"Research Ethics and nanoScience"

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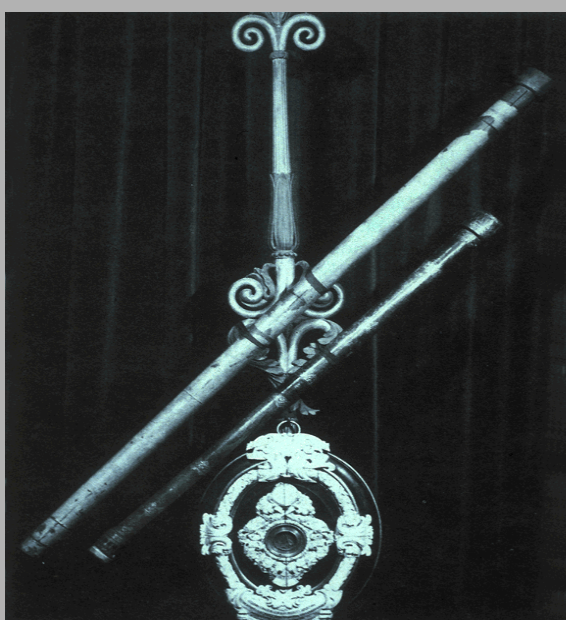
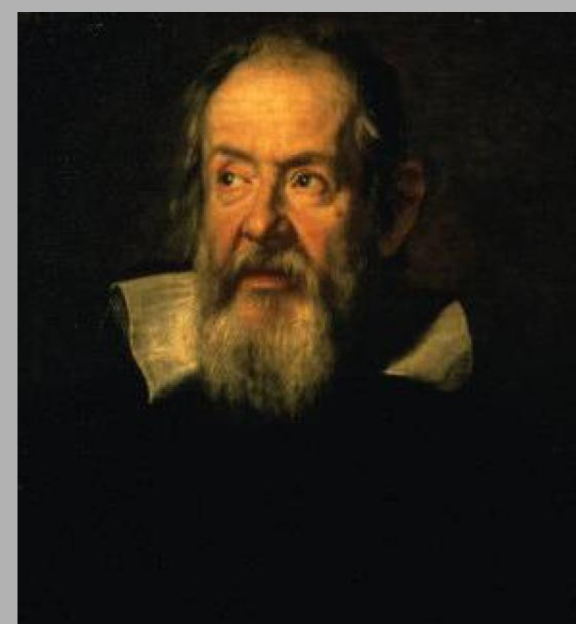
NANOCODE – Trends in Nanotechnology TNT Tenerife 2011

Accademia dei Lincei **Founded in 1603 by Federico Cesi (1585-1630)**
Villa Farnese, Trastevere, Roma

affreschi by Rafaello Sanzio



Galileo Galilei
Justus Sustermans (Antwerp 1597-1681), Galeria Uffizi, Florence
Oil on linen, 66 x 56cm, **1636**

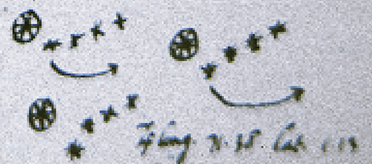


Ser.mo Principe.

Galileo Galilei Humiliss.o Servo della Ser.tà V.a inuigilando assiduamente et con ogni spirito per potere non solamente satisfare al carico che tiene della lettura di Matematiche nello Studio di Padova,

Hauere determinato di presentare al Ser.mo Principe l'Occhiale et di poter essere di giouamento inestimabile per ogni negozio et impresa marittima o terrestre stima di tenere questo nuovo artifizio nel maggior segreto et solam.te a disposizione di V. Ser.tà L'Occhiale cauato dalle più recondite speculazioni di prospettiva ha il uantaggio di scoprire Legni et Vele dell'inimico due hore et più di tempo prima che egli scuopra noi et distinguendo il numero et la qualità de i Vasselli giudicare le sue forze pallestirsi alla caccia al combattimento o alla fuga, o pure ancora nella campagna aperta uedere et particolarm.te distinguere ogni suo moto et preparamento.

Adi 7. di Gennaio
Giove si vedde così * * ⊛ * occ:
Adi 8 così ⊛ * * *
era dunq. diretto et non retrogrado
Adi 12 si vedde in tale costituzione * ⊛ * occ:
Adi 13 si veddono vicinissime à Giove 4 stelle * ⊛ * * * o meglio così
Adi 14 è nugolo
Adi 15 ⊛ * * * * occ: la pross.a à ♃ era la min.e la 4.a era distante dalla 3.a il doppio in circa.
Lo spazio delle 3 occidentali non era maggiore del diametro di ♃ et erano in linea retta.



♃ long. 71.38 lat. 1.13

Adi 7. di Gennaio 1610 Giove si vedeva col Cannone con 3 stelle fisse così * * ⊛ * occ: delle quali senza il cannone niuna si vedeva. à di 8. appariva così ⊛ * * * era dunq. diretto et non retrogrado come pongono i calculatori.

Adi 9. fu nugolo. à di 10. si vedeva così * * ⊛ ciò è congiunto con la più occidentale si che la occultava per quanto si può credere.

Adi 11. era in questa guisa * * ⊛ et la stella più vicina à Giove era la metà minore dell'altra, et vicinissima all'altra doue che le altre sere erano le dette stelle apparite tutte tre di egual grandezza et tra di loro egualm.te lontane; dal che appare intorno à Giove esser 3. altre stelle erranti invisibili ad ogn'uno sino à questo tempo.

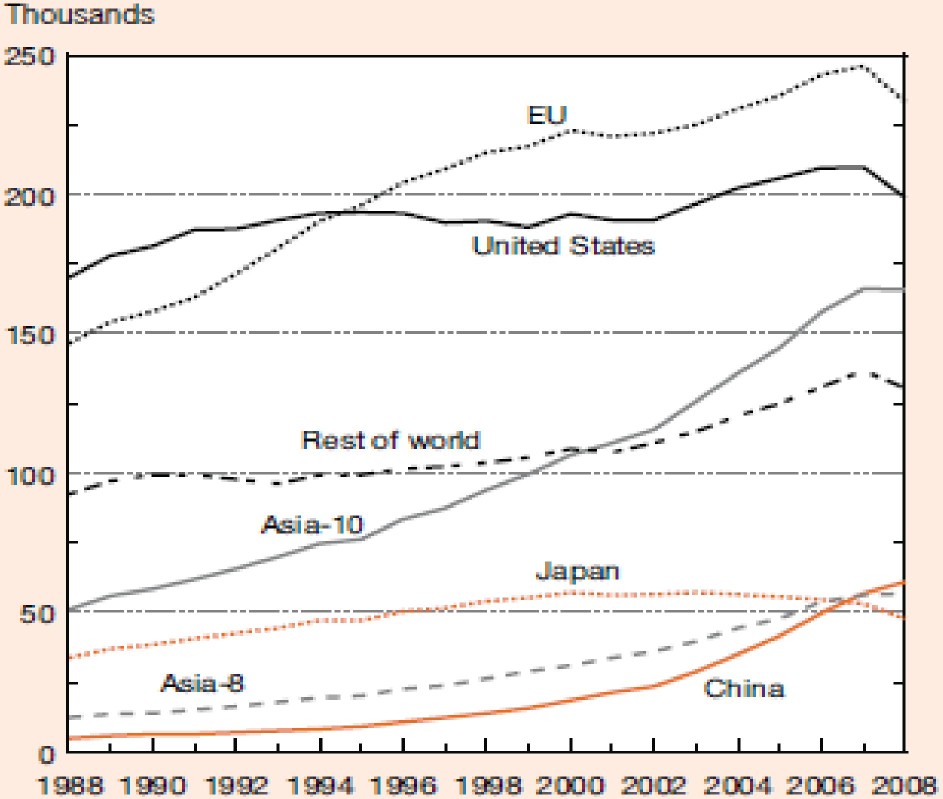
Adi 12. si vedde in tale costituzione * * ⊛ * occ: era la stella occidentale poco minor della orientale, et Giove era in mezzo lontano da l'una et dall'altra quanto il suo diametro in circa: et forse era una terza piccoliss.a et vicinissima à ♃ verso oriente; anzi pur vi era veramente havendo io con più diligenza osservato, et essendo più imbrunita la notte.

Adi 13. havendo beniss.o fermato lo strum.to si veddono vicinissime à Giove 4. stelle in questa costituzione * ⊛ * * * o meglio così * ⊛ * * * e tutte apparivano della med.ma grandezza, lo spazio delle 3. occidentali non era maggiore del diametro di ♃. et erano fra di loro notabilm.te più vicine che le altre sere; ne erano in linea retta esquisitam.te come per l'avanti ma la media delle 3. occidentali era un poco elevata, overo la più occidentale alquanto depressa; sono queste stelle tutte molto lucide benchè piccolissime et altre fisse che appariscono della med.ma grandezza non sono così splendenti.

Adi 14. fu nugolo. Adi 15. era così ⊛ * * * * occ: la pross.a à ♃ era la minore et le altre di mano in mano maggiori: gl'interstizij tra ♃ et le 3. seguenti erano tutti quanto il diametro di ♃, ma la 4.a era distante dalla 3.a il doppio in circa; nè facevano linea retta, mà come mostra l'esempio, erano al solito lucidissime benchè piccoliss.e, et niente scintillavano come anco nelle...

7/P.
♃ long. 71.38 Lat. 1.13
2.30
1.13
1.17

S&E journal articles produced by selected regions/ countries: 1988–2008



EU = European Union

NOTES: See glossary for countries included in Asia-8 and Asia-10. EU includes all 27 member states. Articles classified by year of publication and assigned to region/country on basis of authors' institutional address(es). For articles with collaborating institutions from multiple countries/ economies, each country/economy receives fractional credit on basis of proportion of its participating institutions. Counts for 2008 are incomplete.

SOURCES: Thomson Reuters, Science Citation Index and Social Sciences Citation Index, http://thomsonreuters.com/products_ services/science/; The Patent Board™; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

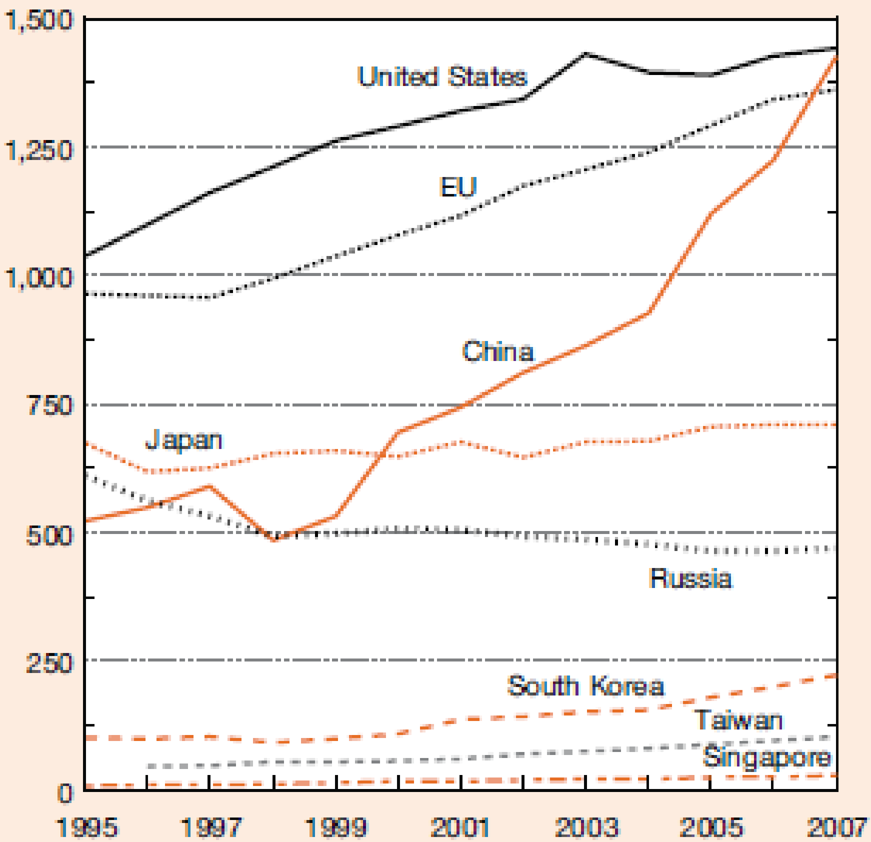
Science and Engineering Indicators 2010

Science and engineering SCI articles
by year and origin

OECD data published in 2010

Researchers in selected regions/countries/economies: 1995–2007

Thousands (FTE)



EU = European Union; FTE = full-time equivalent

NOTES: Researchers are full-time equivalents. Time span is 1995–2007 or closest available year. U.S. data for 2007 estimated based on 2004–06 growth rate.

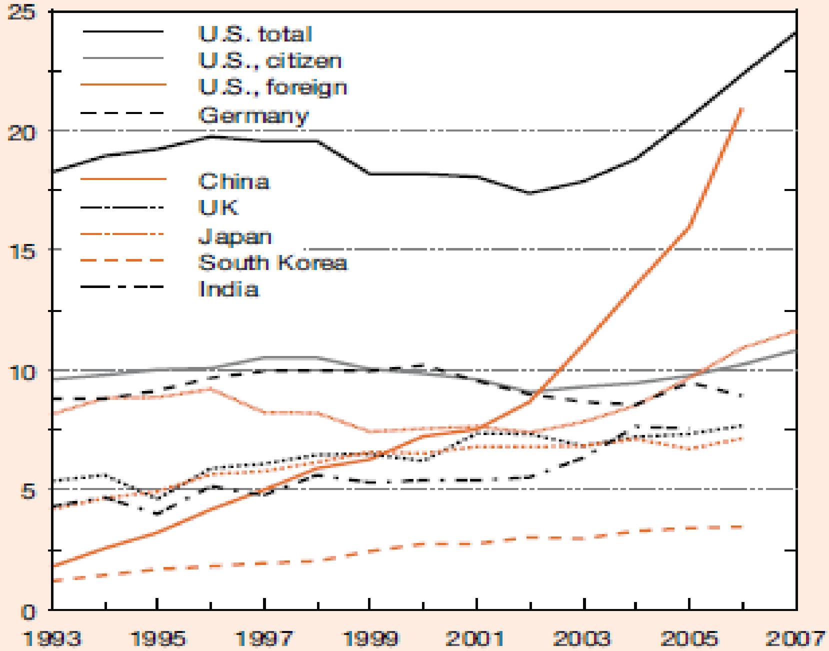
SOURCE: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators* (2009/1 and previous years).

Science and Engineering Indicators 2010

Total number of FTE researchers in S&E (Full time equivalents)

Doctoral degrees in natural sciences and engineering, selected countries: 1993–2007

Thousands



UK = United Kingdom

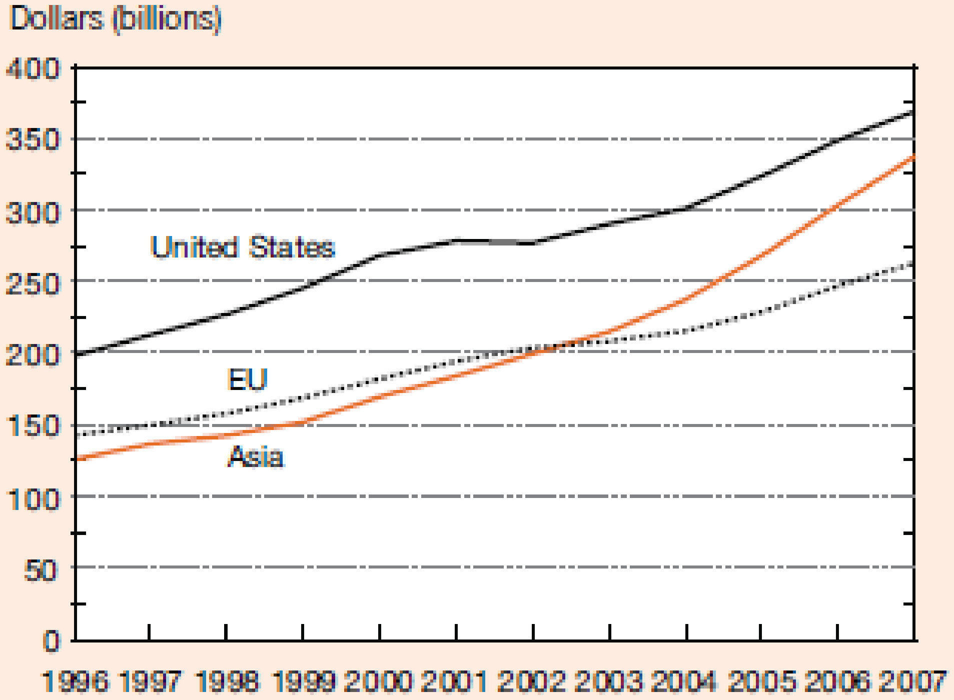
NOTE: Natural sciences include physical, biological, earth, atmospheric, ocean, agricultural, and computer sciences and mathematics.

SOURCES: China—National Bureau of Statistics of China, China Statistical Yearbook, annual series (Beijing), various years; Japan—Government of Japan, Ministry of Education, Culture, Sports, Science and Technology, Higher Education Bureau, Monbusho Survey of Education; South Korea—Organisation for Economic Co-operation and Development (OECD), Online Education Database, http://www.oecd.org/education/ database/; United Kingdom—Higher Education Statistics Agency; Germany—Federal Statistical Agency, Prüfungen an Hochschulen, and OECD, Online Education Database, http://www.oecd.org/education/database/; and United States—National Center for Education Statistics, Integrated Postsecondary Education Data System, Completions Survey; and National Science Foundation, Division of Science Resources Statistics, Integrated Science and Engineering Resources Data System (WebCASPAR), http://webcaspar.nsf.gov.

Science and Engineering Indicators 2010

Number of PhD thesis in S&E per year and country

Figure O-2
R&D expenditures for United States, EU, and Asia: 1996–2007



EU = European Union

NOTE: Asia includes China, India, Japan, Malaysia, Singapore, South Korea, Taiwan, and Thailand. EU includes all 27 member states.

SOURCES: Organisation for Economic Co-operation and Development, *Main Science and Technology Indicators* (2009/1 and previous years); United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics, http://stats.uis.unesco.org/unesco/tableviewer/document.aspx?ReportId=143&IF_Language=eng; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

Science and Engineering Indicators 2010

The “knowledge society”: emergence of a global science and engineering system

- **Open (old style, restricted access industrial laboratories are isolated and not competitive in a globalized science system)**

- **Free, self-assembled, self-organized, self initiative , highly competitive, global, gigantic scientific community**

- **Closely interconnected in real time through the web**

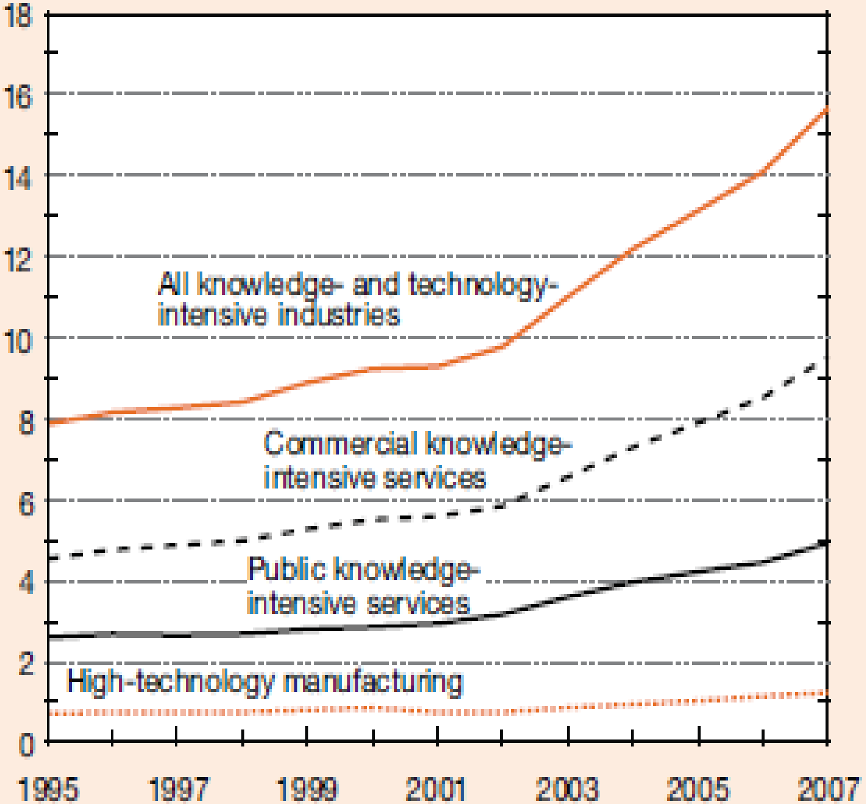
- **Possessing particular values (curiosity, hard working, shearing and multiplication of intelectual property, open dissemination and teaching)**

- **Controlled by simple and widely accepted rules:**
  Ethical codes of good practice, unrestricted publishing,
  external referees, independence of funding agencies and
  panel, advisory committees, strict avoidance of conflicts of interest

- **Successful, lobbying ability, highly respected by society**

Global value added of knowledge- and technology-intensive industries: 1995–2007

Current dollars (trillions)



NOTES: Industries defined by Organisation for Economic Co-operation and Development. See glossary for definitions of knowledge-intensive services and high-technology manufacturing.

SOURCE: IHS Global Insight, World Industry Service database, special tabulations.

Science and Engineering Indicators 2010

1.8×10^{13} $

NANO-TECNOLOGY : The industrial revolution of the XXI century

Sciences and engineering based on the study, understanding , manipulation, designing tools, devices and applications of nano-scale structures, with properties depending on size, according to quantum physics rules.

Nanotechnology is not new!

Natural evolution has been building complex structures and systems using nano-scale components such as aminoacids, proteins, enzimes, DNA fibers, virus, cells…. capable of self-assemble , self-organize, interact and reproduce in large numbers to further evolve into living organisms.

Life is based on nanotechnology!

National Nanotechnology Initiative January 21, 2000

THE INITIATIVE AND ITS IMPLEMENTATION PLAN

"My budget supports a major new National Nanotechnology Initiative, worth $500 million. … the ability to manipulate matter at the atomic and molecular level.

Imagine the possibilities: materials with ten times the strength of steel and only a small fraction of the weight -- shrinking all the information housed at the Library of Congress into a device the size of a sugar cube -- detecting cancerous tumors when they are only a few cells in size.

Some of our research goals may take 20 or more years to achieve, but that is precisely why there is an important role for the federal government."

-- President William J. Clinton

White lighting would represent an enormous market for LEDs in households and workplaces.

Several methods can be used to produce white LED lighting, including combinations of colored LEDs and use of a single blue LED in combination with a phosphor.

These "white LEDs" will require a substantial investment in nanotechnology through development of advanced, efficient LEDs and phosphors.

Dr. Mihail C. Roco
Senior Advisor for Nanotechnology, National Science Foundation
Dr. Roco is the founding chair of the National Science and Technology Council's subcommittee on Nanoscale Science, Engineering and Technology (NSET), and is the Senior Advisor for Nanotechnology at the National Science Foundation.

National Nanotechnology Initiative at Ten:

NANOTECHNOLOGY INNOVATION SUMMIT

DECEMBER 8–10, 2010
GAYLORD CONVENTION CENTER
WASHINGTON, DC

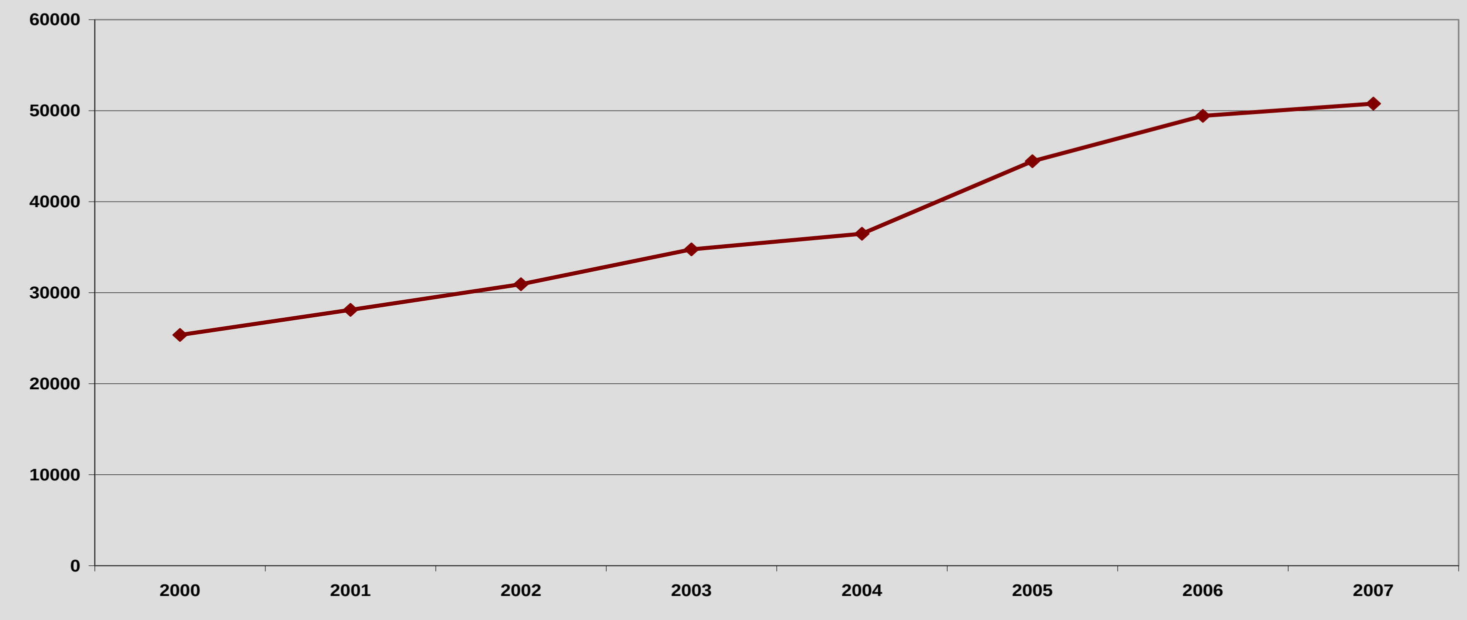
- National Nanotechnology Coordination Office
- Office of Science and Technology Policy
- National Aeronautics and Space Administration
- National Institutes of Health - NCI
- National Institutes of Health - NHGRI
- National Institutes of Health - NIBIB
- National Science Foundation
- National Institute of Standards and Technology
- US Department of Agriculture - FS
- US Department of Agriculture - NIFA
- US Department of Energy
- US Department of Transportation
- US Patent and Trademark Office

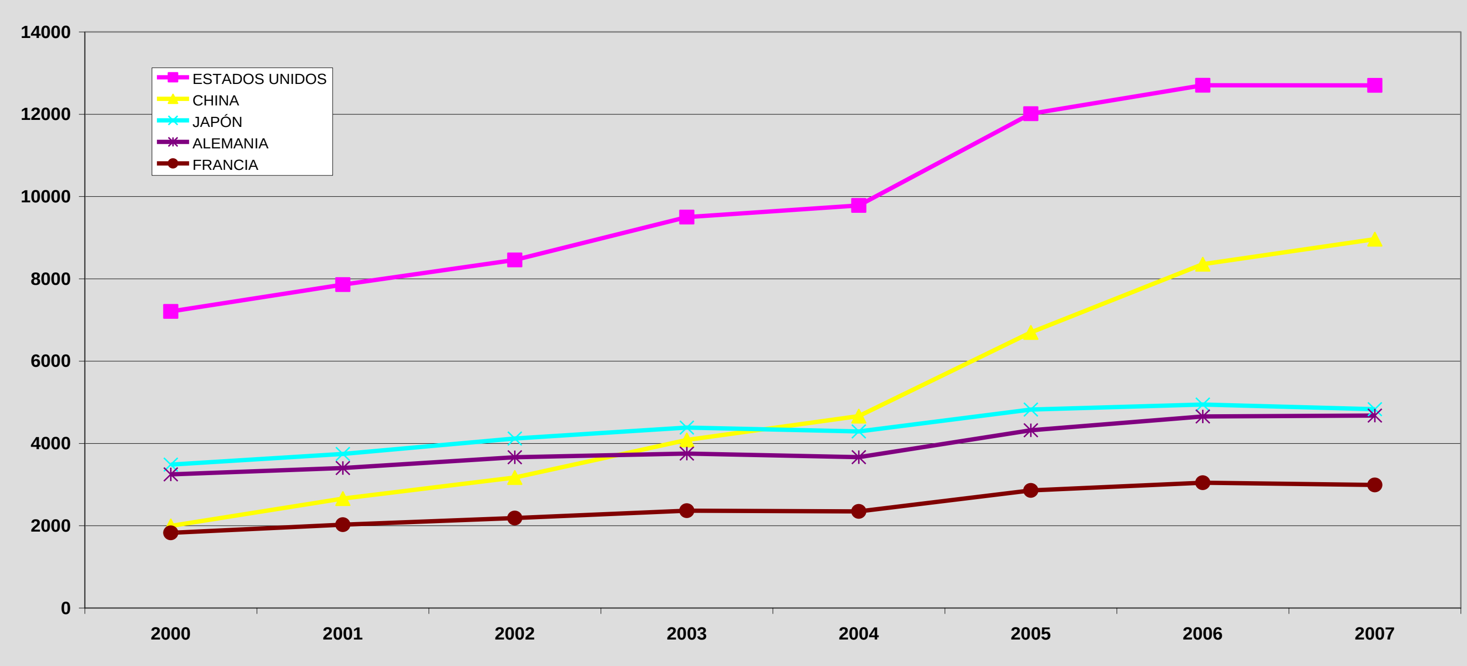
- ACTA Technology Inc.
- Advanced Biomimetic Sensors, Inc.
- Agilent Technologies
- Angstron Materials
- Applied Nanotech, Inc.
- Argonne National Laboratory, Energy Systems Division
- Atomically Precise Manufacturing Consortium (APMC)
- Banyan Environmental, Inc.
- BEE International
- BioNanomatrix, Inc.
- Brewer Science, Inc.
- Bruker Corp
- Buckeye Composites
- California NanoSystems Institute
- Center for Hierarchical Manufacturing
- Center for Nanoscale Science & Technology - NIST
- Clariant Corporatio
- CytoViva, Inc.
- Envia Systems
- eSpin Technologies, Inc.
- Georgia Aerospace Systems
- Hewlett-Packard

Hoowaki, LLC
IBM Research
Idaho National Laboratory
Innovative Materials and Processes, LLC
Inpria Corporation
Intelligent Material Solutions
Lawrence Berkeley National Laboratory- The Molecular Foundry
Liquidia Technologies, Inc.
Lockheed Martin
Los Alamos National laboratory
Materials Research Institute at Northwestern University
MDS Coating Technologies Corporation
Modumetal, Inc.
NanoAxis LLC
Nanocomp Technologies, Inc.
NanoInk, Inc.
NanoIntegris
NanoMech
Nanomix, Inc.
NanoProfessor
NanoRods, LLC
NanoScale Corporation
Nanosphere, Inc.
Nanosys, Inc.
Nanotechnology Center for Learning and Teaching (NCLT)
National Institute for Occupational Safety and Health - CDC
National Reconnaissance Office Director's Innovation Initiative Program
National Venture Capital Association
New Jersey Institute of Technology
nGimat
North Carolina A&T State University and University of North Carolina at Greensboro - Joint School of NanoScience & Nano Engineering
Northwestern University
NovaCentrix
NSF Nanoscale Science and Engineering Center for High-rate Nanomanufacturing

Oak Ridge National Laboratory - Industrial Technologies Program
Oklahoma Nanotechnology Initiative
ONAMI, Inc.
Optomec, Inc
Pacific Northwest National Laboratory
Pennsylvania NanoMaterials Commercialization Center
Pixelligent Technologies, LLC
Planar Energy, Inc.
QD Vision, Inc.
Rensselaer Nanotechnology Center (RNC)
Safer Nanomaterials and Nanomanufacturing Initiative
Sandia and Los Alamos National Laboratories - Center for Functional Nanomaterials
Savannah River National Laboratory
Sensor Electronic Technology, Inc.
SRI International
Stanford University
SouthWest NanoTechnologies
Swan Chemical, Inc.
Technology Innovation Program - NIST
The Center for Integrated Nanotechnologies
The Federal Laboratory Consortium
Transformation Nanotechnologies, LLC
University of Central Florida - NanoScience Technology Center
University of Massachusetts Lowell
University of North Carolina-Chapel Hill
University of Oregon, Center for Green Materials Chemistry
University of Pittsburgh, Petersen Institute of Nanoscience and Engineering
University of Virginia, nanoStar Institute
US Department of Energy - Nanoscale Science Research Centers
Virginia Tech
Vorbeck Materials Corp.
Weinberg Medical Physics LLC
Wildcat Discovery Technologies, Inc.

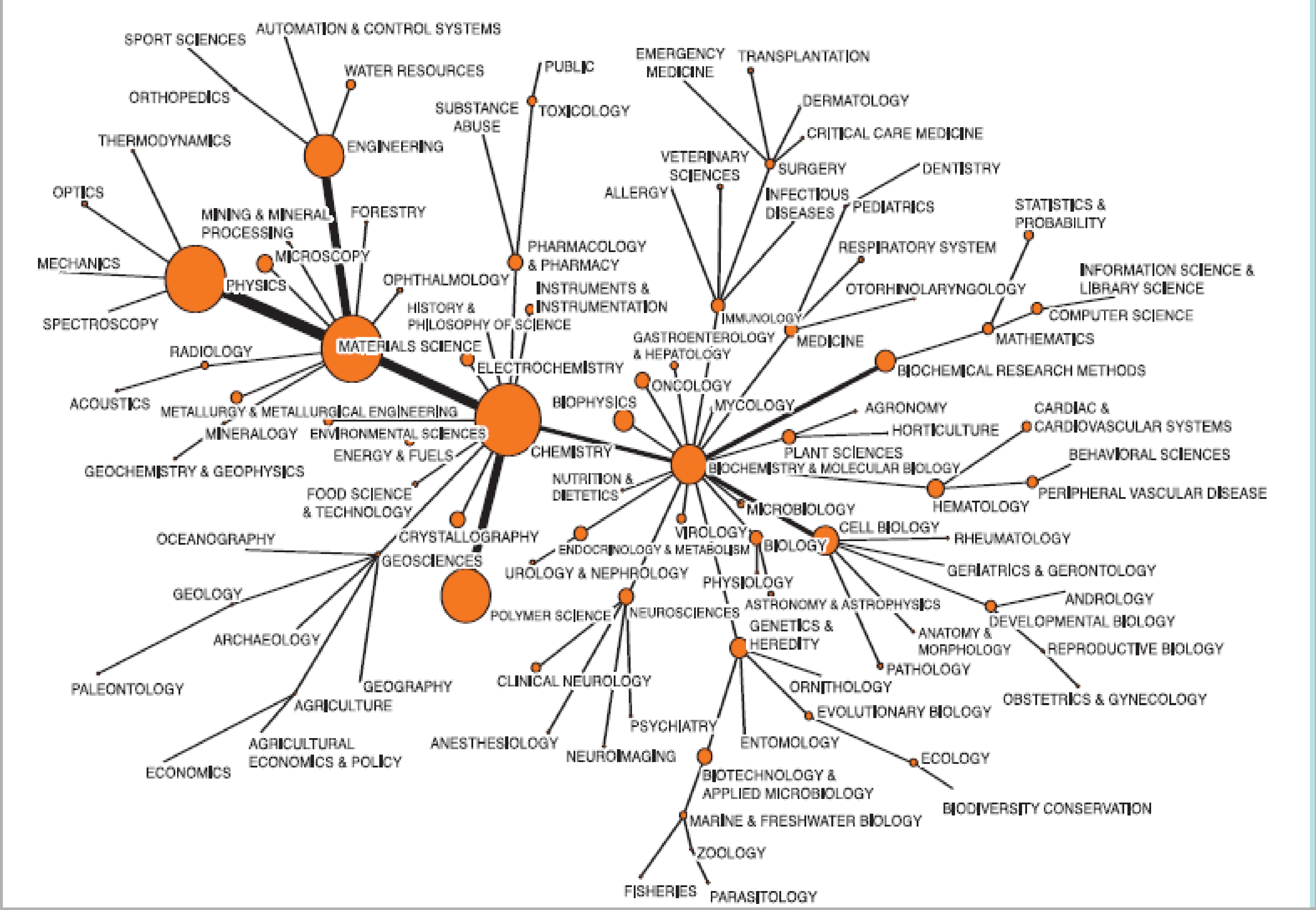
ISI publications on nano- science and nano-engineering (2000-2007)





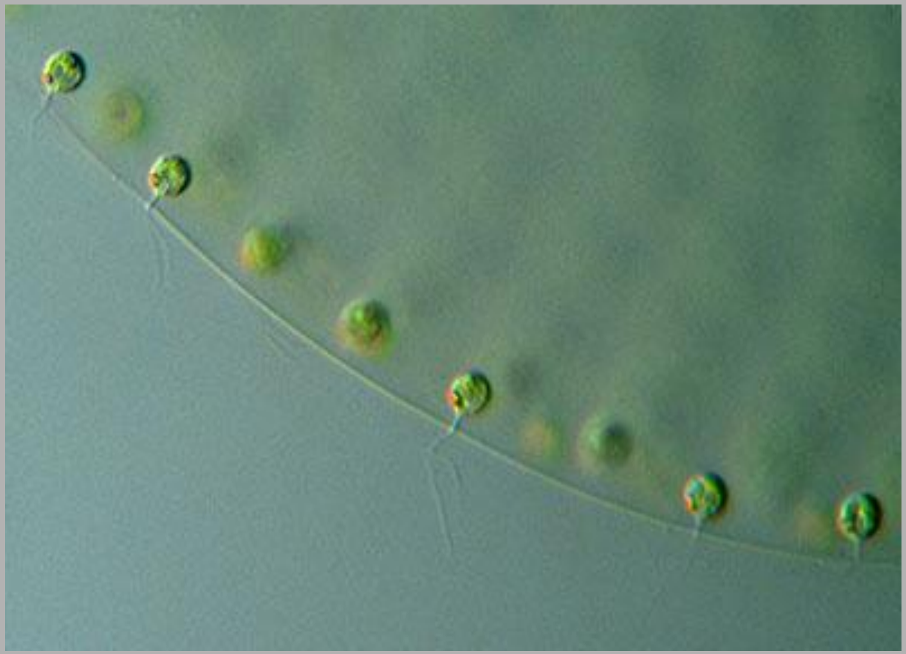
Fuente: Elaboración a partir de datos de SCI-WOS.

nano-citations network for science and technology area (2007)

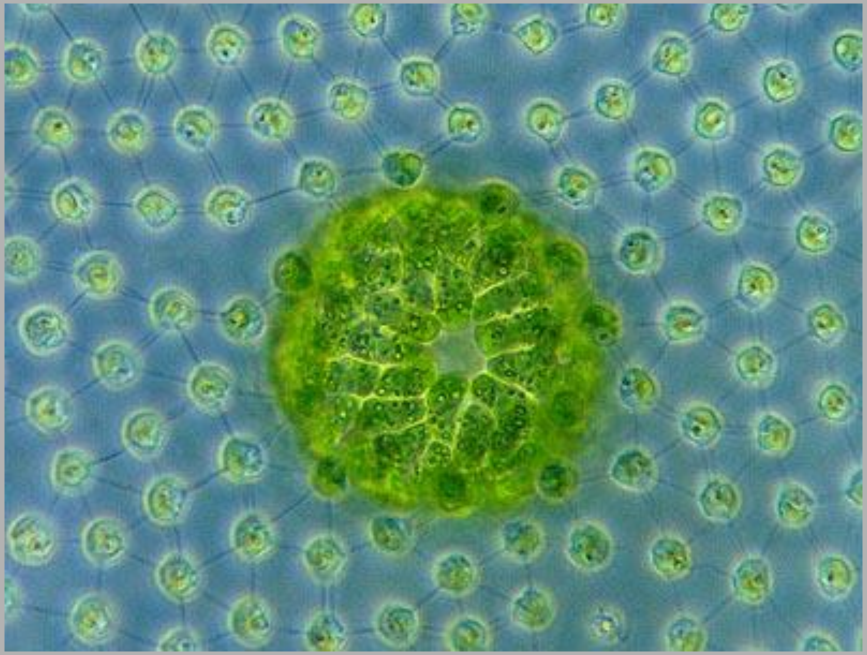


- Natural nanotechnology has been developed by evolution to create and maintain life, in equilibrium with Earth environment during billions of years
- Living beeings incorporate very efficient nano-robot defense strategies (inmune system) against external aggressors such as nanoparticles, virus, bacteria, artificial nanodevices.
- Most artificial nanoparticles and bona-fide nanodevices are detected, neutralized or encapsulated before they can create problems unless intentionally engineered to cheat the inmune system.

Volvox is a Chlorophyte, or green alga. It exists as a grand spherical colony. Each little alga cell within the colony bears two flagella, whip-like hairs. The individual alga cells are connected to each other by thin strands of cytoplasm that enable the whole colony to swim in a coordinated fashion. The individual alga cells also have small red eye spots.



A close-up of individuals cells within the colony,
2 flagella and red eyespot are visible.



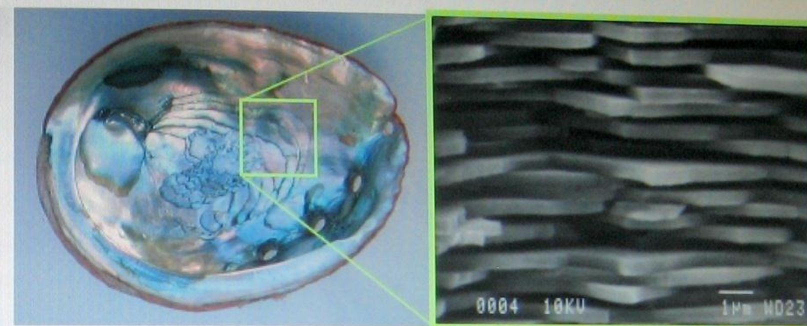
The individual alga cells are connected by thin strands of cytoplasm forming a self-assembled membrane.

The ultimate best-seller

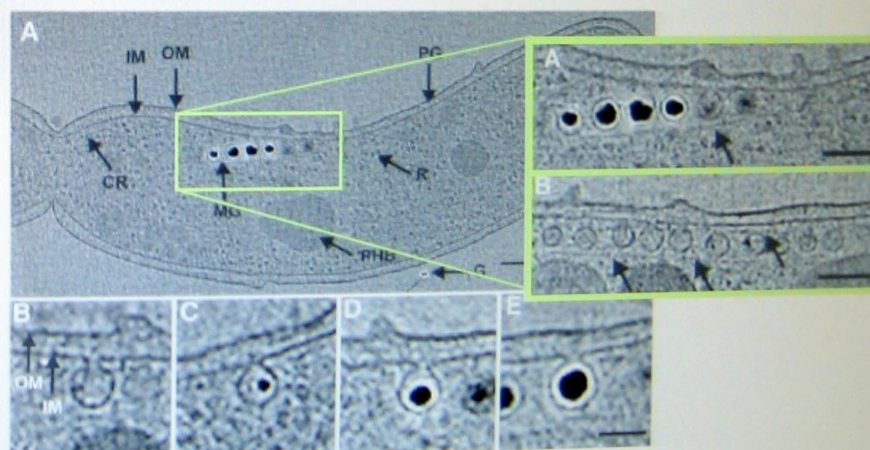
Green algae code has been edited for 1 bilion years without much changes.
Estimated number of copies $>10^{32}$

Biomineralization

Diatom, SiO_2 Morse group, UCSB

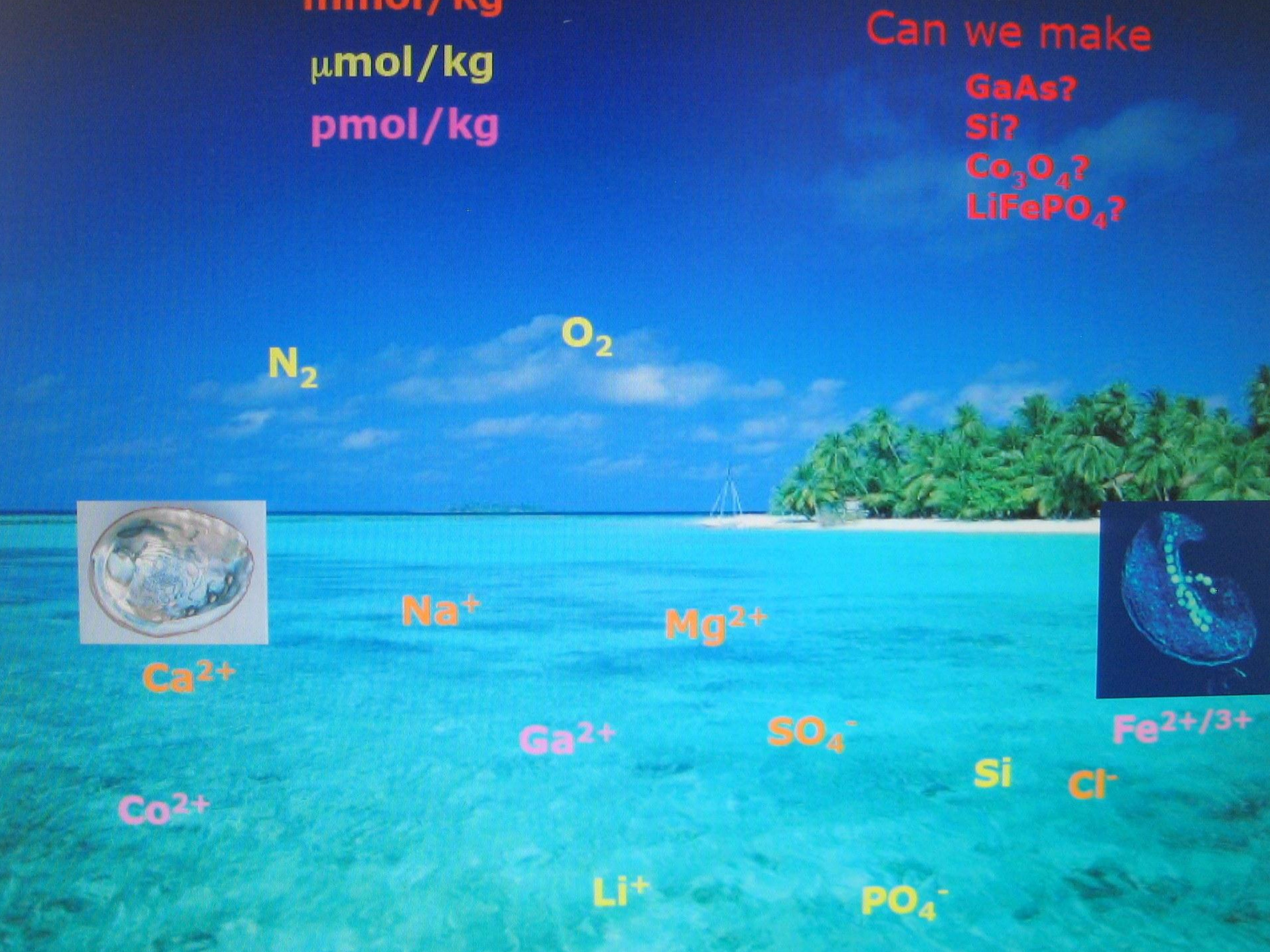


Abalone shell $CaCO_3$ Belcher et al. *Nature* (1996)



Magnetosome Bacteria, Fe_3O_4

A. Komeili et al., *Science* 311, 242 (2006)



μmol/kg
pmol/kg
Can we make
GaAs?
Si?
Co_3O_4?
$LiFePO_4$?
O_2
N_2
Na^+
Mg^{2+}
Ca^{2+}
Ga^{2+}
SO_4^-
$Fe^{2+/3+}$
Si
Cl^-
Co^{2+}
Li^+
PO_4^-

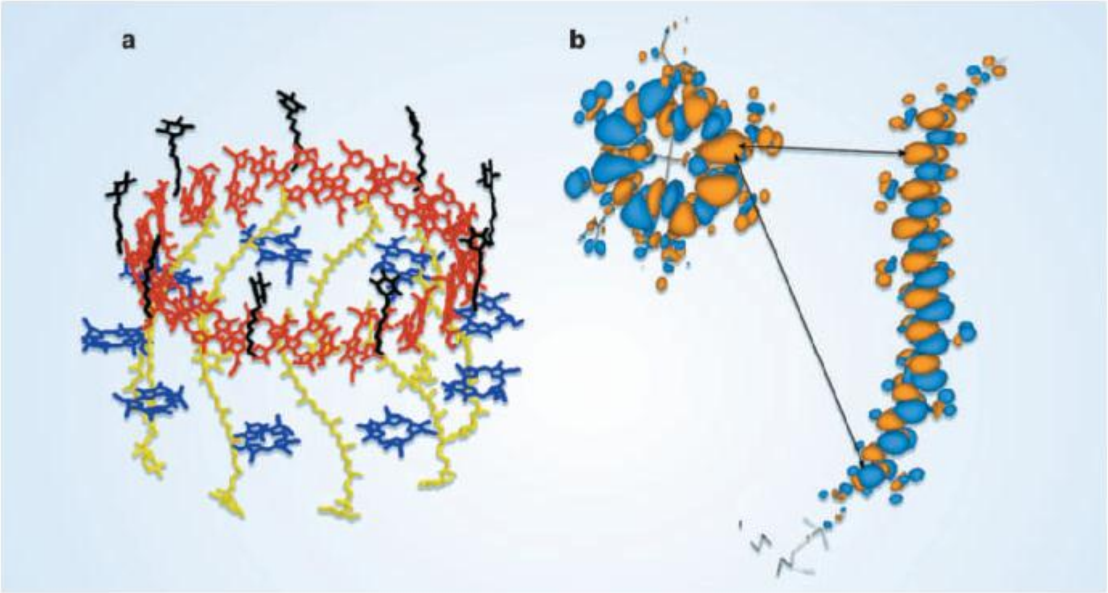


Figure 1 **Designs for energy transfer.** a, **Chromophores in a model of light-harvesting complex (LH) 2 from the bacterium *Rhodopseudomonas acidophila* (Fig. 2), radius 3.4 nm. B800 bacteriochlorophyll molecules (blue) are widely spaced and constitute simple donors, but the B850 molecules (red) interact strongly and constitute a complex acceptor in a confined geometry. Through such interactions between molecules, photosynthetic organisms employ quantum mechanics to funnel absorbed photons to the reaction centre. On time scales of less than 1 picosecond, energy flows from the 800-nm-absorbing B800 molecules to the 850-nm-absorbing B850 molecules, and from the carotenoids (yellow) to both B800 and B850.** b, **A real-space picture of electronic interactions between molecules on a submolecular scale, as seen in the transition densities of LH2 bacteriochlorophyll (left) and carotenoid (right) molecules calculated from ground- and excited-state wavefunctions. The different colours represent the sign of the electron density. Instead of one average separation between donor and acceptor defining the energy transfer rate, as in Förster theory, there are clearly many length scales (examples arrowed) over which the various parts of the donor and acceptor electron densities interact.**

NATURE | VOL 431 | 16 SEPTEMBER 2004 | www.nature.com/nature

Quantum mechanics for plants

Graham R. Fleming and Gregory D. Scholes

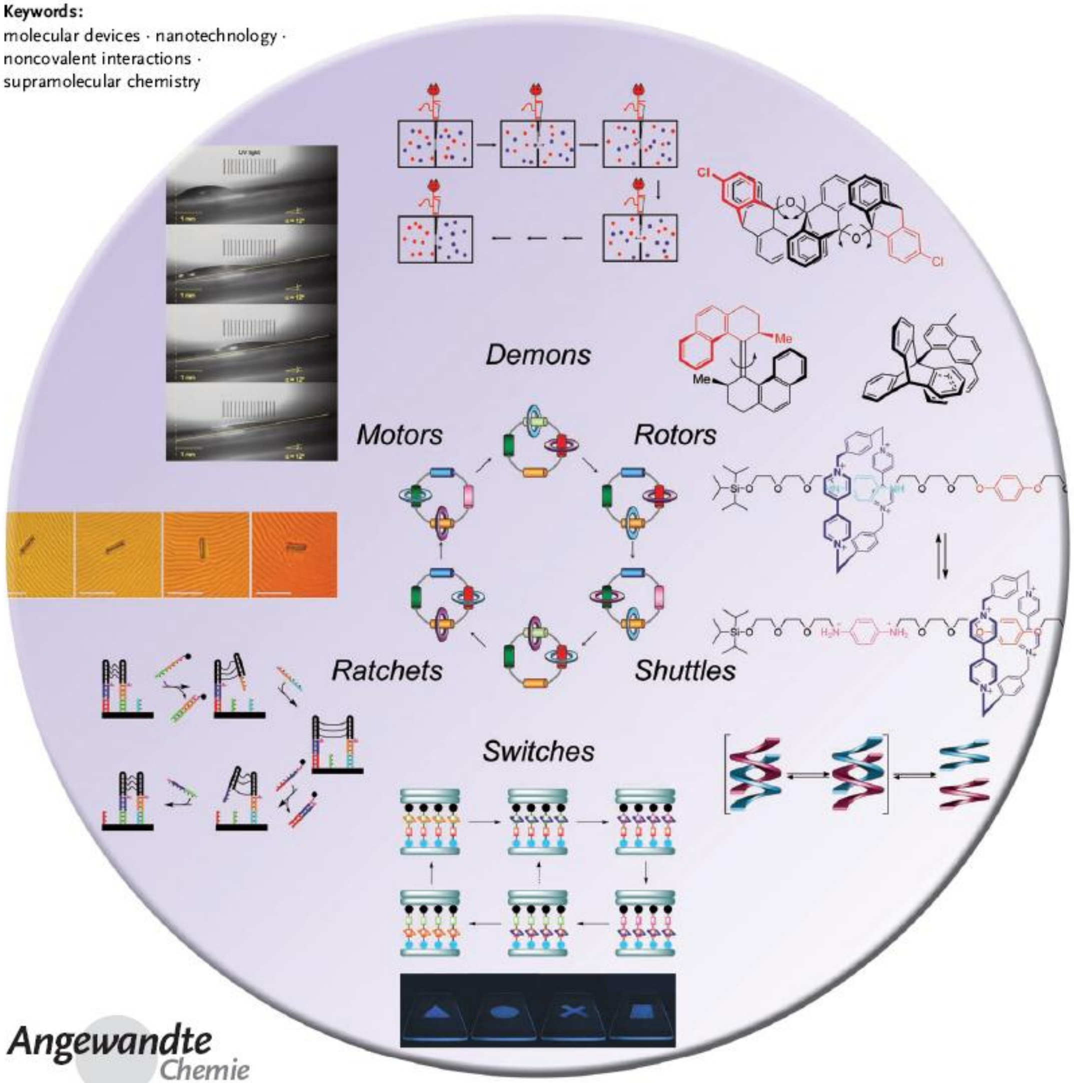
To what extent do photosynthetic organisms use quantum mechanics to optimize the capture and distribution of light? Answers are emerging from the examination of energy transfer at the submolecular scale.

DOI: 10.1002/anie.200504313

Synthetic Molecular Motors and Mechanical Machines

Euan R. Kay, David A. Leigh,* and Francesco Zerbetto*

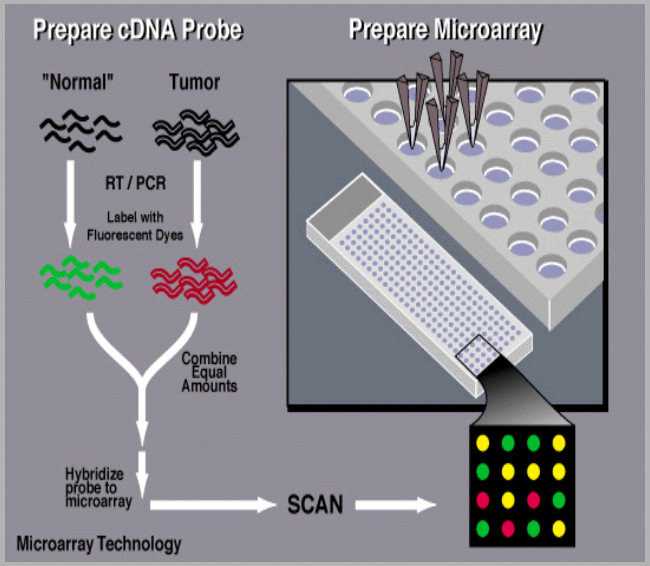
Keywords:
molecular devices · nanotechnology · noncovalent interactions · supramolecular chemistry

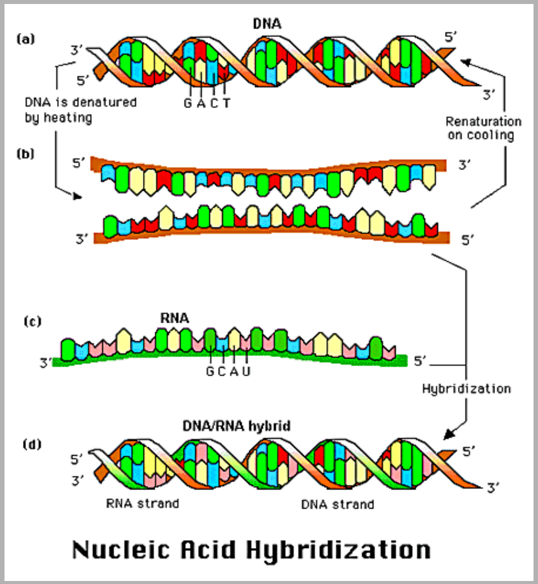


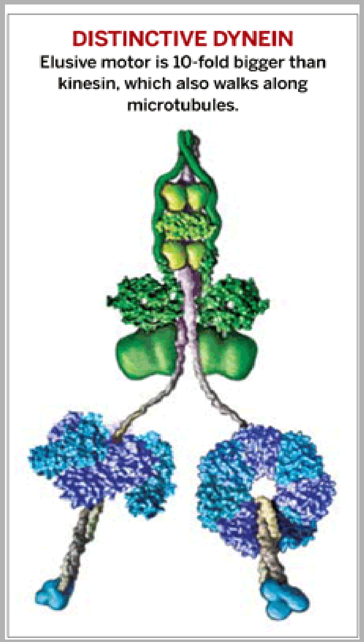
From the Contents

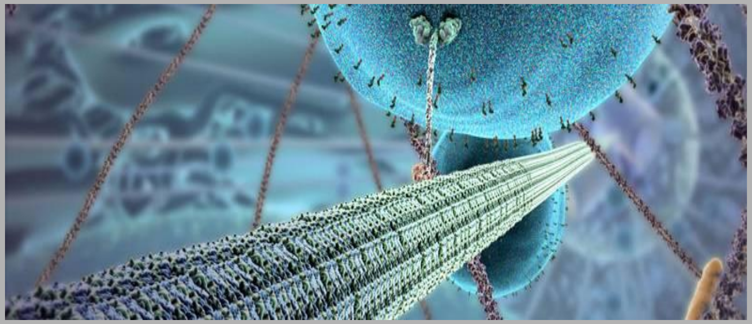
Nanotecnology in biology and medicine:

biosensors, diagnostic kits, molecular image , genomic tools, micro-arrays , functionalized nanoparticles, drug carriers , nano-machines or robots…..

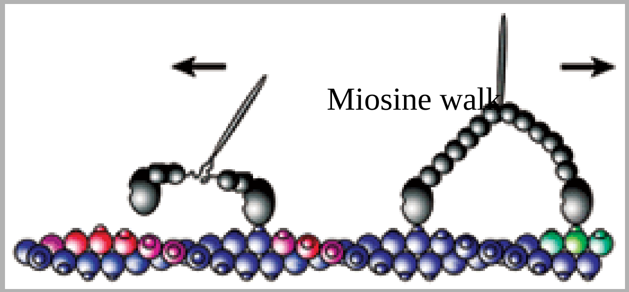








Kinesine transporting a load along a cell microtubule



Small sizes that matter:

Opportunities and risks of Nanotechnologies

Report in co-operation with the OECD International Futures Programme

OECD

Allianz

Editor:
Dr. Christoph Lauterwasser
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Michael Anthony	Barrie Stevens
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7.3. Conclusions for industrial and commercial insurance

Several steps should get high priority for all stakeholders involved in nanotechnologies in the next few years. These include:

- Independent research into the risks of nanoparticles, exposure routes and the effects on humans and the environment. Strengthening the evidence base and allowing public access to the results. Transparency will be a key factor for adequate risk management and public trust,

Developing comparative risk classification schemes and databases, possibly for cross-cutting use by different organisations. Focusing underwriters' and risk engineers' efforts on critical issues such as direct exposure to nanoparticles or their release into the environment.

- Bringing the discussion about nanotechnology to the front line of insurance, that is, to meetings between clients and underwriters and risk engineers,

- Encouraging a willingness to discuss the subject in a way that is not dominated by ideology, and making good use of reviews by independent organisations. Using sustainability as a vision and success criterion.

Risk management approach to nanotechnology from an insurer's perspective

Risk awareness

There is a much uncertainty about emerging risks associated with nanotechnologies. It will take years for studies about exposure routes, the effects on human health and the environment to reach conclusive results. While it is still too early to make conclusive statements, our own risk management will need constantly to "put its feelers out."

The first step in our risk management toolbox is to create an awareness of the risks and an understanding of the hazards. The first step is to determine how underwriters and risk engineers should deal with critical issues such as direct exposure to nanoparticles or their release into the environment.

Scientific Committees

on consumer products
on emerging and newly identified health risks
on health and environmental risk

EUROPEAN COMMISSION

Health & Consumer Protection Directorate-General

Scientific Committee on Consumer Products

SCCP

PRELIMINARY OPINION ON

SAFETY OF NANOMATERIALS IN COSMETIC PRODUCTS

SAFETY OF NANOMATERIALS IN COSMETIC PRODUCTS

Table 2. Examples of nanocosmetic products in the market

Product type	Examples
After sun products	VITAMIN NANOCAPSULES
Anti aging	FULLERENES Firming Anti-Oxidant Serum FULLERENES Aging Skin Resuscitating Serum MICRONIZED GLUCONOLACTATE Anti Aging Finishing Powder MICRONIZED INGREDIENTS Vitamin A and C Serum MICRONIZED LIPOSOMES Serum MICRONIZED ZINC OXIDE, MICRONIZED TITANIUM DIOXIDE NANOENCAPSULATED INGREDIENTS RETINOL NANOCAPSULES VITAMIN NANOSOMES OF SODIUM LACTATE, NANOSOMES OF CALENDULA, NANOSOMES OF WITCH HAZEL, NANOSOMES OF GINSENG, NANOSOMES OF UREA, NANOSOMES OF VITAMIN A AND E, NANOSOMES OF PRO-VITAMIN B5, NANOSOMES OF ALPHA-BISABOLOL AND GERMAL II NANOSOMES OF VITAMIN A
Anti-itch / rash cream	MICRONIZED ZINC OXIDE NANOENCAPSULATED INGREDIENTS
Around-eye cream	FULLERENES LYPHAZOME NANOSPHERES MICROSOME Eye Gel MICRONIZED LIPOSOMES
Blush	MICRONIZED INGREDIENTS MICRONIZED POWDER BRUSHES MICRONIZED TITANIUM DIOXIDE (COATED or not WITH DIMETHICONE) MICRONIZED ZINC OXIDE
Body firming lotion	NANO_DELIVERY SYSTEM Reduction Anti-Cellulite NANOSOMES OF CENTELLA ASIATICA
Body wash /cleanser	NANOSOMES OF VITAMIN A
Bronzer/highlighter	MICRONIZED ITALIAN TALC POWDER MICRONIZED ROSE QUARTZ POWDER, MICRONIZED TOPAZ POWDER MICRONIZED ZINC OXIDE NANO-VITAMINS
Camouflage makeup	MICRONIZED GLUCONOLACTATE
Concealed	MICRONIZED POWDER MICRONIZED TITANIUM DIOXIDE, MICRONIZED ZINC OXIDE NANOSPHERES OF HYALURONIC ACID AND FULVIC ACID
Conditioner	MICRONIZED TITANIUM DIOXIDE
Diaper cream	MICRONIZED ZINC OXIDE

7.3. Conclusions for industrial and commercial insurance

Several steps should get high priority for all stakeholders involved in nanotechnologies in the next few years. These include:

- Independent research into the risks of nanoparticles, exposure routes and the effects on humans and the environment. Strengthening the evidence base and allowing public access to the results. Transparency will be a key factor for adequate risk management and public trust,

Developing comparative risk classification schemes and databases, possibly for cross-cutting use by different organisations. Focusing underwriters' and risk engineers' efforts on critical issues such as direct exposure to nanoparticles or their release into the environment.

- Bringing the discussion about nanotechnology to the front line of insurance, that is, to meetings between clients and underwriters and risk engineers,
- Encouraging a willingness to discuss the subject in a way that is not dominated by ideology, and making good use of reviews by independent organisations. Using sustainability as a vision and success criterion.

Risk management approach to nanotechnology from an insurer's perspective

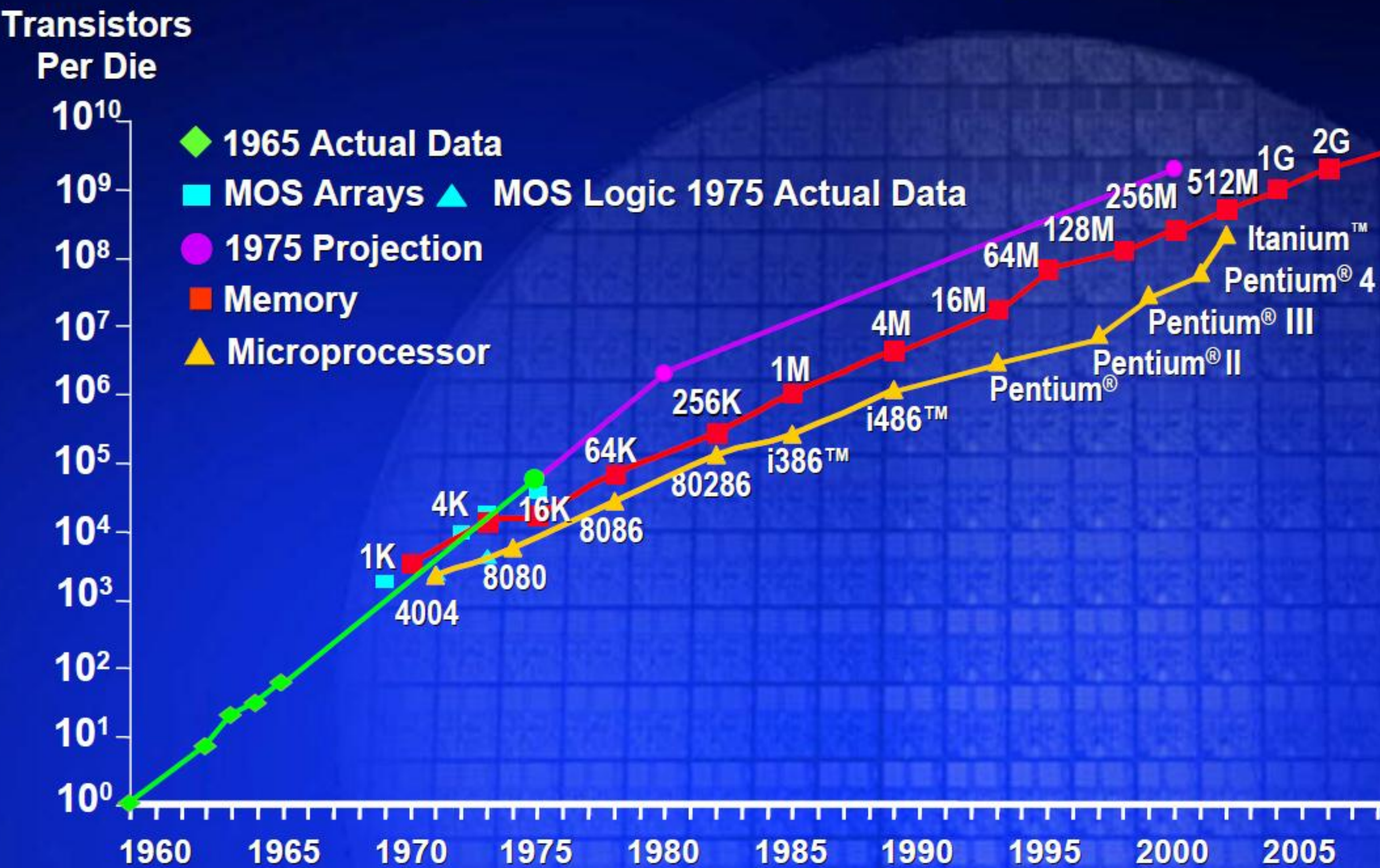
Risk awareness

There is a much uncertainty about emerging risks associated with nanotechnologies. It will take years for studies about exposure routes, the effects on human health and the environment to reach conclusive results. While it is still too early to make conclusive statements, our own risk management will need constantly to "put its feelers out."

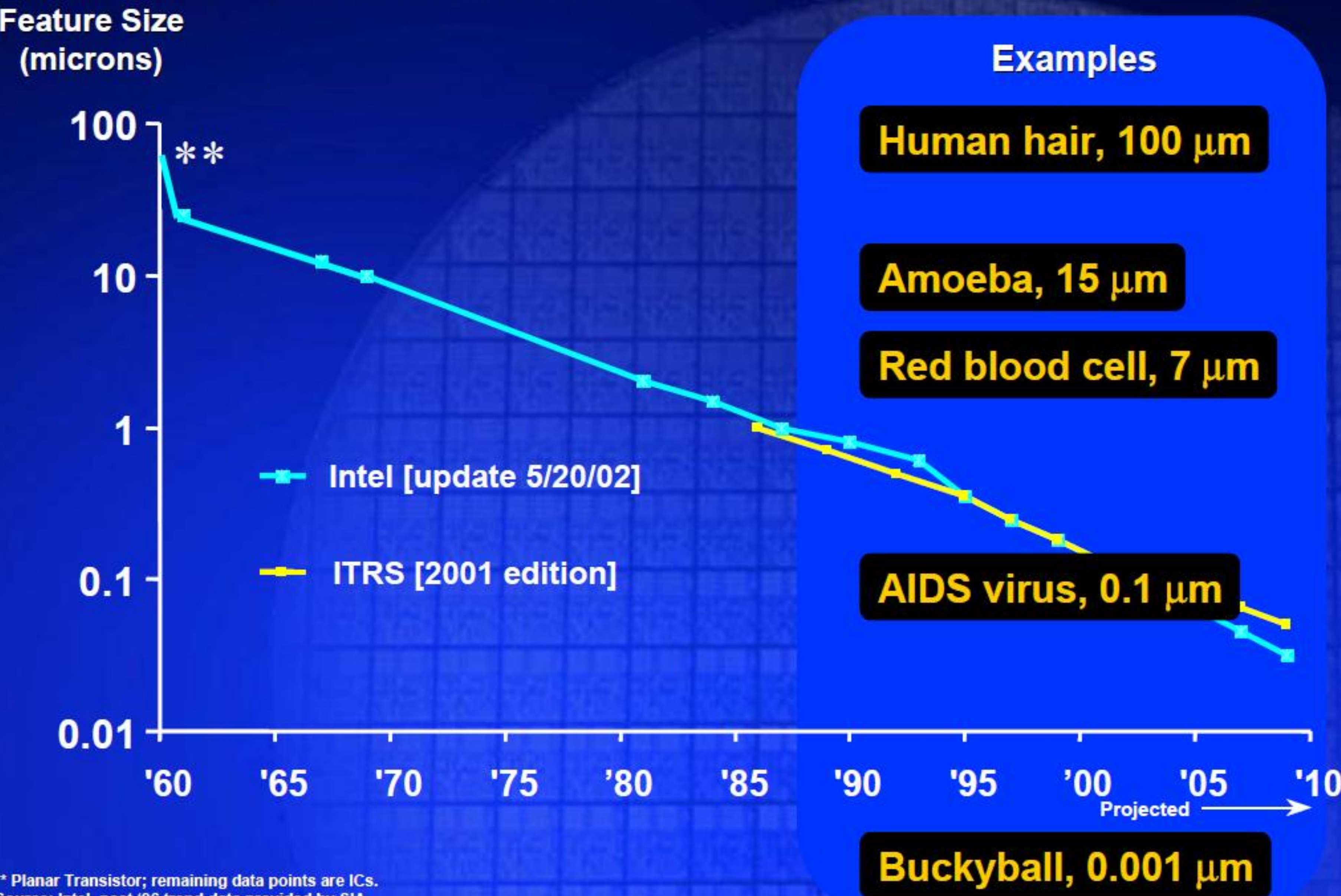
The first step in our risk management toolbox is to create an awareness of the risks and an understanding of the hazards. The first step is to determine how underwriters and risk engineers should deal with critical issues such as direct exposure to nanoparticles or their release into the environment.

Nano-electronics and Nano-photonics

Integrated Circuit Complexity

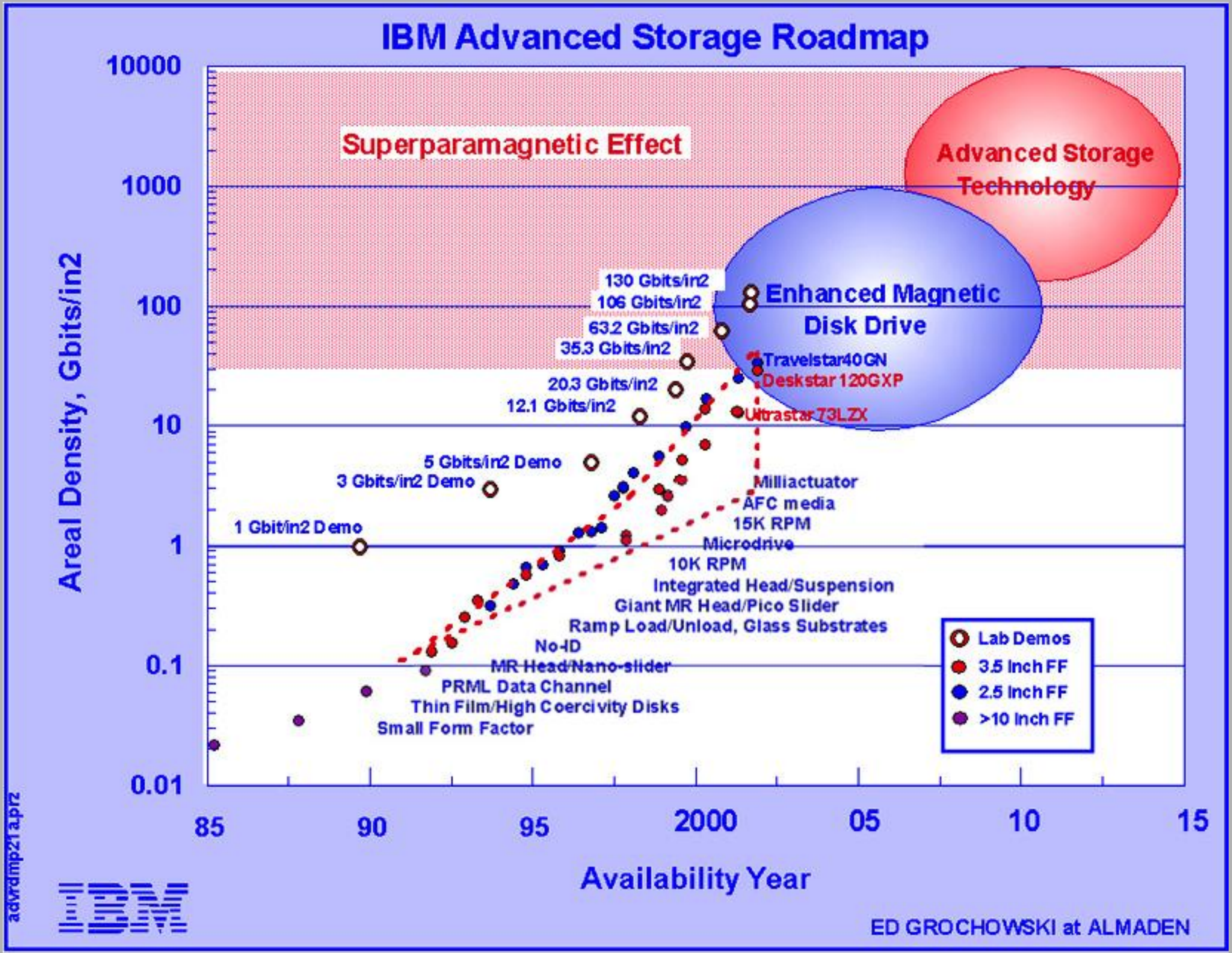


Minimum Feature Size



* Planar Transistor; remaining data points are ICs.
Source: Intel, post '96 trend data provided by SIA
nternational Technology Roadmap for Semiconductors (ITRS)
[ITRS DRAM Half-Pitch vs. Intel "Lithography"]

Moore law for current hard disk technology



Applications of nanostructured III-V Semiconductors (Qwells, Qdots…)

(GaAs, InP, InAs, GaP, GaN, GaSb,AlGaAs, AlInAs .... GaInAsP.....GaInN, AlInN)

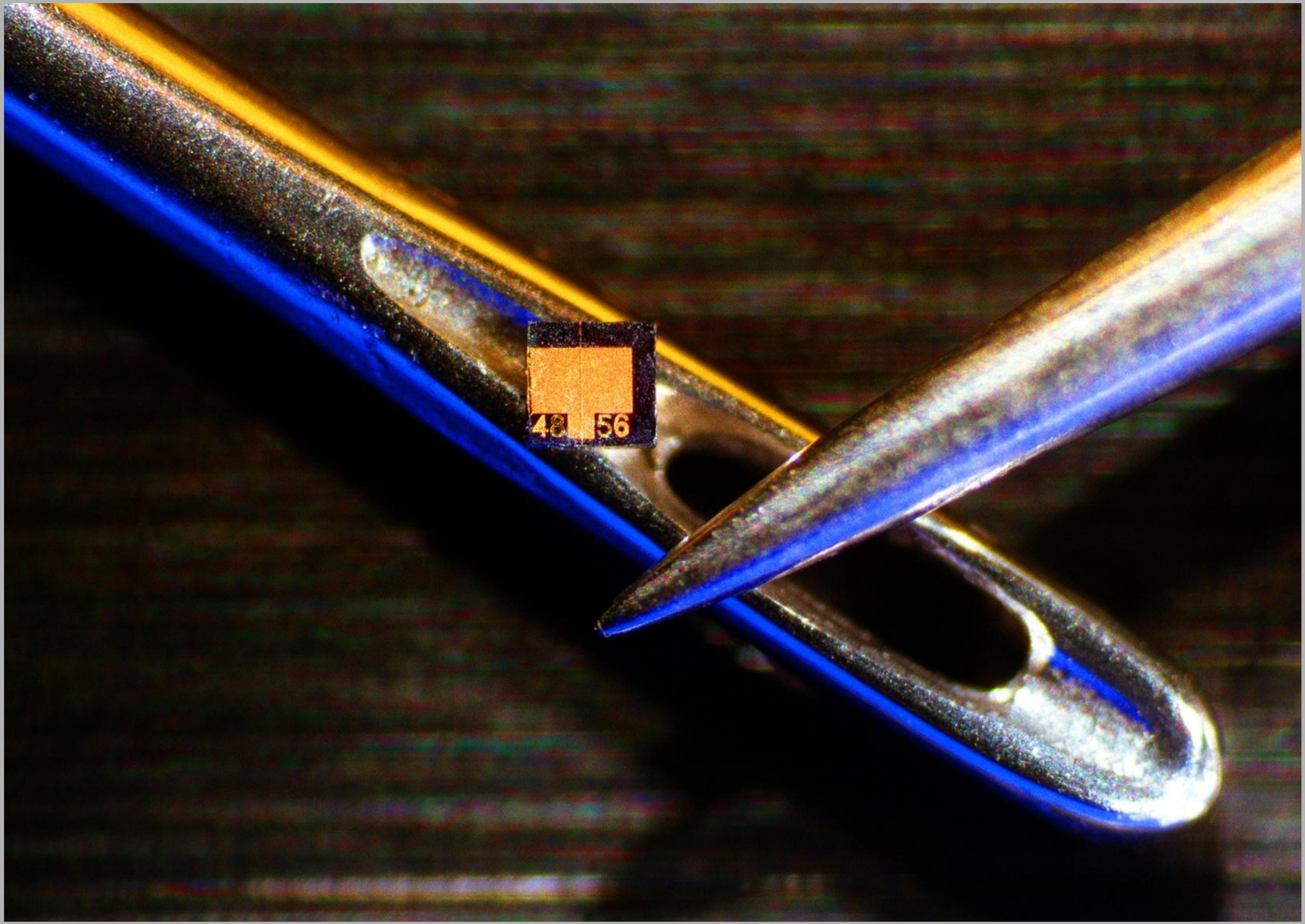
LEDs (aprox. 10.000 milion diodes LEDs/ year)

- Traffic lights
- White illumination, computer, TV , screens
- Automobil headlights

LASER diodes (aprox. 1000 milion Lasers /year):

- Fiber optics communications
- Reading and writing heads for CDs and DVDs
- Laser printers
- Optical sensors, bio-sensors
- Metrology
- Surgery, dentistry,
- Micromachining, welding
- 3D TV

Micrograph of GaAs (10 mW) laser diode chip compared to a needle eye



Unloading a cassette containing sixty four-inch epitaxied aluminum gallium arsenide wafers.

Large scale production of nano-electronic and nano-optoelectronic devices and integrated circuits

INTERNET

Quantum wells and Quantum dots lasers and integrated nanoelectronic and nanophotonic circuits are enabling technologies for fiber optics communications and, therefore, for INTERNET

- Intercontinental Information transmission worlwide

  at 10 Gbit/s per channel (>100 channels/fiber)

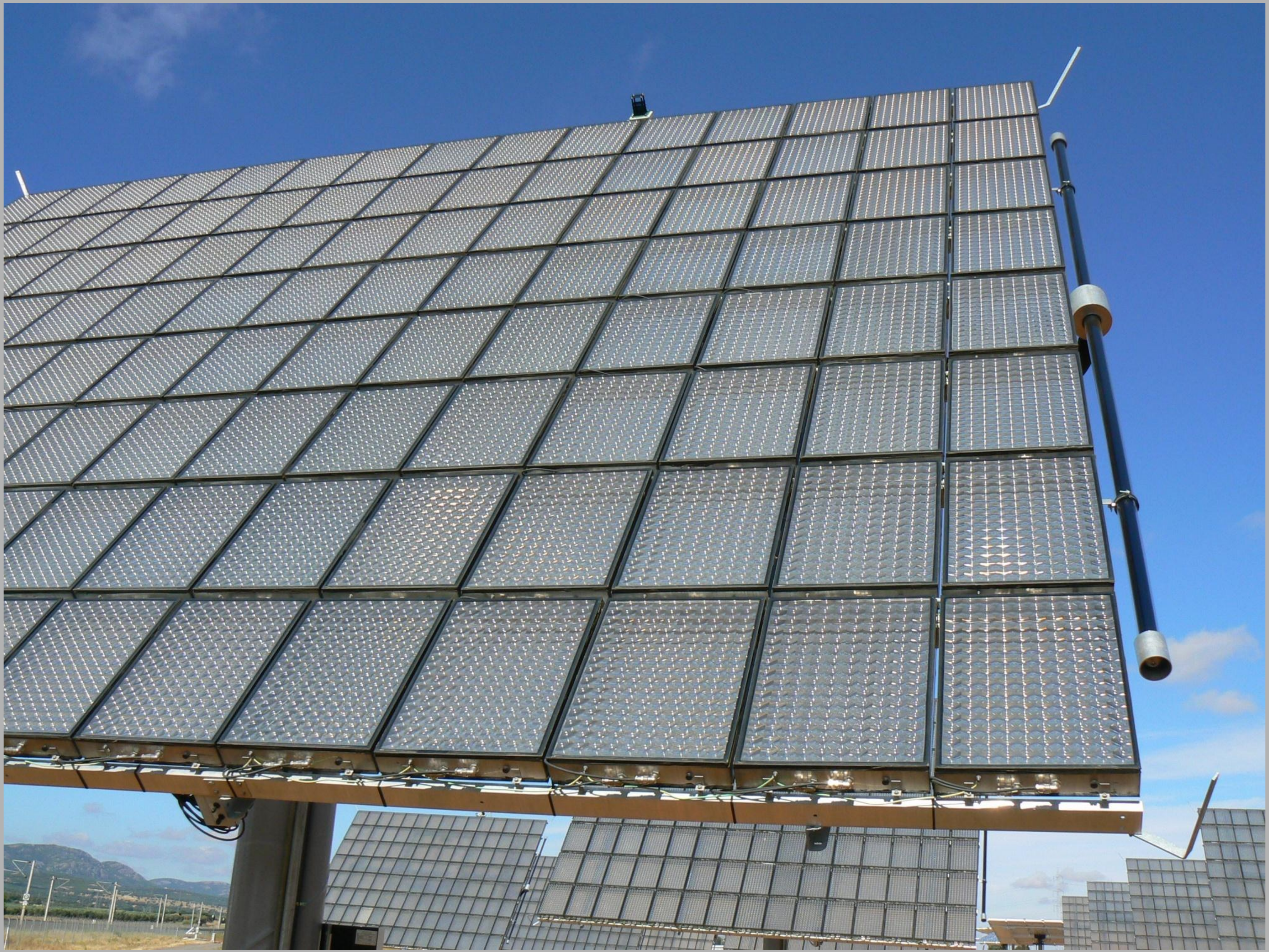
  at 2/3 of light velocity

- About 2000 milion users interconnected in real time, accessing data banks of nearly unlimited capacity and aided by artificial intelligent search engines.

- **Implications?**

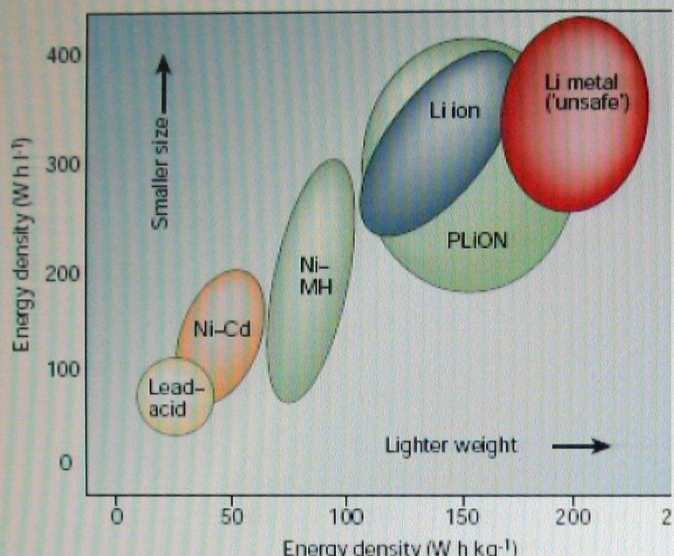
A global artificial intelligence system, incorporating as neurons not only scientist but nearly all people, has been born and is already there

What kind of thi[illegible]?



Highly efficient concentration GaAs solar panels ISFOC Puertollano 2009

Li Ion Battery Technology



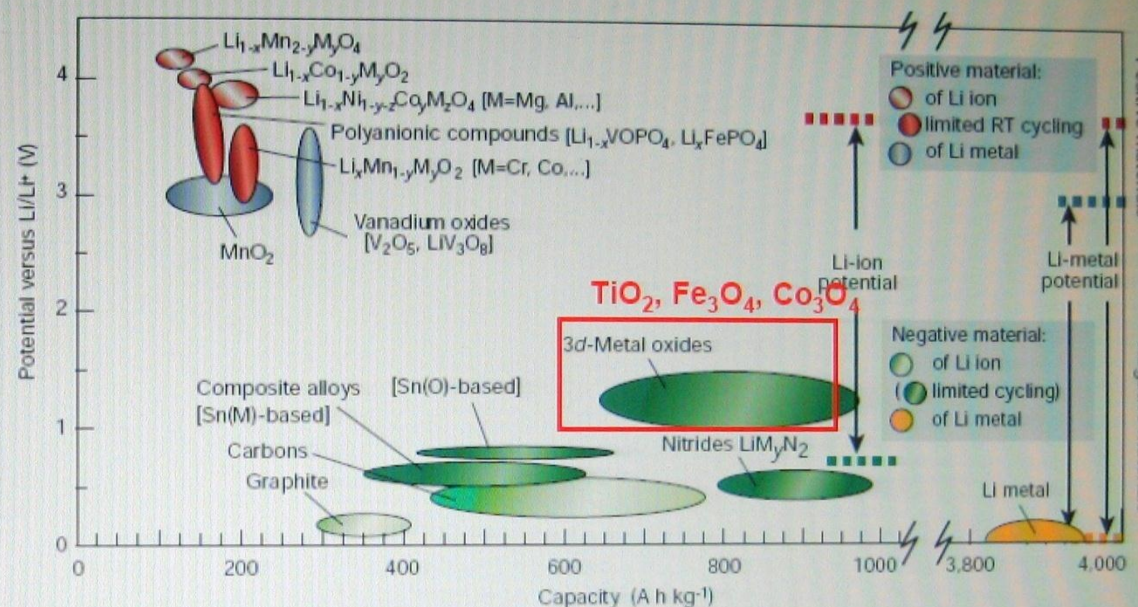


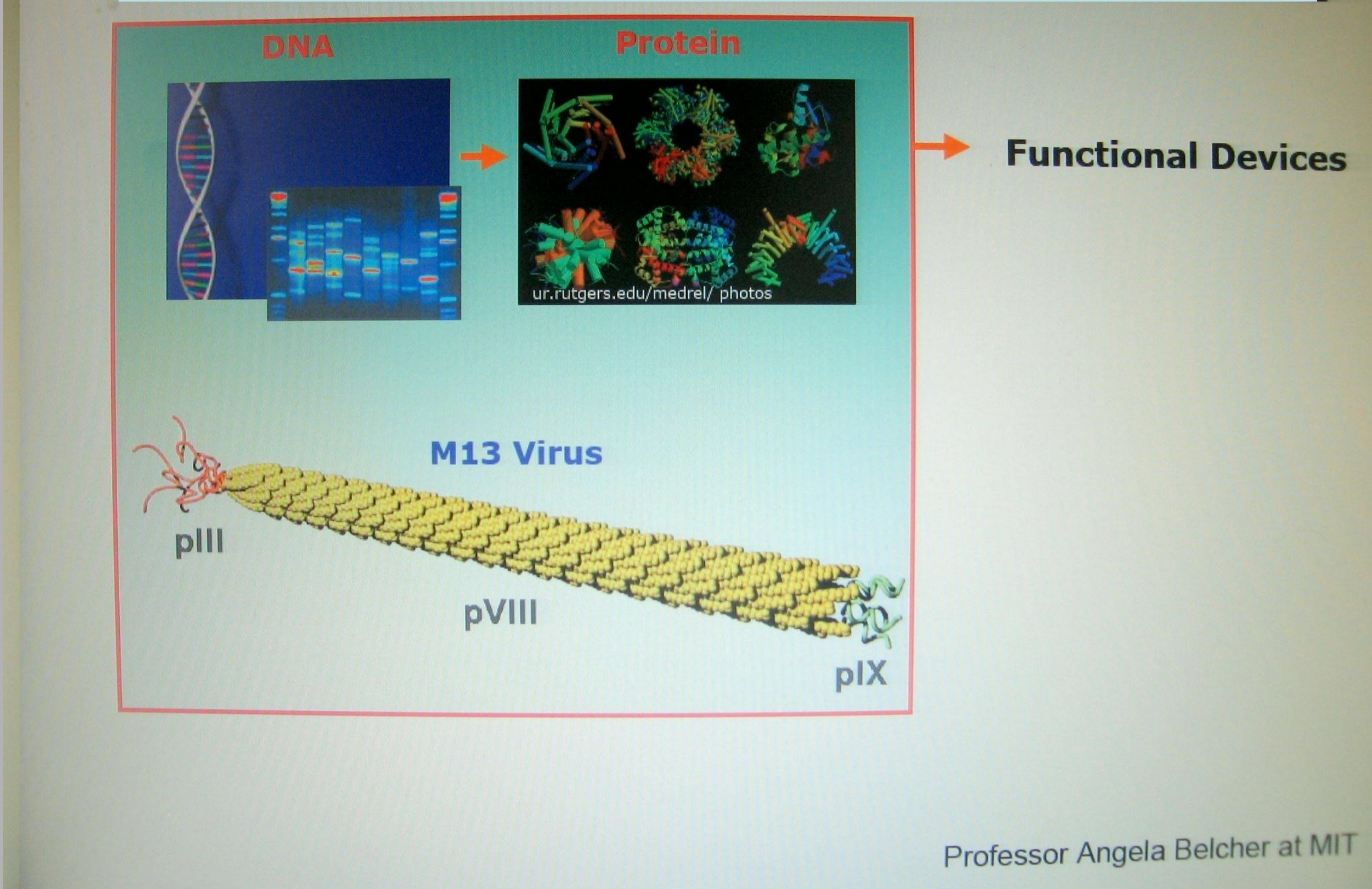
Image :Tarascon Group, Nature (2004)

Li ion based battery

- Low density (0.53 g/cm³)
- Low electron negativity
- high electron/atom mass ratio

The advent of nanoelectronics and the resulting need for Li ion batteries of corresponding size are driving the development of nanoscale components and methods for their assembly.

Self-assembling of nanoelectrodes of cobalt oxide by genetically modified virus (tobacco leaf virus)



Code of Good Scientific Practice

CSIC ETHICS COMMITTEE
PRESIDENT
D. PEDRO PUIGDOMENECH ROSELL PROFESOR DE INVESTIGACION CSIC

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Concluding remarks

Nanocodes are necessary and must be updated regularly in view of the rapid evolution of the particular field and the apparison of unexpected applications, new products and new social and safety implications

Due to the wide interdisciplinary character of nanosciences, covering various research areas, fundamental research carried out at institutions as CSIC and Universities can still be controlled by more general Codes of Good Research Practices

An open discussion and analysis of the deep social implications of new technologies must be promoted within the scientific comunity and widely transmitted to the public.