SEMINÁRIO

Data: **18 de Fevereiro de 2016**
Hora: 10h00
Local: Anfiteatro *Leopoldo Guimarães* – Edif. CENIMAT|i3N

Prof. Arne T. Skjeltorp

Title: "Magnetic field control of colloidal particles and braid description"
Institute for Energy Technology, NO-2007, Kjeller, Norway, Giamag Technologies, NO-2007, Kjeller, Norway

Prof. Paul Dommersnes

Department of Physics, Norwegian University of Science and Technology - NTNU, Trondheim, Norway
Title of talk: Electric field assisted assembly and manipulation of particles and liquid drops

Magnetic field control of colloidal particles and braid description

Arne T. Skjeltorp[1,2]

[1] Institute for Energy Technology, NO-2007, Kjeller, Norway
[2] Giamag Technologies, NO-2007, Kjeller, Norway
Email: Arne.Skjeltorp@ife.no

Abstract
The talk will present historical and recent advances in magnetic micro-nanoparticle separation, manipulation and description using very forceful magnet systems. A new design of a magnet system denoted GIAMAG* (GIant MAgnet field Gradient) has been realized with an unprecedented value of the product of the magnetic field strength B and the field gradient ∇B. This is crucial for rapid extraction of e.g. magnetic particles in dispersions as the magnetic force acting on magnetic particles is $F \sim B \times \nabla B$.
Existing magnet systems can just pull magnetic microparticles from solutions, whereas GIAMAG can extract magnetic particles down to nanosizes.
An interesting development has been to describe the space-time trajectories of the motion of colloidal particles using braid mathematics.
*www.giamag.com

Paul Dommersnes
Department of Physics, Norwegian University of Science and Technology - NTNU, Trondheim, Norway
Title of talk: **Electric field assisted assembly and manipulation of particles and liquid drops**

Abstract:
Drops fully covered by particles stabilize Pickering emulsions, and they are also ideal templates for producing particles and advanced capsules [1]. Our own studies in this area show how electrohydrodynamic circulation flows in drops can assemble solid or fluid colloidal particle films on drop surfaces, and how DC electric fields can be used to structure particles on drop surfaces [2,3,4],. Recently we have performed further investigations of both the rheology and dynamics of Pickering drops subjected to DC electric fields. This is considered in the context of previous studies which include the response of particle covered drops or bubbles exposed to shear flow [5] or other mechanical forces [6]. We demonstrate that DC electric fields offer good control of the plasticity of leaky-dielectric capsules as the applied electric stress can easily be adjusted, reversed or turned off. We find that there is critical electric field corresponding to a deformation yield point of the colloidal capsule above which a capsule plastically deforms. Below the yield point, we observe electro-orientation, weak capsule deformation and crumpled and folded states. By using DC electric fields to induce Quincke rotation dynamics of colloidal capsules [8], we also observe tumbling ("stiff") rotation dynamics to tank-treading ("deformable") dynamics [9], as well as swimming [9] of counter rotating Pickering drop pairs.

References:
1. Zeng, C., Bissig, H. & Dinsmore, A. D. *Particles on droplets: From fundamental physics to novel materials*. Solid State Commun. 139, 547-556 (2006)
2. Rozynek, Z., Mikkelsen, A., Dommersnes, P. & Fossum, J. O. *Electroformation of Janus and patchy capsules*. Nature communications 5 (2014)
3. Dommersnes, P. et al. *Active structuring of colloidal armour on liquid drops*. Nature Communications 4, 2066 (2013)
4. Rozynek, Z., Dommersnes, P., Mikkelsen, A., Michels, L. & Fossum, J. O. *Electrohydrodynamic controlled assembly and fracturing of thin colloidal particle films confined at drop interfaces*. Eur. Phys. J. Special Topics 223, 1859-1867 (2014)
5. Ha, J. W. & Yang, S. M. *Electrohydrodynamic effects on the deformation and orientation of a liquid capsule in a linear flow*. Phys Fluids 12, 1671-1684 (2000)
6. Subramaniam, A. B., Abkarian, M., Mahadevan, L. & Stone, H. A. *Colloid science: non-spherical bubbles*. Nature 438, 930, (2005)
8. T.B. Jones, *Quincke Rotation of Spheres*, IEEE TRANSACTIONS ON INDUSTRY APPLICATIONS, IA-20, 845-9, (1984)
9. E. M. Purcell, *Life at low Reynolds number*, American Journal of Physics 45, 3-11 (1977)