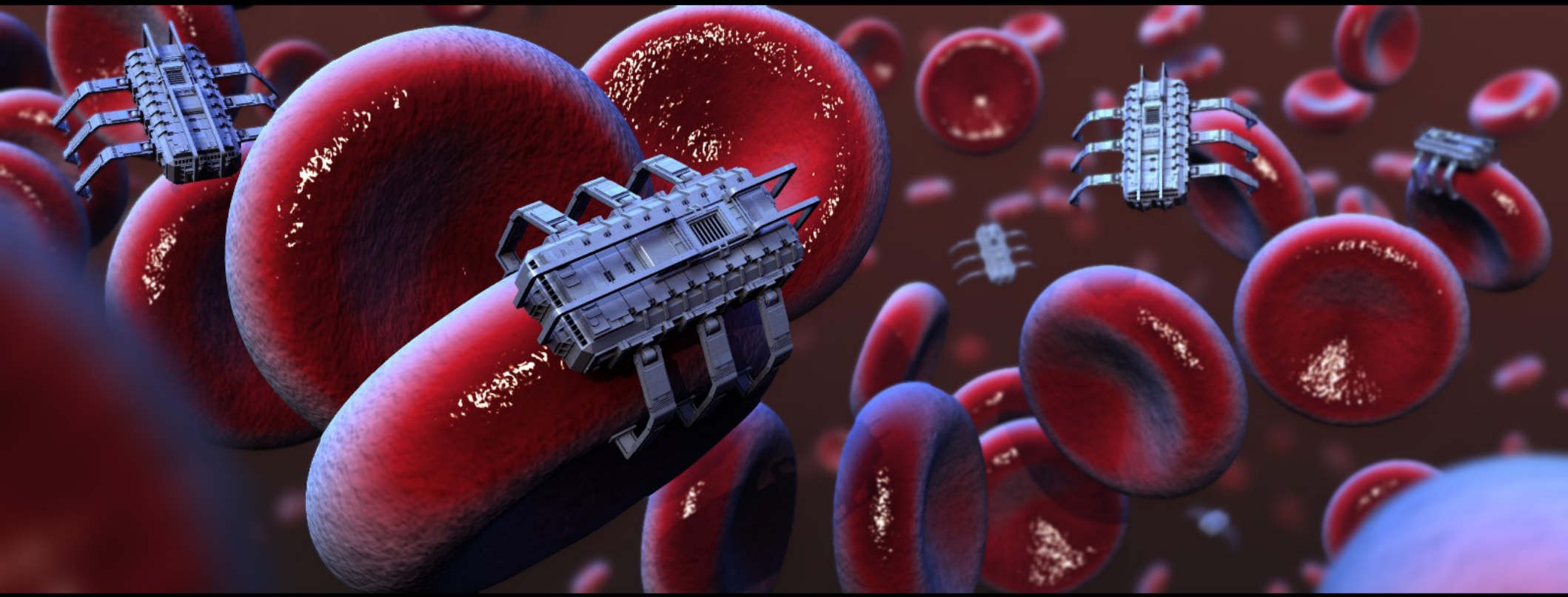
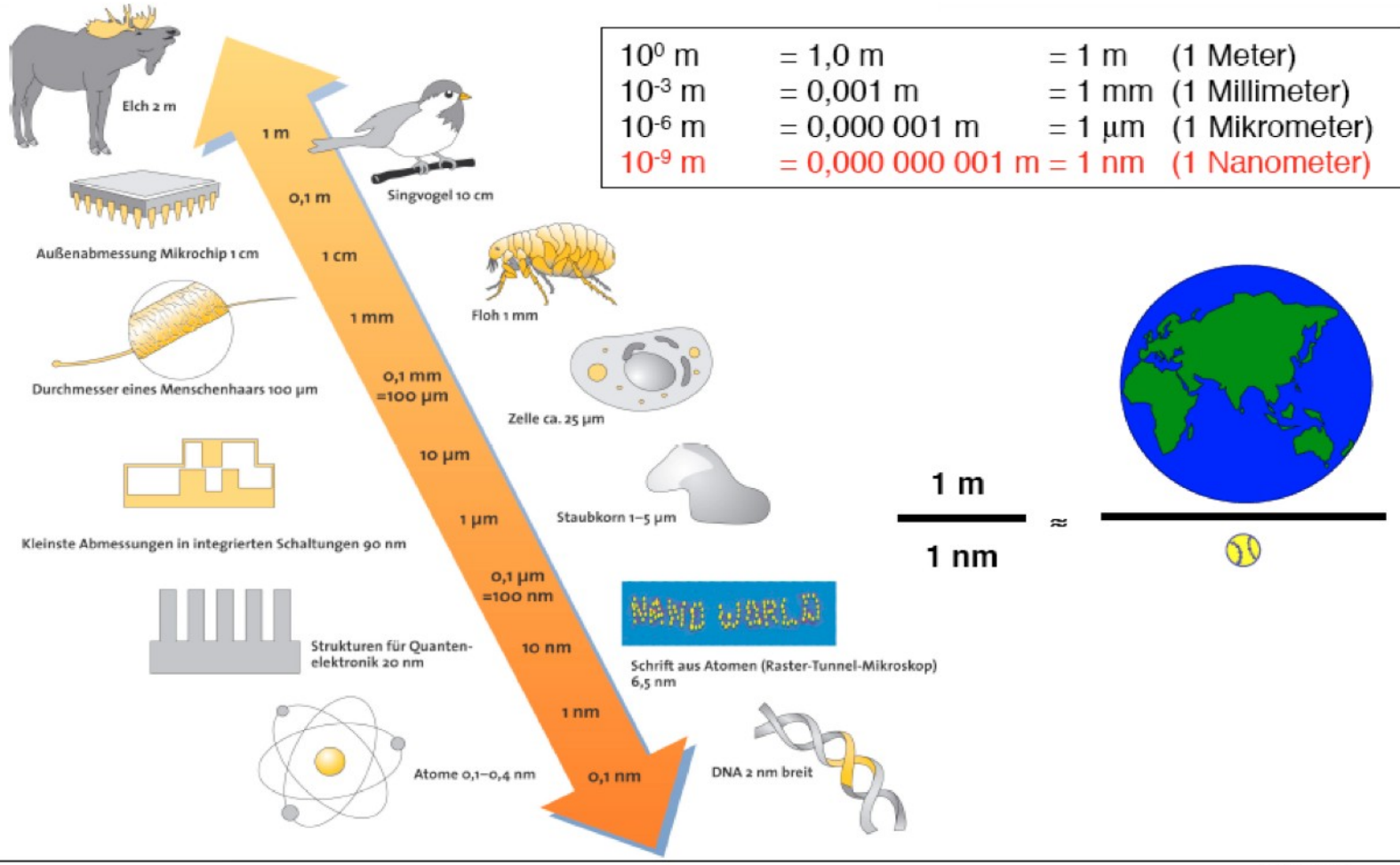


N A N O B O T S

Overview

- A little Help
- Past
  - Ideas and Visions
- Present
  - Technology and Structure
  - ETH Zurich and a Game
- Future
  - The Good
  - The Bad

Size Matters



10^0 m	= 1,0 m	= 1 m	(1 Meter)
10^{-3} m	= 0,001 m	= 1 mm	(1 Millimeter)
10^{-6} m	= 0,000 001 m	= 1 µm	(1 Mikrometer)
10^{-9} m	= 0,000 000 001 m	= 1 nm	(1 Nanometer)

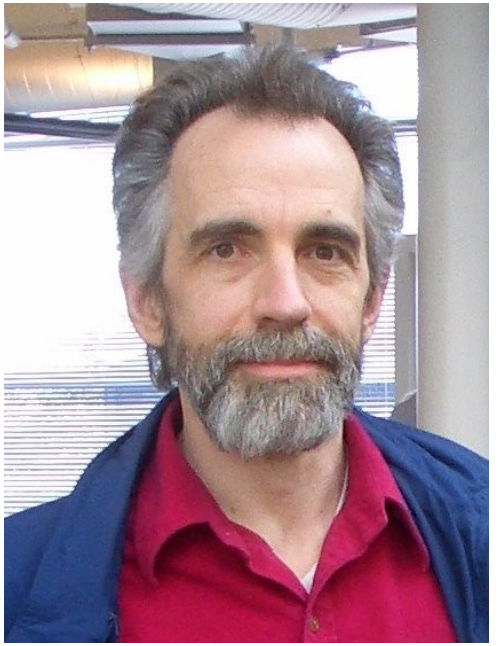
Bild (links): Flad & Flad Communication GmbH, Eckental

VDI Technologiezentrum

EINE INITIATIVE VOM Bundesministerium für Bildung und Forschung

Past

- 1959: „There is plenty of room at the bottom“
- The idea of a nanobot was first introduced by Eric Drexler in the 1980s.
- His vision: nanobots could
  - Sense and respond to environment
  - Communicate and cooperate
  - Self-repair
  - Replicate



Eric Drexler(2007)

Why Nano

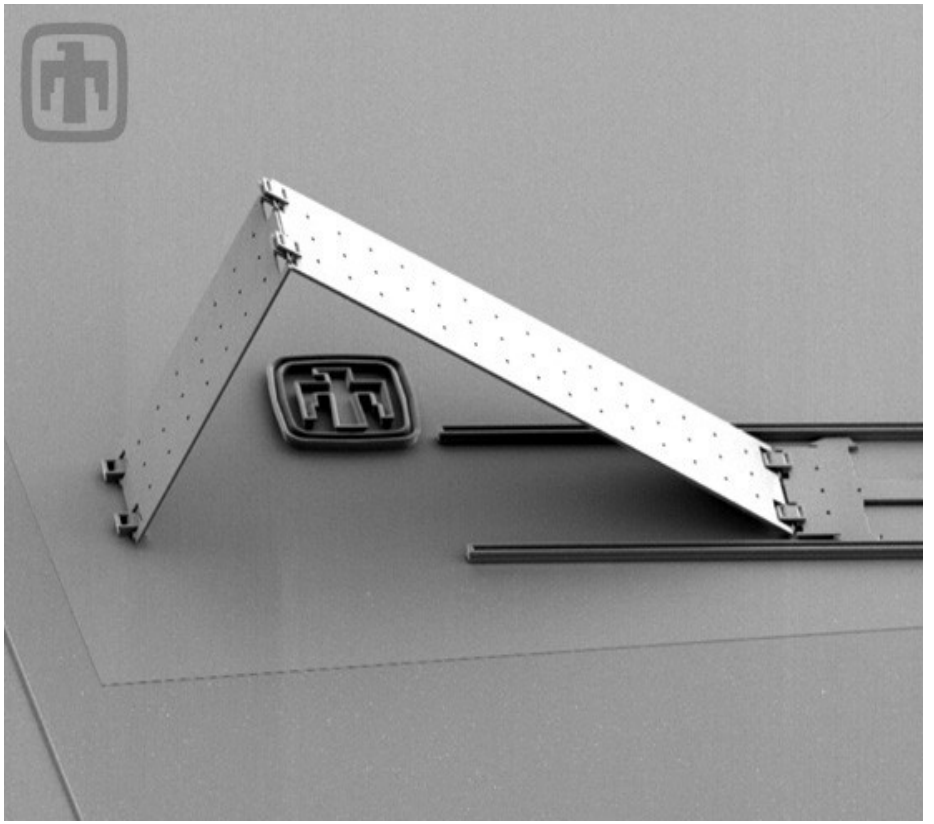
- Nanotechnology makes almost every manufactured product:
  - faster & lighter
  - safer & cleaner
  - smarter & stronger
- Nearly no material costs
- 100% recycling of used goods

Visions

- Production
  - Tiny production robots, assemblers, to built anything “bottom up“
- Medicine
  - Robots swim through human blood, analysing, enhancing, reparing and defending
- War
  - Warmachines on nanoscale...

Present

- What we have so far:
  - The ability to produce microstructures
  - “simple“ nanostructures
  - “complex“ nanostructures
  - Processors
  - Soccerfields...
    - Microrobots



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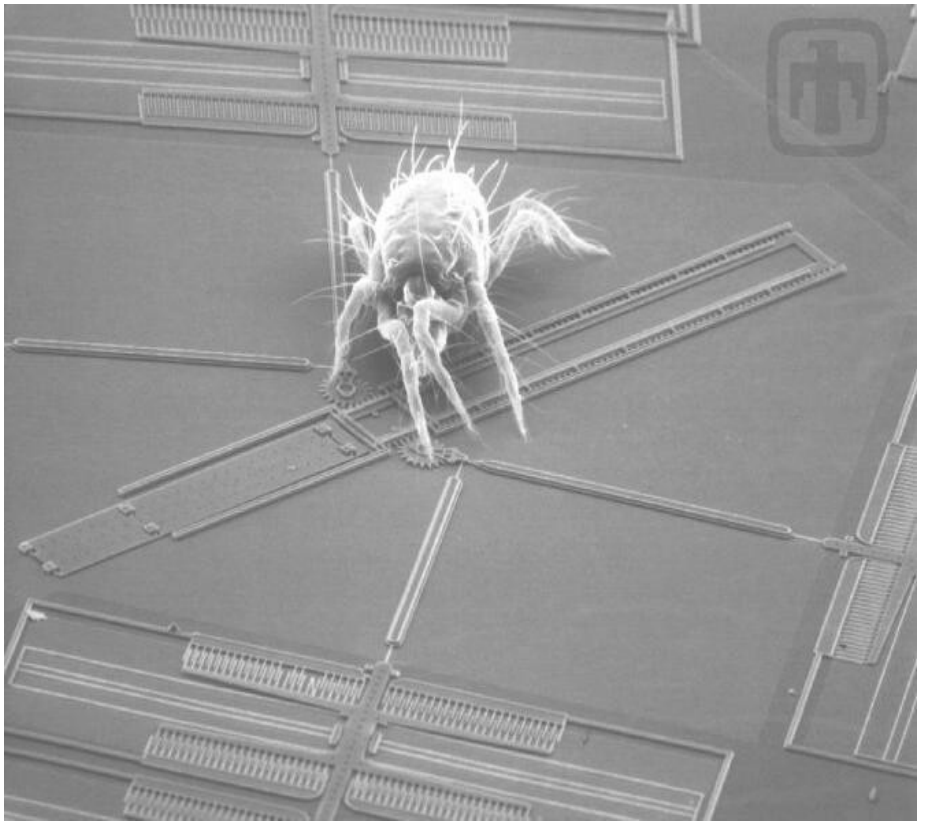

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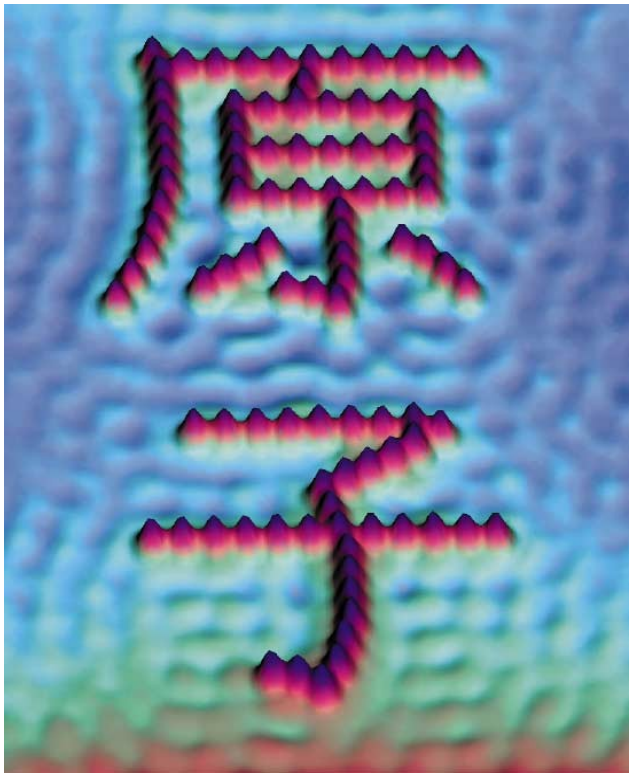

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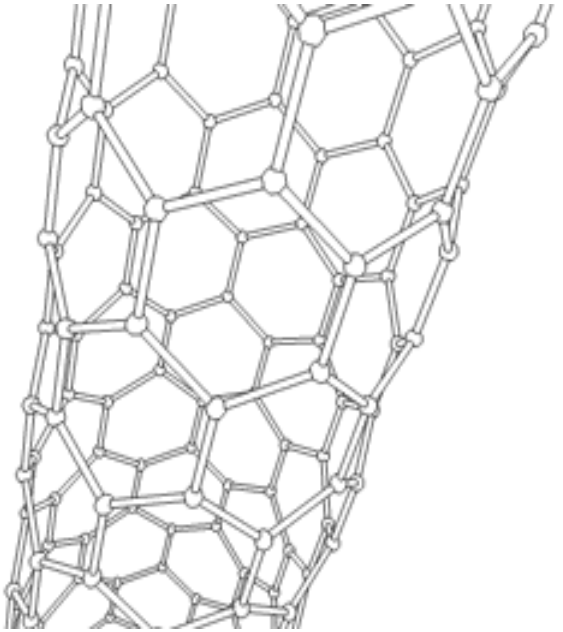

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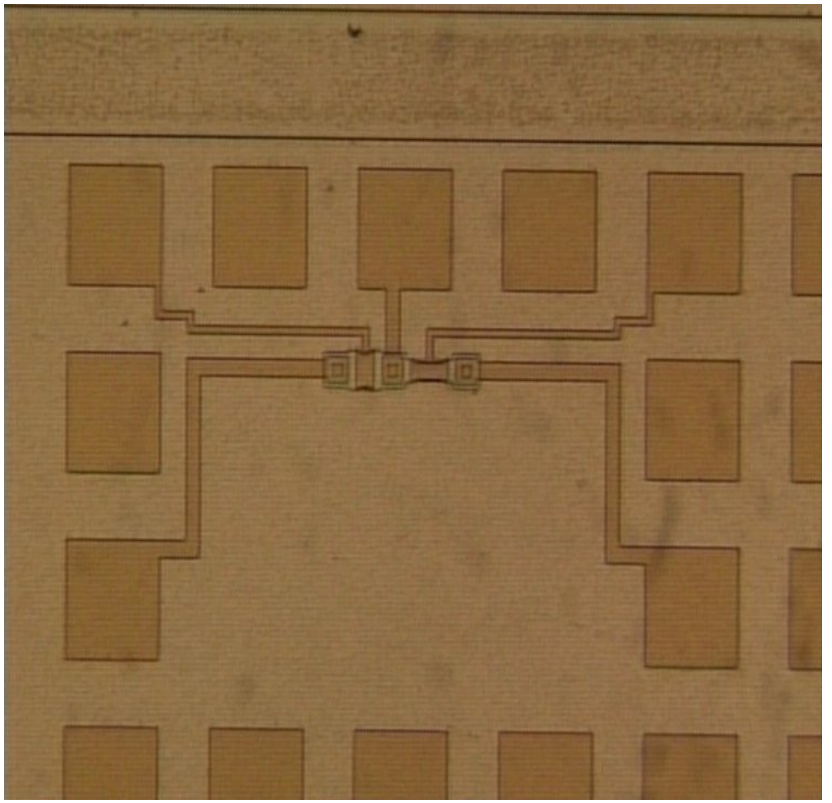

Present

- What we have so far:
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  - “complex“ nanostructures
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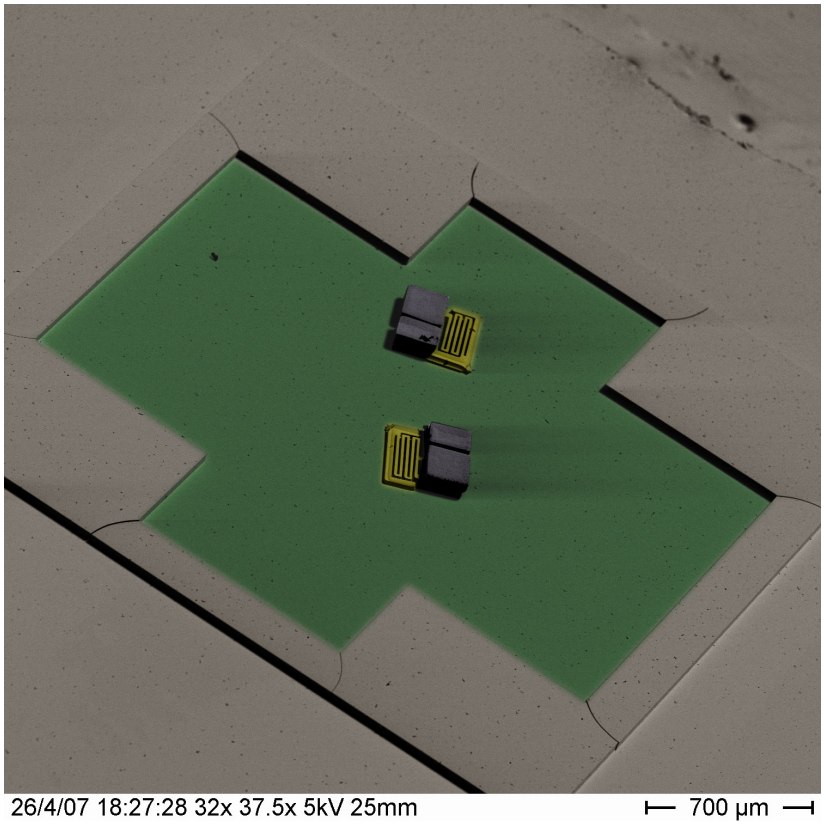
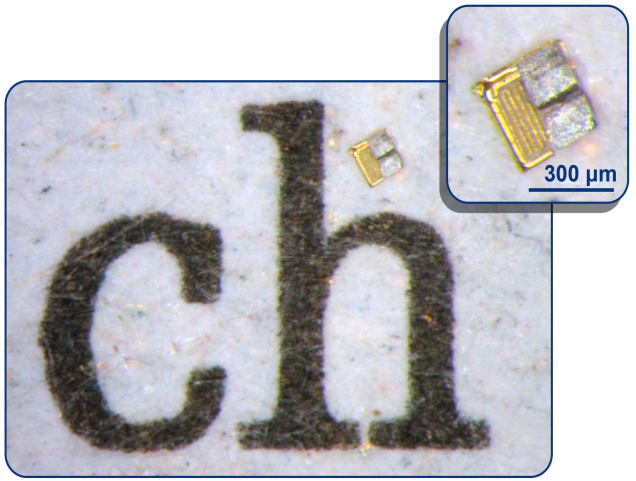
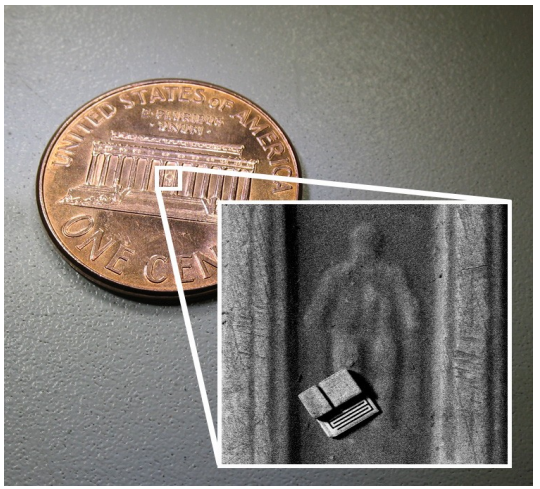
  - Soccerfields... and Soccerplayer
    - Microrobots

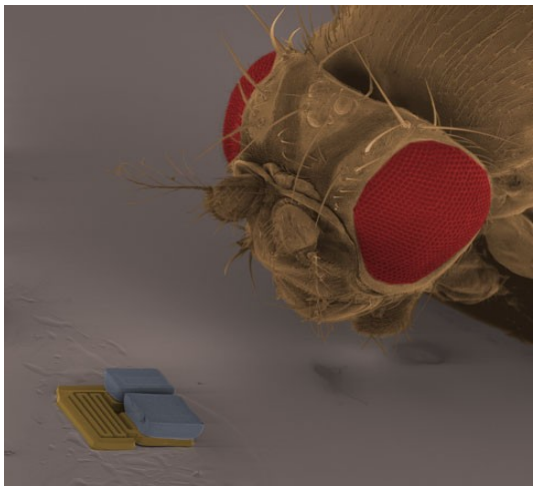


The Robot

- Movement:
  - forwards, backwards and turning in place
- Sensing through a digital camera
- Completely autonomous, no human interaction







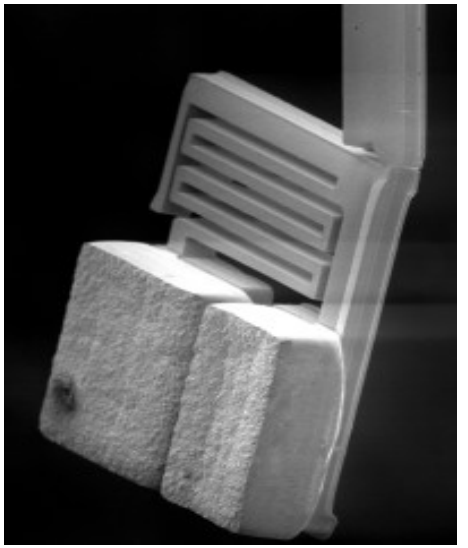
Let's have a look

Videos

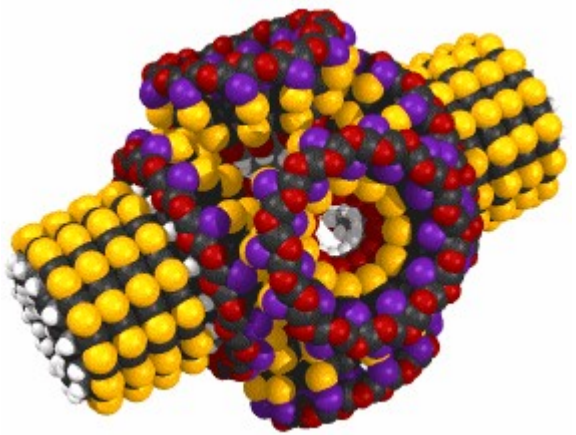
- An animation of the resonating mechanism
- Microbot on the field (autonom)
- Microbot in a maze (half autonom)

How is that possible

- A uniform magnetic field is applied
- This field is oscillated, causing the spring to deflect
- Without a frictionless ground the robot would only vibrate in place
- A speed of about
  15 cm/sec is achieved



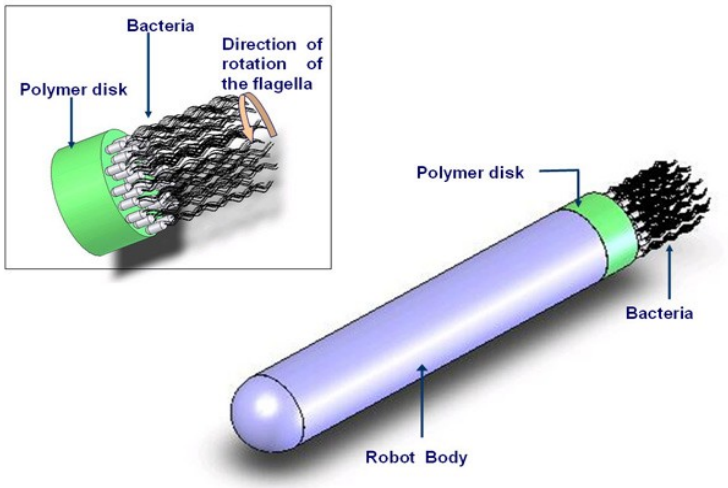
Future



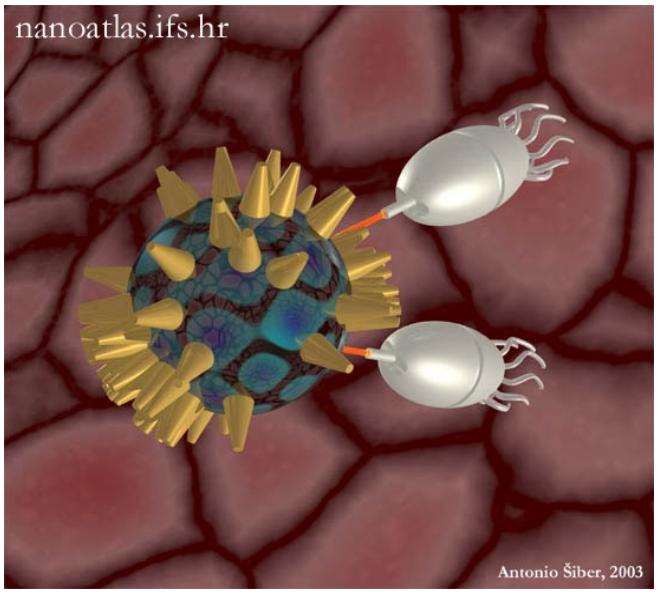
A differentialgear
made from single atoms

A Nanobot enhancing
the capabilities of red blood cells

Future

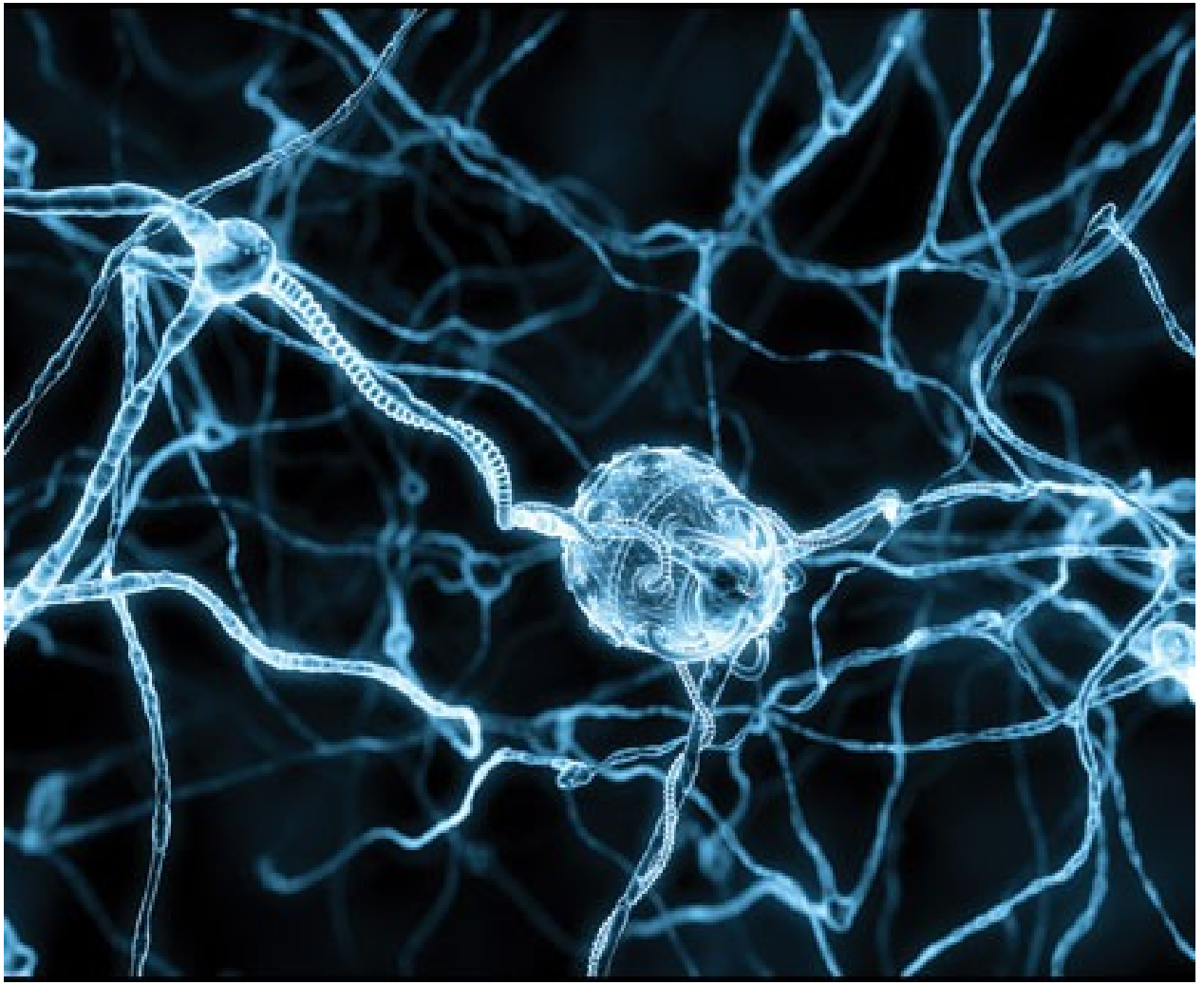


A microscale swimming robot, using bacteria for locomotion.



Nanobots working as white blood cells

Future



A nanobot connected to neurons enhancing the capabilities of the brain.

The Good

- They help us in any situation
  - We have an alltime connection to everyone through a direct brain interface
- In a car accident
  - The car will repair itself
  - Broken bones are repaired in minutes
- Anything is built in seconds or minutes e.g. food or buildings
- A perfect world...

The Bad

By accident

- Robots are able to reproduce themselves and do so, until nothing is left, “Grey Goo“
- controlability

By purpose

- War is now on nanoscale
- Spying
- Swarms of millions, invisible and deadly

It's upon us to decide

Nanotechnology can be a very powerful technology and we are just at the beginning...


Thank You!