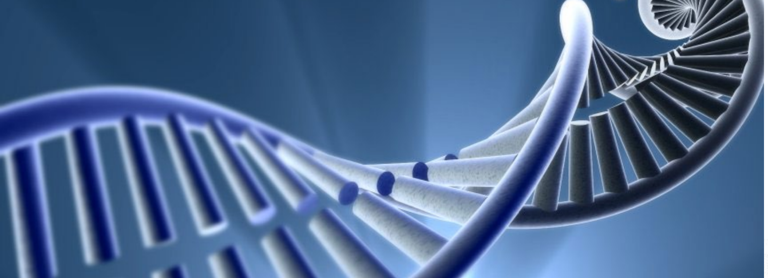
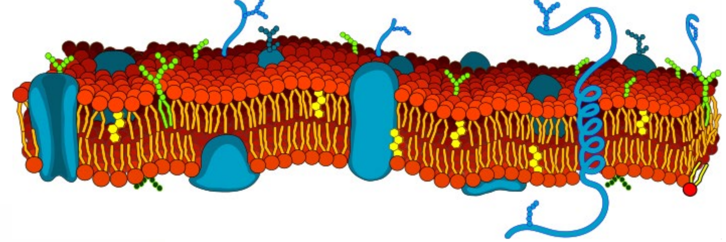
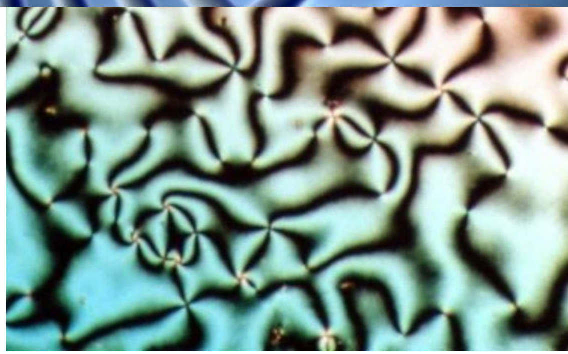
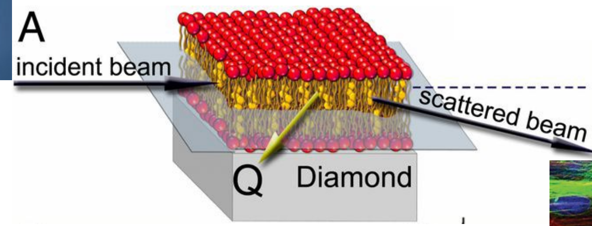
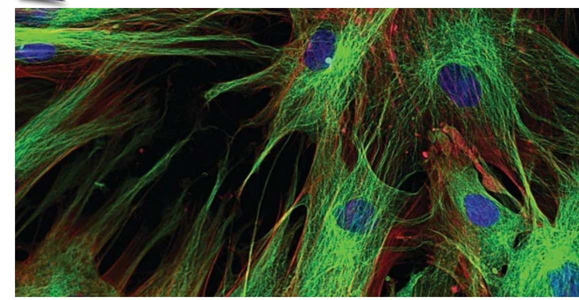










Seminar
Soft Matter und Biophysik
Matthias Schneider, Jan Kierfeld

Vorbesprechung: Do., 27.10., 10Uhr, Raum P1-O2-323

→ moodle https://moodle.tu-dortmund.de/course/view.php?id=38362

Themen

- •Fluorescence Microscopy of Living Materials
- •Mechanical Properties of Cells and Proteins
- •Cell Deformation under Flow – High Throuput
- •X-Rays for Membranes
- •Microfluidics

- •Nobelpreis 2018: Optische Pinzetten
- •Nobelpreis 2014: Superauflösende Mikroskopie

- •harte Kugeln, Kolloide, …
- •Proteinfaltung
- •Vesikel: Formen und Formübergänge
- •Schäume
- •Polymere: Aktin und Mikrotubuli
- •Viren: Struktur, SIR-Modelle …
- •Flüssigkristalle
- •molekulare Motoren
- •Theorie der Quasikristalle

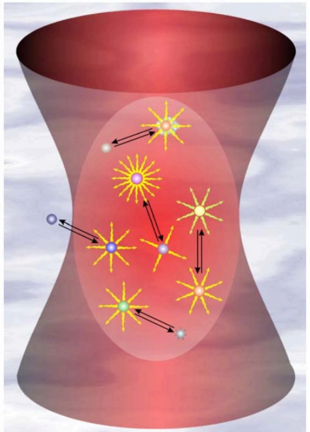
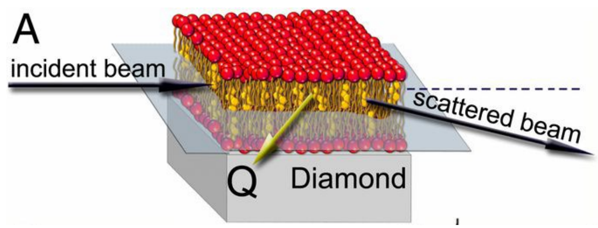
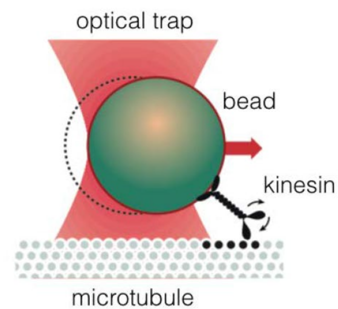
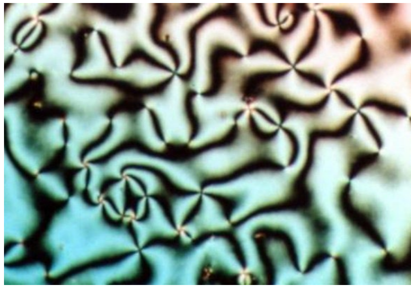
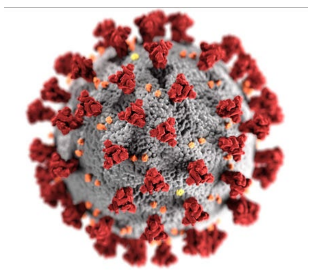


Figure 1: Molecular mechanisms that might give rise to florescence fluctuations comprise particle movements, conformational changes, chemical or photophysical reactions.

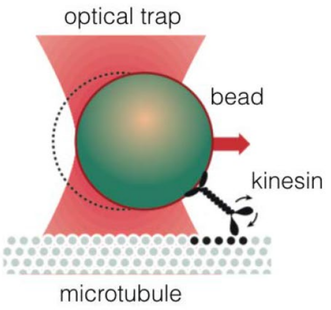








Theorieteil



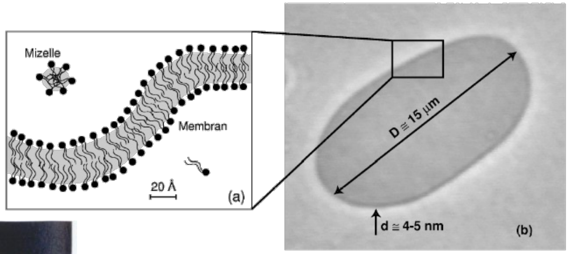
Proteine

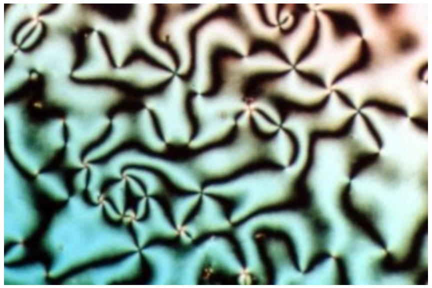
- Proteinfaltung: Grundlegende theoretische Modelle
- Simulation von Proteinen
  (→ Kraftspektroskopie)
- molekulare Motoren
  (→ optische Pinzette)
- Polymere: Aktin und Mikrotubuli

Kristallisation, Self-Assembly

- Statistische Physik harter Kugeln
- Flüssigkristalle
- Schäume
- Viren
- Vesikel
  (→ Lipid-Membranen)
- Quasikristalle

- Aktive Teilchen, Mikroschwimmer
  (→ Mikrofluidik)





Proteine

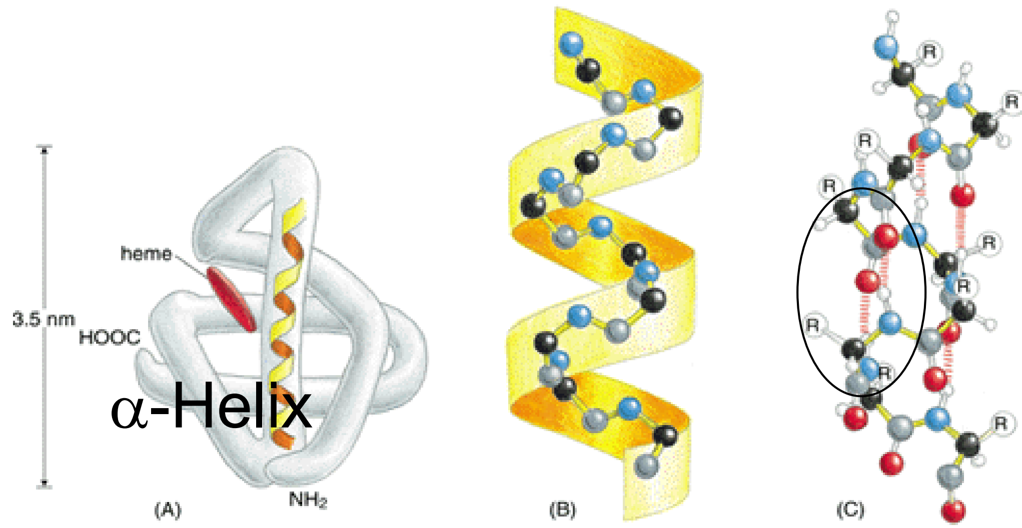
Polypeptid, 20 Aminosäuren

komplizierte
Strukturbildung durch schwache WW.
(H-Brücken oder hydrophober Effekt)

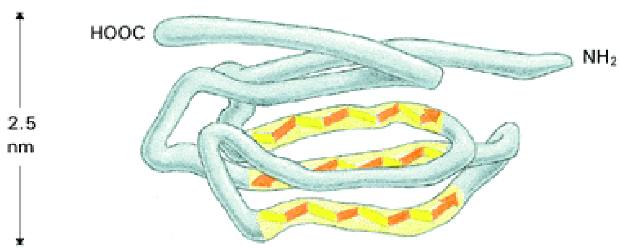
<u>Beispiele:</u>
Sekundärstrukturen
durch H-Brücken stabilisert:
α-helix, β-sheet

Proteinstrukturen

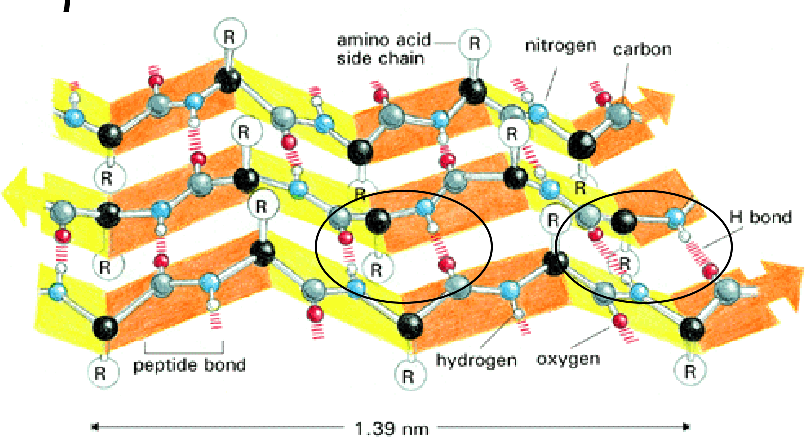
Sekundärstrukturen
α-Helix, β-Faltblatt
durch H-Brücken



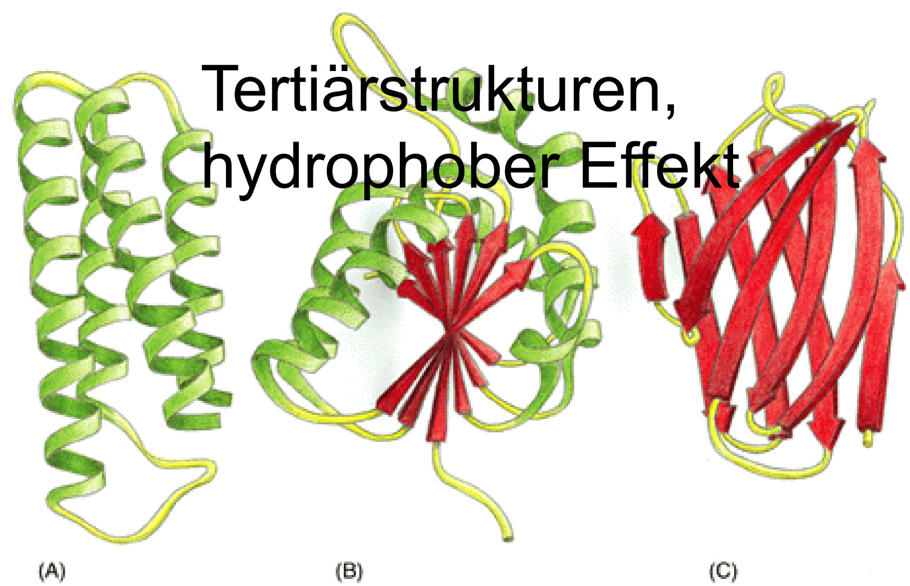
α-Helix



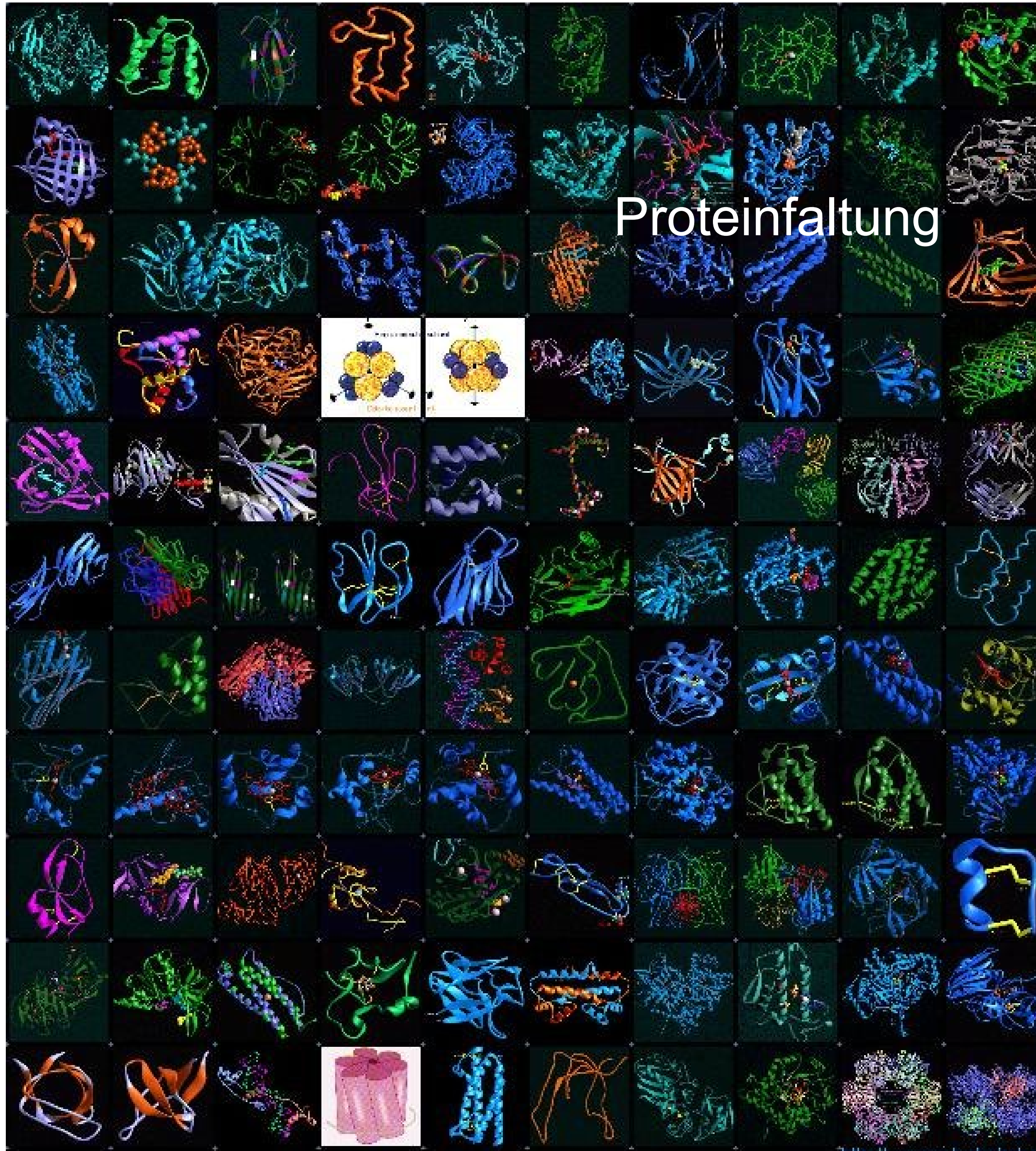
β-sheet



Tertiärstrukturen,
hydrophober Effekt



richtige Faltung
entscheidend
für biologische
Funktion
→Struktur-
bestimmung
mit Hilfe von
Röntgensstreuung

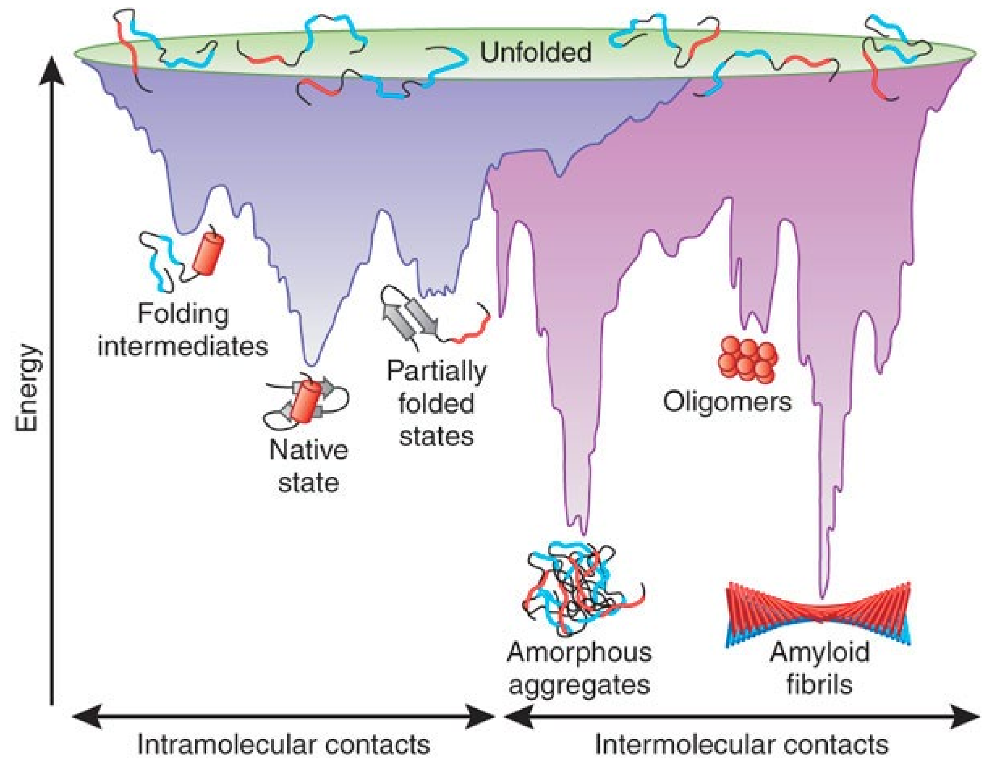


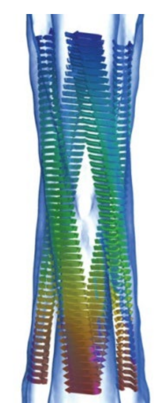
Proteine

•Levinthal-Paradox
•hydrophober Effekt

einfache Modelle:
HP-Modell
Go-Modell
Tube-Modell

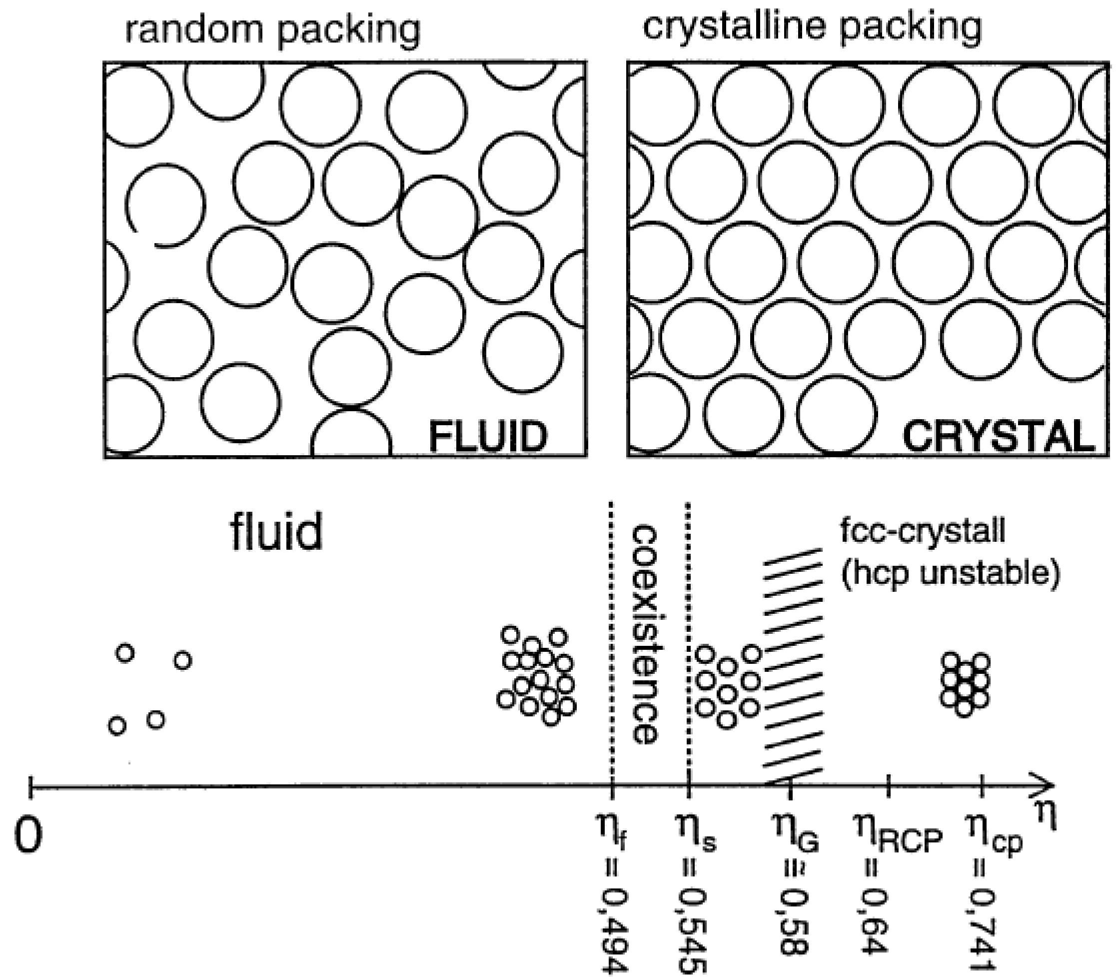
Protein-Aggregation:
•Krankheiten
kinetische Modelle,
•aber auch Wachstum von
Protein-Fäden (Aktin, Mikrotubuli)
im Zellskelett





Kristallisation

Kristallisation **ohne** Wechselwirkungsenergie:
harte Kugeln



rein entropisch,
Phasendiagramm,
Theorie,
Experimente,

KT-Übergang in 2D,
…..

Nobelpreis 2016,
Kosterlitz,
Thouless

Nobelpreis Physik 2016

2D Schmelzen (Dislokationen, Disklinationen)
→KTNHY-Theorie
→Schmelzen kolloidaler 2D Kristalle

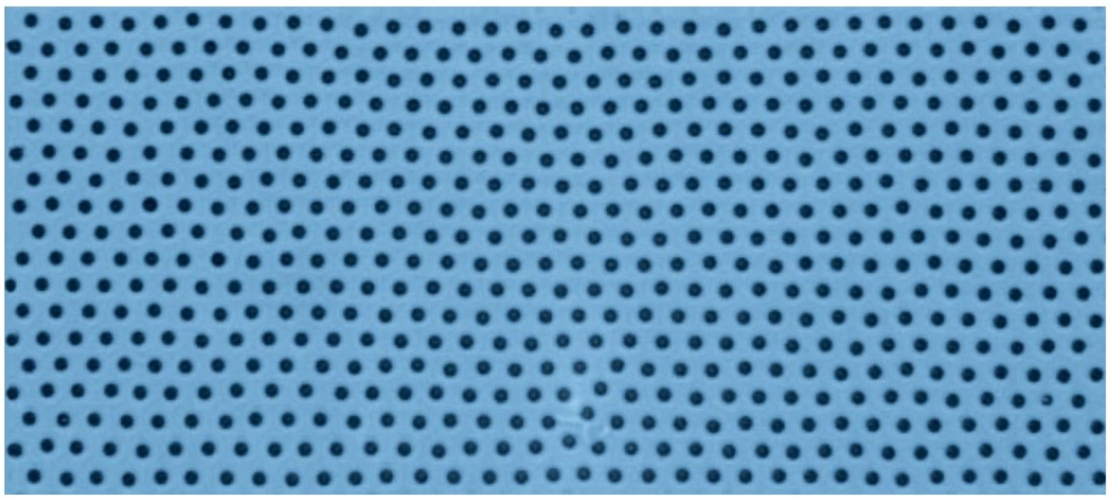
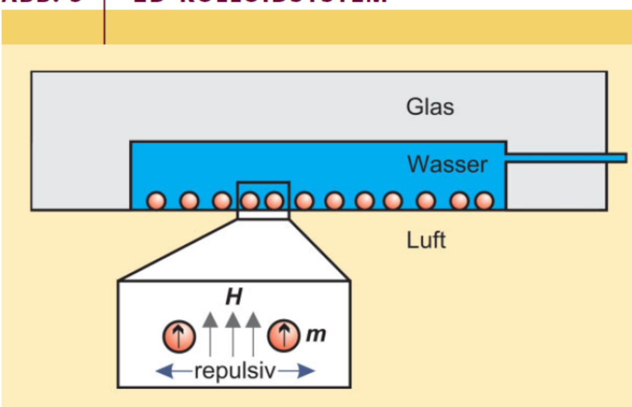


Abb. 2 *Mikroskopische Aufnahme eines zweidimensionalen Kolloidkristalls mit hexagonaler Symmetrie. Der Ausschnitt misst 500 × 190 µm², die Kolloidteilchen sind jeweils 4,5 µm groß.*

ABB. 5 | 2D-KOLLOIDSYSTEM



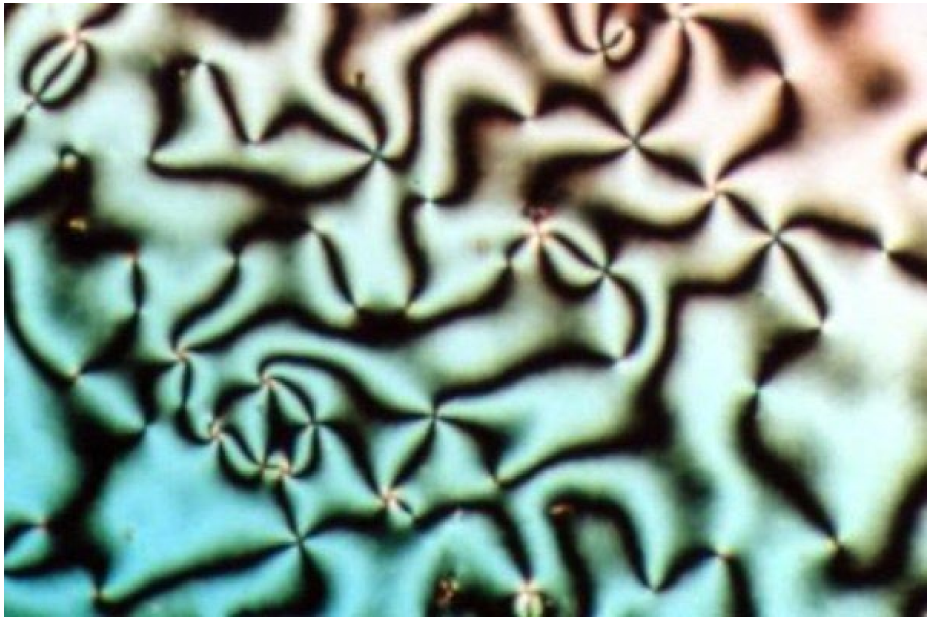
Schematische Darstellung: Die Kolloide sind an die Wasser-Luft-Grenzfläche sedimentiert. Ein äußeres Magnetfeld H induziert magnetische Momente m in den Kolloiden, was hier zu einer abstoßenden Wechselwirkung führt.

Phasenübergänge durch topologische Defekte: Das Schmelzen zweidimensionaler Kristalle
URS GASSER | GEORG MARET | PETER KEIM, Physik in Unserer Zeit 2008

Flüssigkristalle

ebenfalls rein entropisch,
harte Stäbchen

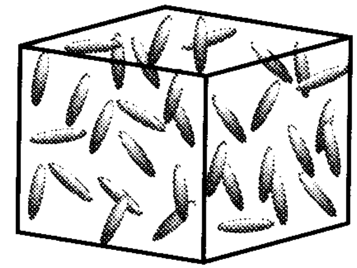
stäbchenförmige Moleküle
→Positionsordnung und Orientierungsordnung



neue Phasen
zwischen
fest und flüssig

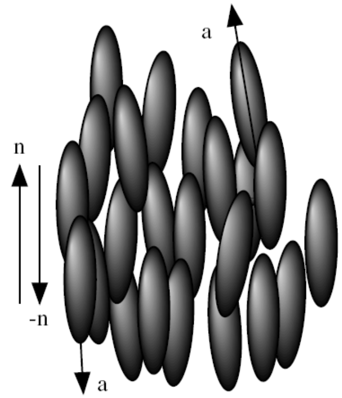
nematische Phase
polarisiertes Licht

Flüssigkrista

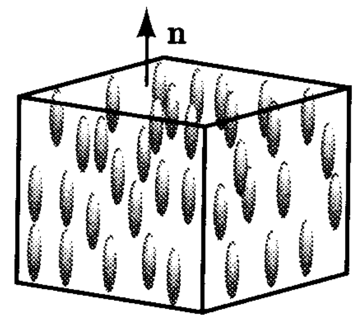


(a)

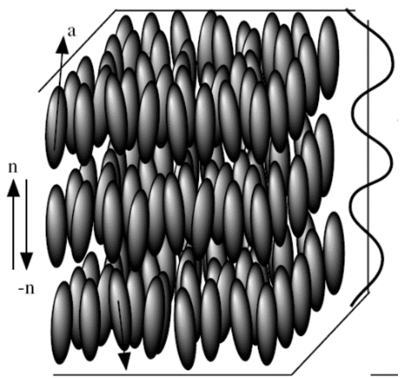
isotrop



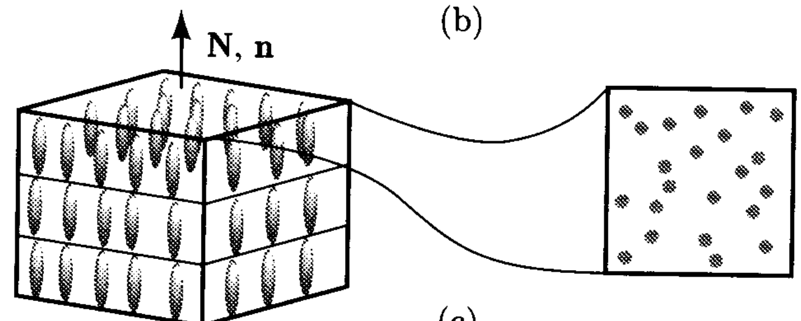
nematisch



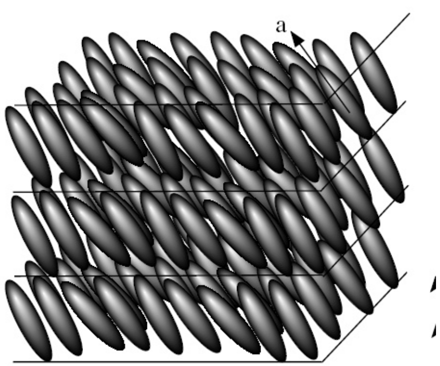
(b)



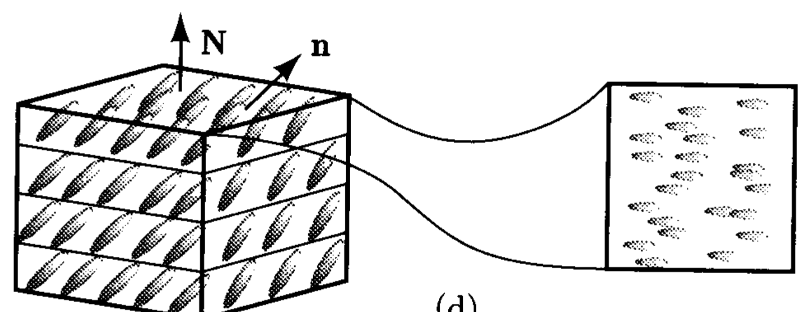
smektisch A



(c)

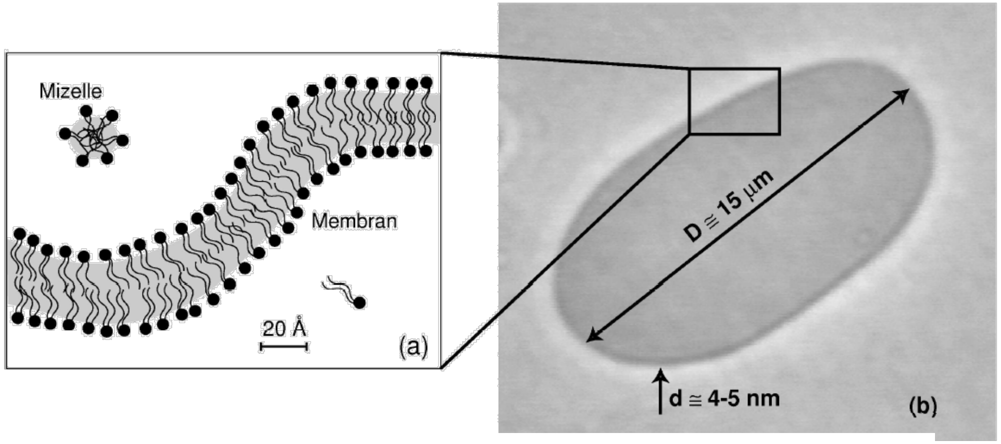


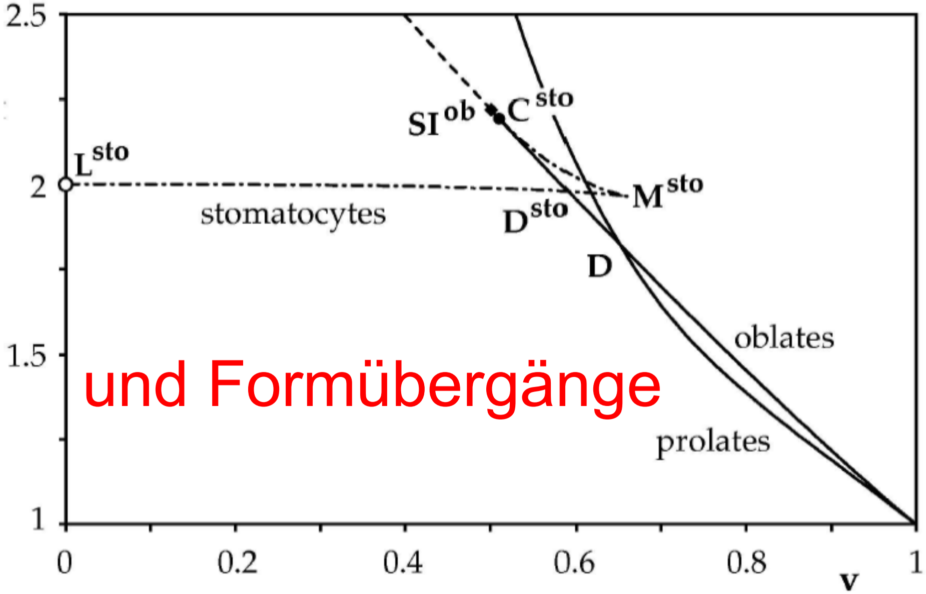
smektisch C



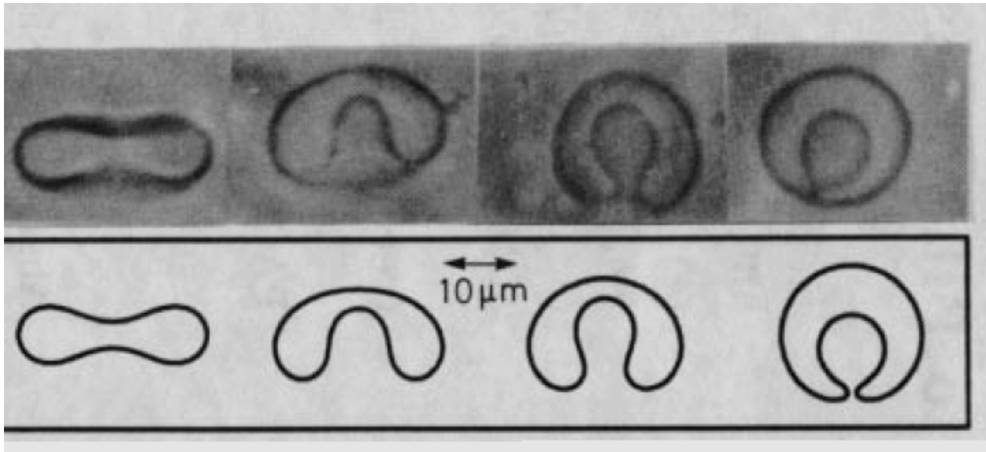
(d)

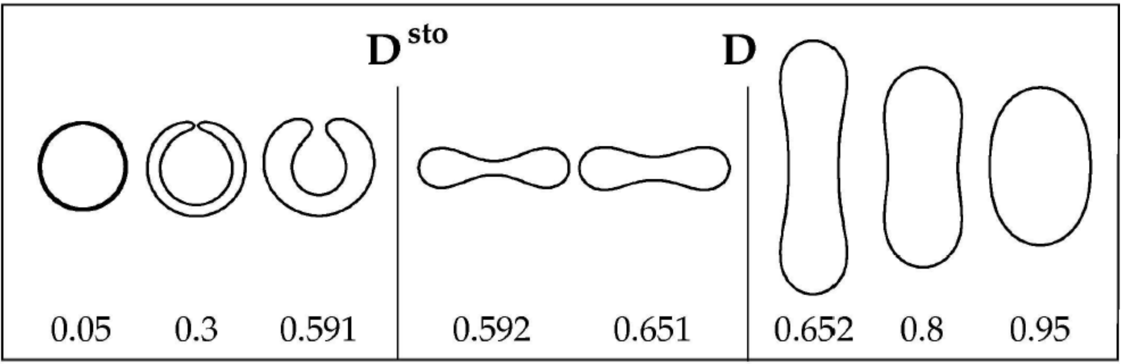
Vesikel-formen





und Formübergänge





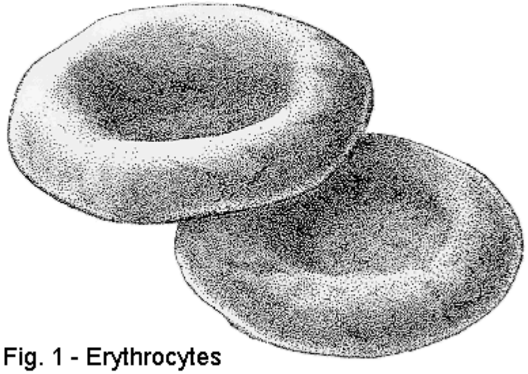
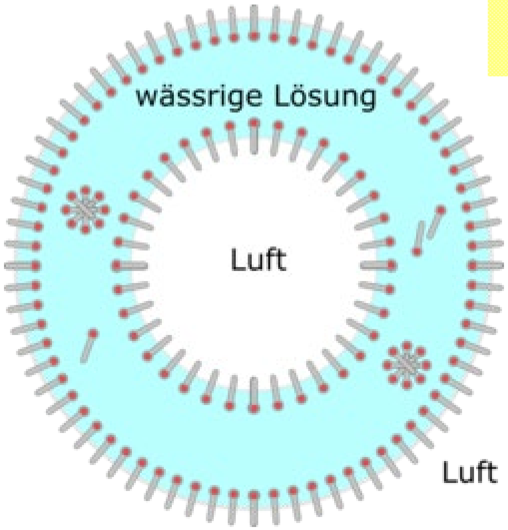


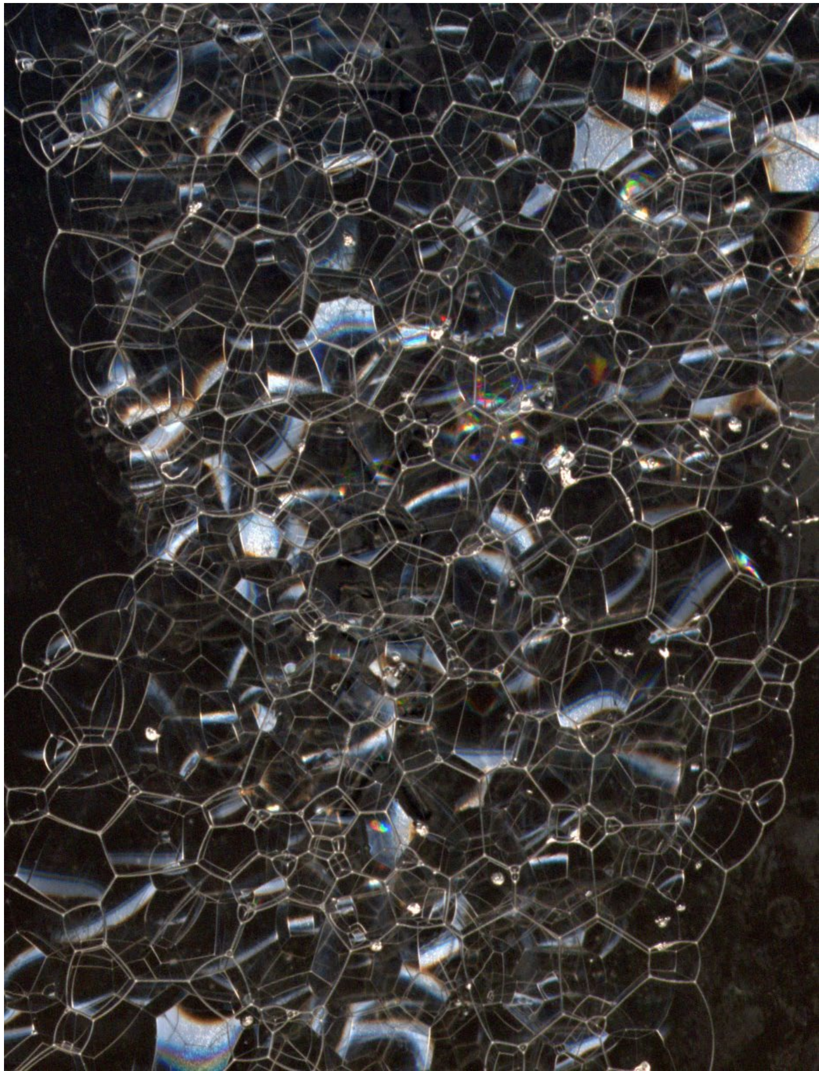
Fig. 1 - Erythrocytes

Schäume

→jede Schaumzelle ist eine Fläche konstanter mittl. Krümmung (CMC)

$$-H = \frac{\Delta p}{\sigma} = \mathrm{const}$$

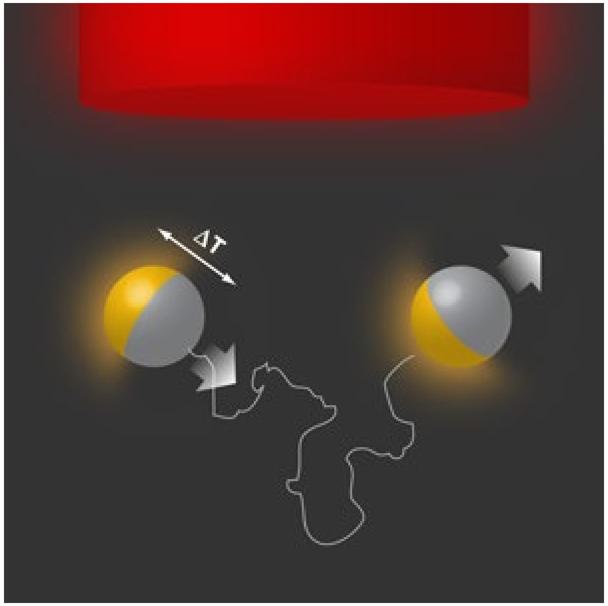


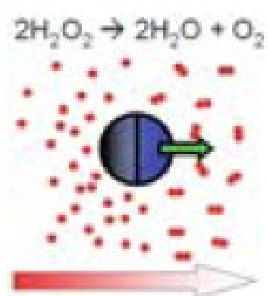


Plateau-Regeln, „Schaumgesetze", …..

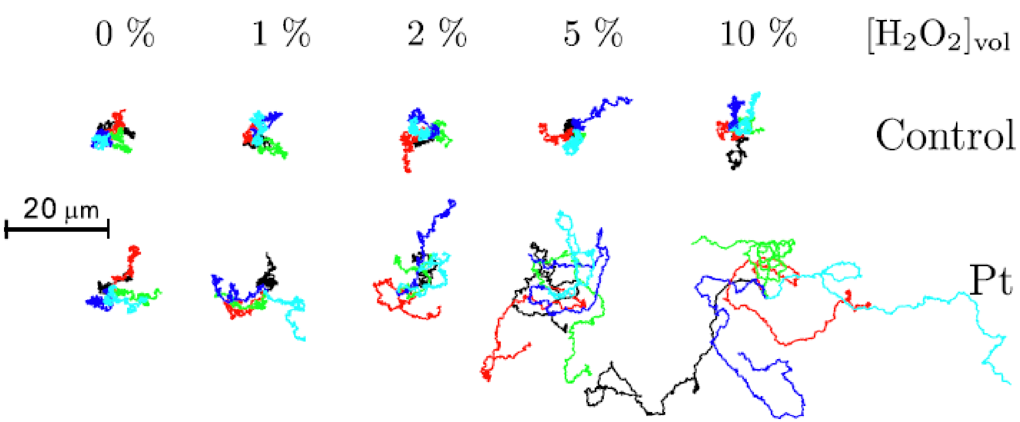
Aktive Teilchen

Chemisch oder
von Thermophorese
angetriebene Teilchen

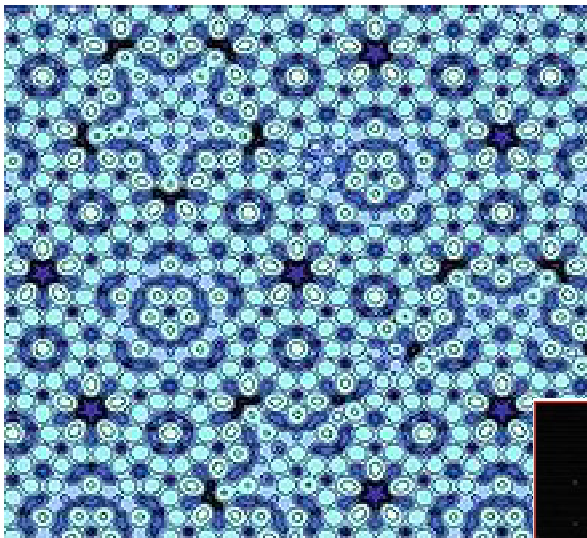




“künstliche
Schwimmer”:
Antriebs-
mechanismen,
Hydrodynamik,
….

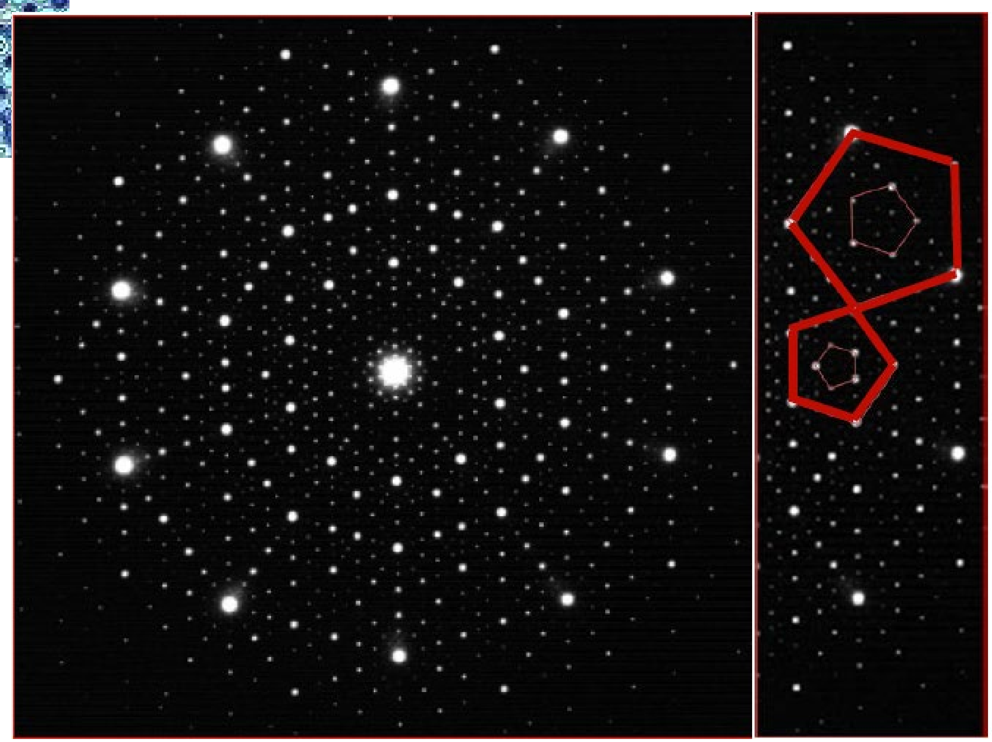


Quasikristalle

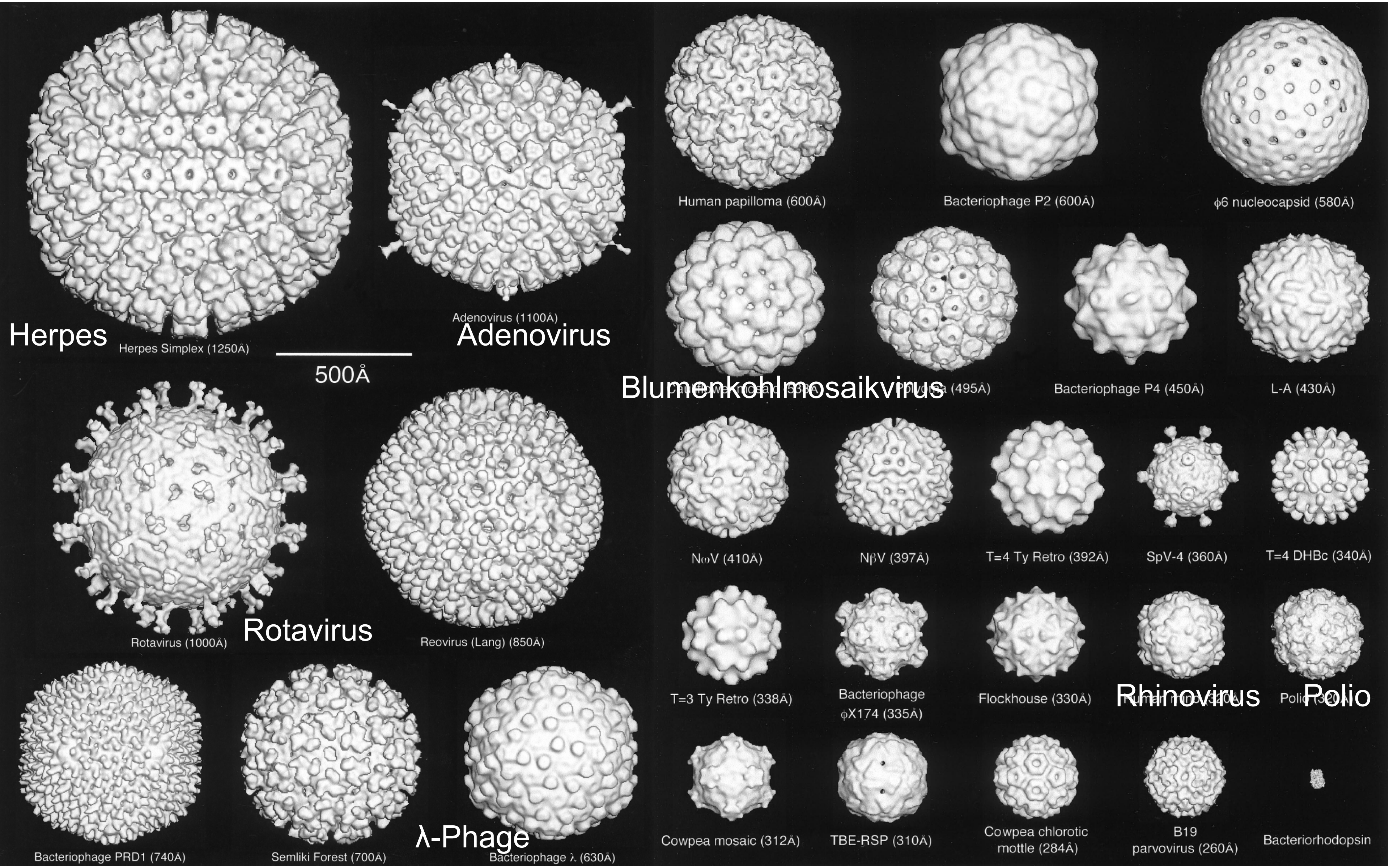


Nobelpreis 2011,
Dan Shechtman

raumfüllend,
geordnet,
aber nicht periodisch



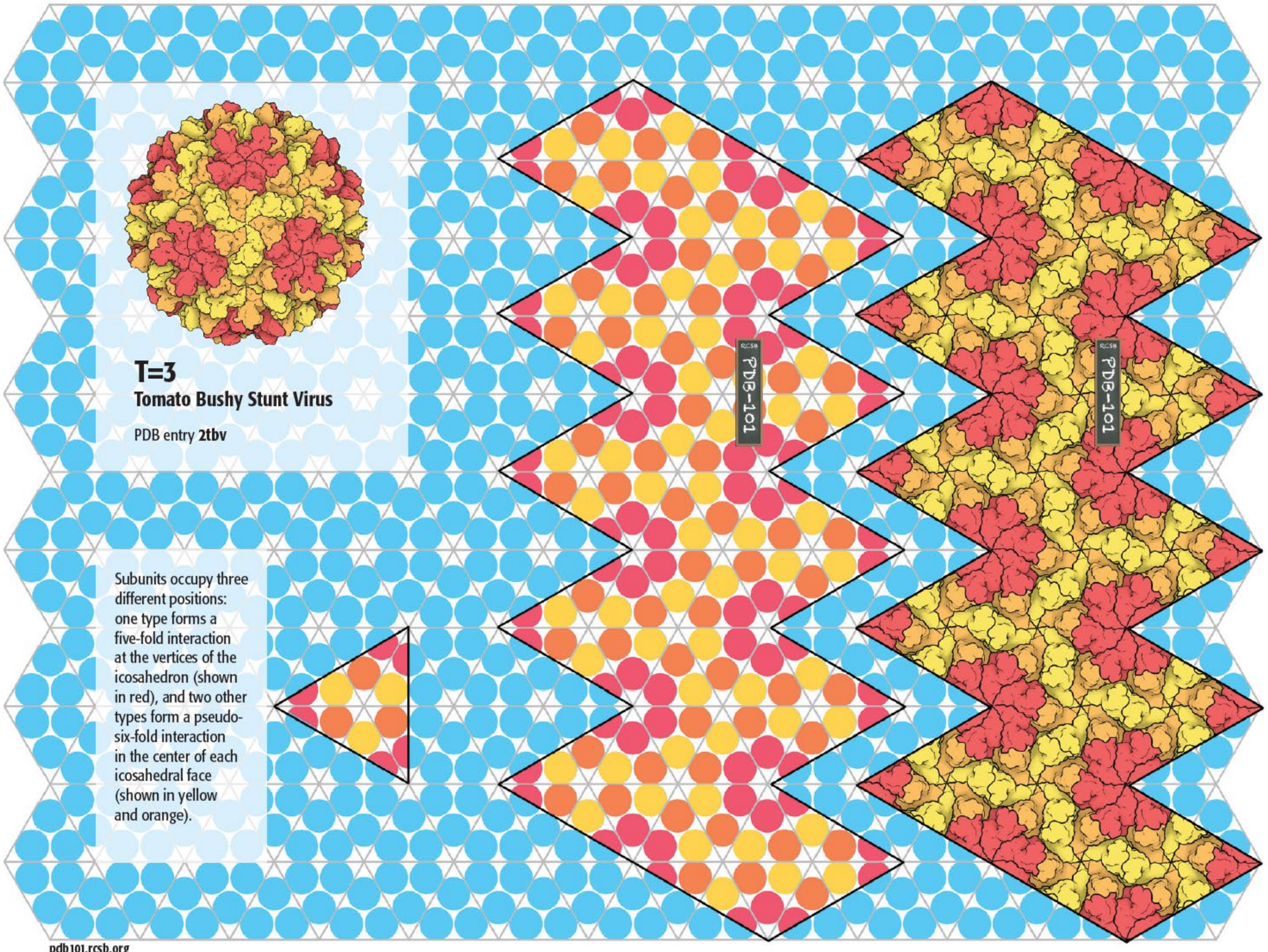
Viren

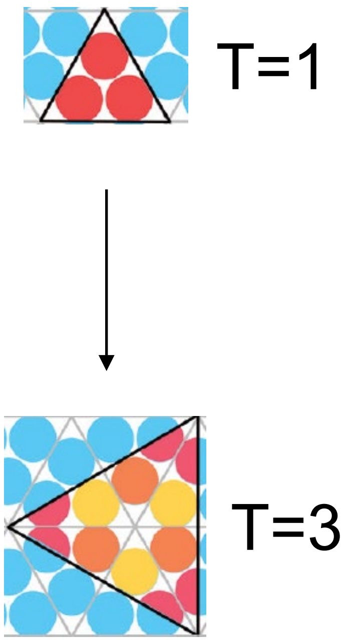


[Baker, Olson, Fuller, Microbiol. Mol. Biol. Rev., 1999]

Viren

wie baut man eine Kugel aus quasi-identischen Protein-Bausteinen?

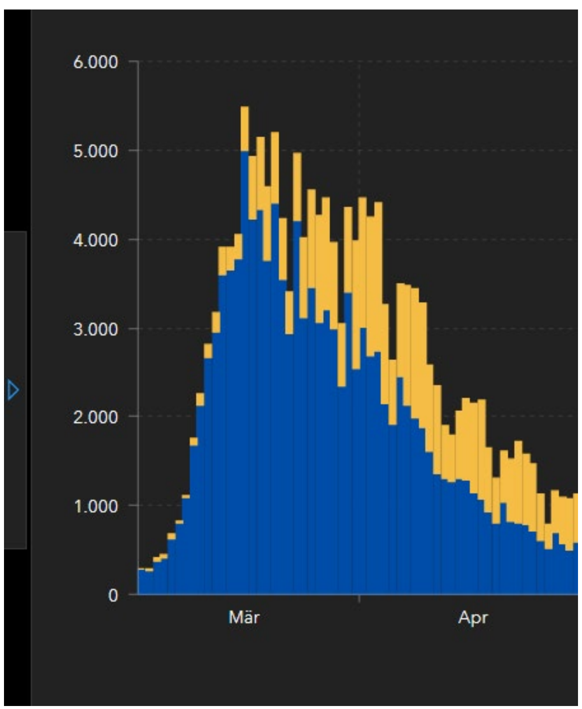


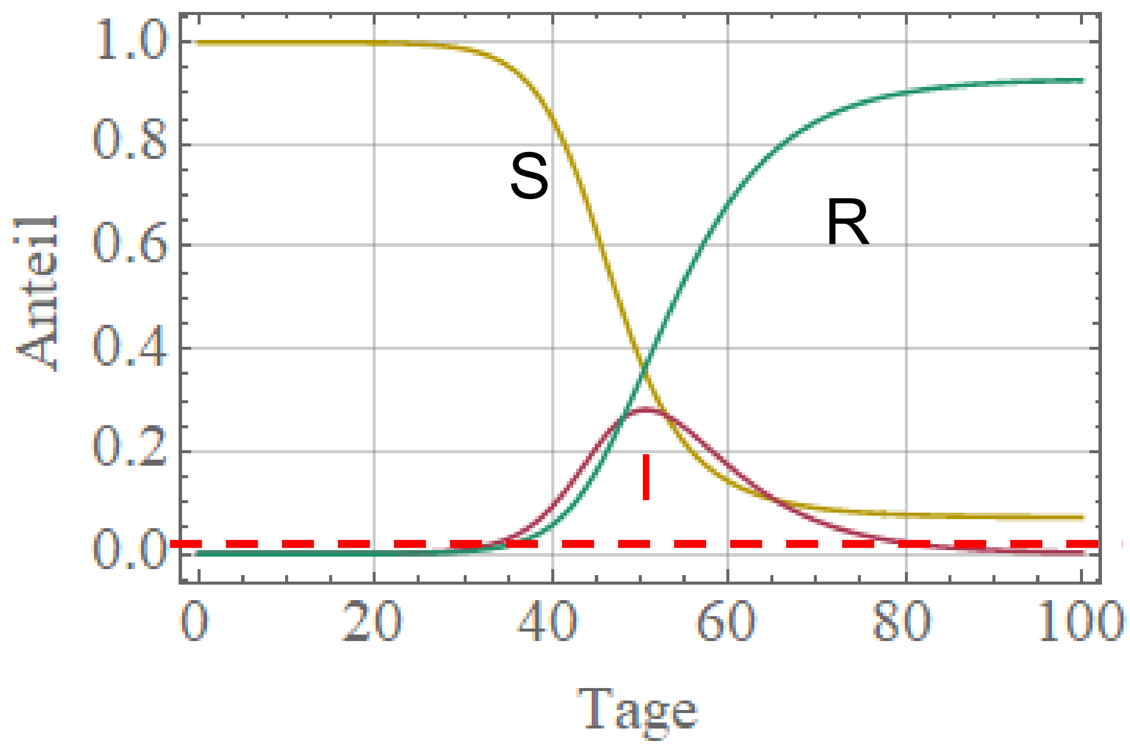


180 identische Einheiten

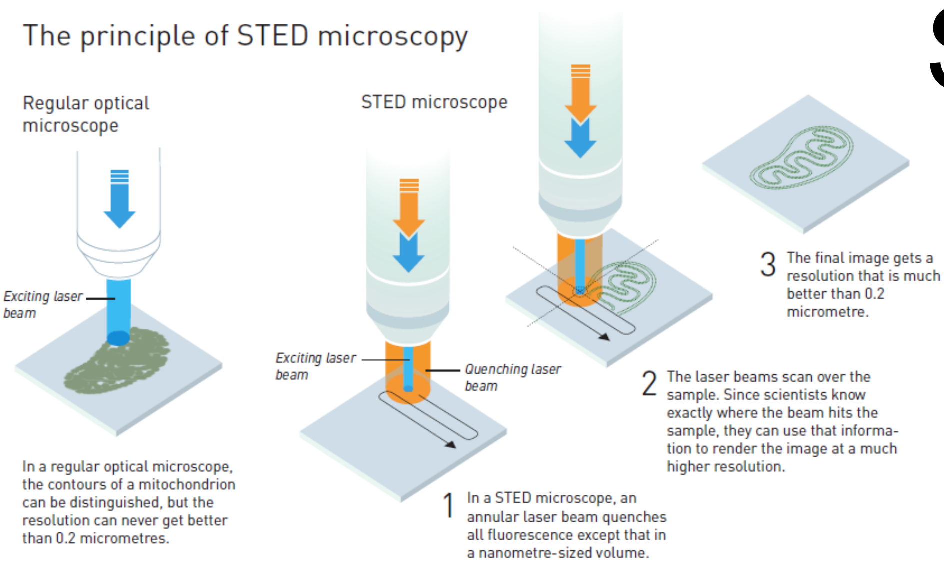
SIR-Modell


Susceptible
βSI
Infectious
γI
Recovered

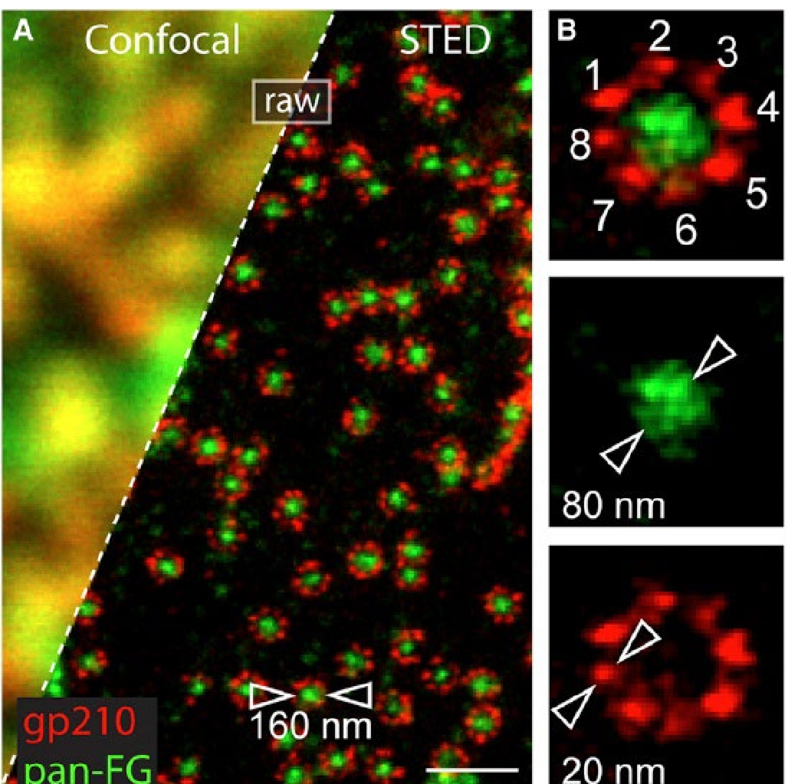

6.000
5.000
4.000
3.000
2.000
1.000
0
Mär
Apr

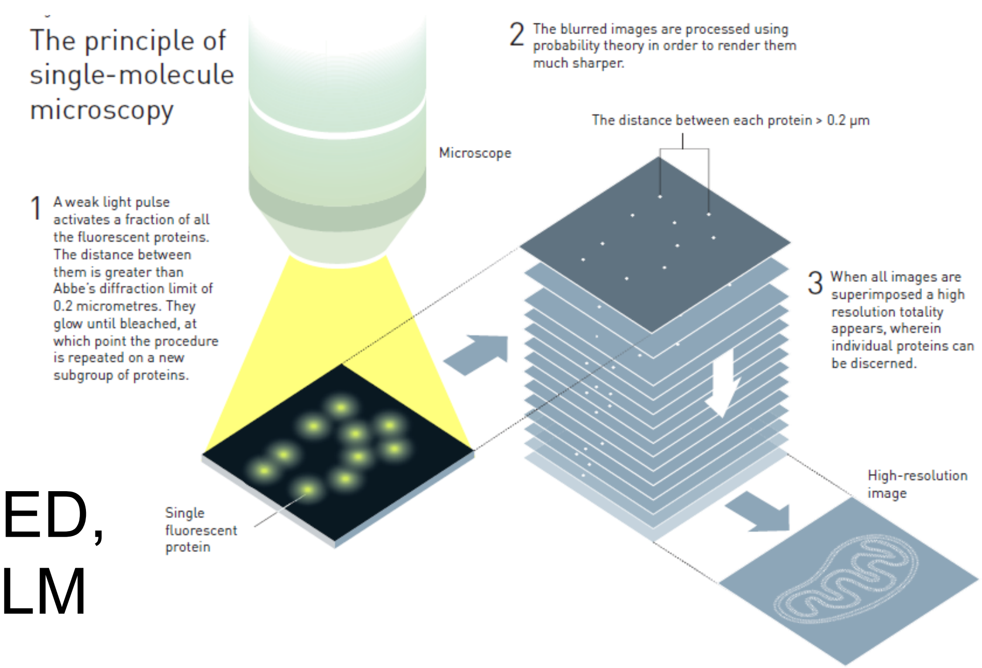

1.0
0.8
0.6
0.4
0.2
0.0
Anteil
S
R
0
20
40
60
80
100
Tage

Superauflösende Mikroskopie



Nobelpreis 2014,
Hell,
Betzig, Moerner





STED,
PALM

Nobelpreis Physik 2018

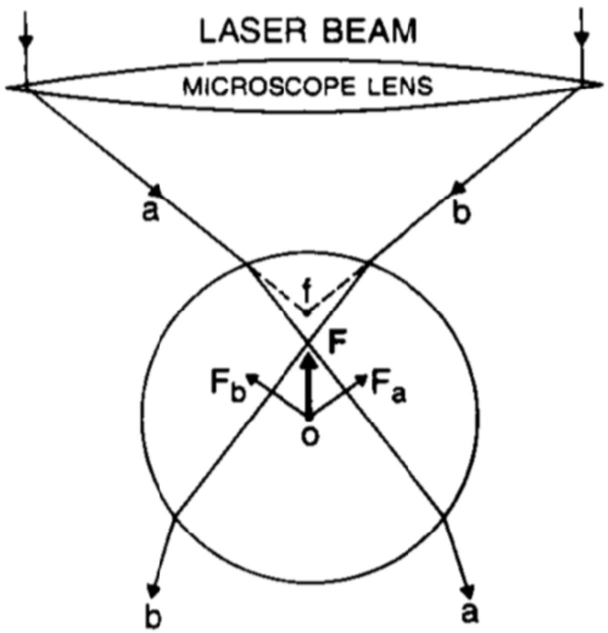
Arthur Ashkin
1/2

Gerard Mourou
1/4

Donna Strickland
1/4

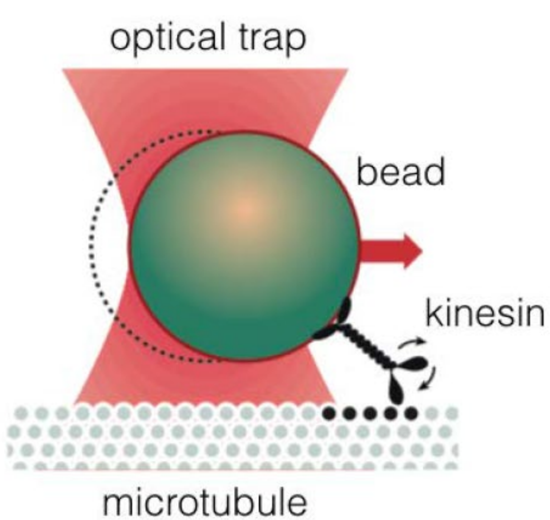
"for groundbreaking inventions in the field of laser physics" with one half to Arthur Ashkin "for the optical tweezers and their application to biological systems", the other half jointly to Gérard Mourou and Donna Strickland "for their method of generating high-intensity, ultra-short optical pulses."

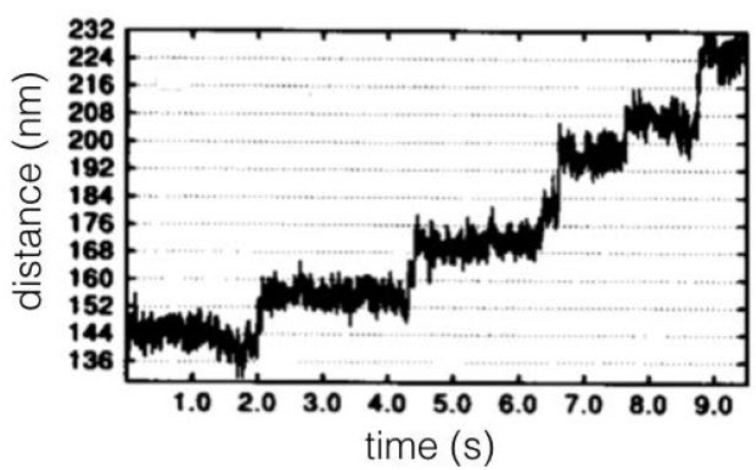
Nobelpreis Physik 2018



Funktionsweise:
Strahlenoptik,
Wellenoptik

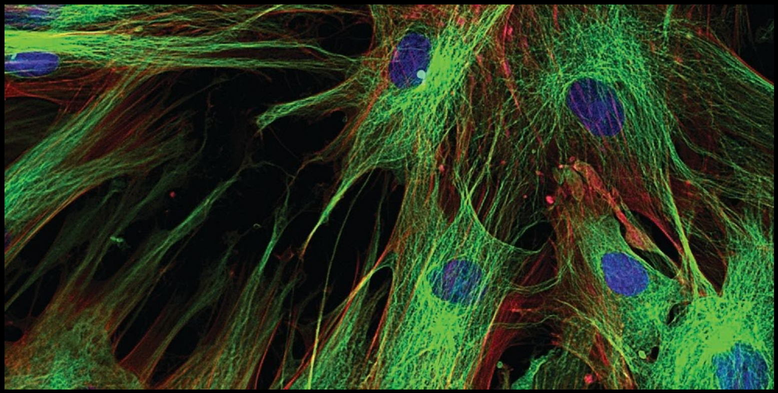
Anwendungen:
Molekulare Motoren,
Einzelpolymerexperimente, ….





Themen zu experimentellen Methoden

1. Fluorescence Microscopy of Living Materials



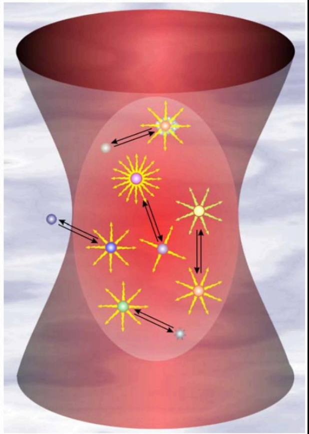
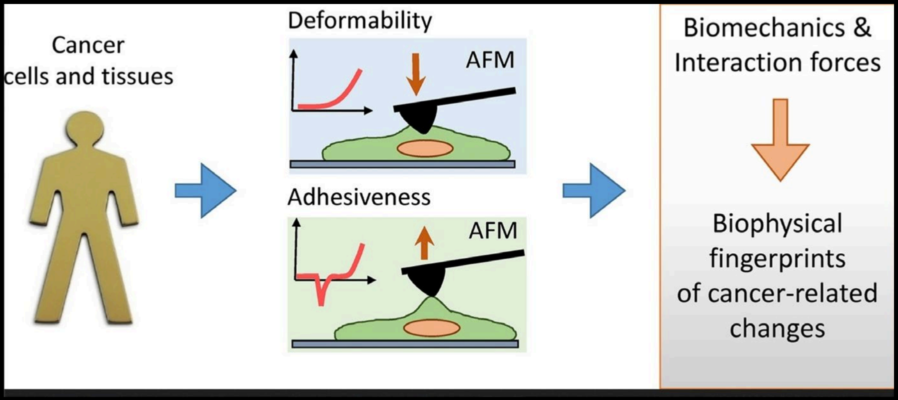


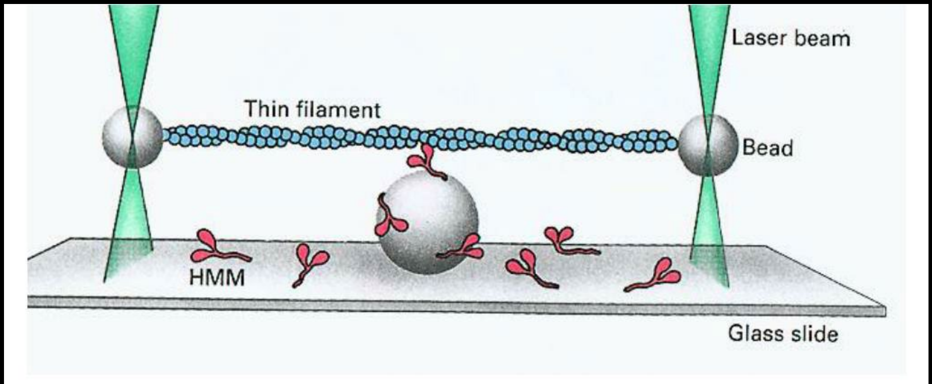
Figure 1: Molecular mechanisms that might give rise to florescence fluctuations comprise particle movements, conformational changes, chemical or photophysical reactions.

Wie kommen solche Bilder eigentlich zustande?
Was sind Ihre limits?

Themen zu experimentellen Methoden

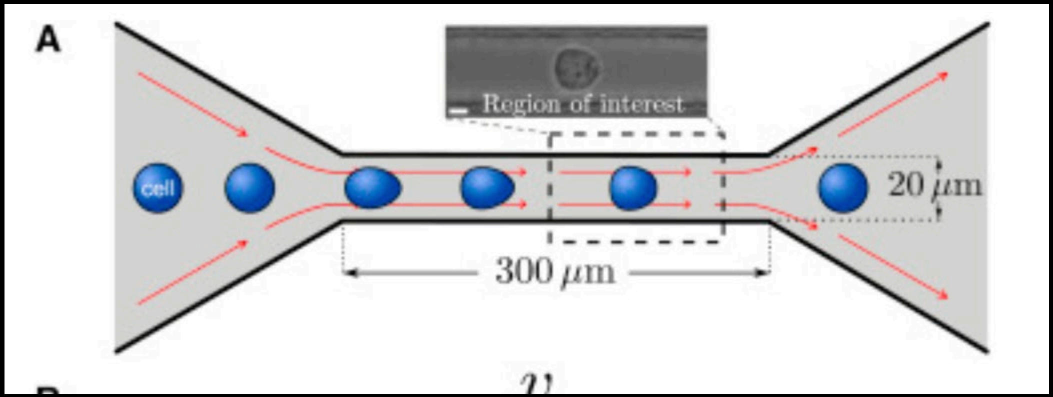
2. Mechanical Properties of Cells and Proteins





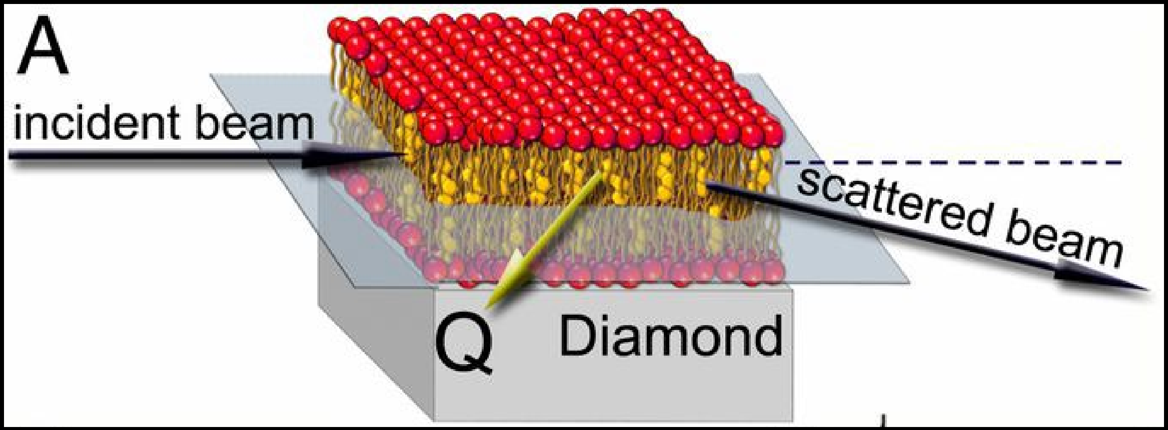
Themen zu experimentellen Methoden

3. Cell deformation under Flow – High Throuput



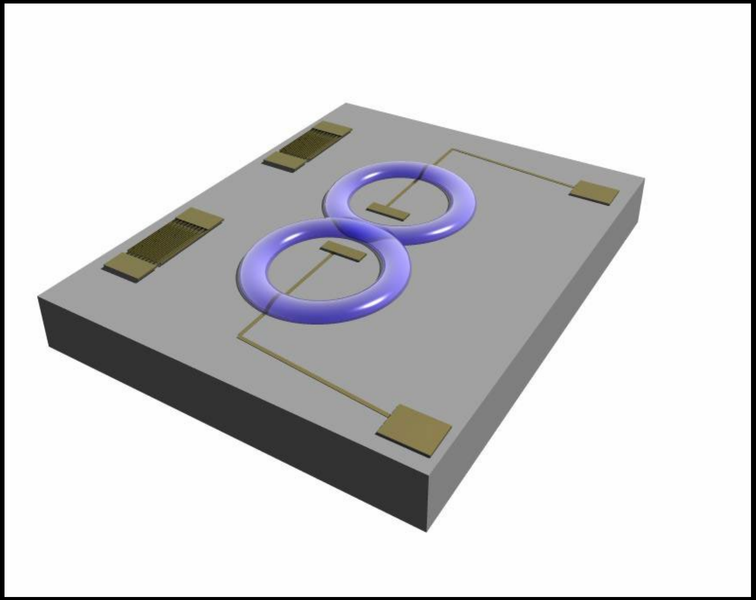
Themen zu experimentellen Methoden

4. X-Rays for Membranes



Themen zu experiemntellen Methoden

5. Microfluidics



Themen

- Fluorescence Microscopy of Living Materials
- Mechanical Properties of Cells and Proteins
- Cell Deformation under Flow – High Throuput
- X-Rays for Membranes
- Microfluidics

- Nobelpreis 2018: Optische Pinzetten
- Nobelpreis 2014: Superauflösende Mikroskopie

- harte Kugeln, Kolloide, …
- Proteinfaltung
- Vesikel: Formen und Formübergänge
- Schäume
- Polymere: Aktin und Mikrotubuli
- Viren: Struktur, SIR-Modelle …
- Flüssigkristalle
- molekulare Motoren
- Theorie der Quasikristalle

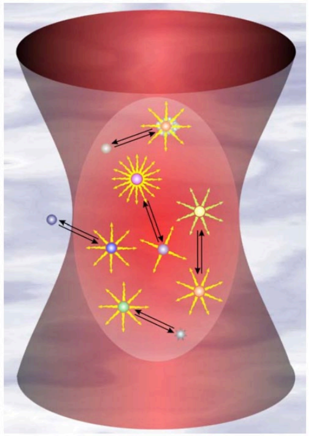
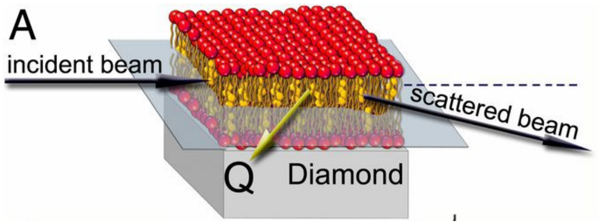
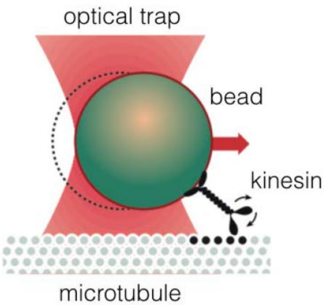
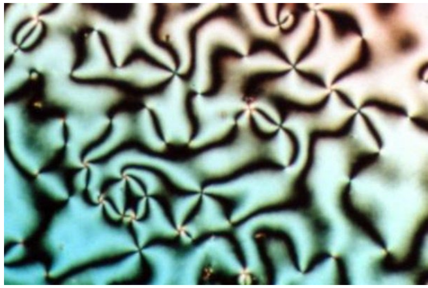
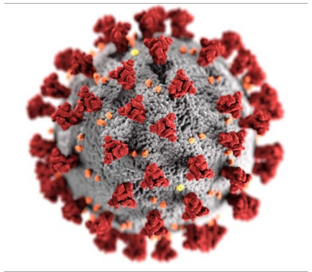


Figure 1: Molecular mechanisms that might give rise to florescence fluctuations comprise particle movements, conformational changes, chemical or photophysical reactions.









Themen/Termine

8.12.:

22.12.:

12.1.:

19.1.:

26.1.:

2.2.: