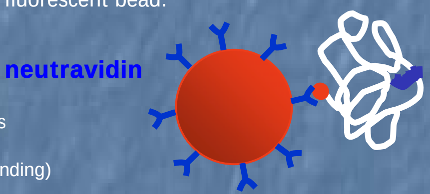

Interactions: reversible H-bonds
3 H-bonds between G-C and 2 H –bonds between A-T
⇒ reversible melting & hybridization (binding)

### System we use:

Bacterial λ -DNA with ~48 kbp's (base pairs)

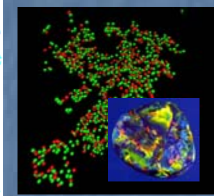



Attach to a red fluorescent colloid (1μ in∅), and the complementary DNA-biotin chain to a green fluorescent bead.



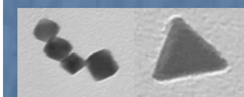

T. Schmatko, B. Bozorgui, N. Geerts, D. Frenkel, E. Eiser and W. C. K. Poon, Soft Matter, 3, 703 (2007).

### What can we do with it?



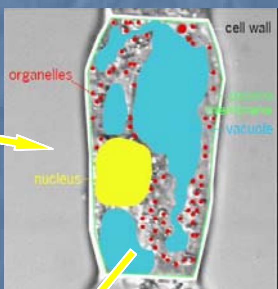
Using the specificity of DNA and self-assembling tools we want to build **photonic crystals** (examples in nature: opal, wings of some butterflies).

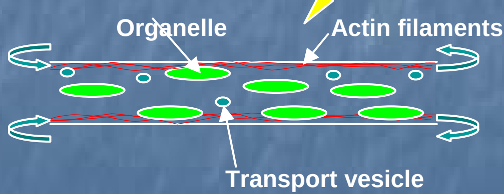
**Self-assembly** By use of several colloids, each with a specific property, new self-assembling finite size "nano-electronics" can be devised (e.g. self-replicating colloid-chains have been already achieved by P. Chainkin et al.)



Home made gold-nano colloids of ~ 20 nm in diameter (Electron Microscopy image)

## Molecular Motors: Hydrodynamics is important

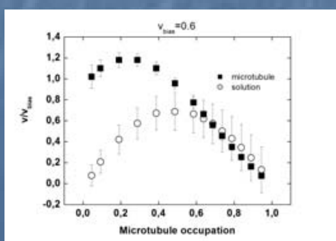




Processive molecular motors are essential for the fast transport of nutrients and building material to various parts in the cell. For instance in plant cells, the molecular motor myosin attaches with its head to actin filaments while its tail can bind a cargo (e.g. organelles, vesicles or mitochondria). By consuming ATP it can drag the cargo fast and unidirectional along the actin filament.

### Simulations & Experiments:

We developed a simple 2D-lattice model in order to test the influence of hydrodynamic interactions on the collective transport of molecular motors, which is important for the understanding of cell growth and development.




First results form our simulation study:

We see an optimum motor velocity on the filament at half occupation. These motors set up a flow field very close to the filament, demonstrating that hydrodynamic interactions adds to the active transport in cells.

Our results were also supported by experiments.


D. Houtman, I. Pagonabarraga, C.P. Lowe, A. Esseling-Ozdoba, A.M. C. Emons and E. Eiser, Europhys. Lett., 78, 18001 (2007).
A. Esseling-Ozdoba, D. Houtman, A.A.M. van Lammeren, E. Eiser and A.M.C. Emons, submitted.



Collaboration with: I. Pagonabarraga (Barcelona), A.M.C. Emons (Wageningen), and R. Goldstein (Cambridge)



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