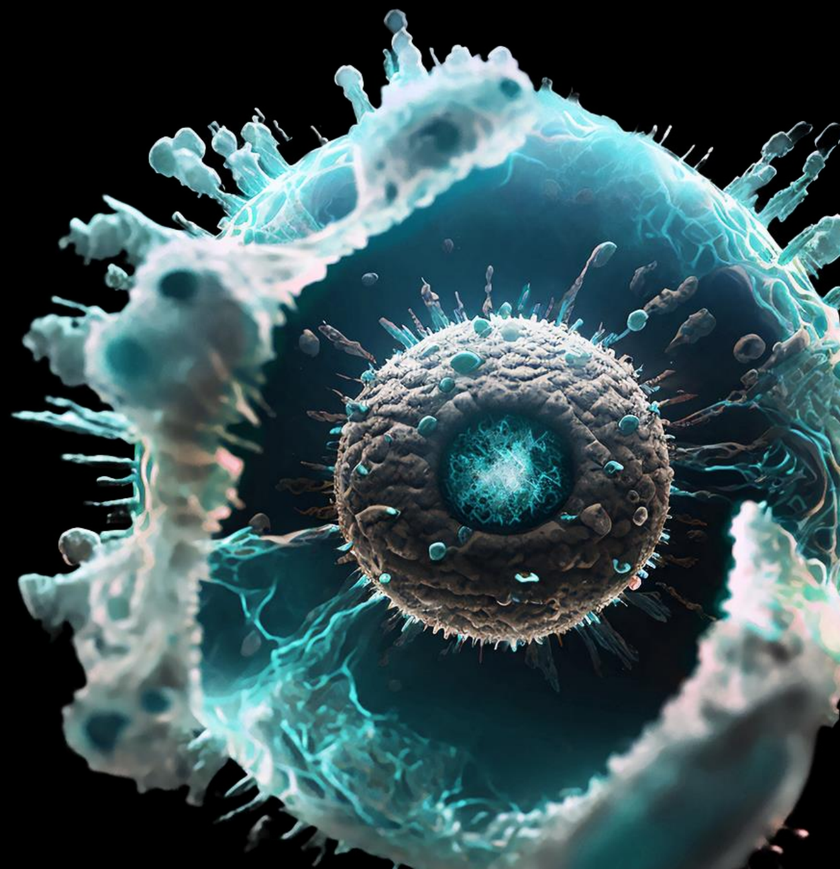
PINT OF SCIENCE FESTIVAL 22.-24. Mai 2023.

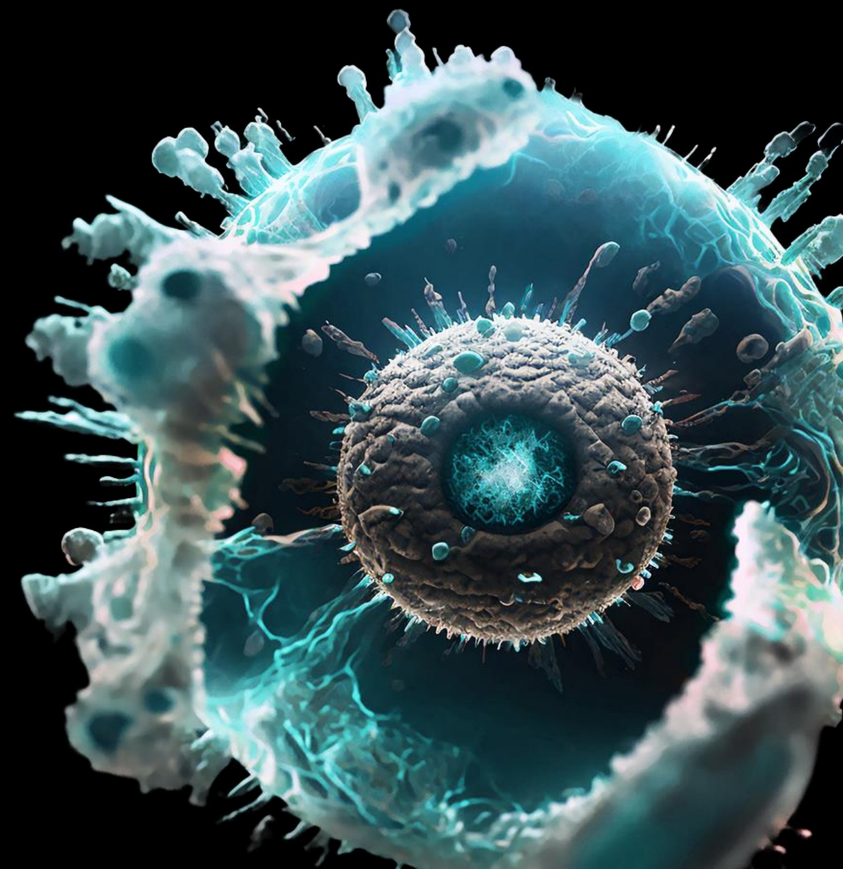
Mit Lichtkraft voraus Traktorstrahlen zur (nano)Partikelanalyse



NANOPAT:

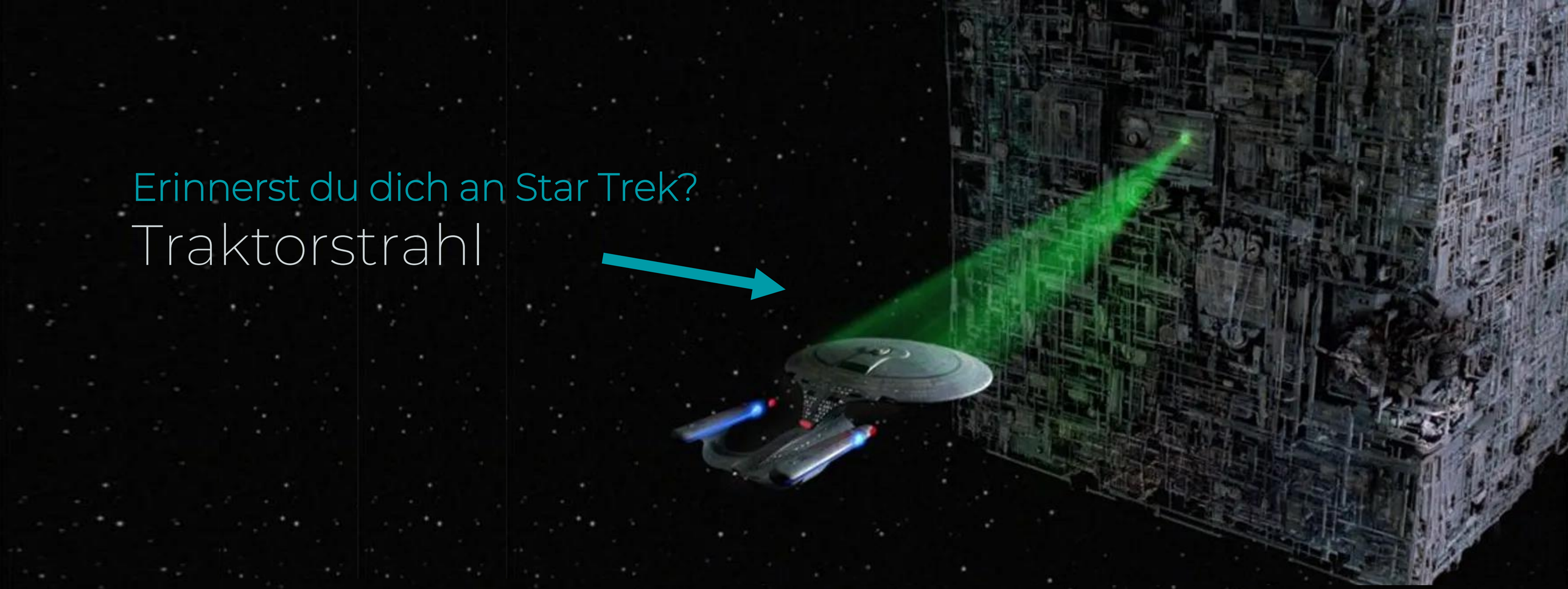
Med Uni Graz

BRAVE®
ANALYTICS



Erinnerst du dich an Star Trek?

Traktorstrahl

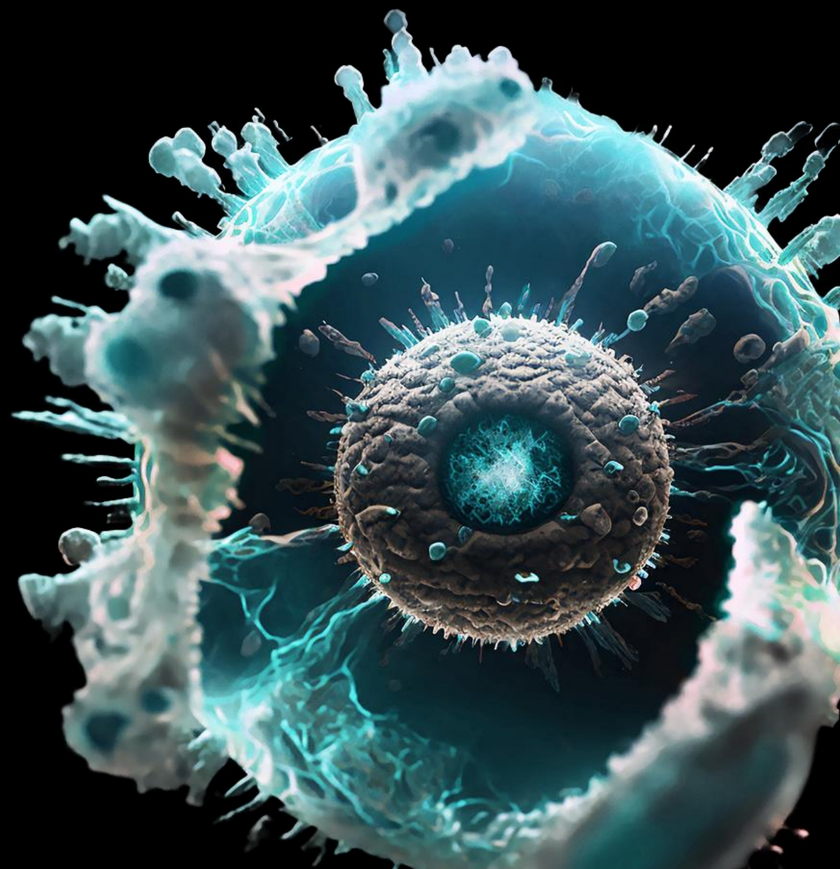


...mit Traktorstrahlen kann man

(nano)Partikeln messen...

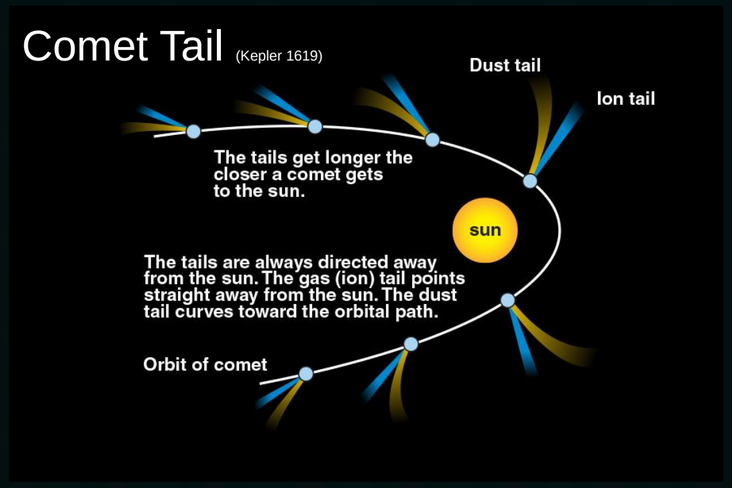
PINT OF SCIENCE FESTIVAL 22.-24. Mai 2023.

Mit Lichtkraft voraus Traktorstrahlen zur (nano)Partikelanalyse

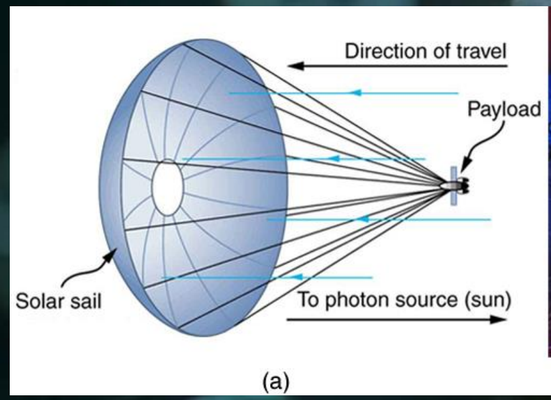


Die Entdeckung der optische Kräfte

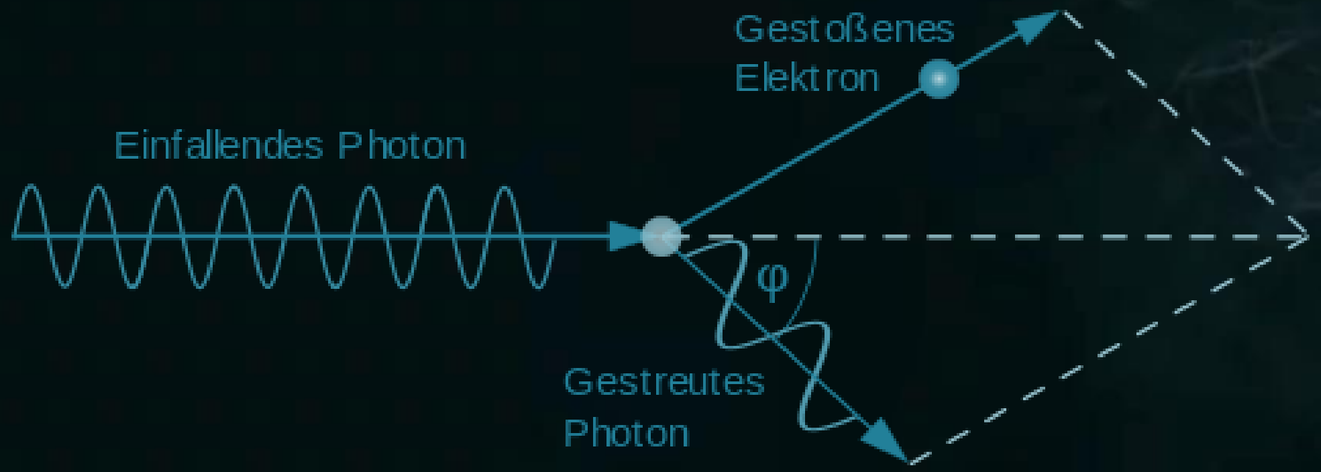
Comet Tail (Kepler 1619)



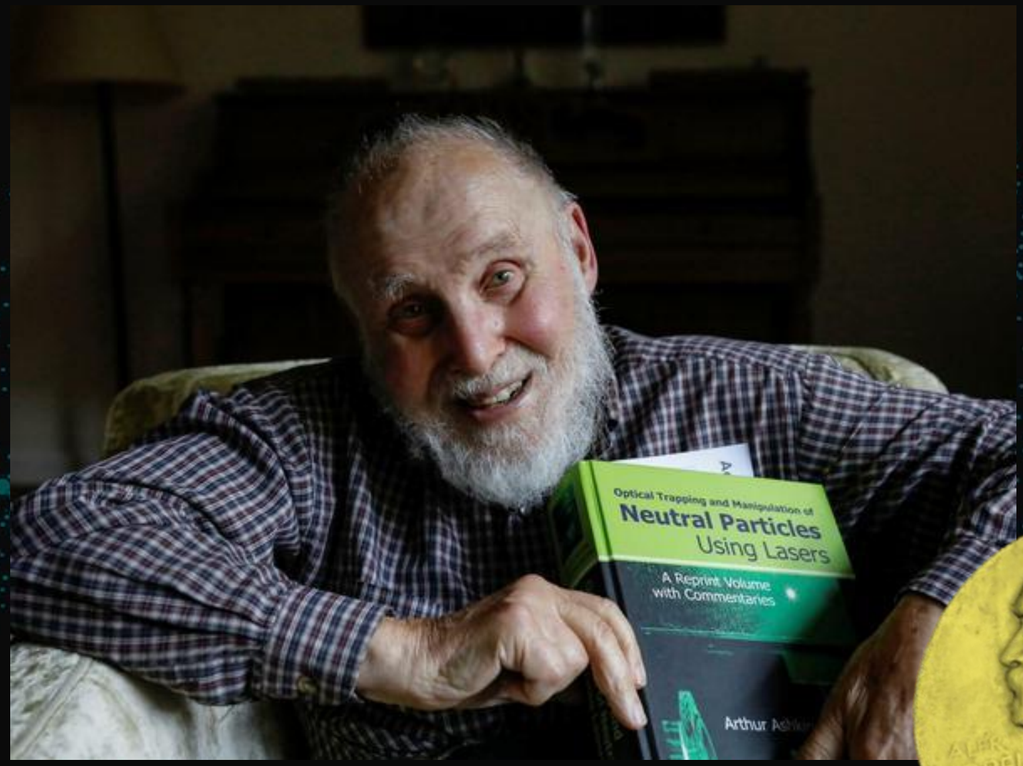
Solar sail (Cosmos1) 2005




(b)



Laserphysics – Optische Kräfte …



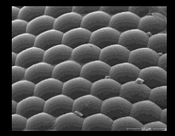
Arthur Ashkin (born September 2, 1922)

NOBEL PRICE 2018 PHYSICS
Ashkin et al.

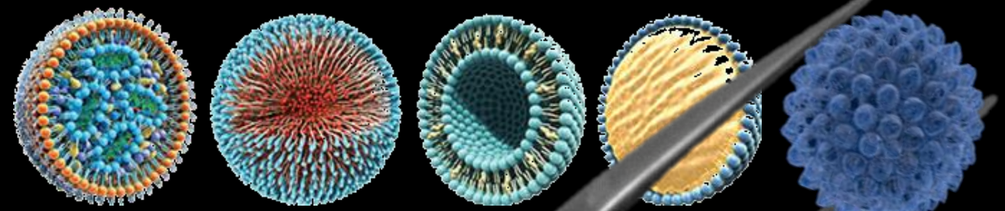
Optische Pinzetten: Größenbereich

1 cm

1 mm

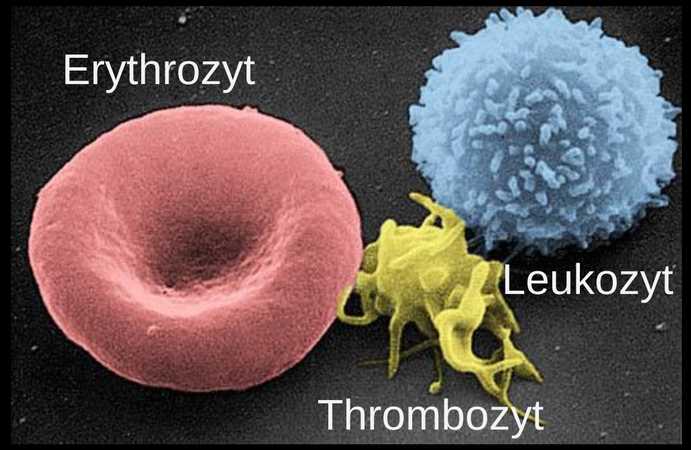


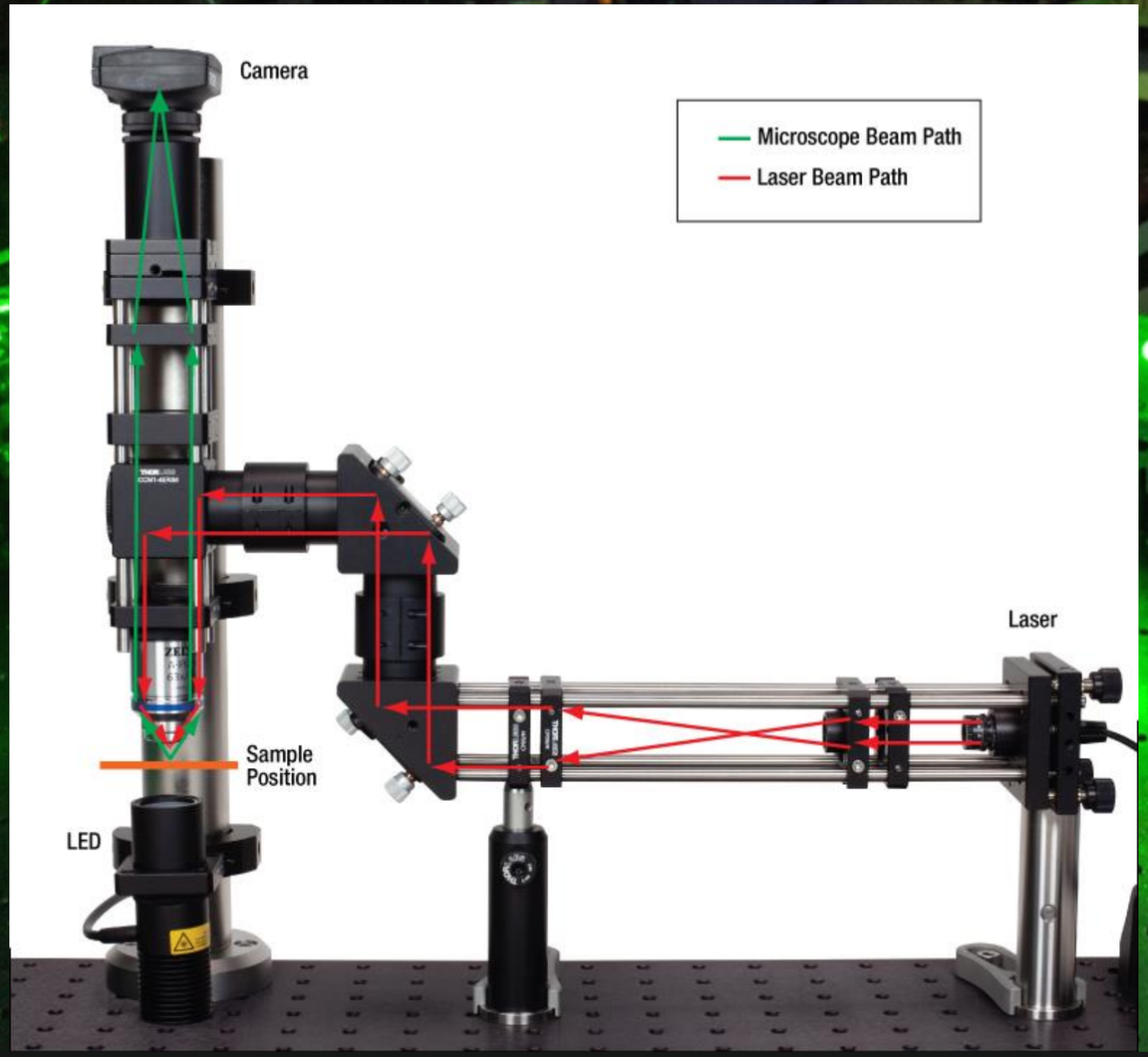
1-5 µm



2-1000 nm

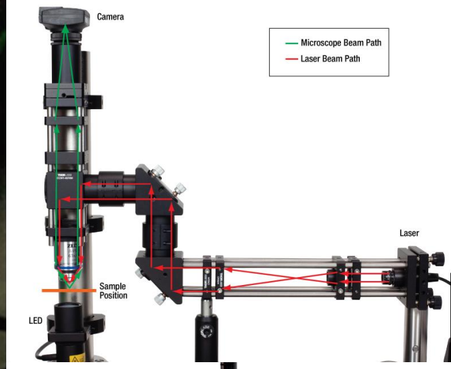
"Diese Technologie hat völlig neue Möglichkeiten geschaffen, die Maschinerie des Lebens zu beobachten…", so die Begründung der Königlich-Schwedischen Akademie der Wissenschaften.





Optical Tweezer Setup

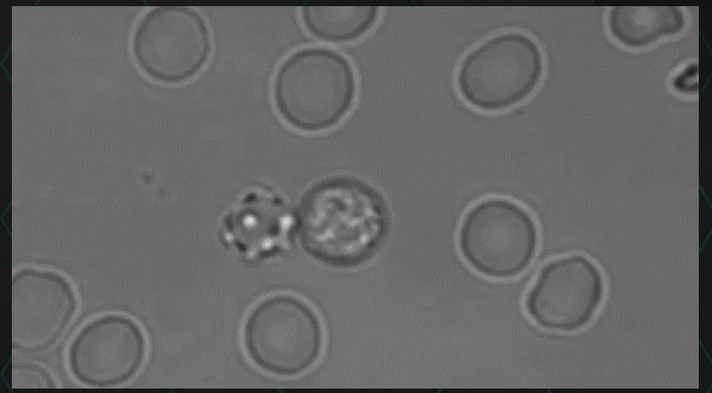
OTM211

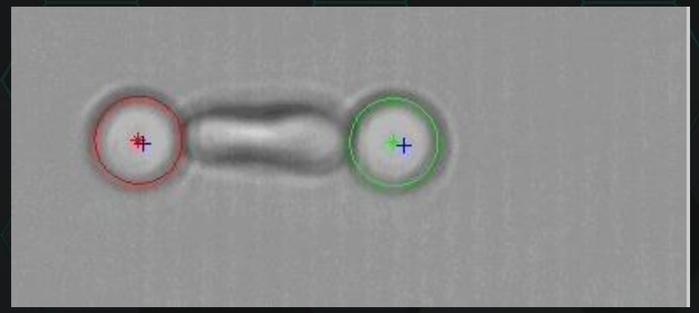


Anwendung: Optischer Kräfte

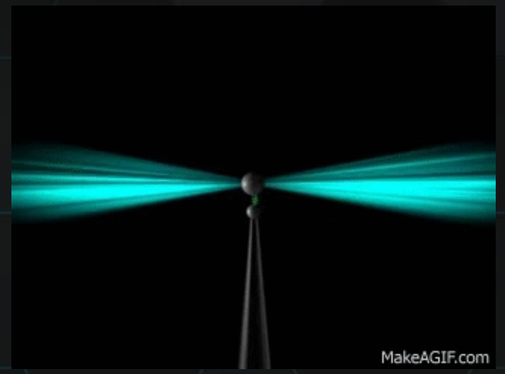
Micro – Tetris (1µm Kugeln)

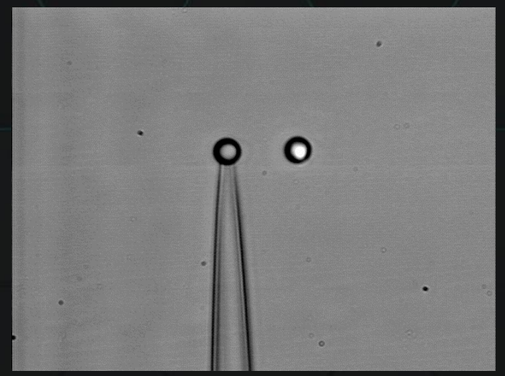
Blut-Zellen Manipulation



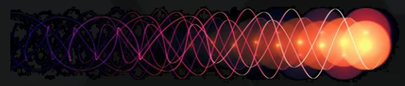


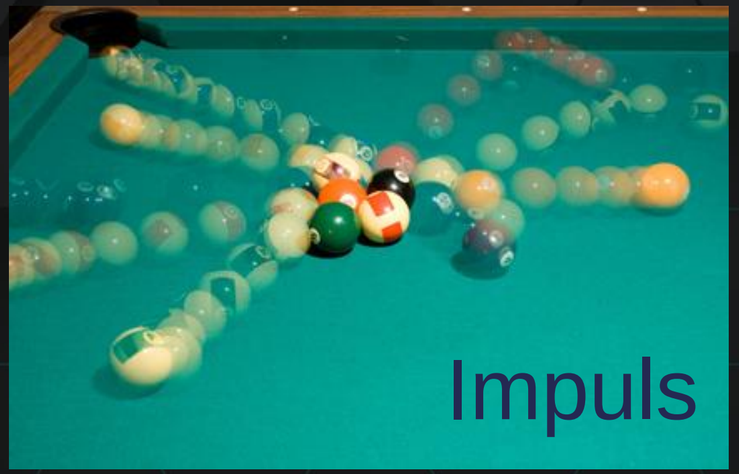
DNA/protein pulling

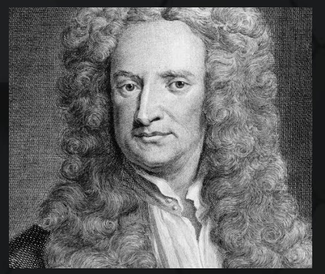




Wie funktionieren optische Kräfte

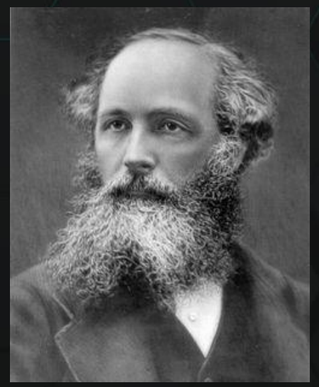




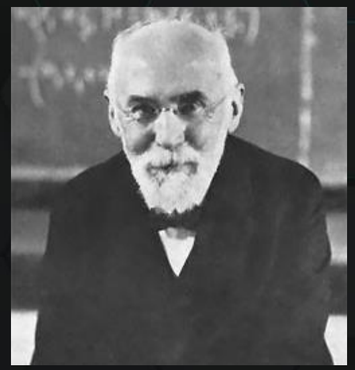


$$p = mv$$

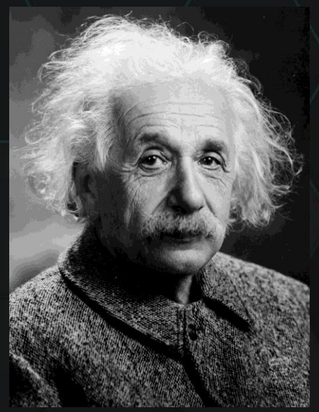
$$\nabla \cdot \mathbf{D} = \rho$$
$$\nabla \cdot \mathbf{B} = 0$$
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$
$$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$



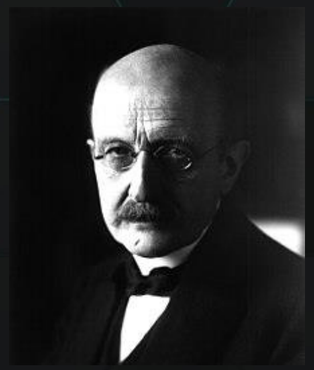
$$F_l = QvB$$



$$E = mc^2$$

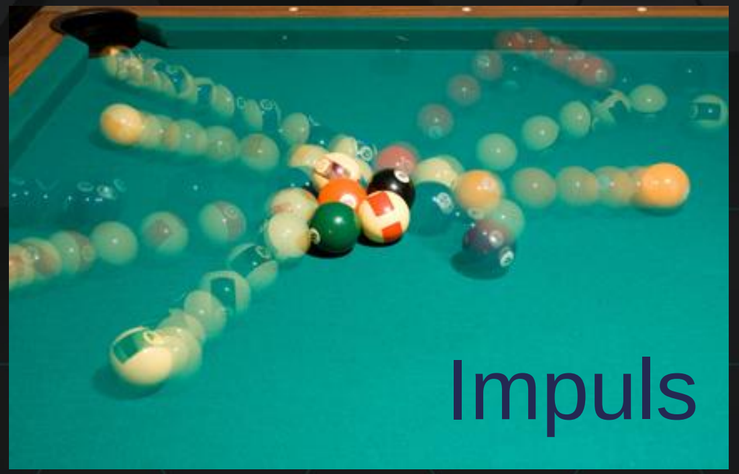


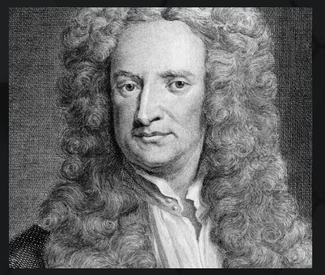
$$E = hf$$



$$p = \frac{h}{\lambda}$$

Wie funktionieren optische Kräfte





$$p = mv$$

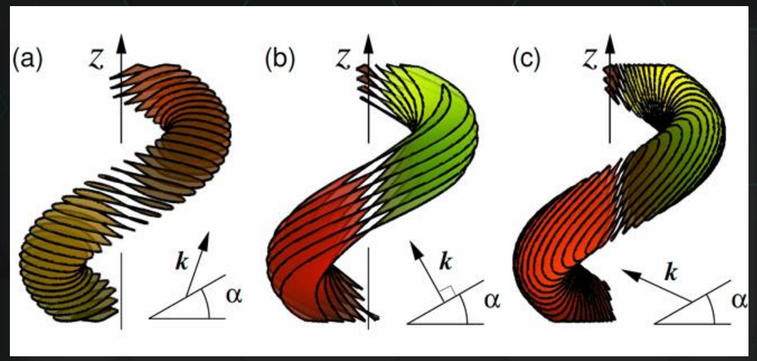
$$p = \frac{h}{\lambda}$$

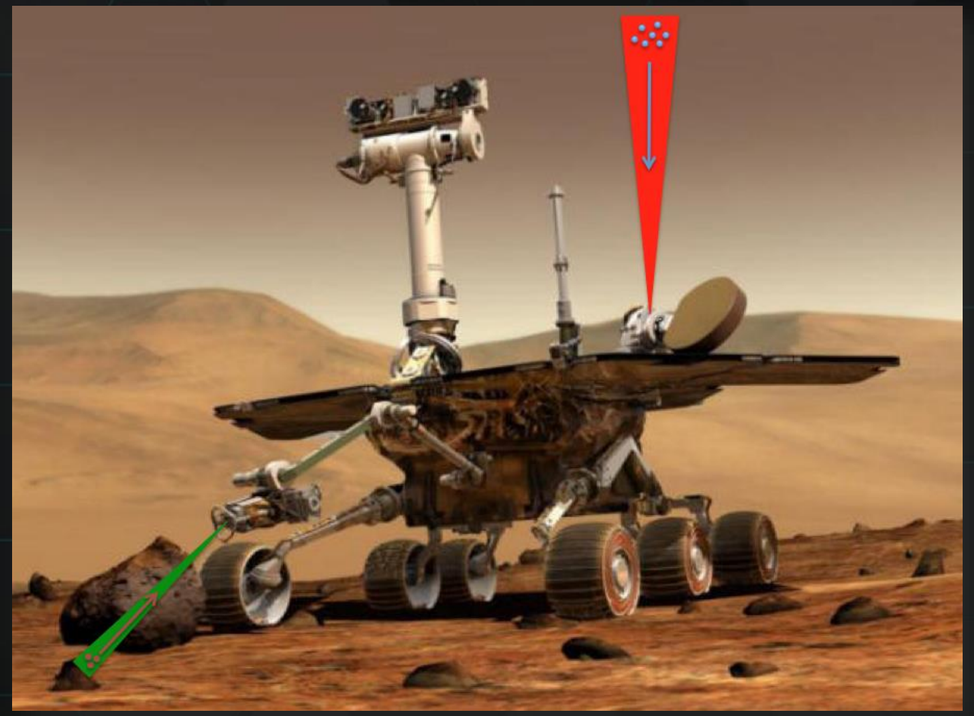
Licht in verschiedenen Ausprägungen

Light Beam

Particle

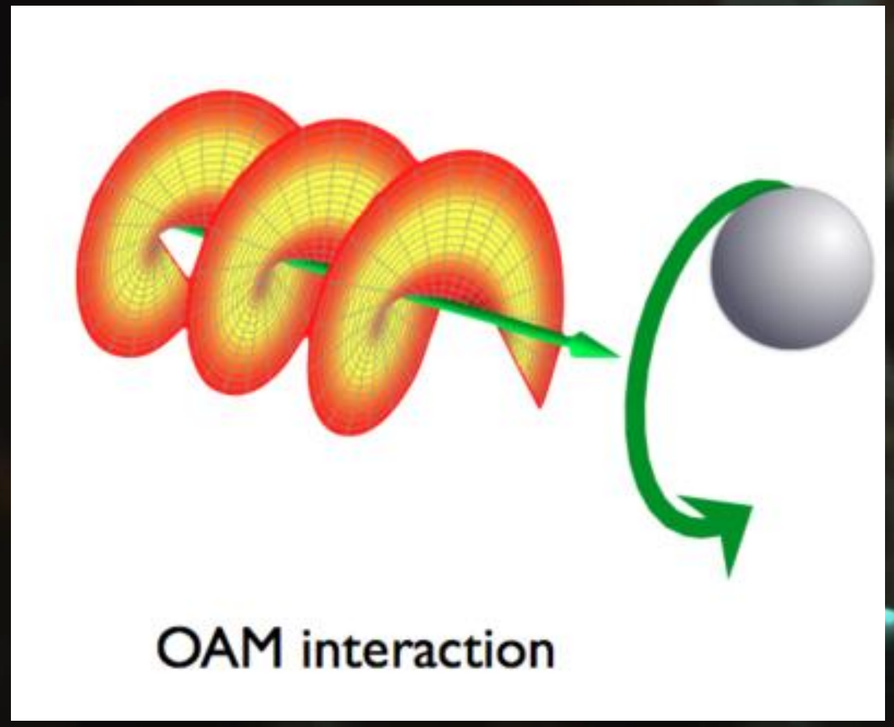
Approach with solenoid beam

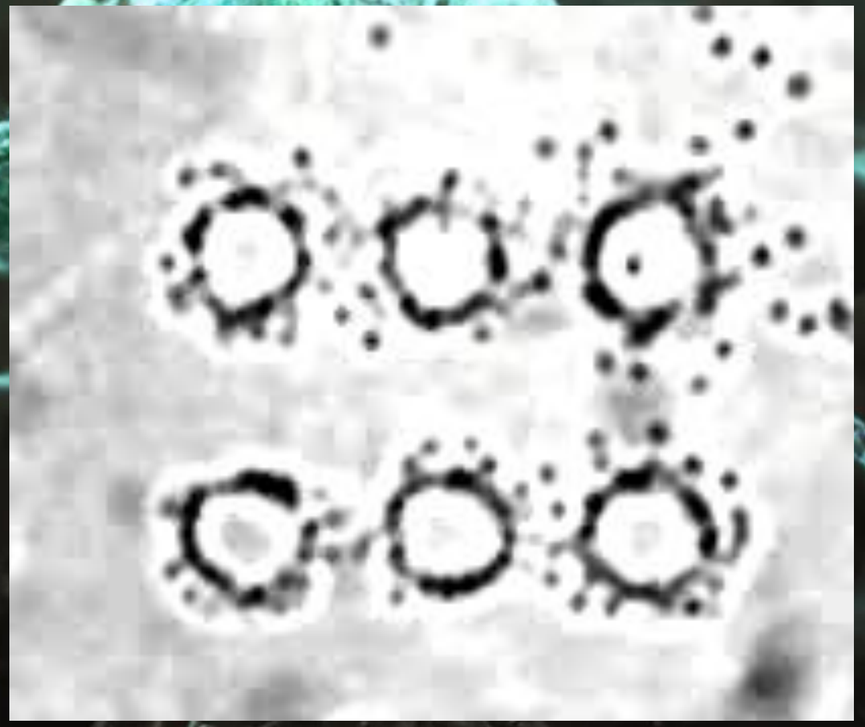




Nasa examines 'tractor beams' for sample gathering:
https://www.bbc.com/news/science-environment-15535115

Licht in verschiedenen Ausprägungen

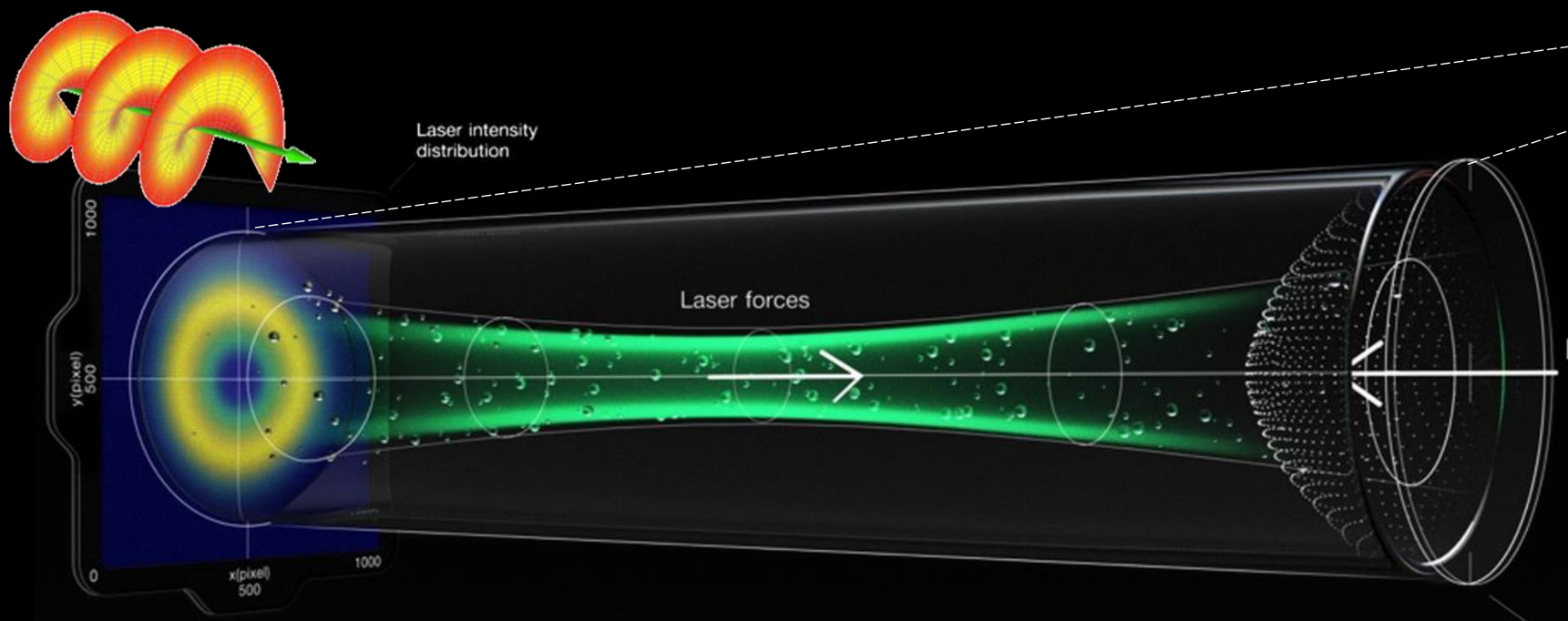


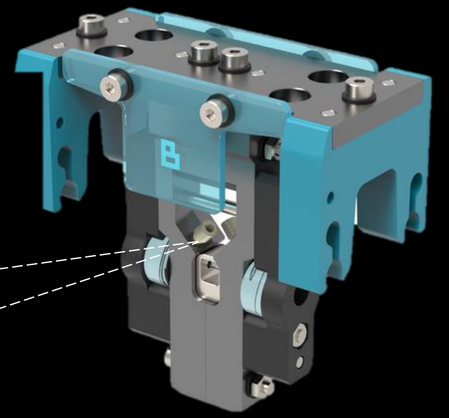


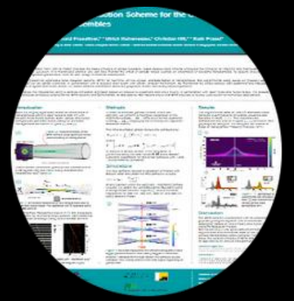
Micro-optomechanical pumps assembled and driven by holographic optical Vortex arrays (Ladavac, Grier, 2004)
Beam: 532nm, charge = +/- 21, 6 Vortices (ca. 300mW), Particle: 800nm silica spheres

Challenging the state of the art

OF2i® actively induced forces of biophotonics and µ-fluidics to break the barrier of Brownian Motion







Peer-reviewed technology paper; PhysRevA Simic et al.

PATENTED

BRAVE B-Curious

Features in a nutshell

- Determines ultra-low concentrations (even a few particles per milliliter)
- Detects single large particles including large-particle tails, anomalies and LPC
- Seamless measurement: you get automated, time-resolved and continuous PSD curves over seconds, minutes and even hours; proven throughput up to 2500 particles/minute
- Monitor kinetic processes like aggregation, dissociation, crystallization, formation, dissolution, etc. and record the parameters as they happen in one continuous measurement
- Exact measurement of particle size, particle size distribution as well as particle concentration; Detection range: 50 nm* to 5 µm (*sample-dependent)
- Reliable and representative measurement results with raw data available for later analysis even for complex, polydisperse systems
- The possibility to use the same method in the lab as is used for online production monitoring, e.g. of nanoemulsions (PAT sensor)
- An automated self-cleaning cycle takes approx. 30 seconds

Applications*

Investigation of virus-like particles in cell cultures (downstream & upstream process

Prof. Tobias Madl from the Gottfried Schatz Research Center for Cell Signaling, Metabolism and Aging, Molecular Biology and Biochemistry at the Medical University of Graz

*For the mentioned applications we have proven successes, however the range of application of the device grows with our clientele

Prof. Madl carri… concentrations of pr…

- Visualizing the formation a… change over time in one seamle… possible for the first time ever.
- Results with single-particle sensi… in the size range 10 nm to 2000 n…
- Measurements on low-volume… concentrations relevant for dru…

The measuring results clearly … processes and allowed comp… particles in the presence of d…

- optimization.
- Current measurements do not capture all … anomalies.

Application of OF2i:

Christoph Koeth and his colleagues tested a number of sensor sy… but ultimately a chance meeting with Chris and Gerhard led to th… collaboration and development of BRAVE B-Continuous.

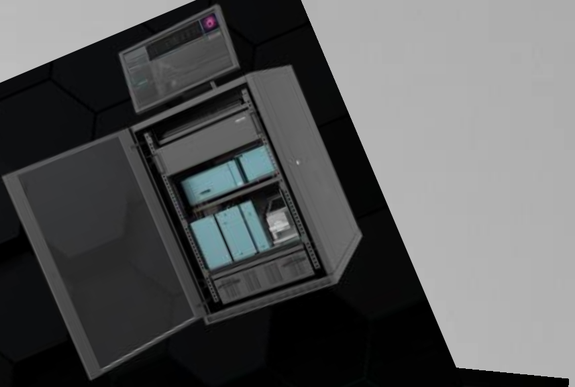
- The BRAVE B-Continuous online unit (including a continuous a… automated online sample preparation unit) was installed in a fou… stage homogenization pilot plant.
- After the first step, the particle size is reduced from 3 µm to approx. 0.3 µm. The process analyzer continuously monitors the PSD distribution and automatically evaluates data such as D-values to assess the efficiency of the first homogenization step.
- It provides data to develop a better understanding of the process. The values are sent to the LIMS every 20 seconds.

BRAVE B-Continuous

The new way of monitoring your production.

Application areas:

- Monitoring of Critical Quality Attributes (CQA)
- Identification of Critical Process Parameters (CPP)
- Flocculation processes for storage and product stability
- Multi-parameter measurements (aggregations, size etc.)
- Real-time Release Testing (RTRT)
- In-Process Quality Control (IPQC)
- On-line detection of particles
- Predictive Maintenance



CONTINUOUS PRODUCTION

OF2i Checking the particle sizes and concentration

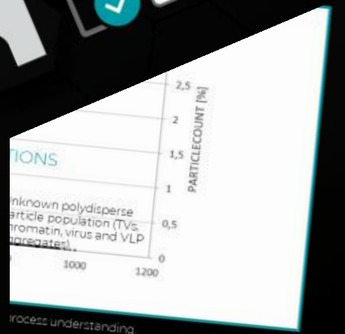
OF2i Measurement for the final, online product release and documentation in real time

OF2i Statistically valid data are determined for the interpretation

READY-TO-GO PRODUCT

NEXT STEP: Real-time Release Testing (RTRT) with OF2i

…OF2i® time resolved online characterization as number based size distributions versus nanoparticle …nt processing steps in looped emulsion production. Timestep10: fault detected within homogenization



…TIONS

…nknown polydisperse …article population (TVs, …romatin, virus and VLP …nocrates).

…rocess understanding.

BRAVE®
ANALYTICS

revolutionizes nanoparticle characterization for production and R&D

by providing a sensor which generates statistically relevant and representative (nano)particle sizing data continuously, seamlessly, and in real-time with single-particle accuracy.

We are BRAVE

MARKO ŠIMIĆ
Physics & Modelling

MAGDALENA SCHNEIDHOFER
Business Development & Events

THOMAS GRUBER
Testing & Mechatronics

DORIS AUER
Lab & Application

CHRISTIAN NEUPER
Physics & Optical Engineering

NIKOLA ŠIMIĆ
Physics & Algorithms

RAPHAEL HAUER
Physics & Modeling

MICHAEL SCHNUR
Fluidics, Mechanics & QM

GERHARD PROSSLINER
Founder | COO | CFO

VITAN STRASSER
Product & Sales

MAGDALINE OKUMU-HARTWIG
Team Assistant

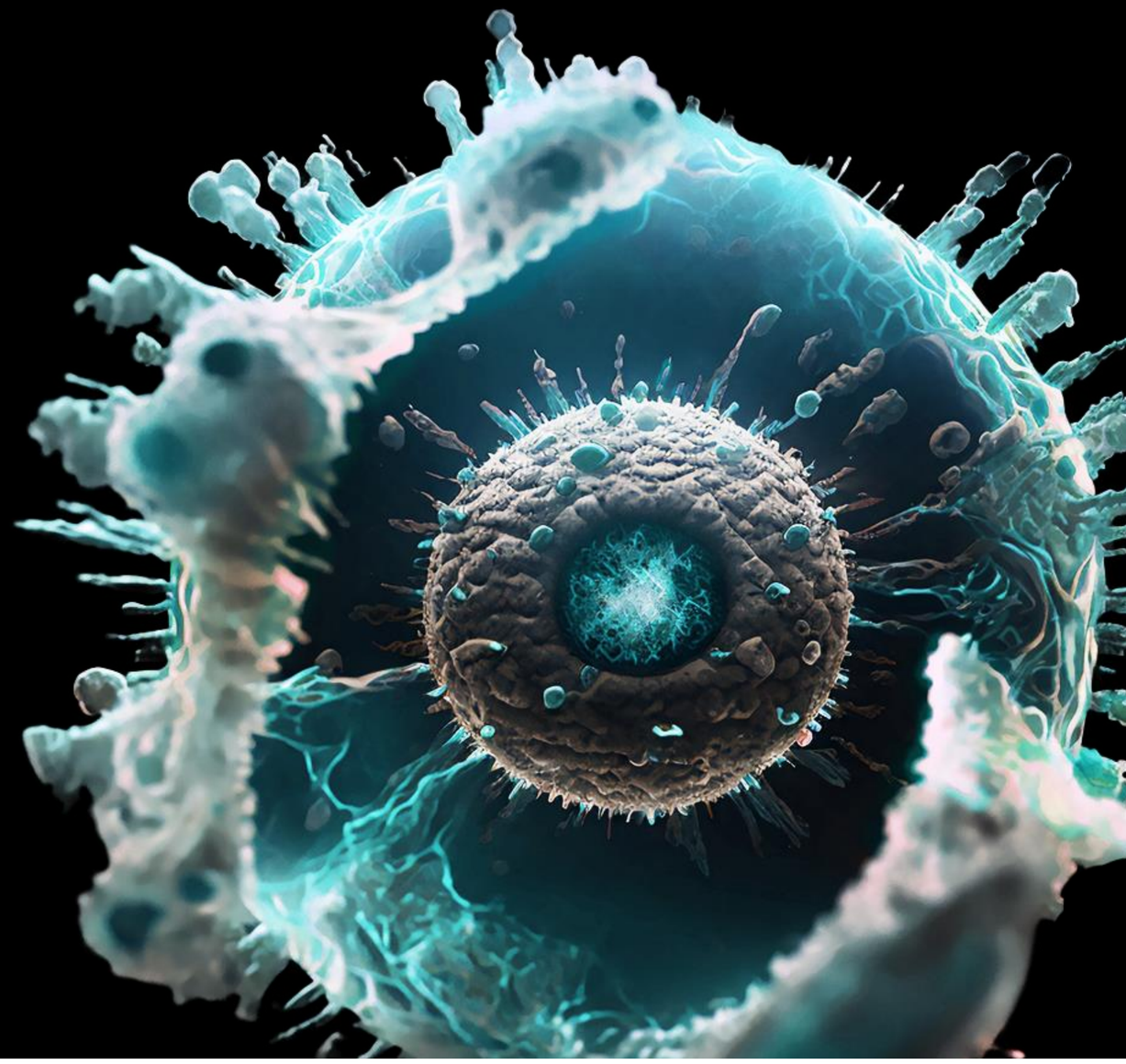
MICHAEL PEINHOPF
Software & IT

SARAH KNIGHTS
Marketing & Communications

CHRISTIAN HILL
Founder | CEO | CTO

ALEXANDER LELJAK
Design & Engineering

BRAVE®
ANALYTICS



BRAVE IS THE WAY FORWARD.

The new era in nanoparticle characterization

FFG Promoting Innovation.

austria wirtschafts service aws

Federal Ministry Republic of Austria Education, Science and Research

Federal Ministry Republic of Austria Digital and Economic Affairs

NANOPAT: MOZART

As a partner in the NanoPAT project, BRAVE Analytics has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n°862583.

Med Uni Graz

UNI GRAZ

TU Graz

FELMI-ZFE

BRAVE®
ANALYTICS

BRAVE IS THE WAY FORWARD.

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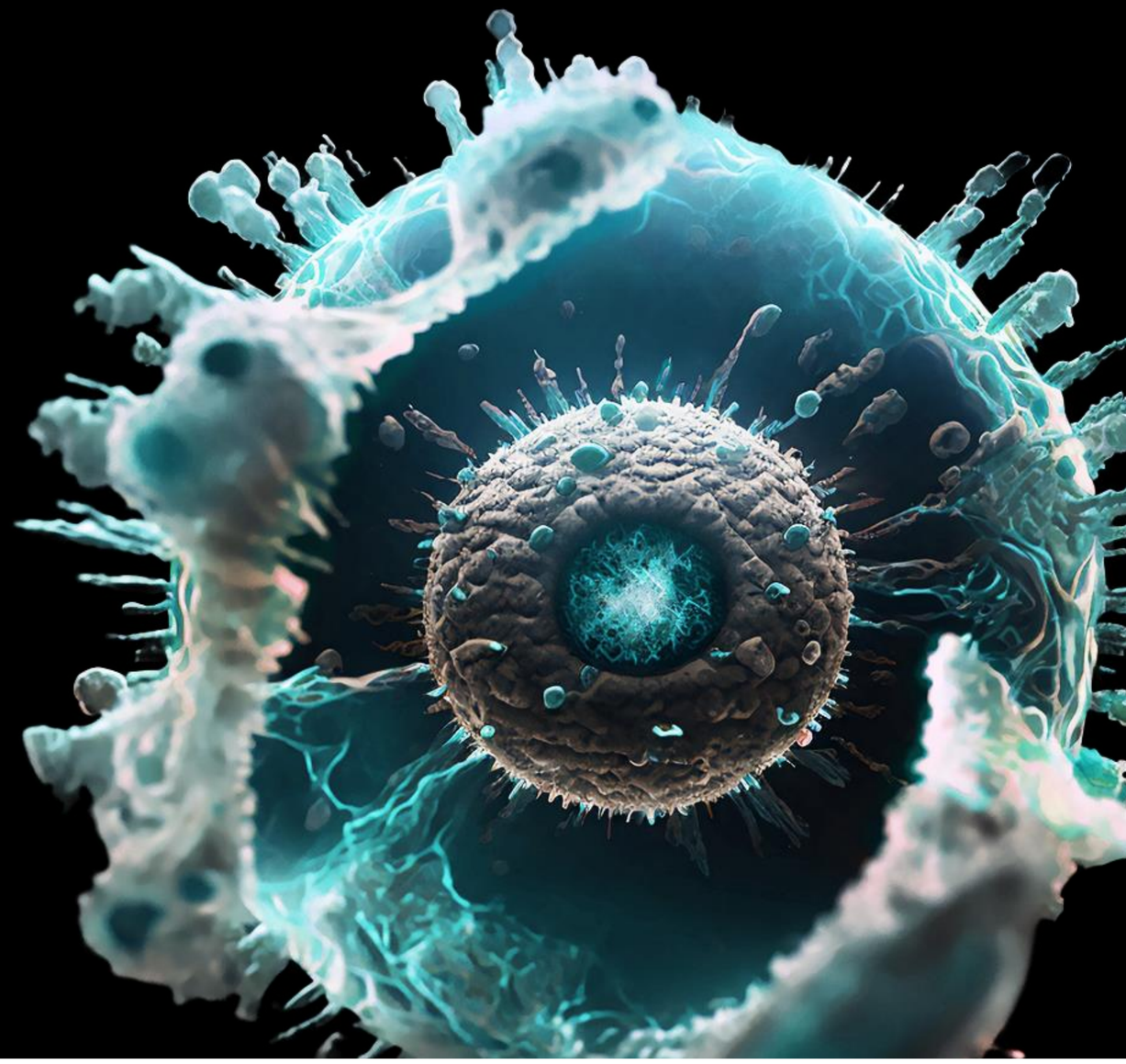

FFG Promoting Innovation.

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Med Uni Graz

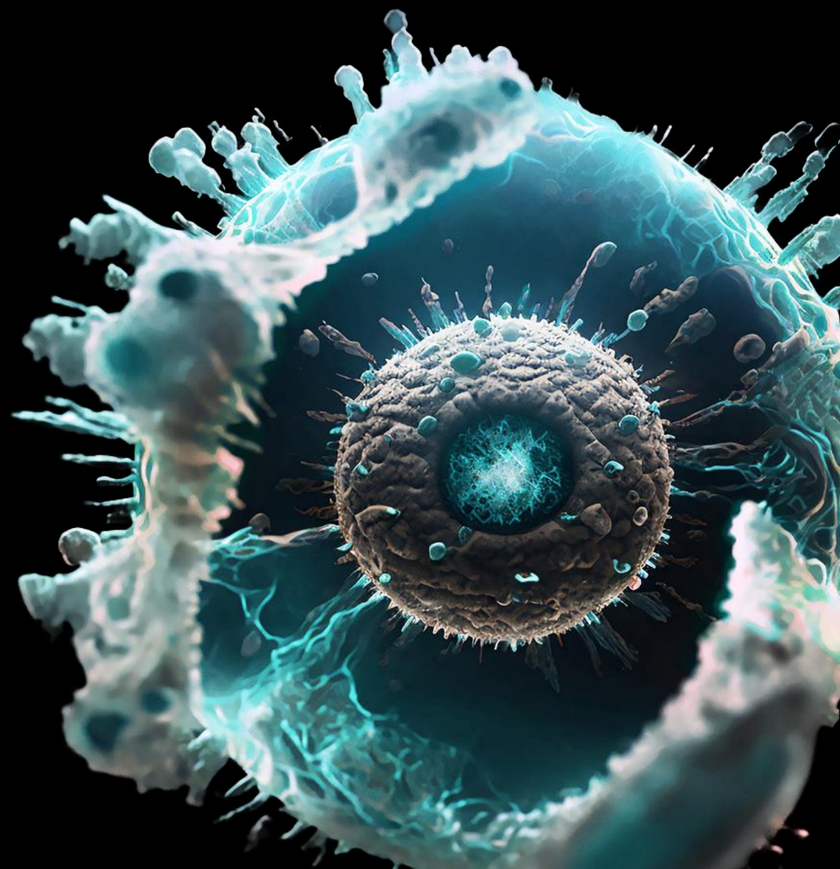
UNI GRAZ

TU Graz

FELMI-ZFE

PINT OF SCIENCE FESTIVAL 22.-24. Mai 2023.

Mit Lichtkraft voraus Traktorstrahlen zur (nano)Partikelanalyse



USE CASE: DISCOVER LIKE NEVER BEFORE.

Research on drug targeting of the early processes of bimolecular condensate formation

Prof. Tobias Madl from the Gottfried Schatz Research Center for Cell Signaling, Metabolism and Aging, Molecular Biology and Biochemistry at the Medical University of Graz

Understanding dynamic liquid-liquid phase separation (LLPS) processes by observing the formation and size distribution of the proteins as they change over time.

State-of-the-art challenges:

- No possibility for live/ time-resolved measurements to monitor changes of molecular condensates and PSD.
- Only small sample amounts are available (patient samples), while high protein and RNA concentrations are required to obtain results.
- Particle size is very small, while size distribution range is wide.
- Microscopy does not resolve the formation processes in the early stages when condensates start to form and proteins start to interact with RNA.

Application of OF2i®:

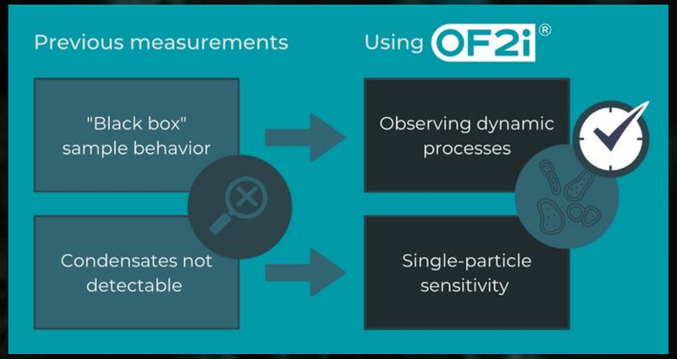
Prof. Madl carried out time-resolved measurements on different concentrations of proteins and RNA. Using OF2i brought benefits:

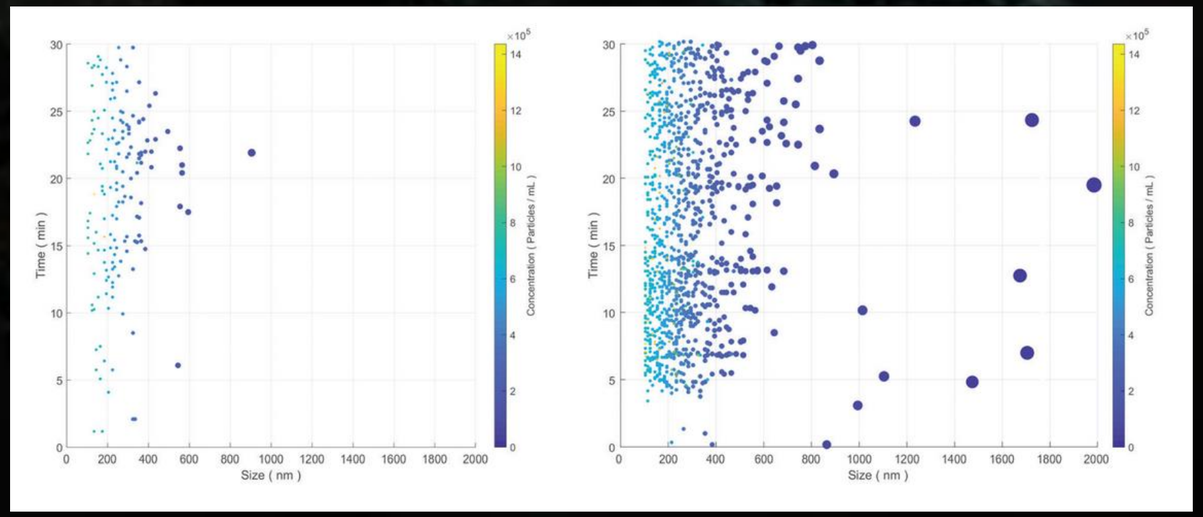
- Visualizing the formation and size distribution of proteins as they change over time in one seamless and complete measurement was possible for the first time ever.
- Results with single-particle sensitivity, even for condensate particles in the size range 10 nm to 2000 nm.
- Measurements on low-volume samples of 80 µL to 100 µL and at concentrations relevant for drug discovery

The measuring results clearly showed the kinetics of LLPS processes and allowed comparison of the formation of particles in the presence of different RNA concentrations.

Results:

"The OF2i method closes a huge gap and enables in-depth and seamless observation of the proteins as they change over time, in this case time-resolved information over seconds to hours."





© BRAVE Analytics & Marko Šimić: Time-resolved PSD: Particle formation processes during liquid-liquid phase separation (LLPS) with low (left) and high (right) RNA concentrations over 30 minutes.

BRAVE B-Continuous

The new way of monitoring your production.

Application areas:

- Monitoring of Critical Quality Attributes (CQA)
- Identification of Critical Process Parameters (CPP)
- Flocculation processes for storage and product stability
- Multi-parameter measurements (aggregations, size etc.)
- Real-time Release Testing (RTRT)
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- Predictive Maintenance