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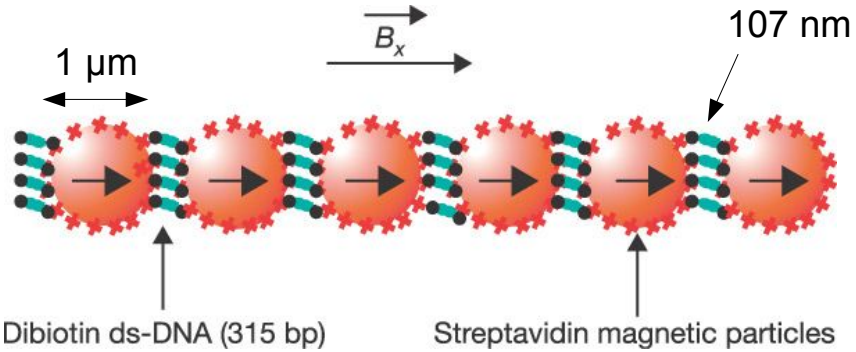
Microstructure of brushes of supracolloidal ferromagnetic filaments

Pedro A. Sánchez,
Elena S. Pyanzina,
Ekaterina V. Novak,
Joan J. Cerdà,
Tomás Sintes,
Sofia S. Kantorovich

Supracolloidal magnetic filaments

- Permanent chains of polymer-crosslinked magnetic colloids



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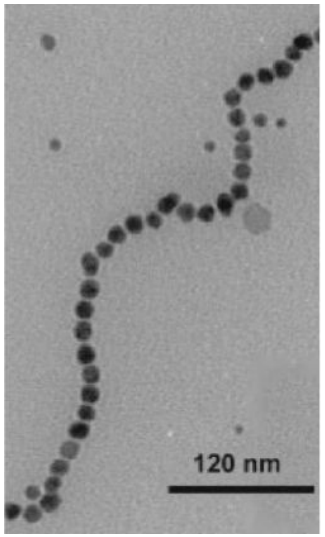

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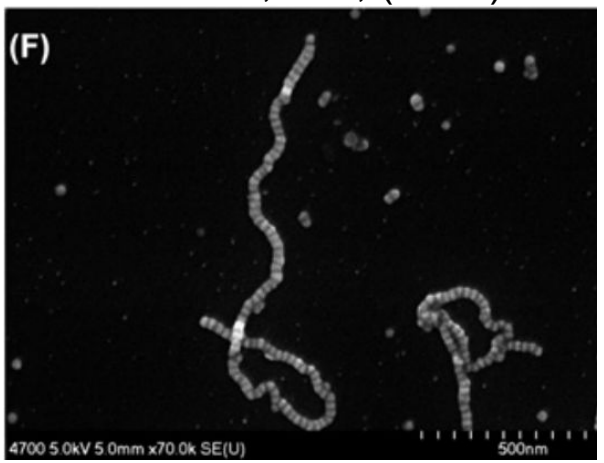
J.J.Benkoski et al, *Soft Matter* 6, 602, (2010)



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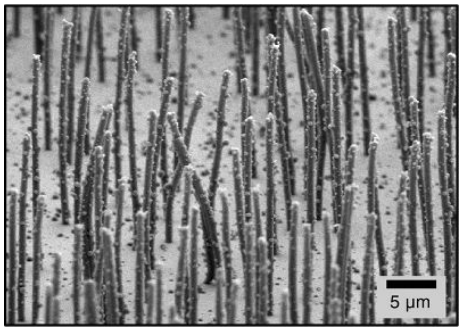
Supracolloidal magnetic brushes

- Prospective applications
  - Micro and nanofluidic actuators and propellers
  - Nanoscopic watermarks, tunable diffraction grids, magnetoresponsive coatings...



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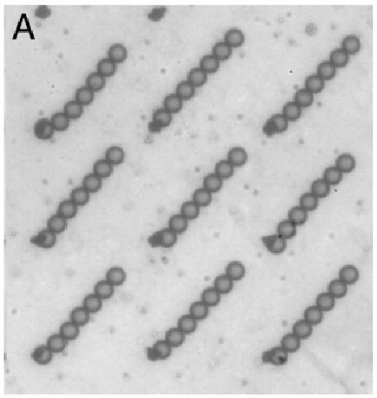

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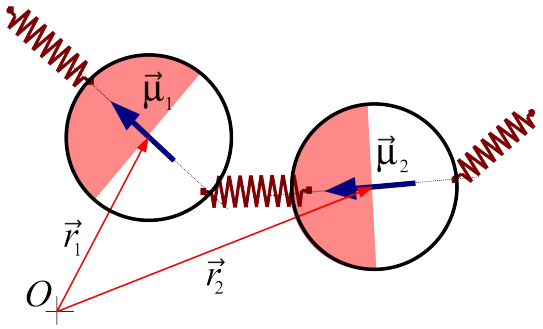
Modeling approach

- Bead-spring model of magnetic filaments
  - Magnetic dipolar interaction
  - Soft core steric repulsion
  - Chain connectivity: dipole-backbone coupling



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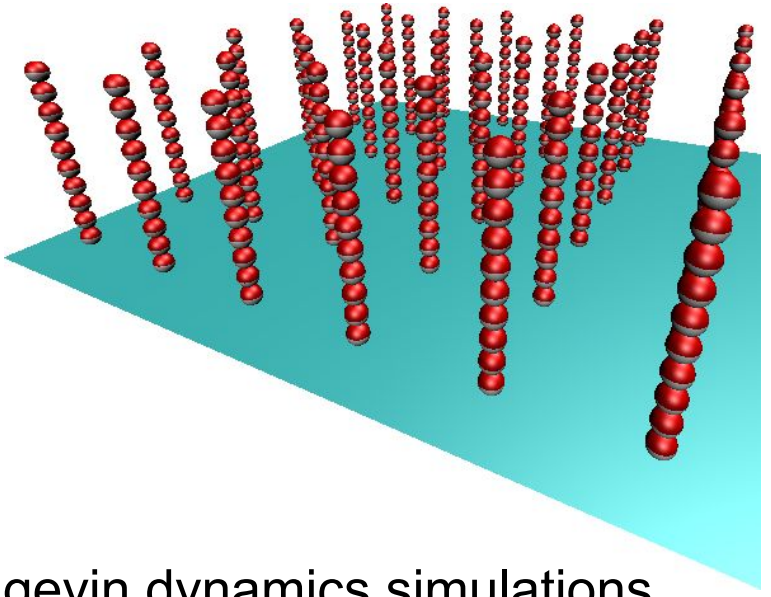


- Langevin dynamics simulations
- LPBC, d-p3m+DLC, ESPResSo simulation package
- Parameters:
  - Grafting density, σ
  - Squared dipolar moment, μ^2

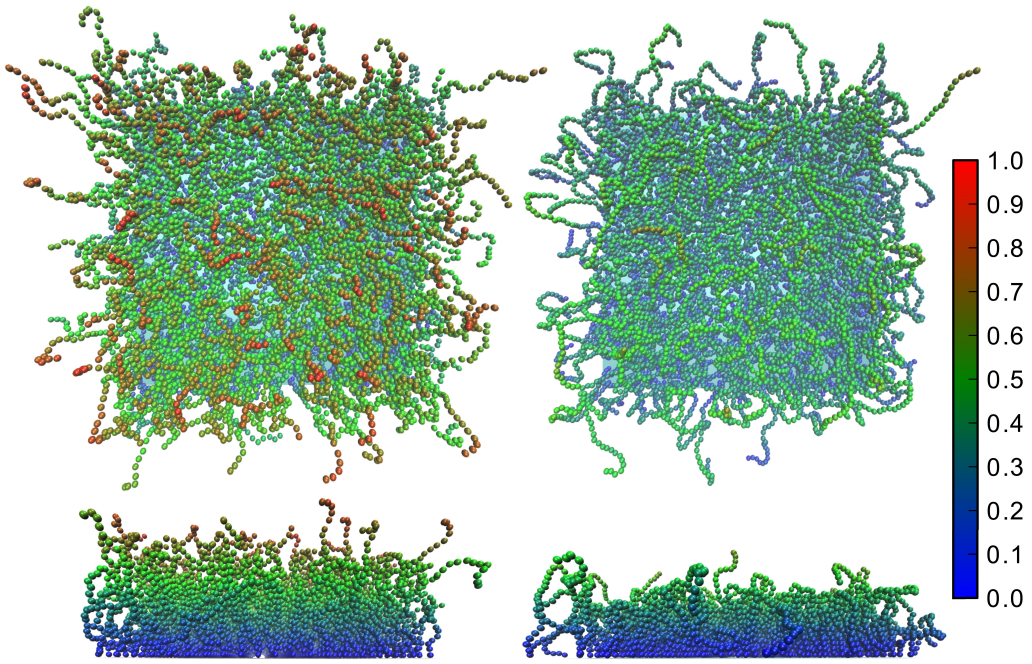
Overall structural properties

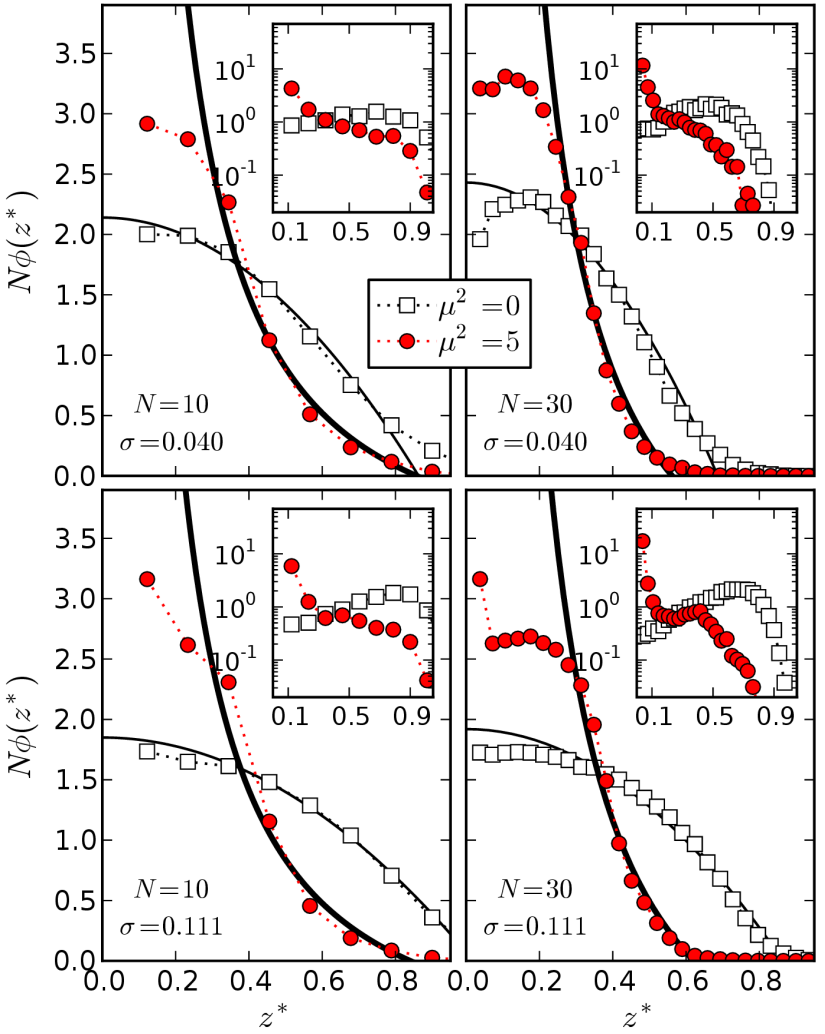
- Magnetic Vs Nonmagnetic:

  Density profiles

T=1, H=0

μ^2=0 μ^2=5





Sánchez, P. A.; Pyanzina, E. S.; Novak, E. V.; Cerdà, J. J.; Sintes, T.; Kantorovich, S. S.
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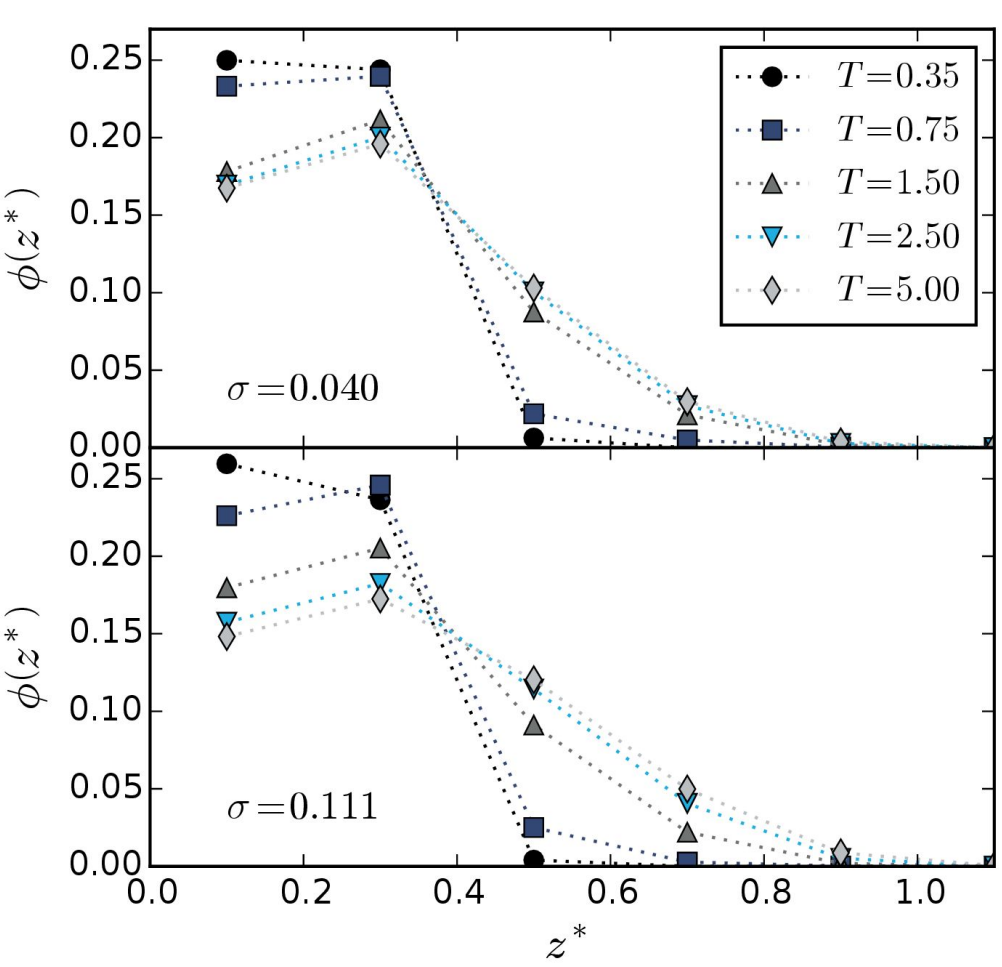
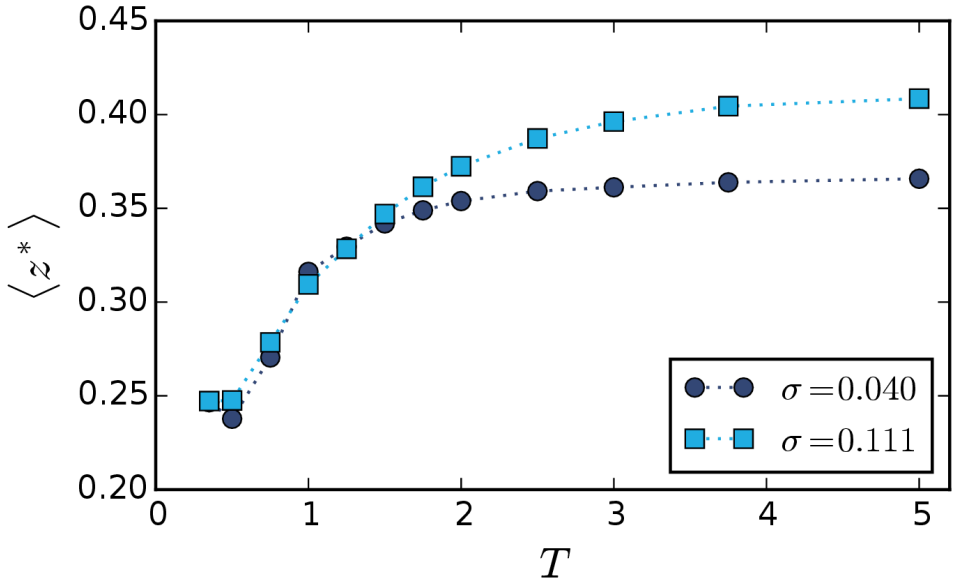
Overall structural properties

- Effects of temperature

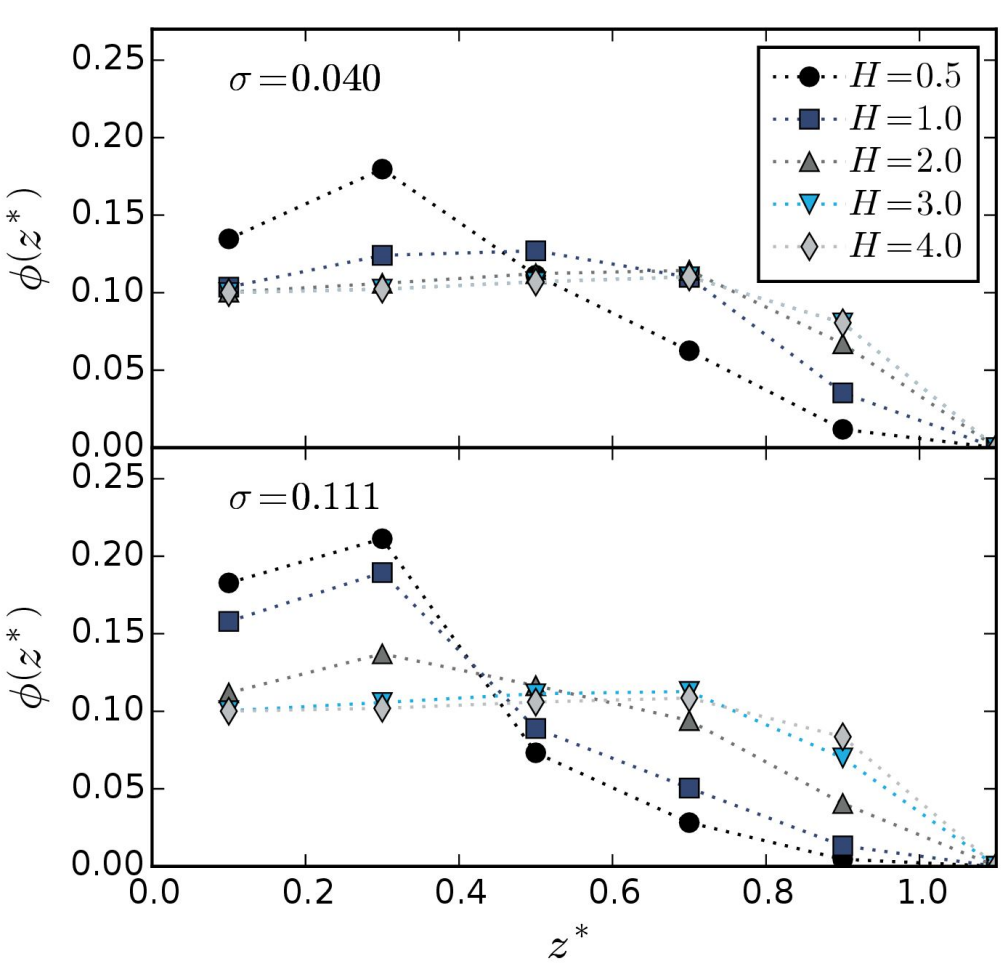


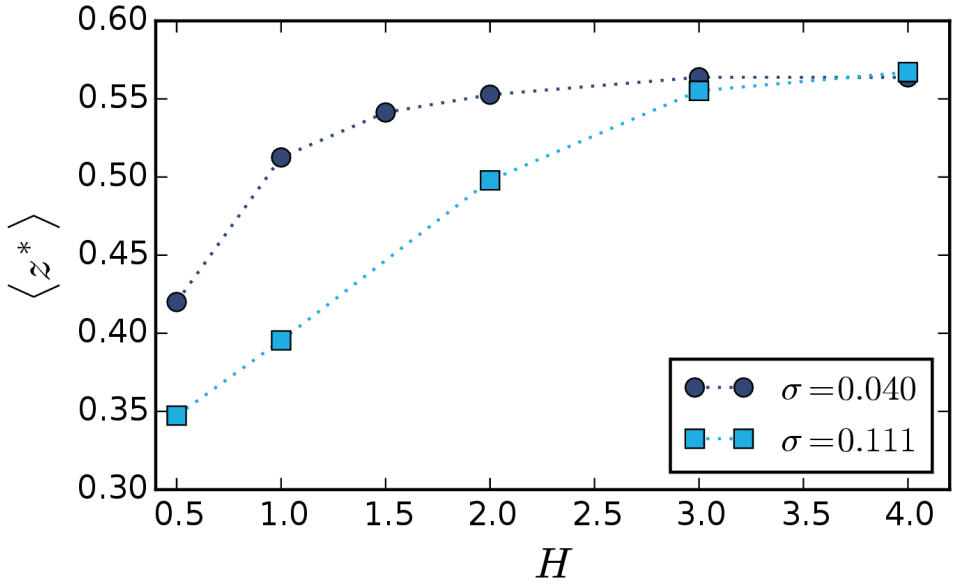


Sánchez, P. A.; Pyanzina, E. S.; Novak, E. V.; Cerdà, J. J.; Sintes, T.; Kantorovich, S. S. *Submitted to Faraday Discussions.*

Overall structural properties

- Effects of external magnetic field





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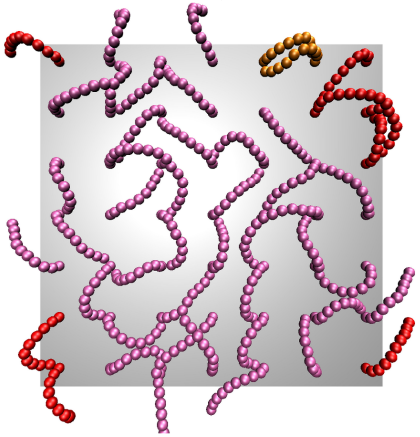
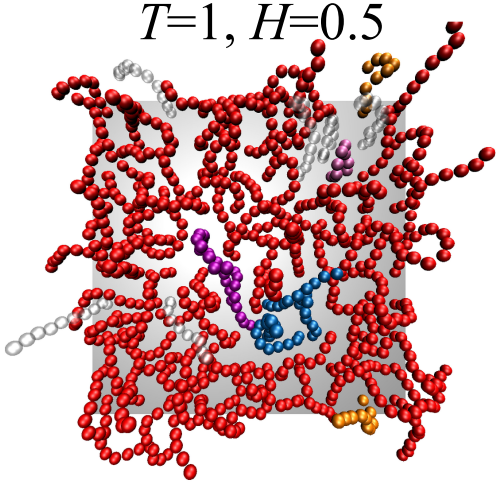
Microstructure analysis

- Distance criterium connectivity analysis

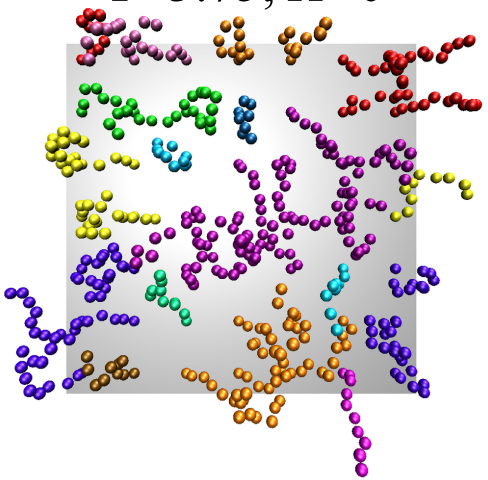
T=0.5, H=0



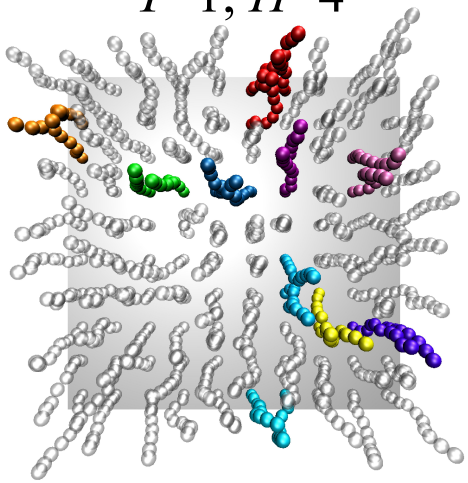
T=1, H=0.5



T=3.75, H=0



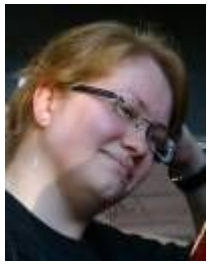
T=1, H=4



Conclusions

- Dipolar interactions make the brush structure more compact
- Dipolar interactions hinder unfavorable non permanent close contact connections: overall less connected network, more connected chain ends (mainly free ends to grafted ends of neighboring chains)
- Strong structural change with temperature and magnetic field

E. S. Pyanzina



E. V. Novak

S. S. Kantorovich

J. J. Cerdà

T. Sintes

Thank you for your attention