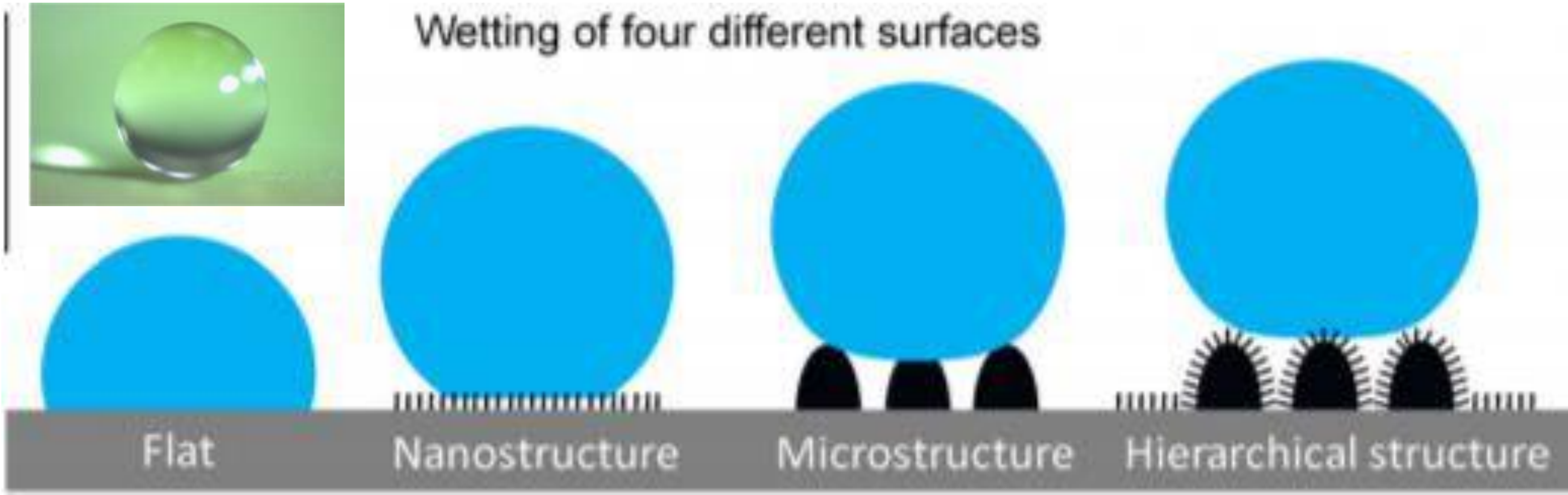
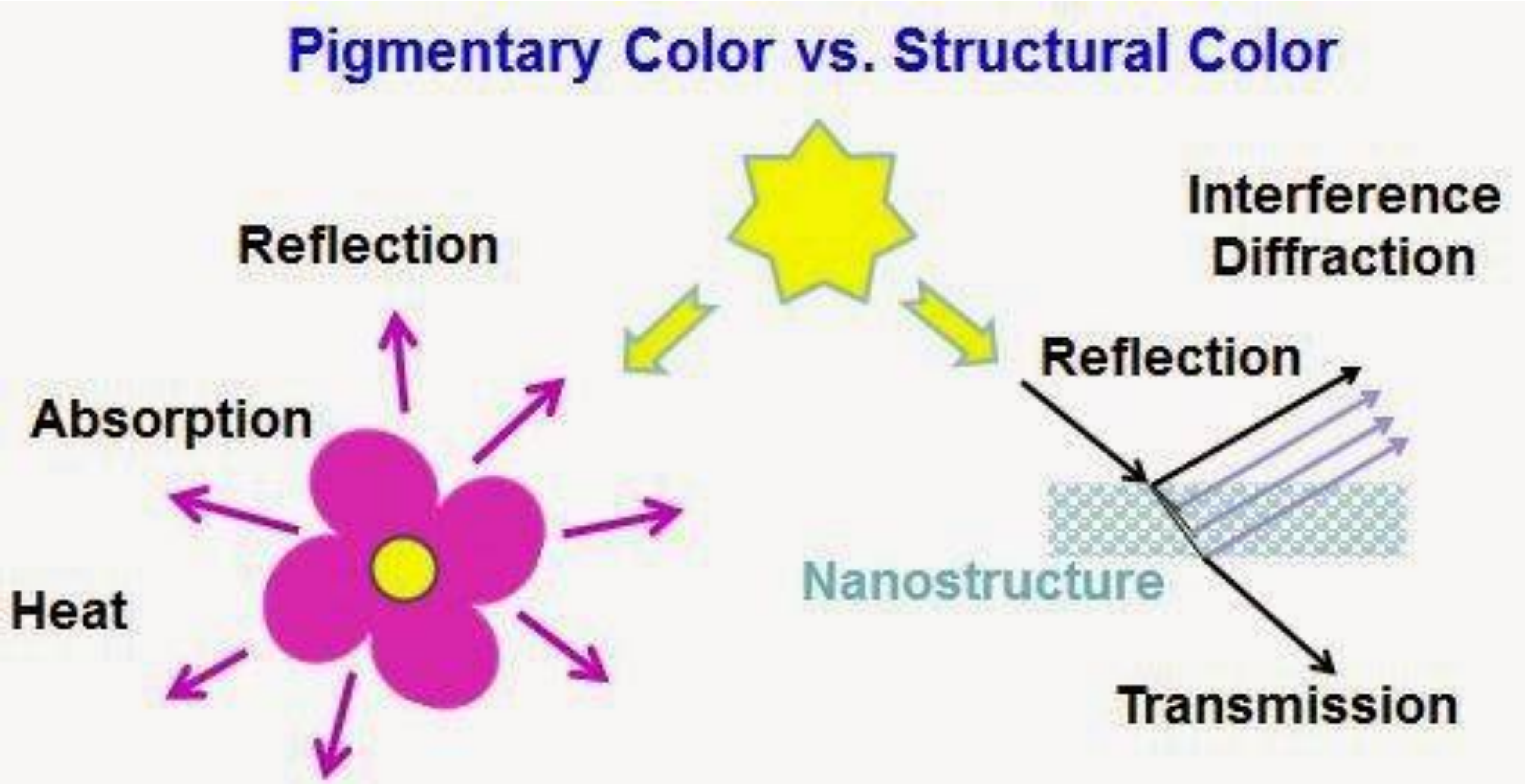


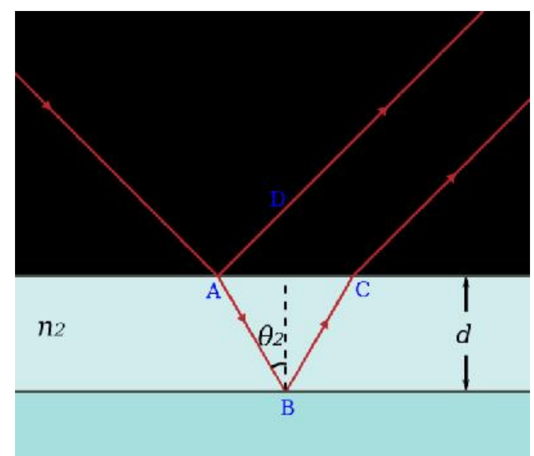
Schematics of wetting of four different surfaces. The largest contact area between the droplet and the surface is given in flat and micro-structured surfaces, is reduced in nano-structured surfaces, and is minimized in hierarchical (nano-micro) structured surfaces. This contains the principle of the so-called self-cleaning Lotus leaf effect, depicted to the left.

Natural and biomimetic artificial surfaces for super-hydrophobicity, self-cleaning, low adhesion, and drag reduction, B. Bhushan, Y. C. Jung, Progress in Materials Science 56, 1-108 (2011)

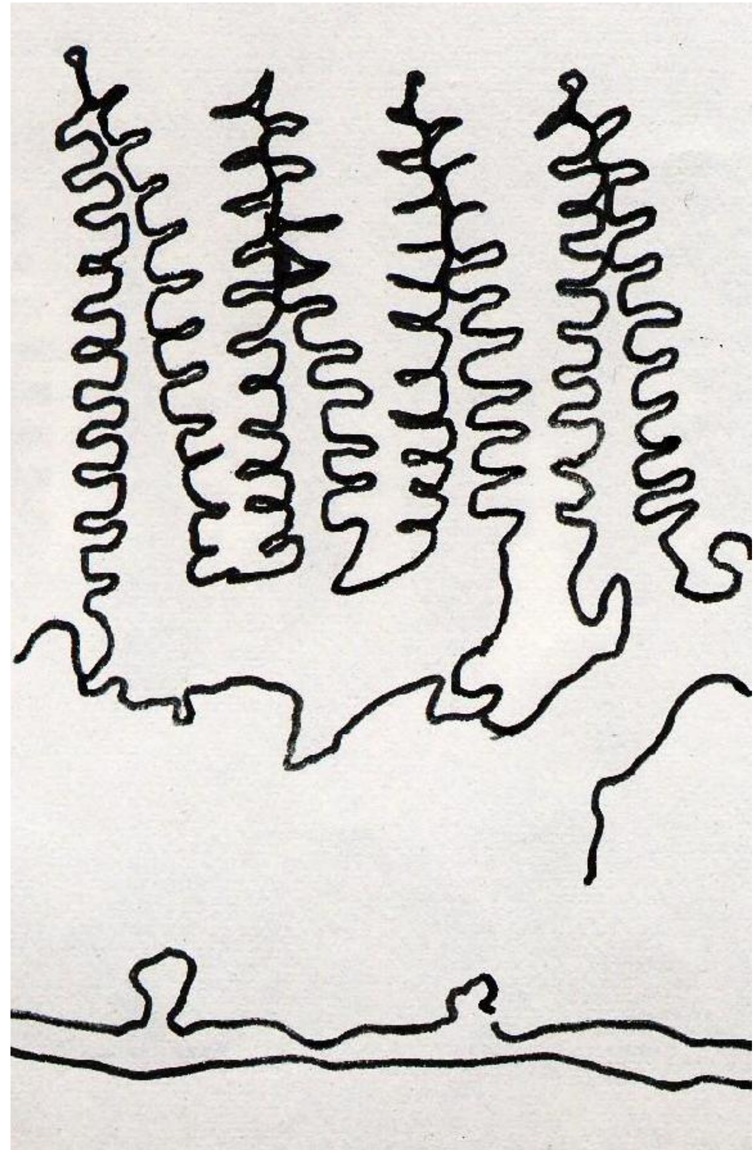
Peacock feathers: Brown pigment + nanostructures



When light falls on a thin film, the waves reflected from the upper and lower surfaces travel different distances depending on the angle, so they interfere.



Butterfly wing at different magnifications reveals mesostructured chitin acting as a diffraction grating



Article | OPEN

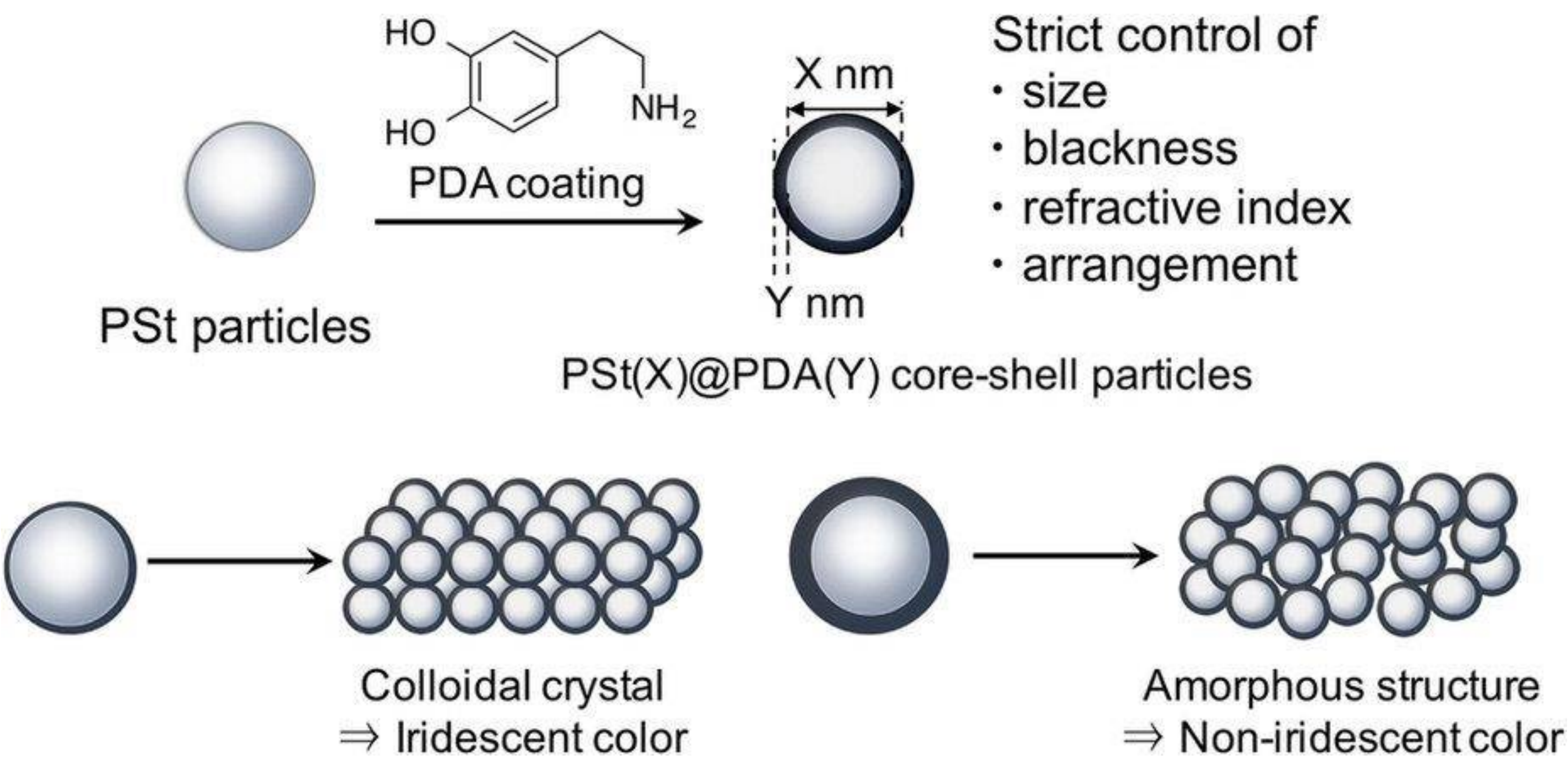
Full-Color Biomimetic Photonic Materials with Iridescent and Non-Iridescent Structural Colors

Ayaka Kawamura, Michinari Kohri ✉, Gen Morimoto, Yuri Nannichi, Tatsuo Taniguchi & Keiki Kishikawa

Scientific Reports **6**,
Article number: 33984 (2016)
doi:10.1038/srep33984
Download Citation
Materials for optics
Optical materials

Received: 04 August 2016
Accepted: 06 September 2016
Published online: 23 September 2016

Polydopamine (PDA) shell layers
+ core polystyrene (PSt) particles



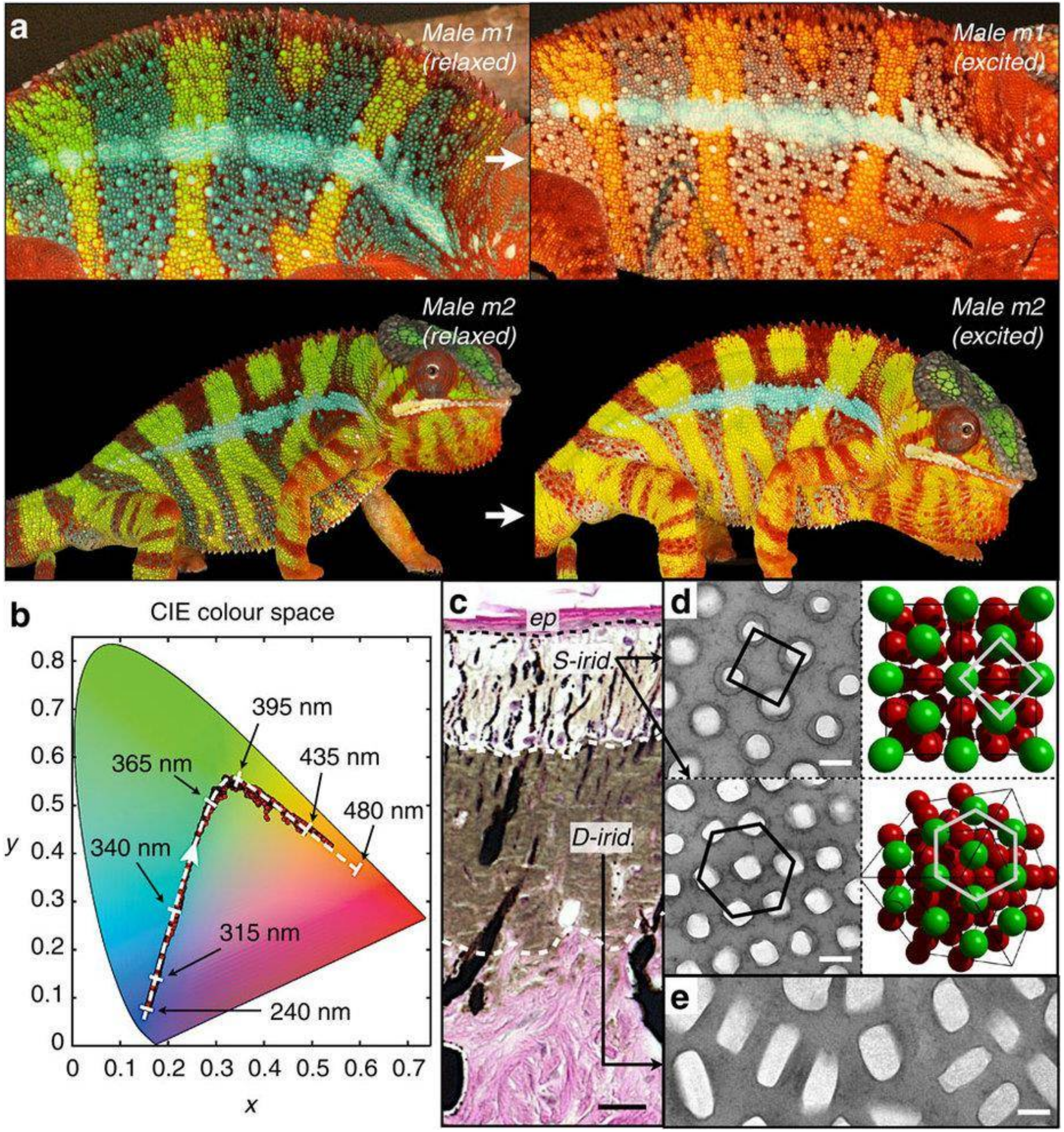
Article | OPEN

Photonic crystals cause active colour change in chameleons

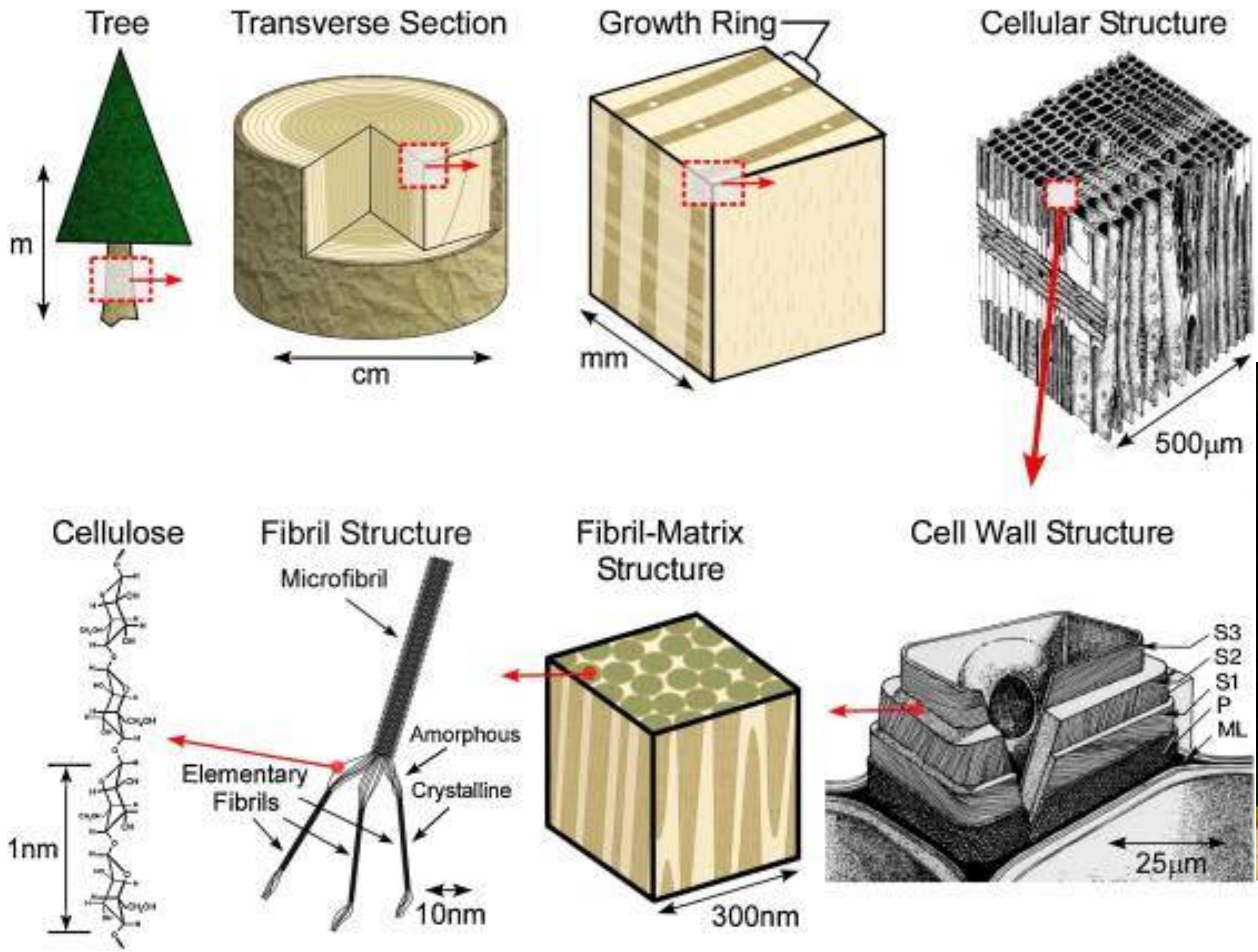
Jérémie Teyssier, Suzanne V. Saenko, Dirk van der Marel & Michel C. Milinkovitch

Nature Communications **6**, Article number: 6368 (2015)
doi:10.1038/ncomms7368
Download Citation
Photonic crystals

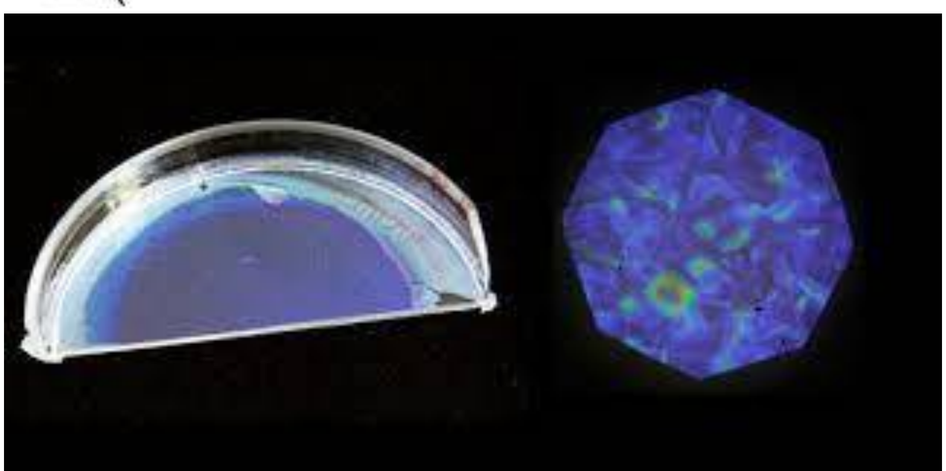
Received: 16 June 2014
Accepted: 22 January 2015
Published online: 10 March 2015



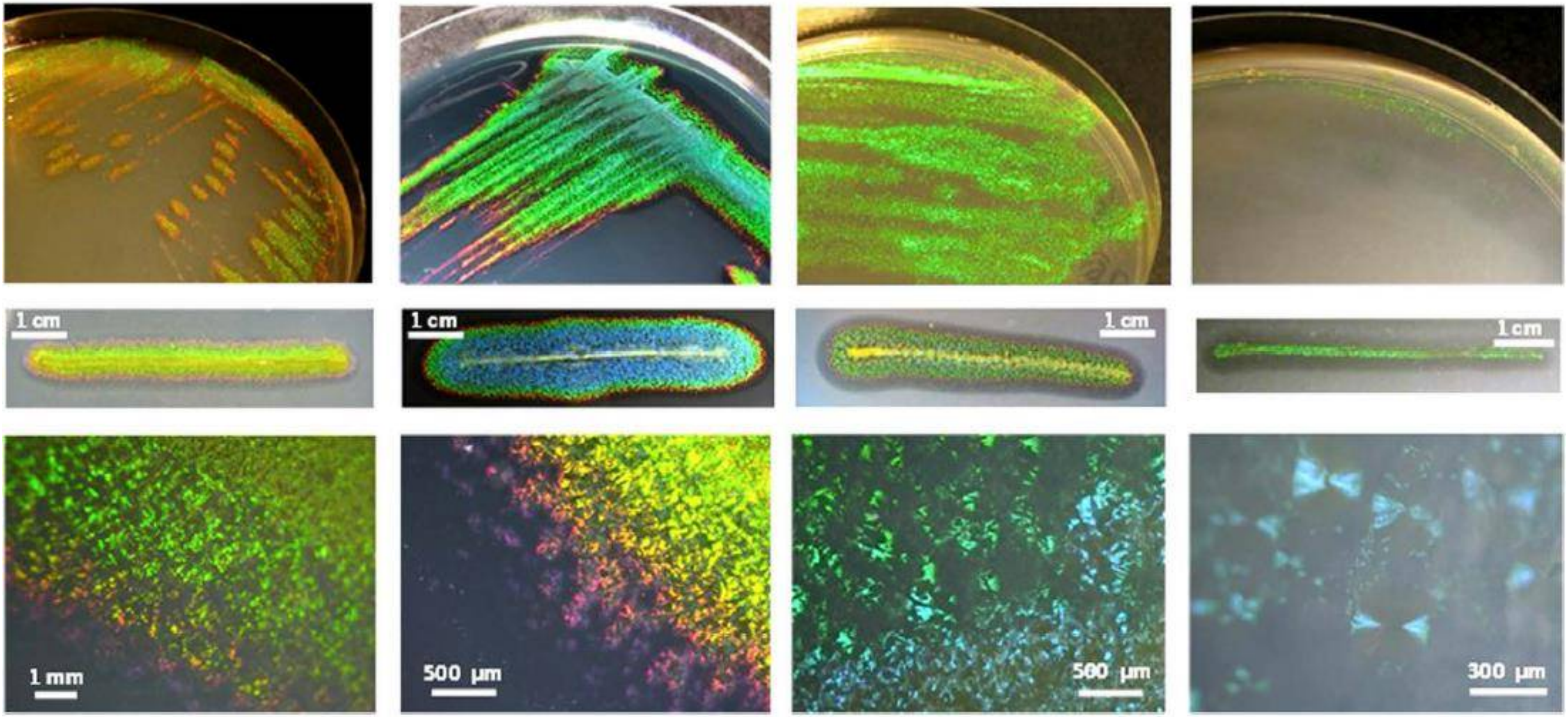
Chameleons can change their color in less than 1 second



The most intense blue known in nature: African Pollia condensata berries



Dumanli, A. G., Kamita, G., Landman, J., van der Kooij, H., Glover, B. J., Baumberg, J. J., Steiner, U. and Vignolini, S. (2014), "Controlled, Bio-inspired Self-Assembly of Cellulose-Based Chiral Reflectors." Advanced Optical Materials. doi: 10.1002/adom.201400112



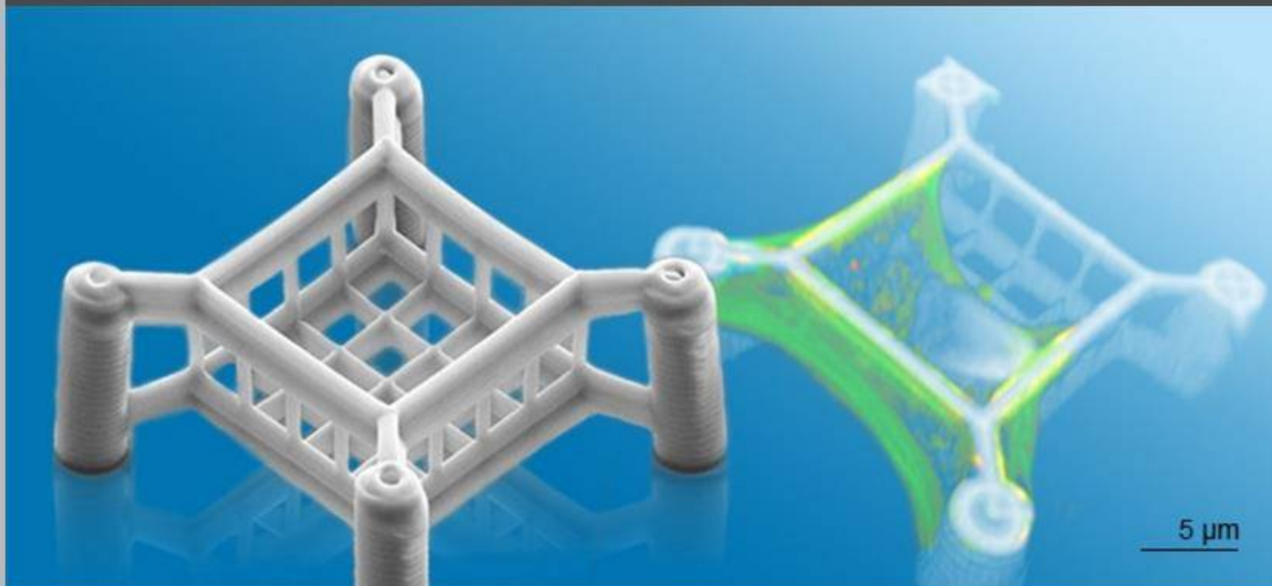
SCIENTIFIC REPORTS

OPEN

A unique self-organization of bacterial sub-communities creates iridescence in *Cellulophaga lytica* colony biofilms

Received: 30 July 2015
Accepted: 17 December 2015
Published: 28 January 2016

Betty Kientz[1,*], Stephen Luke[2], Peter Vukusic[2,*], Renaud Péteri[3,*], Cyrille Beaudry[3], Tristan Renault[4], David Simon[3], Tâm Mignot[5] & Eric Rosenfeld[1,*]



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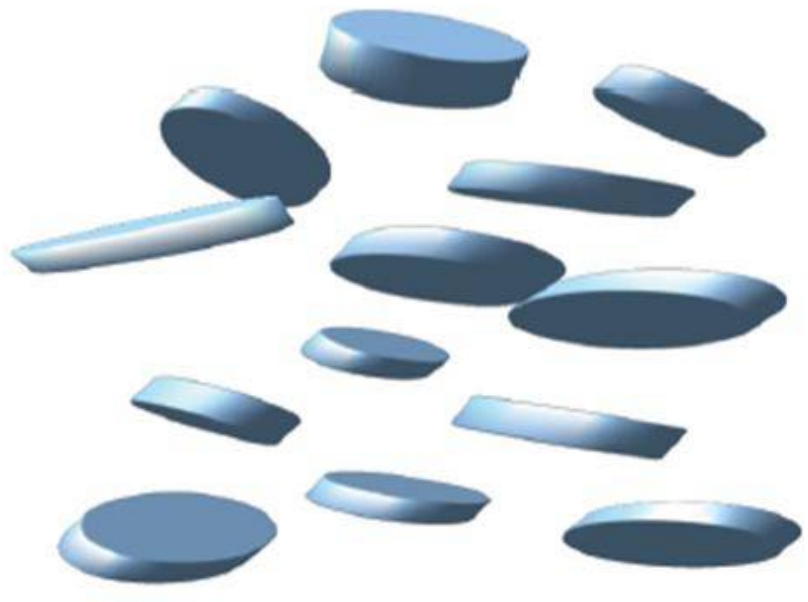
Self-assembly:

Making a macroscopic sample (i.e. about 10^{20} nanoparticles) by physically picking up and moving nanoparticles into place, one by one, would take about 300 million years, even if the time for moving individual particles could be made as short as 1 millisecond.



1896. **ANNALEN** № 11.

DER

PHYSIK UND CHEMIE.

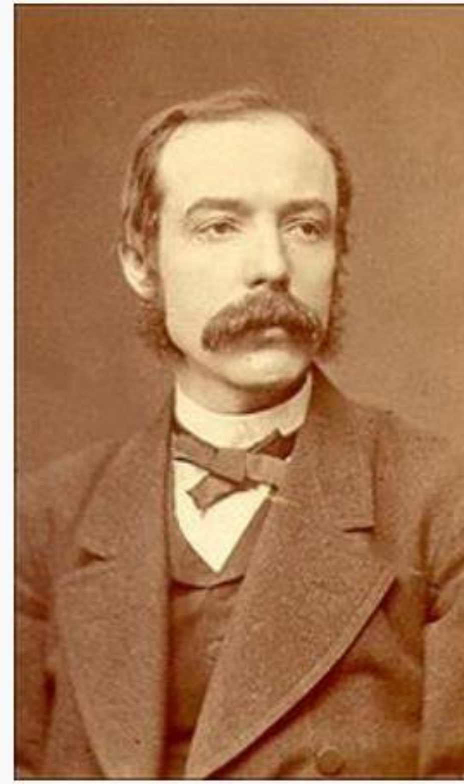
NEUE FOLGE. BAND 59.

1. *Ueber Rotationen im constanten electrischen Felde; von G. Quincke.*[1])

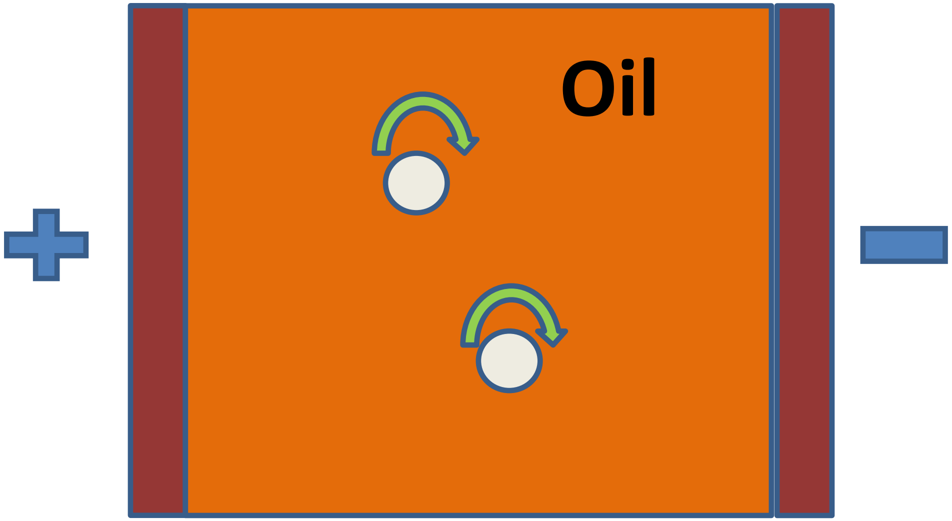
(Hierzu Taf. V u. VI Fig. 1—38.)

Quincke rotation

Georg Hermann Quincke



Born	19 November 1834 Frankfurt (Oder)
Died	13 January 1924 (aged 89) Heidelberg
Nationality	German
Fields	Physics
Doctoral advisor	H. G. Magnus, F. E. Neumann
Doctoral students	K. F. Braun, P. Lenard

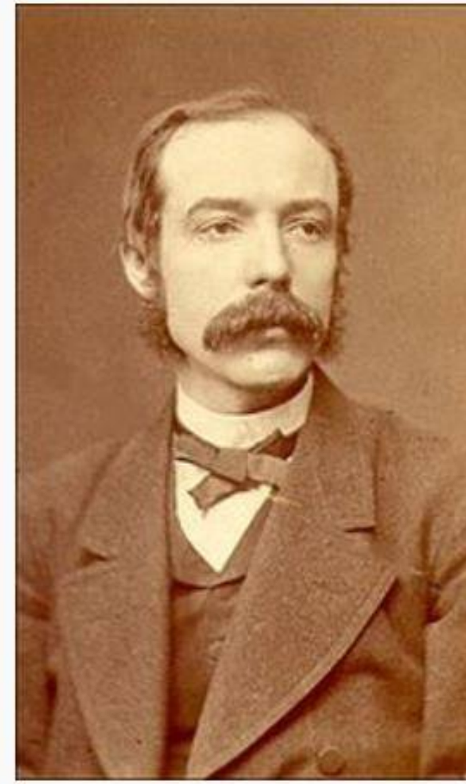


Small glass beads rotate spontaneously when immersed in liquids and subject to an electrostatic field

1. Threshold electric field
2. Rotation axis normal to the applied E-field

Quincke rotation

Georg Hermann Quincke



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1896. ANNALEN № 11.
DER
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1. *Ueber Rotationen im constanten electrischen Felde; von G. Quincke.* [1])
(Hierzu Taf. V u. VI Fig. 1—38.)

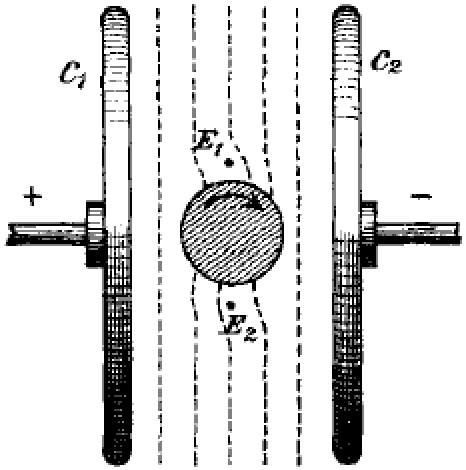
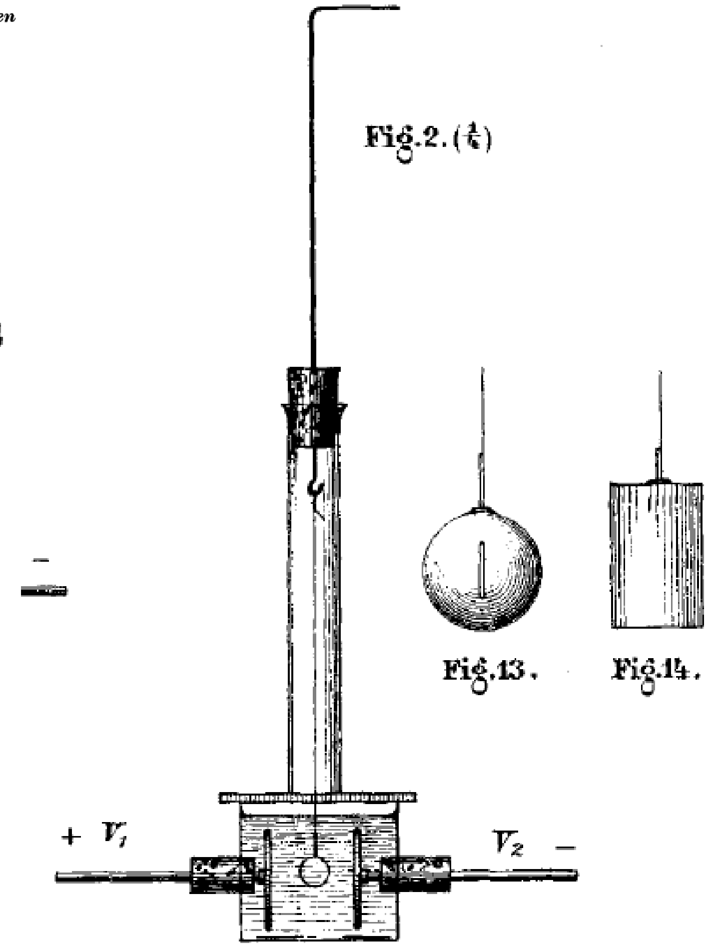
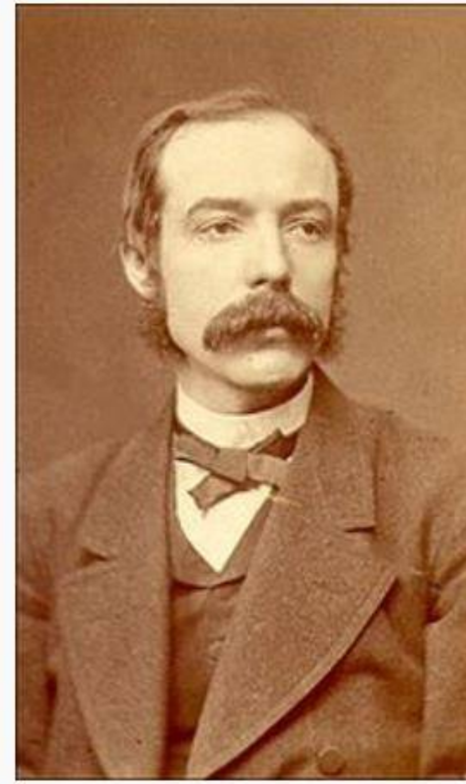


Fig.18.



Quincke rotation

Georg Hermann Quincke



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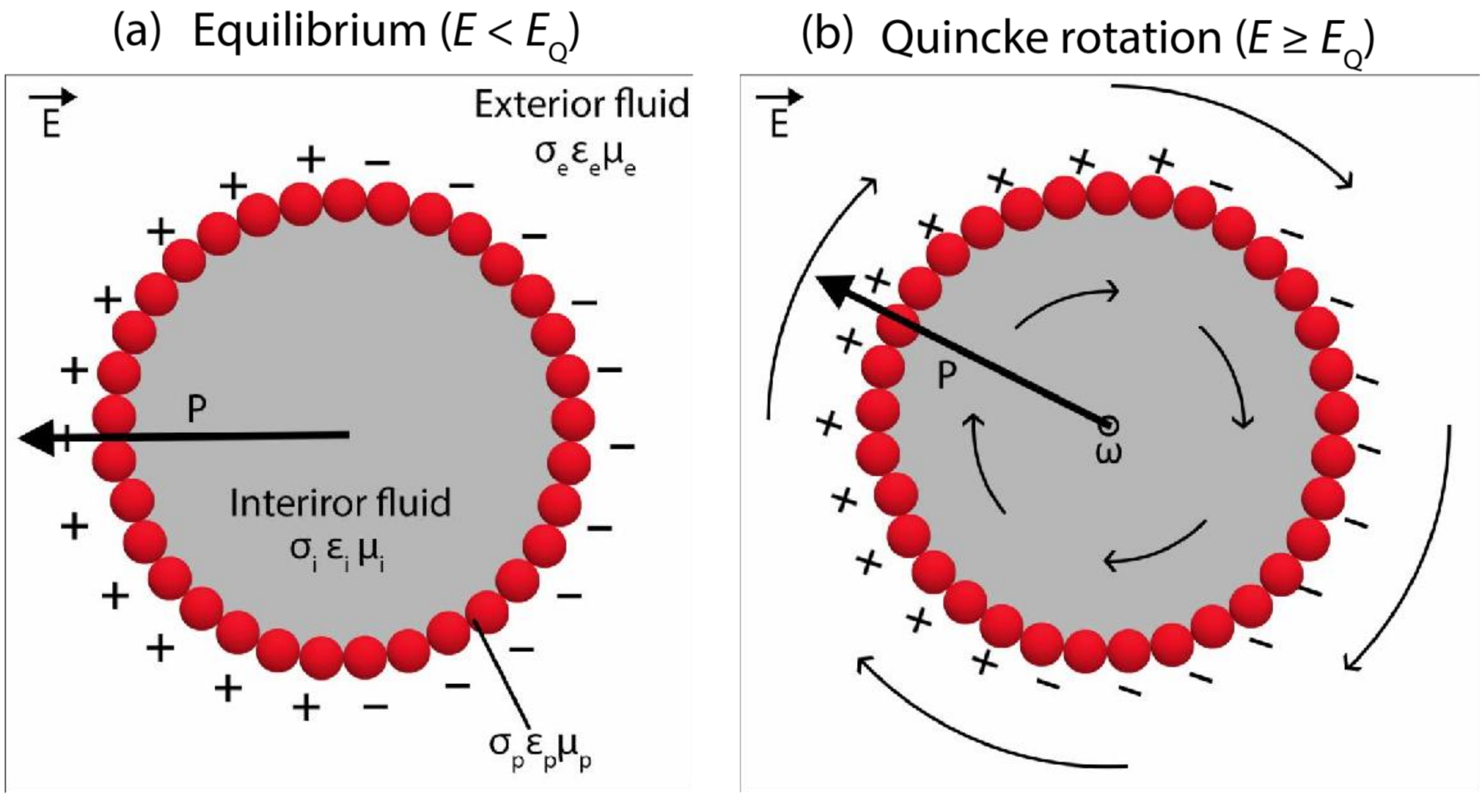
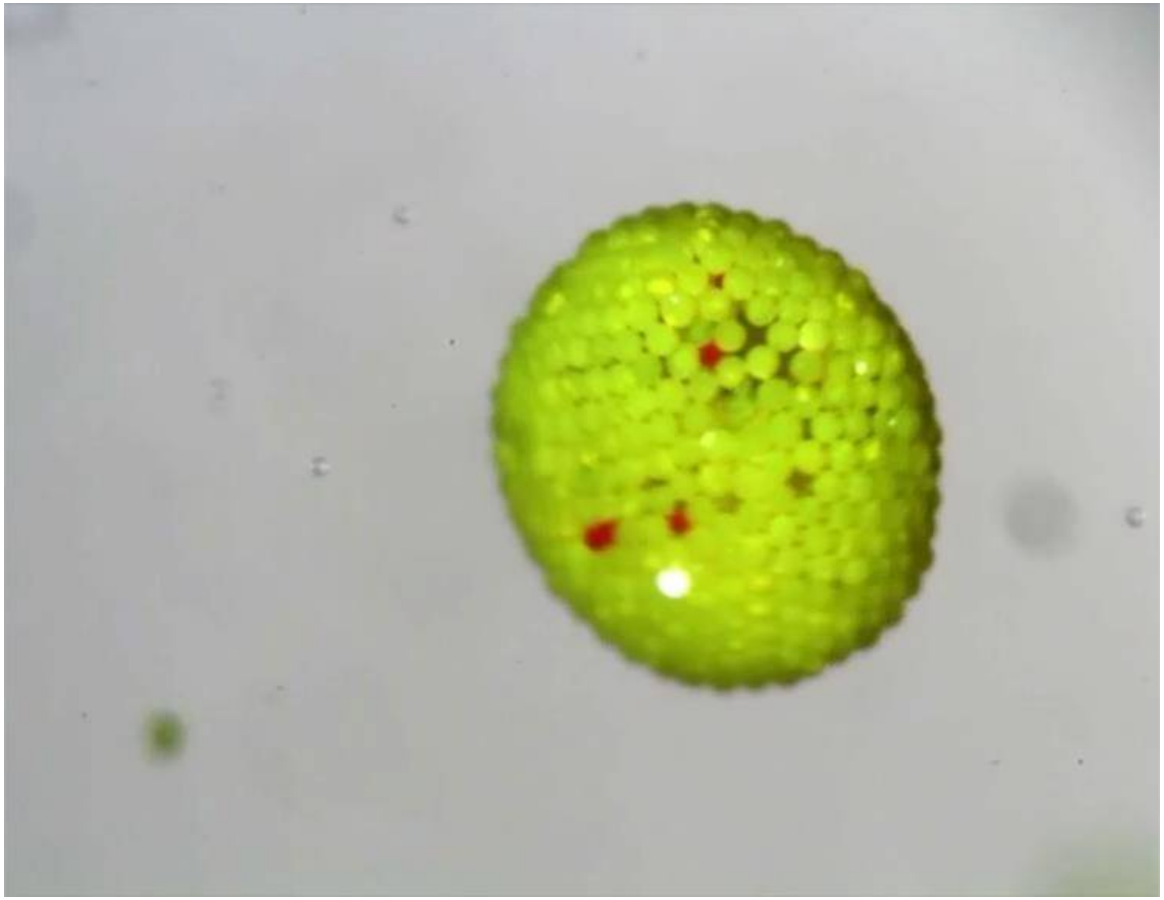
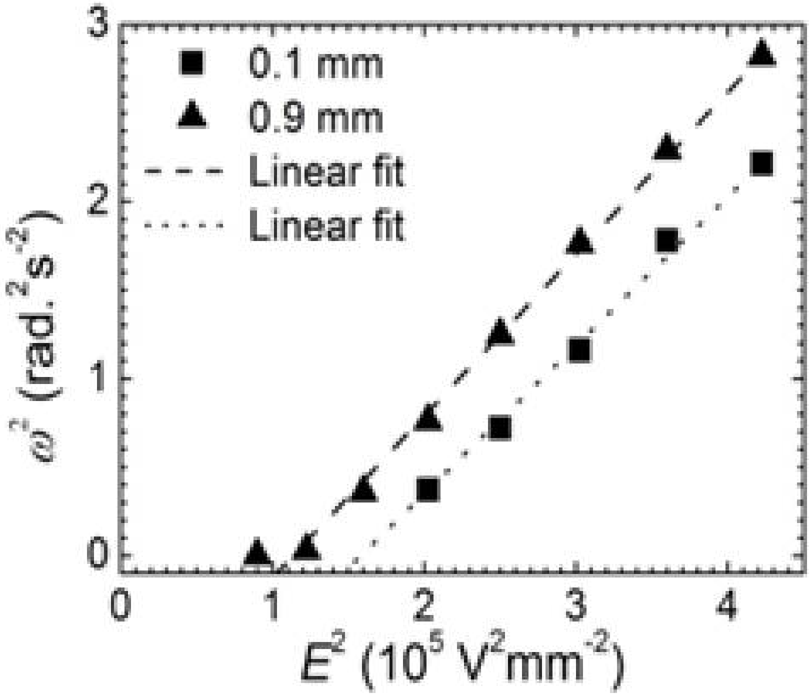


Quincke rotation of Pickering frops. Experiments at NTNU Trondheim

Movie of single Quincke rotating Pickering drop

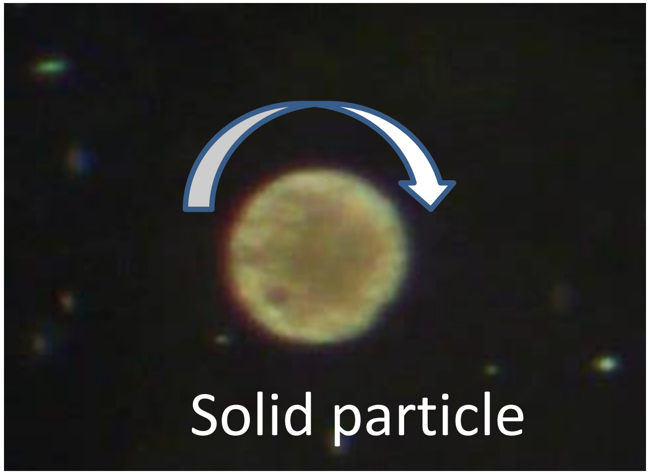


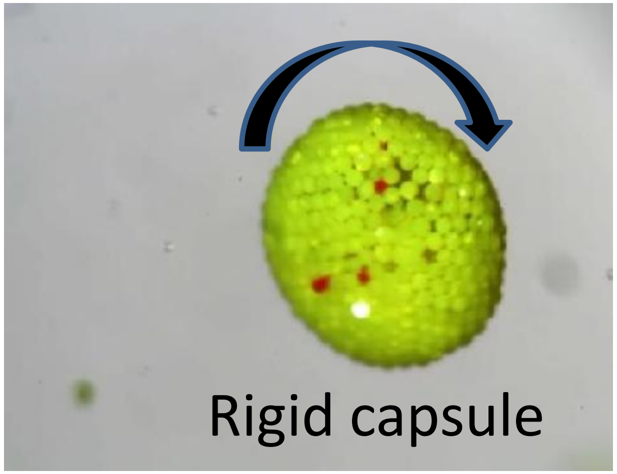
Quincke rotation of Pickering drops. Experiments at NTNU Trondheim



$$\Omega = \pm \frac{1}{\tau_{\rm MW}} \sqrt{\left(\frac{E_e}{E_c}\right)^2 - 1}, \quad \text{with}$$

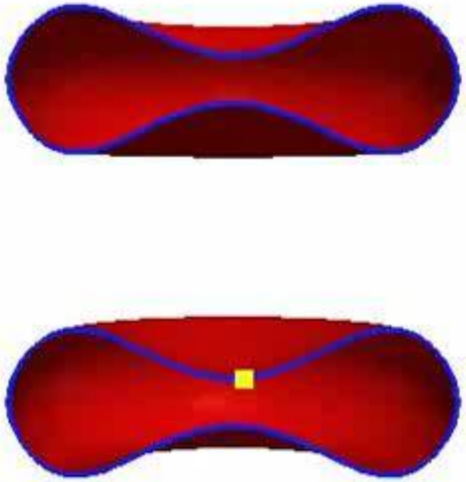
$$E_c = \sqrt{\frac{2\eta}{\varepsilon_1 \tau_{\rm MW}(\varepsilon_{21} - \sigma_{21})}}.$$





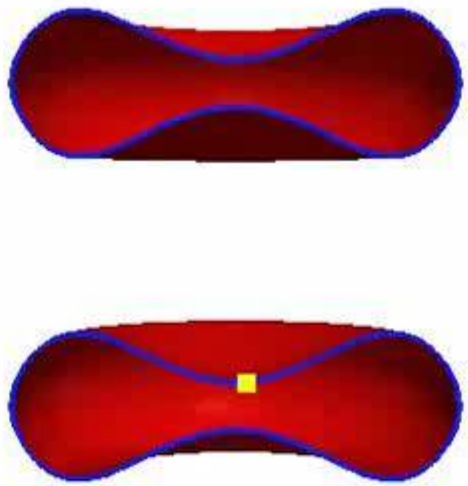
Quincke rotation of Pickering drops. Experiments at NTNU Trondheim

Tank treading and tumbling motion

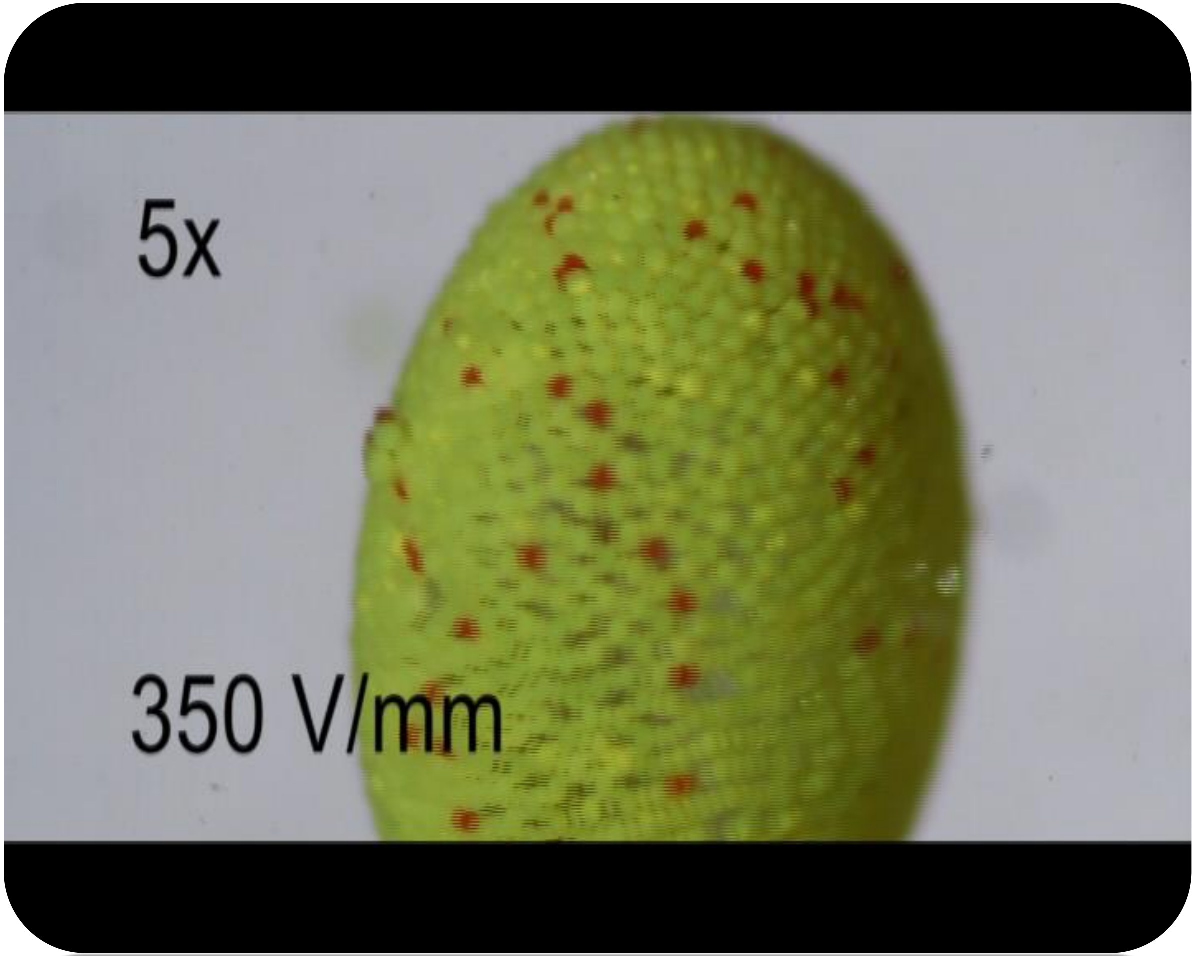


Video from: http://www.youtube.com/watch?v=mKLhfb5csr4

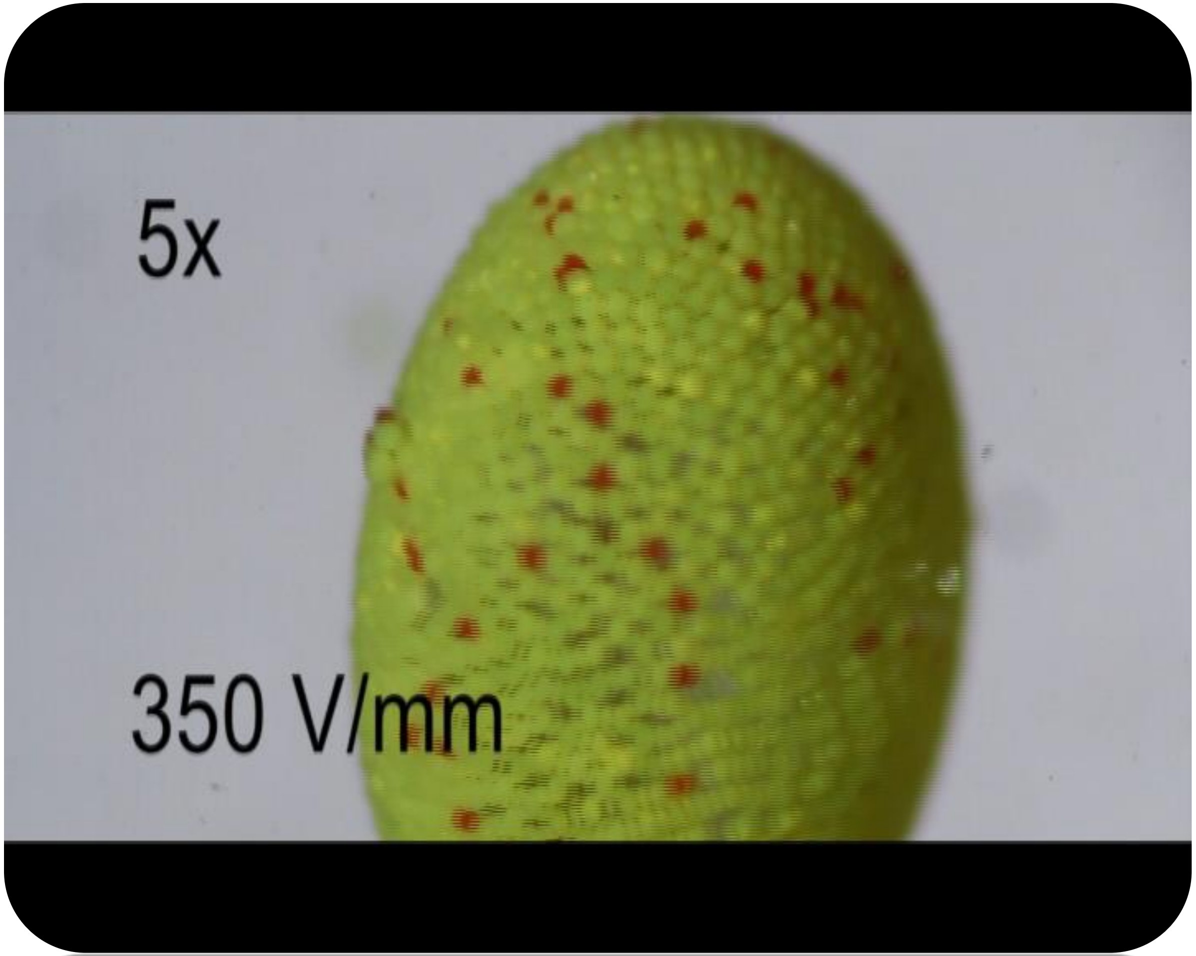
Tumbling and tank treading motion



Video from: http://www.youtube.com/watch?v=mKLhfb5csr4



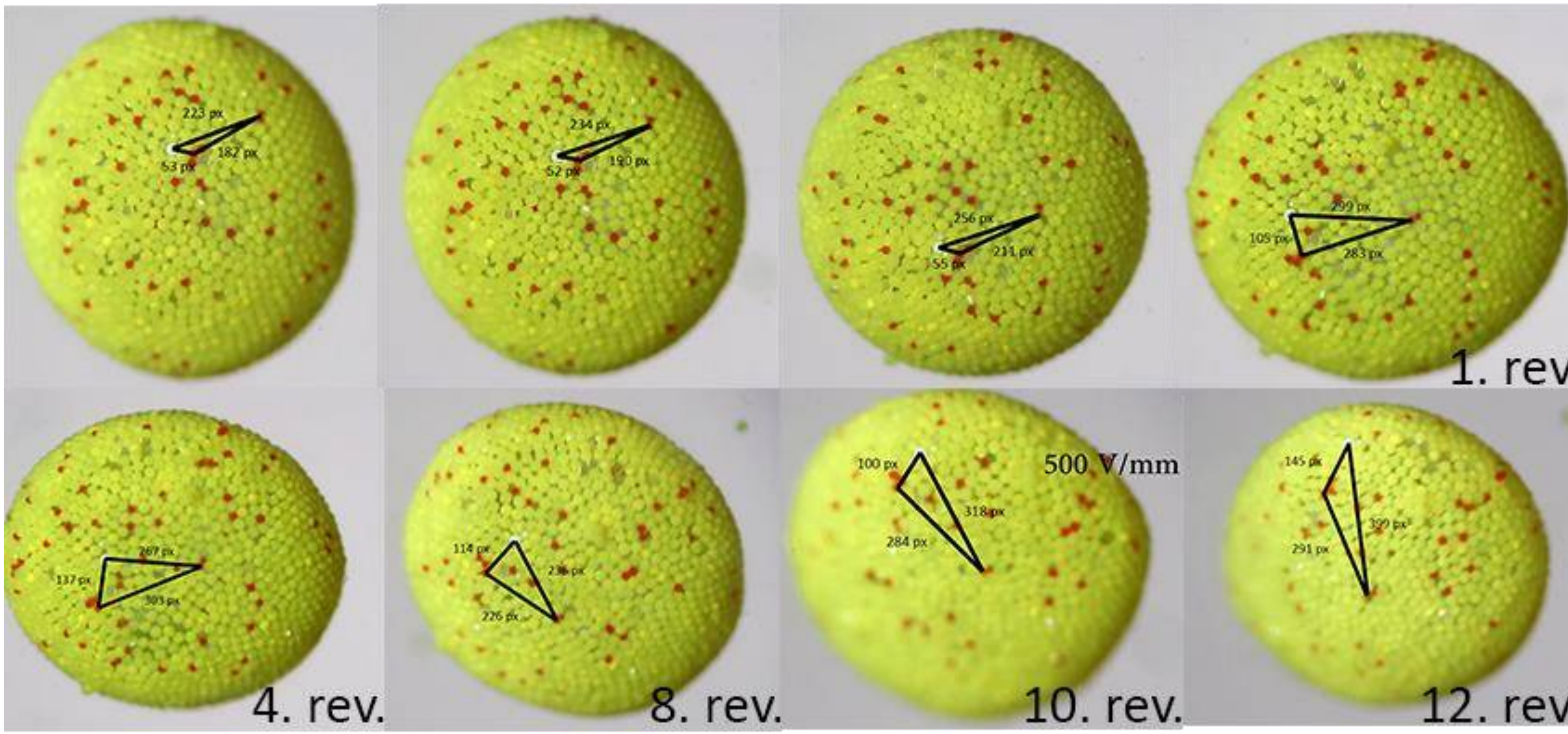
Transition from solid shell rotation to **tank treading:**
Experiments at NTNU Trondheim



Transition from solid shell rotation to **tank treading:**
Experiments at NTNU Trondheim

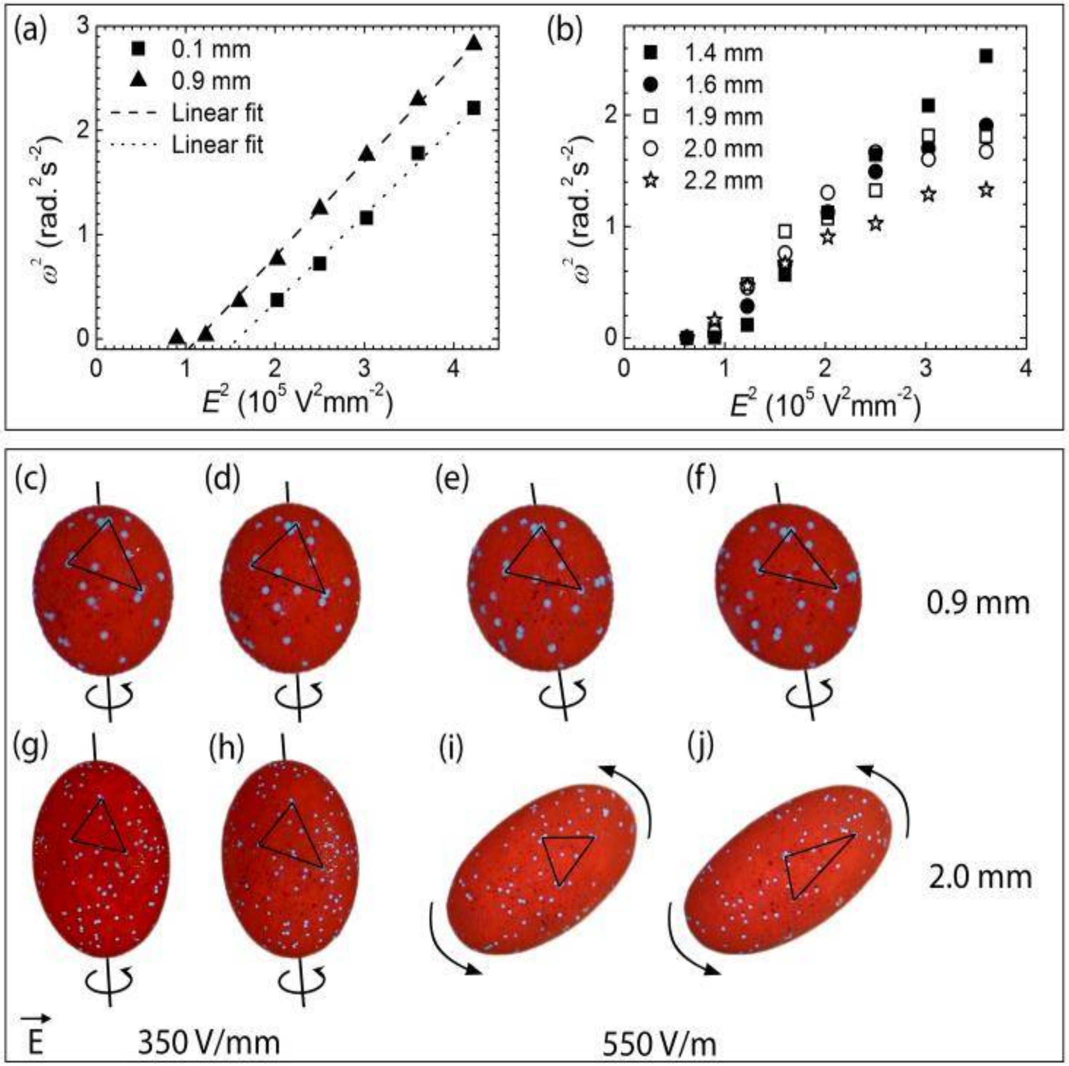
Particle tracking

0 V/mm, 0 s | 200 V/mm, 18 s | 250 V/mm, 40 s | 300 V/mm, 117 s



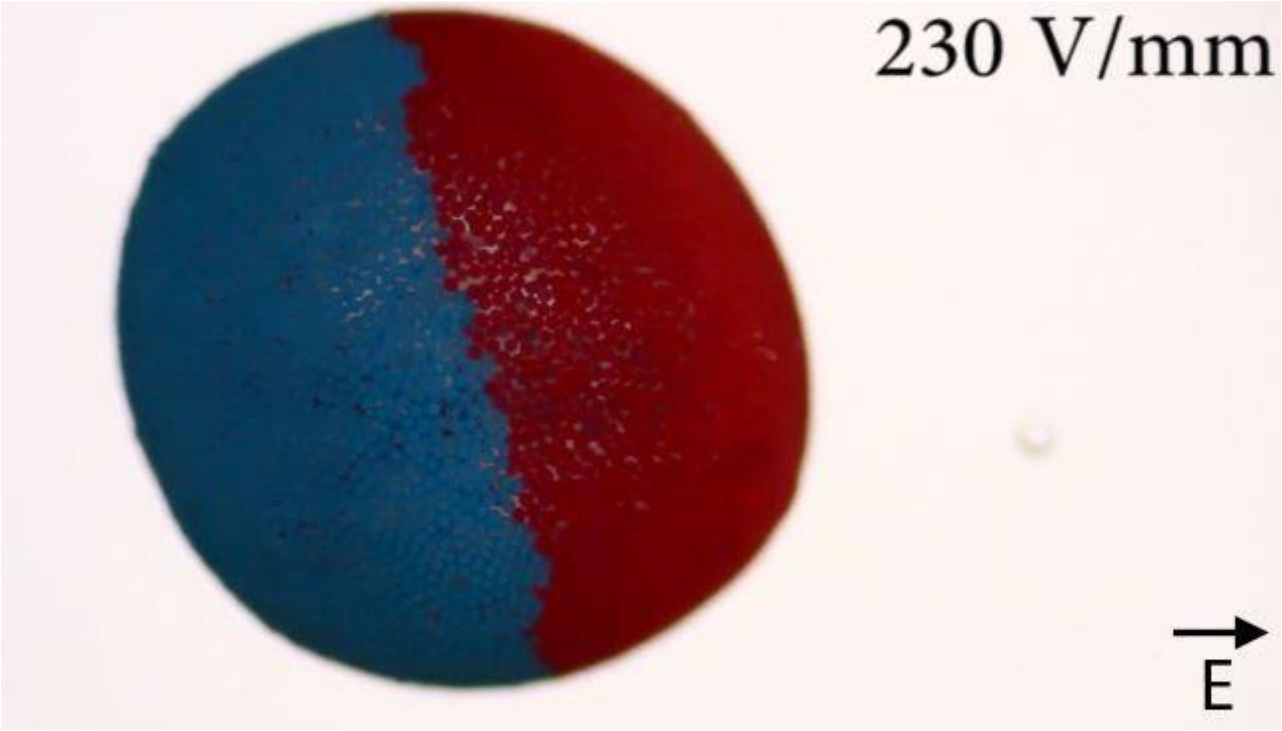
350 V/mm, 142 s | 400 V/mm, 171 s | 500 V/mm, 182 s | 500 V/mm, 191 s

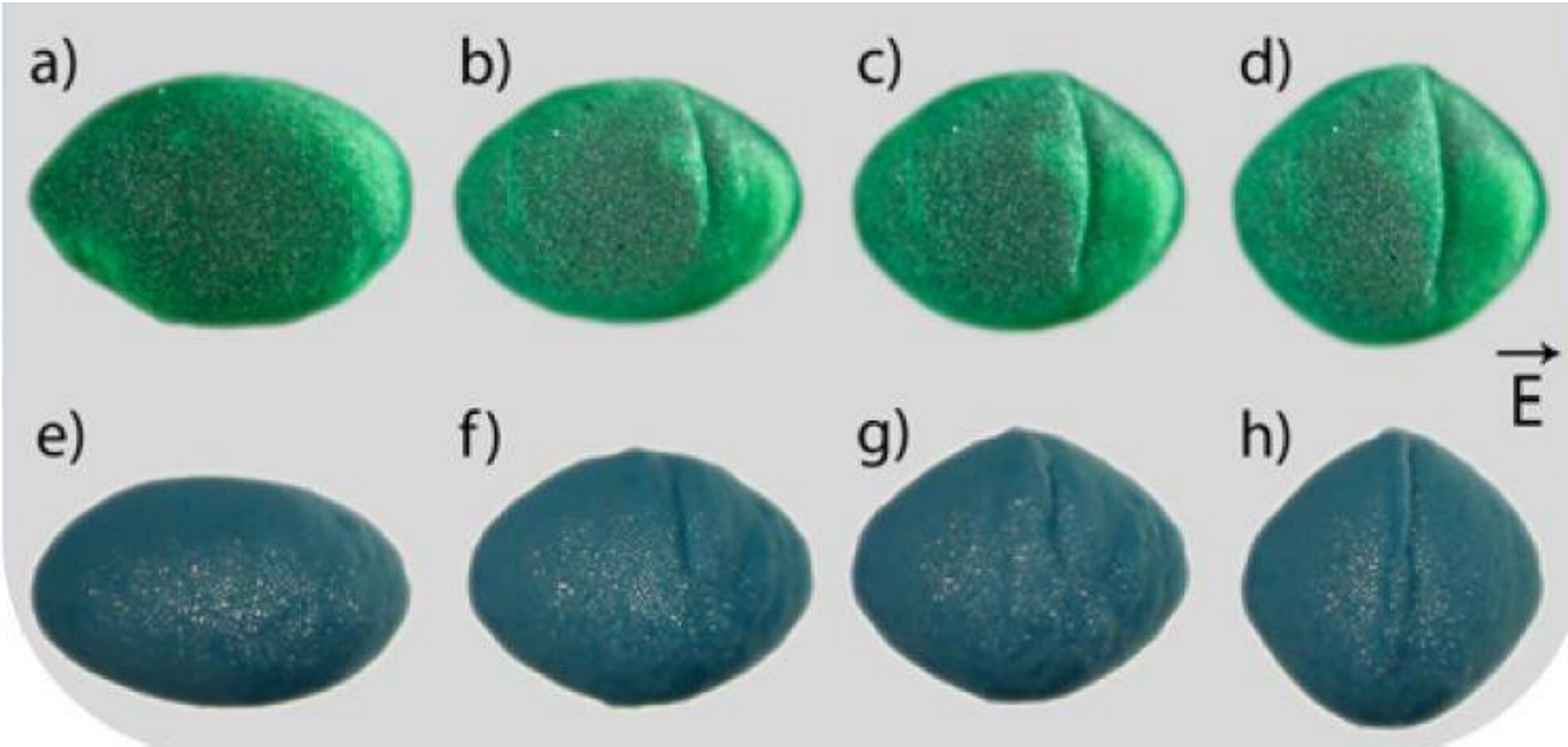
Transition from solid shell rotation to **tank treading:**
Experiments at NTNU Trondheim



Transition from solid shell rotation to **tank treading: Experiments at NTNU Trondheim**

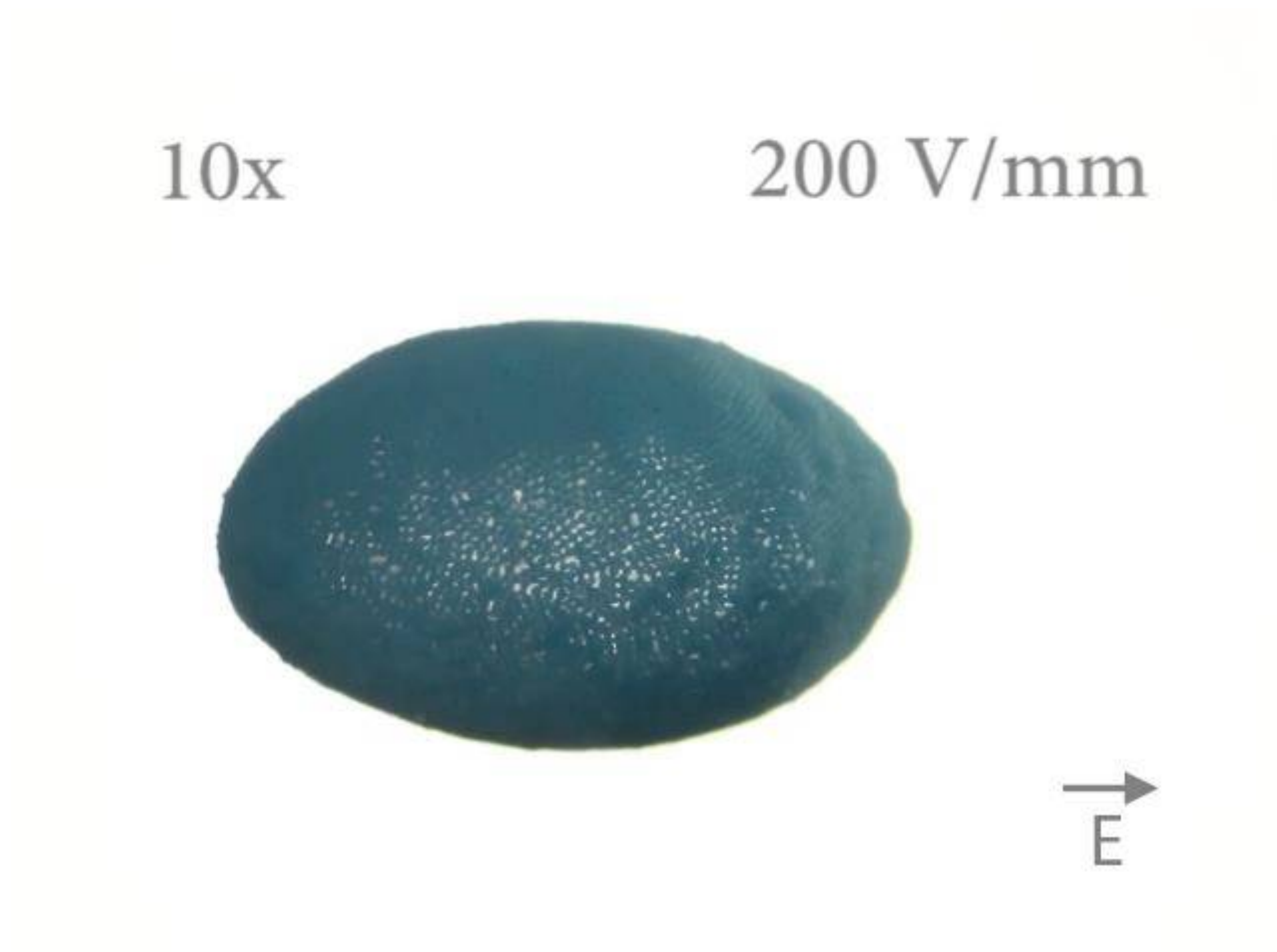
Solid to liquid transition of the particle layer occurs when we increase the E-field





Electrobuckling: Experiments at NTNU Trondheim

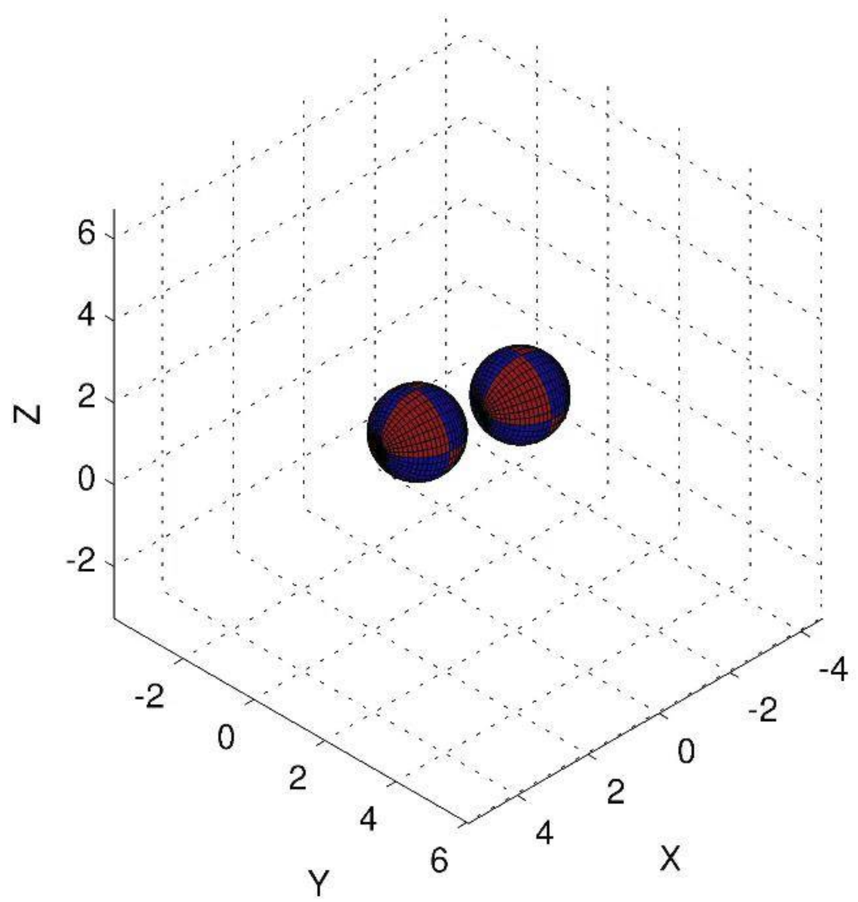
Crumpling



PHYSICAL REVIEW E 87, 043014 (2013)

Electrohydrodynamic interaction of spherical particles under Quincke rotation

Debasish Das and David Saintillan*
Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA
(Received 3 March 2013; published 29 April 2013)



Interaction of Quincke rotating beads

Swimming Quincke rotating Pickering pair

→

E

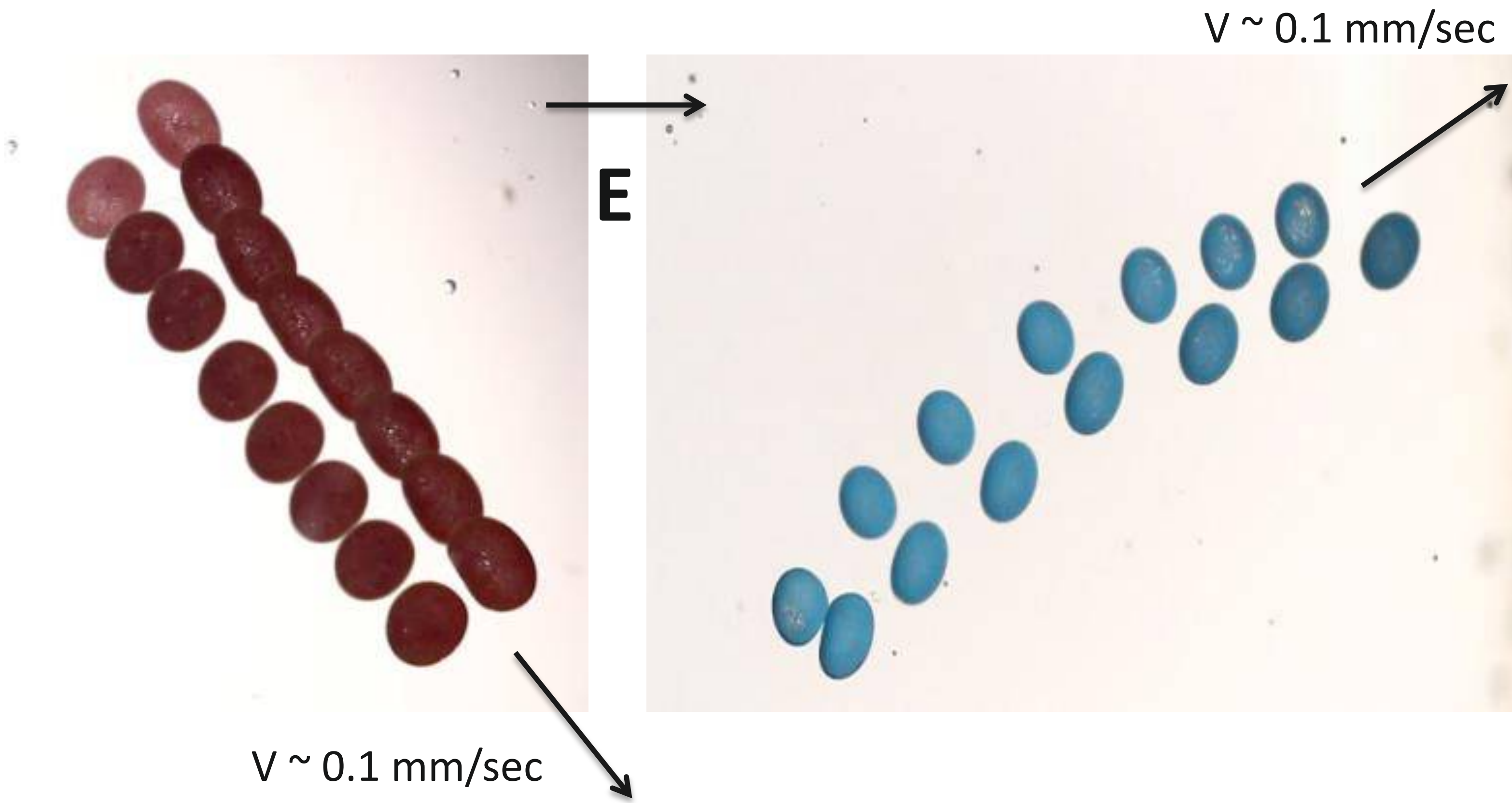
Experiments at NTNU Trondheim

Swimming upwards

- E

Experiments at NTNU Trondheim

Pair swimming of tank treading capsules



Experiments at NTNU Trondheim

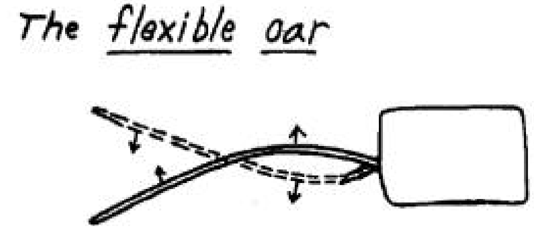
Electro-hydrodynamic propulsion of counter-rotating Pickering drops P. Dommersnes, A. Mikkelsen & J. O. Fossum EUROPEAN PHYSICAL JOURNAL SPECIAL TOPICS 225, 699-705 (2016)

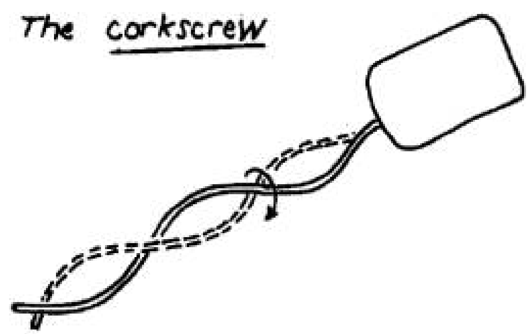
Life at low Reynolds number

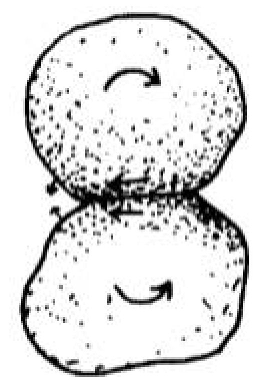
American Journal of Physics, Vol. 45, No. 1, January 1977

E. M. Purcell
Lyman Laboratory, Harvard University, Cambridge, Massachusetts 02138
(Received 12 June 1976)

Another animal might consist of two cells which were stuck together and were able to roll on one another by having some kind of attraction here while releasing there. That thing will "roll" along.







Counter-rotating rotors

Swimmers

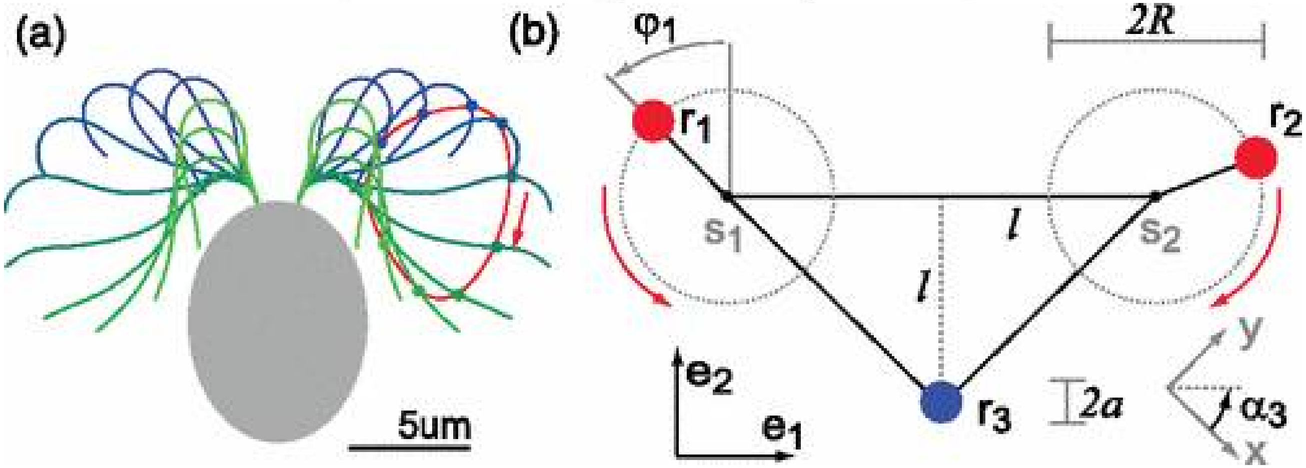
Chlamydomonas is a single-cell green alga about 10 micrometres in diameter that swims with two flagella.

Two-rotor bifilament swimmer: Chlamydomonas

Selected for a Viewpoint in *Physics*
PRL **109**, 138102 (2012) PHYSICAL REVIEW LETTERS week ending 28 SEPTEMBER 2012

Flagellar Synchronization Independent of Hydrodynamic Interactions

Benjamin M. Friedrich* and Frank Jülicher
Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany
(Received 7 June 2012; published 24 September 2012)



New Journal of Physics
The open access journal for physics

Phase-dependent forcing and synchronization in the three-sphere model of *Chlamydomonas*

Rachel R Bennett and Ramin Golestanian[1]
Rudolf Peierls Center for Theoretical Physics, University of Oxford, Oxford OX1 3NP, UK
E-mail: ramin.golestanian@physics.ox.ac.uk

New Journal of Physics **15** (2013) 075028 (17pp)
Received 10 April 2013
Published 30 July 2013
Online at http://www.njp.org/
doi:10.1088/1367-2630/15/7/075028

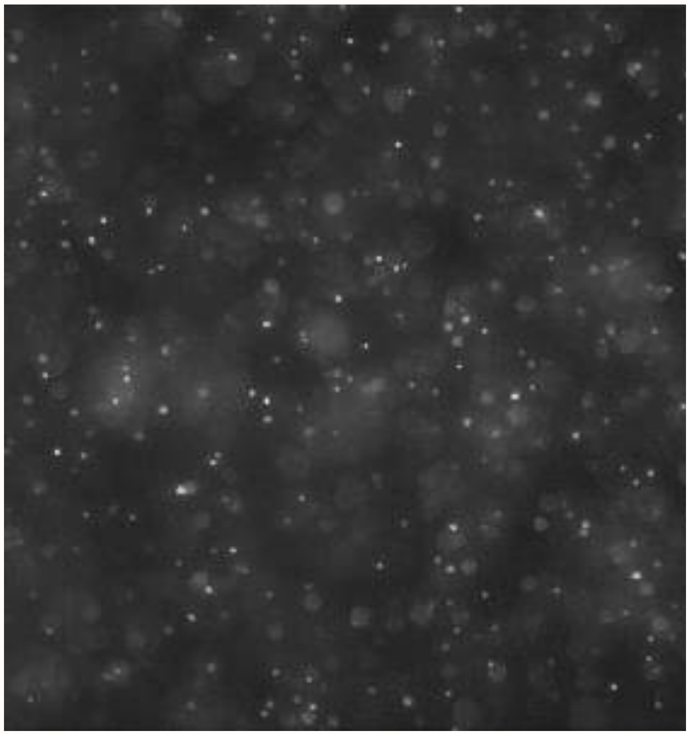
Two-rotor model of bifilament swimmer

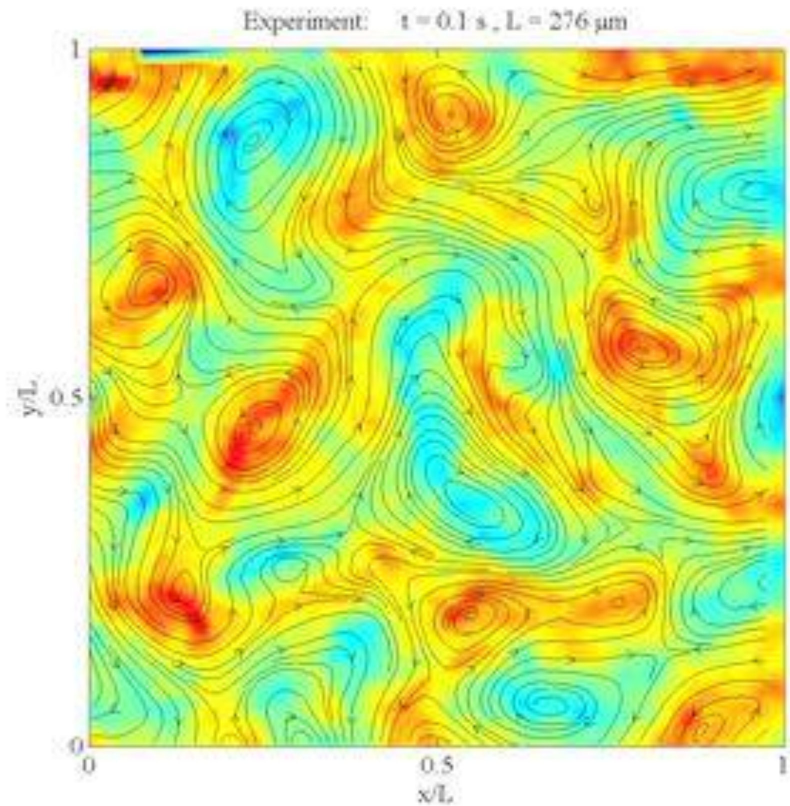
Flocking and swarming

Selected for a Viewpoint in *Physics*
PRL **110,** 228102 (2013) PHYSICAL REVIEW LETTERS week ending 31 MAY 2013

Fluid Dynamics of Bacterial Turbulence

Jörn Dunkel,[1] Sebastian Heidenreich,[2] Knut Drescher,[3] Henricus H. Wensink,[4] Markus Bär,[2] and Raymond E. Goldstein[1]





exp_03_40xoil_40fps_flow.mov: Real-time low-resolution movie (duration 10 s) of tracer motion as used for the PTV analysis (see main text for imaging parameters).

exp_03.mov: Real-time movie (duration 50 s) of the PIV flow field as extracted from "exp_03_40xoil_40fps_brightfield.mov"

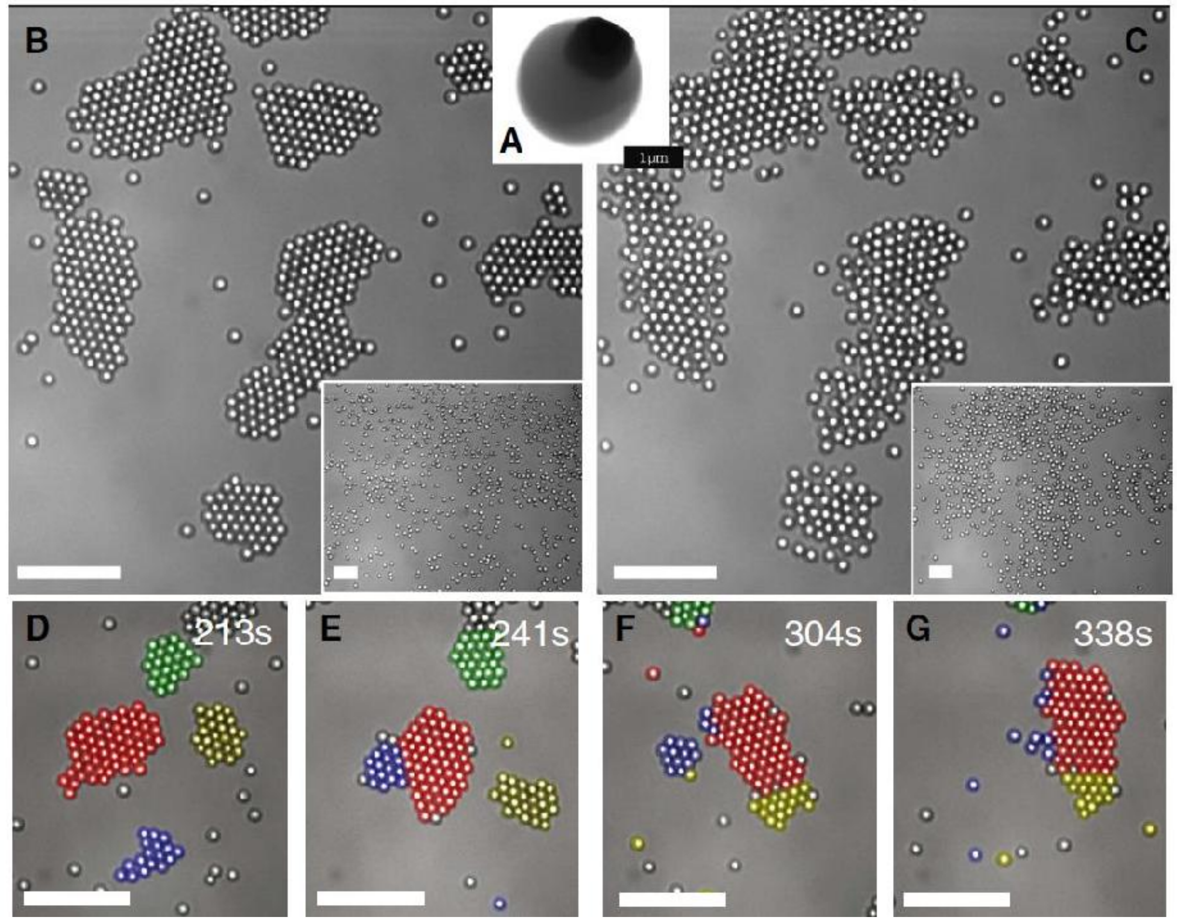
Science AAAS

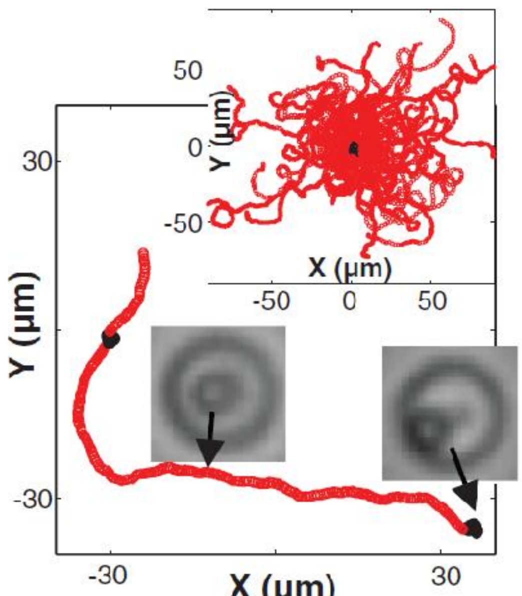
Living Crystals of Light-Activated Colloidal Surfers

Jeremie Palacci *et al.*

Science **339**, 936 (2013);
DOI: 10.1126/science.1230020

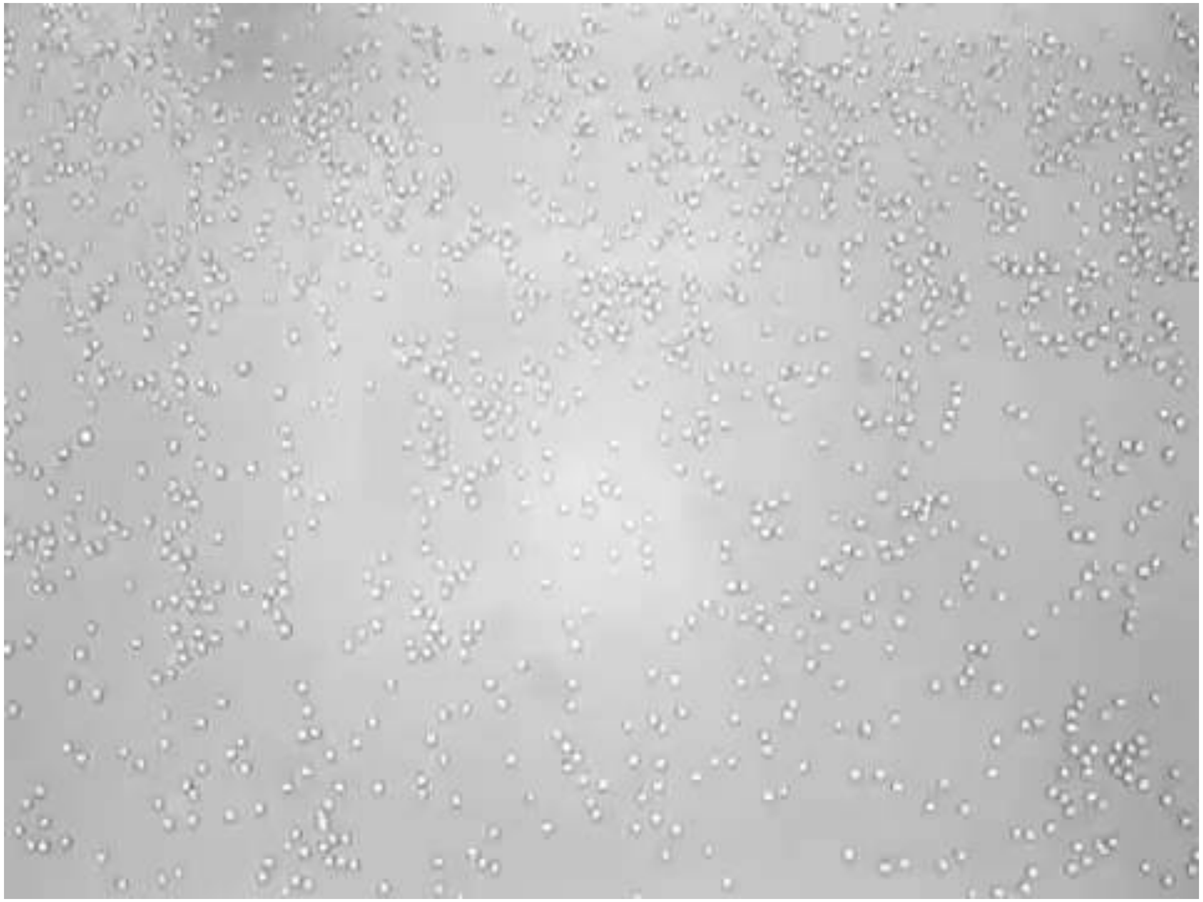
Fig. 1. (**A**) Scanning electron microscopy (SEM) of the bimaterial colloid: a TPM polymer colloidal sphere with protruding hematite cube (dark). (**B**) Living crystals assembled from a homogeneous distribution (inset) under illumination by blue light. (**C**) Living crystals melt by thermal diffusion when light is extinguished: Image shows system 10 s after blue light is turned off (inset, after 100 s). (**D** to **G**) The false colors show the time evolution of particles belonging to different clusters. The clusters are not static but rearrange, exchange particles, merge (D→F), break apart (E→F), or become unstable and explode (blue cluster, F→G). For (B) to (G), the scale bars indicate 10 μm. The solid area fraction is $\Phi_s \approx 0.14$.





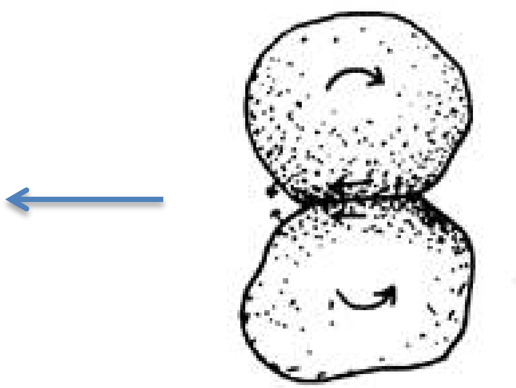
A hematite cube protruding from a TPM polymer spheremoves on fixed glass substrate when exposed to blue light (red part of trace) and diffuses when the light is off (black part of trace). Initially, with no light, the hematite cube is oriented randomly (image, right) but rotates and faces downward toward the glass substrate when the light is turned on (image, left). The particle then surfs on the osmotic flow it induces between the substrate and itself. (Inset) A superposition of the trajectories of many particles with their origins aligned.

Living Crystals of Light-Activated Colloidal Surfers
Jeremie Palacci *et al.*
Science **339**, 936 (2013);
DOI: 10.1126/science.1230020

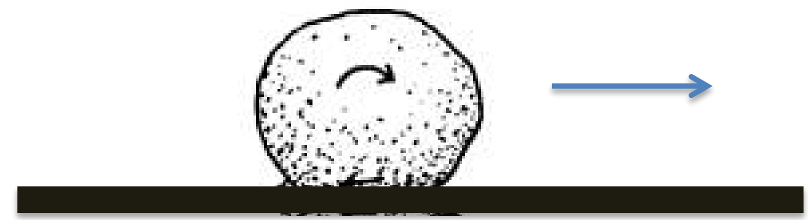


Phoretic and osmotic effects can conveniently be switched on and off by light.

Pair rollers

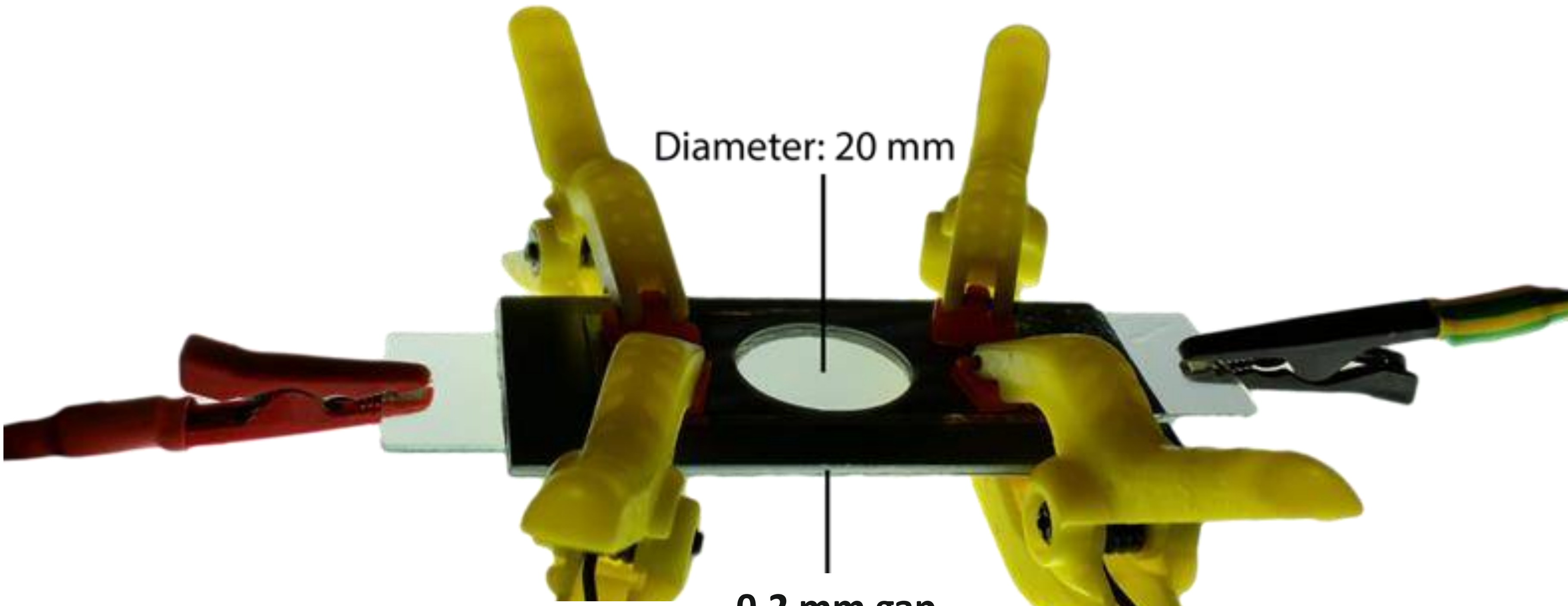


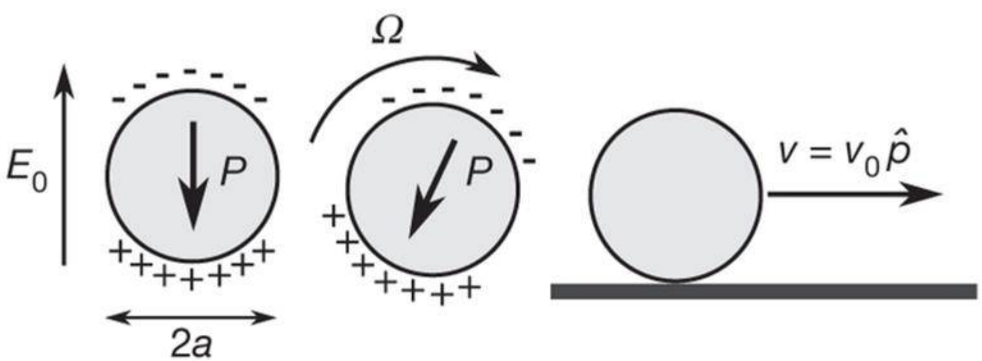
Surface roller



Kicking off one another, or kicking of a surface

Hele-Shaw cell with ITO glass covers: suspension containg 30micron PS beads





Experiments at NTNU Trondheim: Tommy Kristiansen

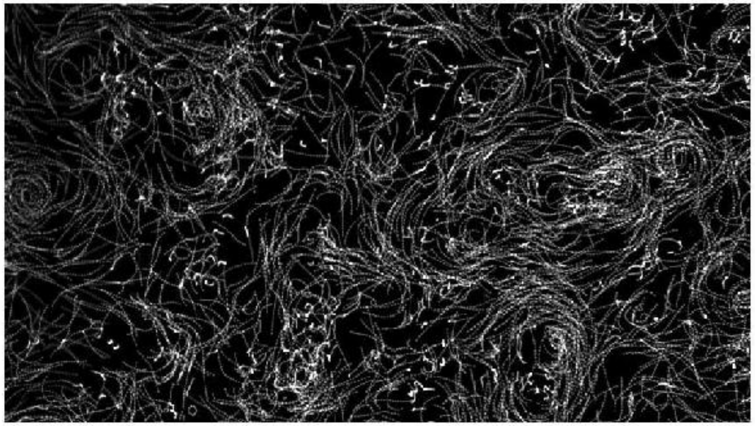
40µm 2250V/mm

Fast moving quincke rollers

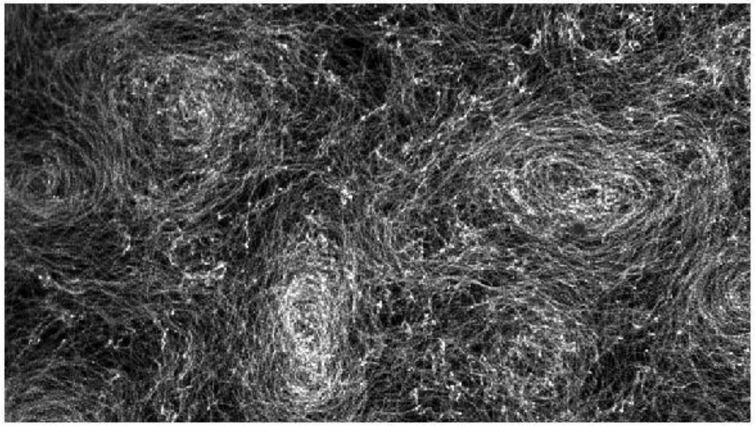
Experiments at NTNU Trondheim: Tommy Kristiansen

Streak photography night sky

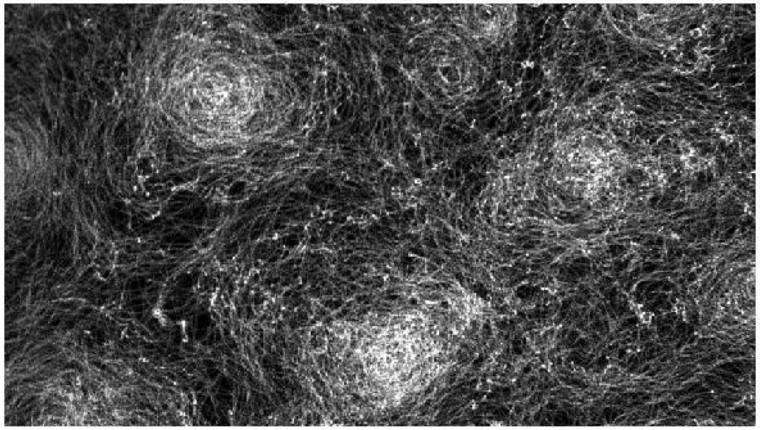
Streak photos of fast moving Quincke rollers: «Vortices»



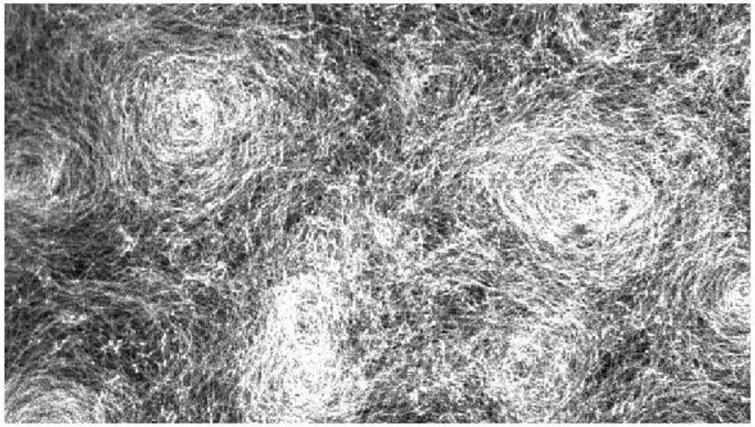
15 frames after 0 secs



100 frames after 3 secs

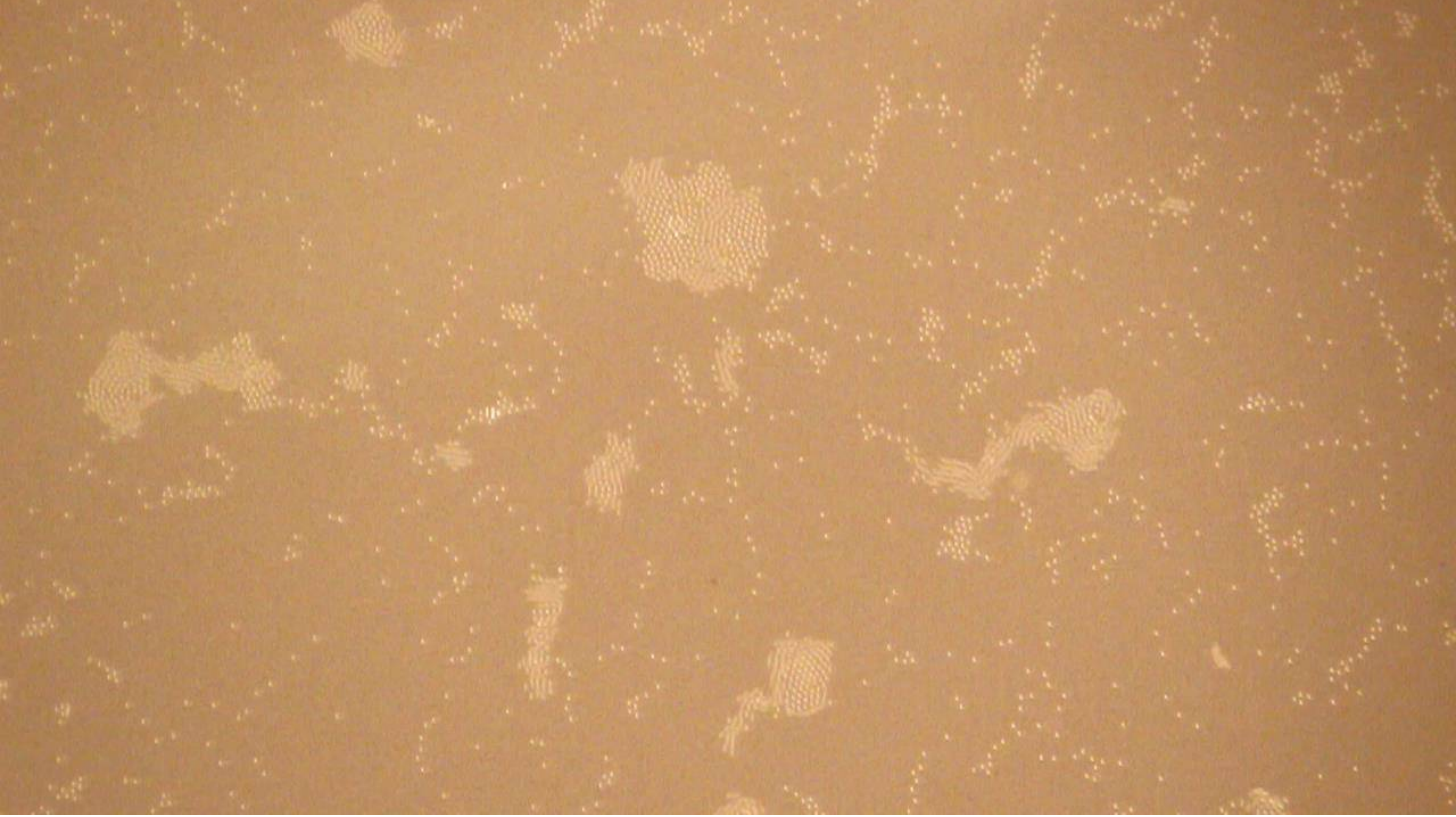


100 frames after 6 secs



100 frames after 9 secs

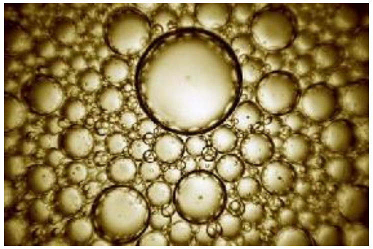
Experiments at NTNU Trondheim: Tommy Kristiansen



30µm 1375V/mm 60fps «Living crystals «or active «entangled matter»

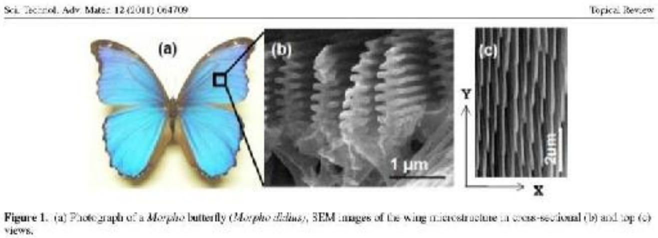
Experiments at NTNU Trondheim: Tommy Kristiansen

Enhanced Oil-Recovery by means of nanofluids
(Dept. of Petr. Eng. & Appl. Geophys. NTNU)

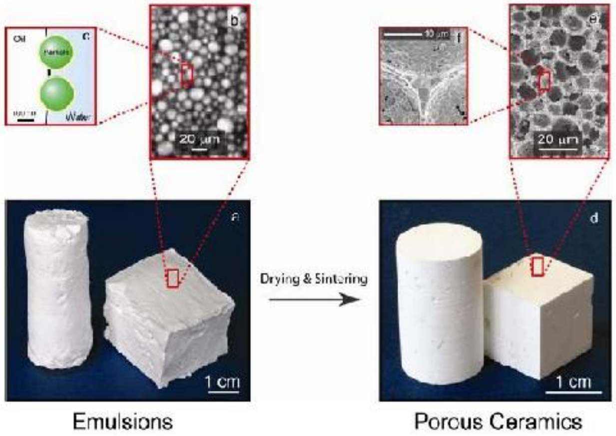


+ nanoparticles

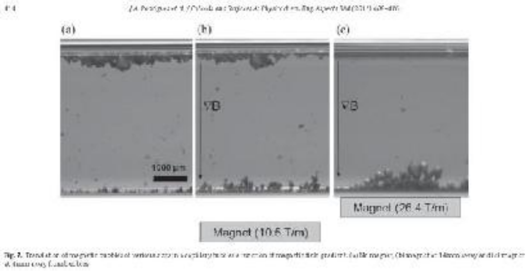
Structural colours: Biomimetic etc
(Dept. of Physics, NTNU)



Pickering foams for new construction materials
(Dept. of Physics, NTNU)

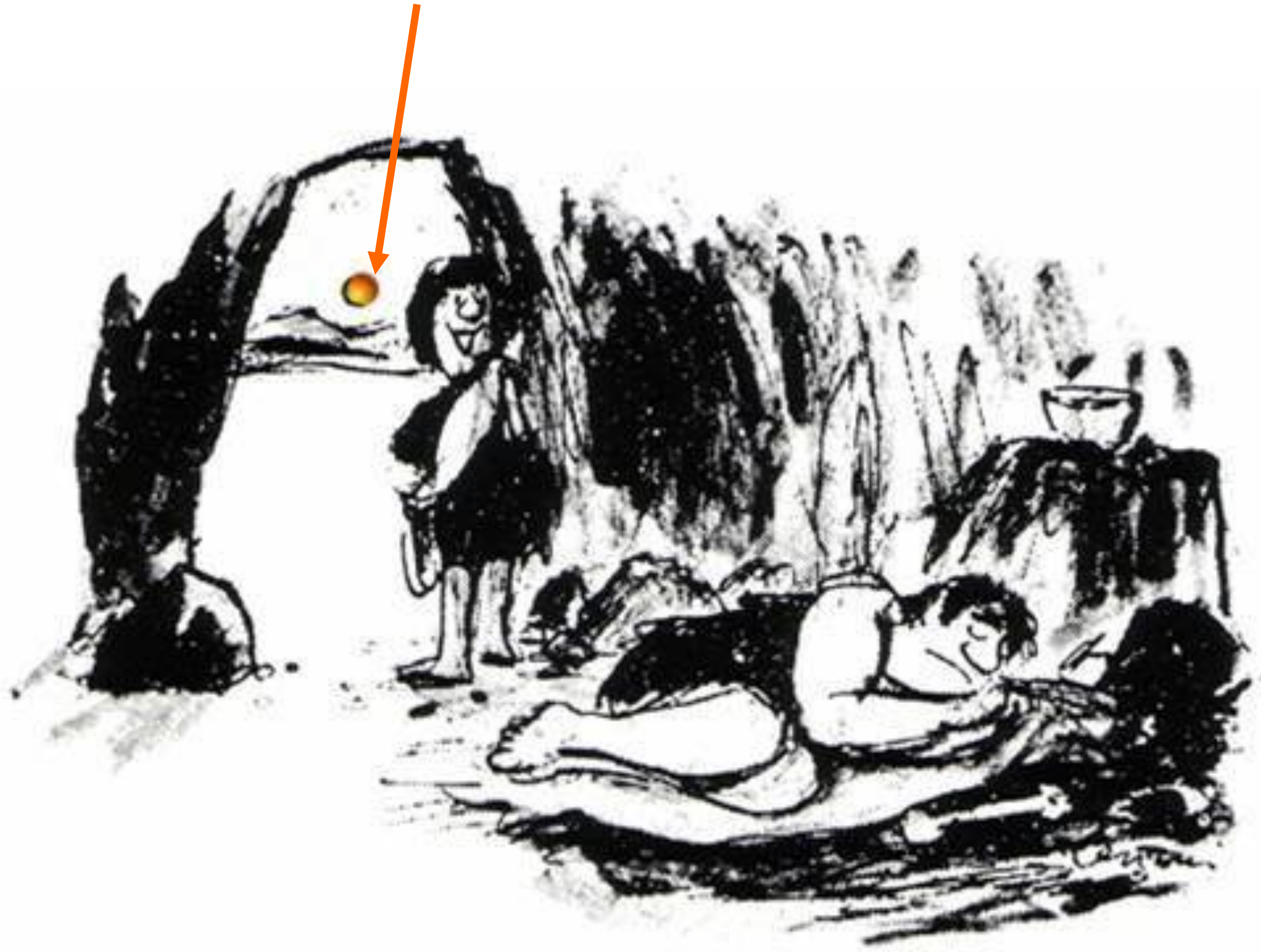


Magnetic control of Pickering drops
(Dept. of Physics, NTNU)



NTNU

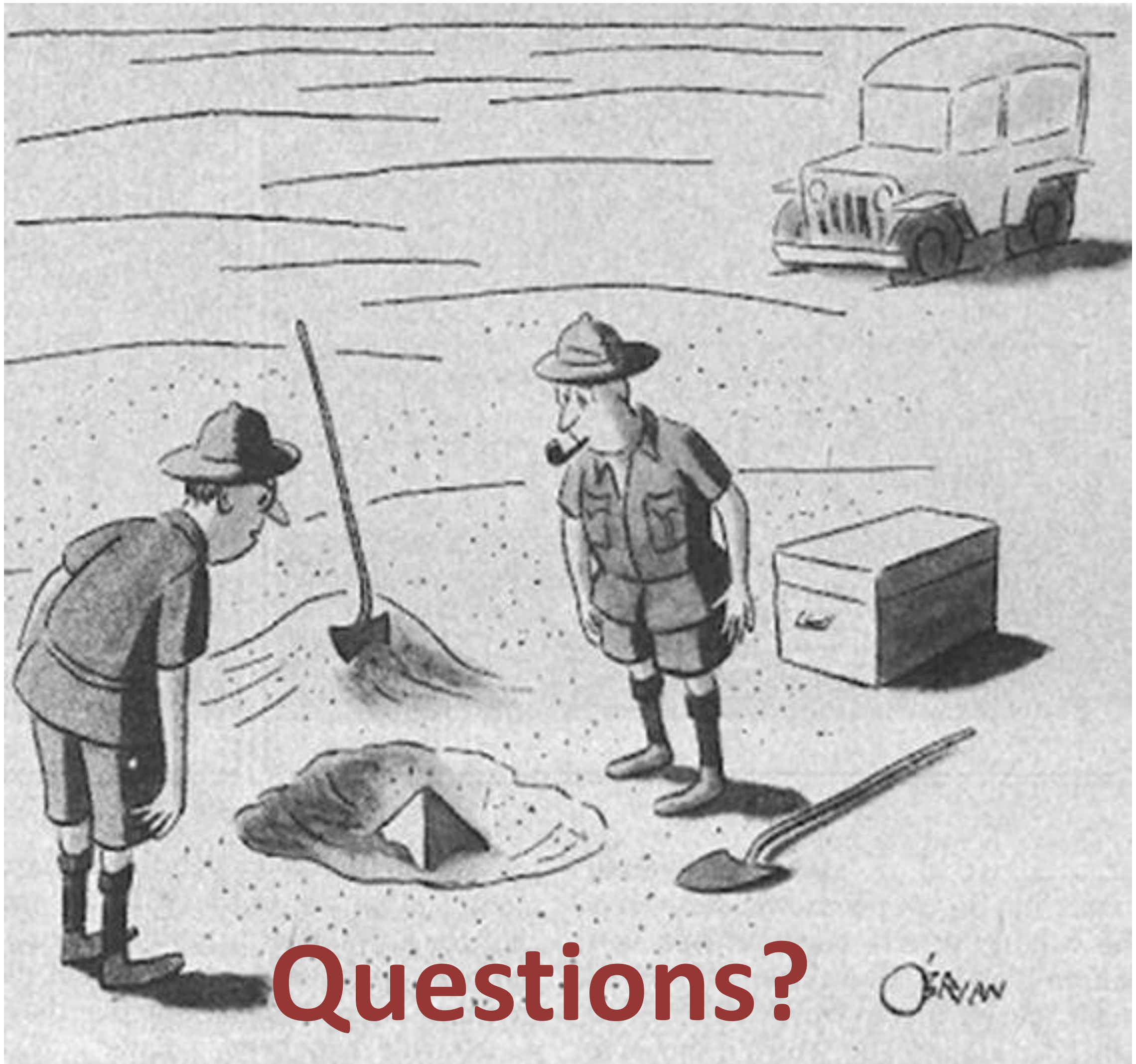
Curiosity driven research



«HEY, SÀM, THE BIG ROUND YELLOW THING CAME UP AGAIN»


LET ME THROUGH, I'M A PHYSICIST!
complex

Thank you for your attention!



"This could be the discovery of the century. Depending, of course, on how far down it goes."