SCIENCE FOR AND IN INFORMATION SOCIETIES

NORBERT KROO

HUNGARIAN ACADEMY OF SCIENCES and the

EUROPEAN RESEARCH COUNCIL

Budapest 11.11.2011

WE ARE LIVING IN A CHANGING WORLD

Characterized by:

- Rapid technological, political, social und cultural changes
- Financial, economic, political, social, cultural crises
- Decline of the old industries (with their value system)
- Increasing of the knowledge added value of products and services
- Increasing competition combined with decreasing social safeguarding
- Increasing need for making use of the full range of human capacities
- Increasing need for „creative“ labour forces
- Increasing heterogenity of national populations
- Increasing unproductivity of national education systems
- Stormy changes in **East-Central Europe**

AND WE ARE FACING GLOBAL (GRAND) CHALLENGES

And they are problems mankind has experienced never before:

(They include issues such as energy and raw materials supply, the preservation of the environment, competitiveness and employment, health and the security of people)

But the same applies to the scientific and technological develomments of our age

BUT NEW TECHNOLOGIES ARE AVAILABLE

(based on knowledge)

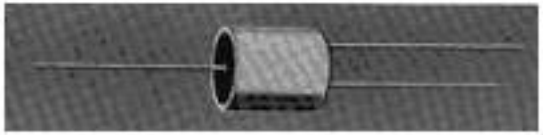
Technologies in the 1950's

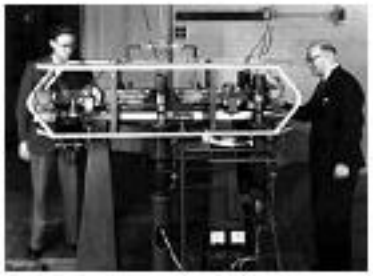
Lasers

Programmable Systems

ENIAC

Transistor



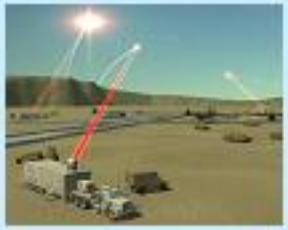


Atomic Clock

DNA

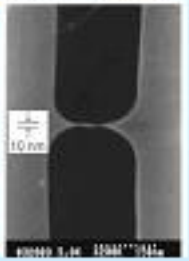
Today for 2015 and beyond…

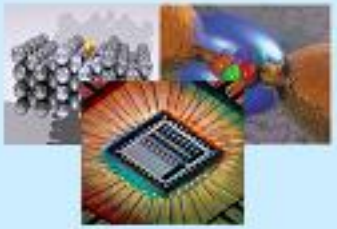
Directed Energy



Robotics

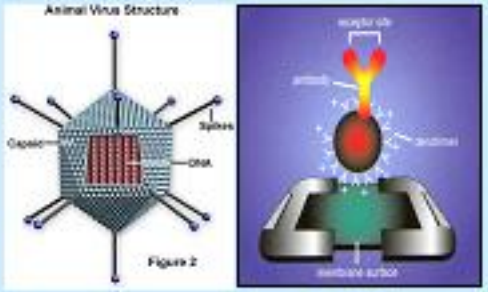
Nanotechnology





Advanced Computing

Immersive Environments



Biotechnology

GROWING SIGNIFICANCE OF KNOWLEDGE

KNOWLEDGE BASED SOCIETY (ECONOMY)

→INNOVATION ORIENTED SOCIETY

RESOURCES (LABOUR, MATERIALS, ENERGY, CAPITAL,

***KNOWLEDGE*). SCIENTIFIC KNOWLEDGE!**

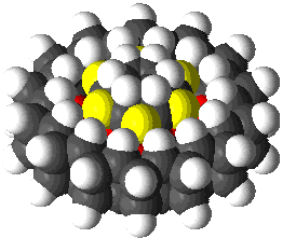
NEW PRACTICES IN RESEARCH (multidisciplinary,groups)

NEW PRIORITIES (sustainable development,jobs, competitiveness)

DRYING OUT TECHNOLOGIES

CRITICAL SIZE: INTERNATIONAL COOPERATION

NEW POTENTIAL REVOLUTIONS (BIO-, NANO-, INFO-TECHNOLOGIES)



1

A top view of the protein-conducting channel, looking down into it. The channel's "plug" is shown in green.

2

3

INFORMATION SOCIETY

WHAT IS NANOTECHNOLOGY?

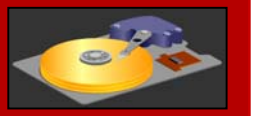
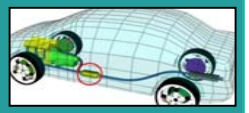
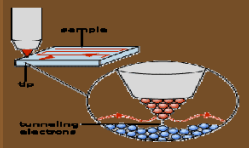
Nanotechnology is the creation of functional materials, devices and systems through control of matter on the nanometer length scale and exploitation of novel phenomena and properties (physical, chemical, biological) at that length scale

"If I were asked for an area of science and engineering that will most likely produce the breakthroughs of tomorrow, I would point to nanoscale science and engineering."

Neal Lane

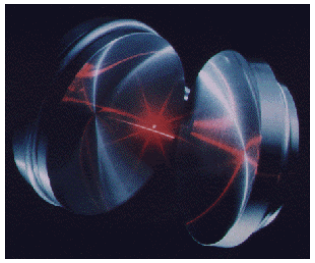
Nanotechnology (applications)

- **Expected to impact upon virtually all technological sectors as an “enabling” or “key” technology**

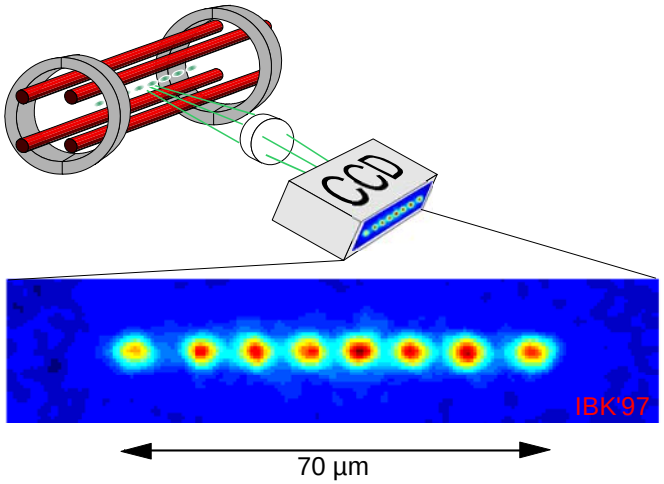
Medicine and Health	Information Technology	Energy Production / Storage	Materials Science	Food, Water and the Environment	Instruments
 Drug delivery	 GMR Hard Disk	 Hydrogen Fuel Cells	 Lightweight and strong	 Remediation methods	 Tunneling microscopy

and Quantum Technologies ??

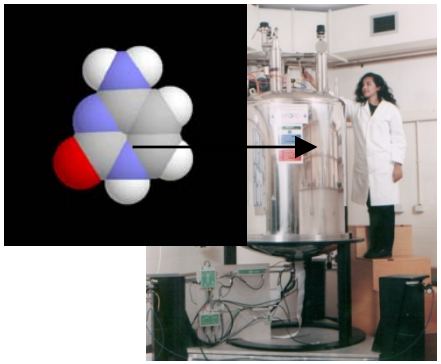
Wide, divergent approaches



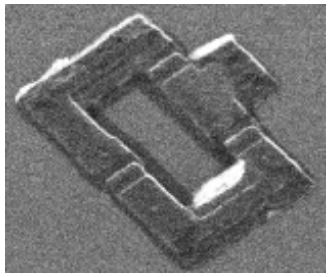
Cavity QED



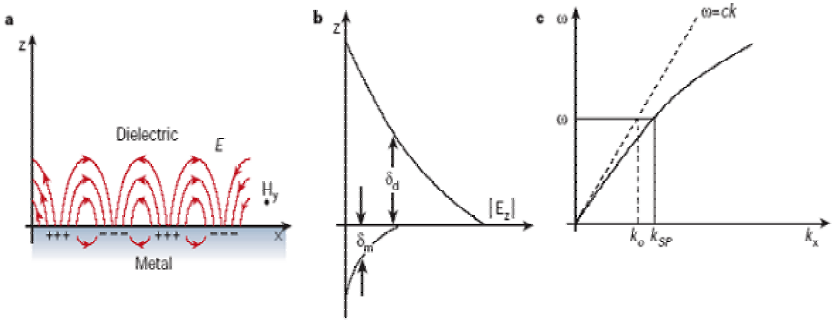
Trapped Ions



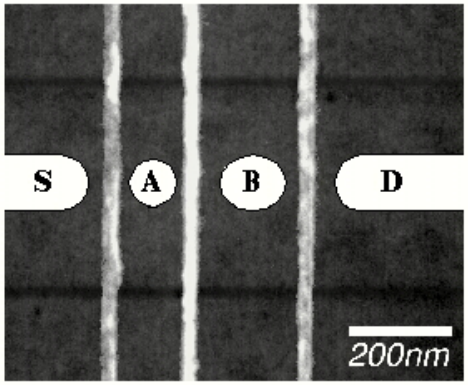
NMR



Superconductors

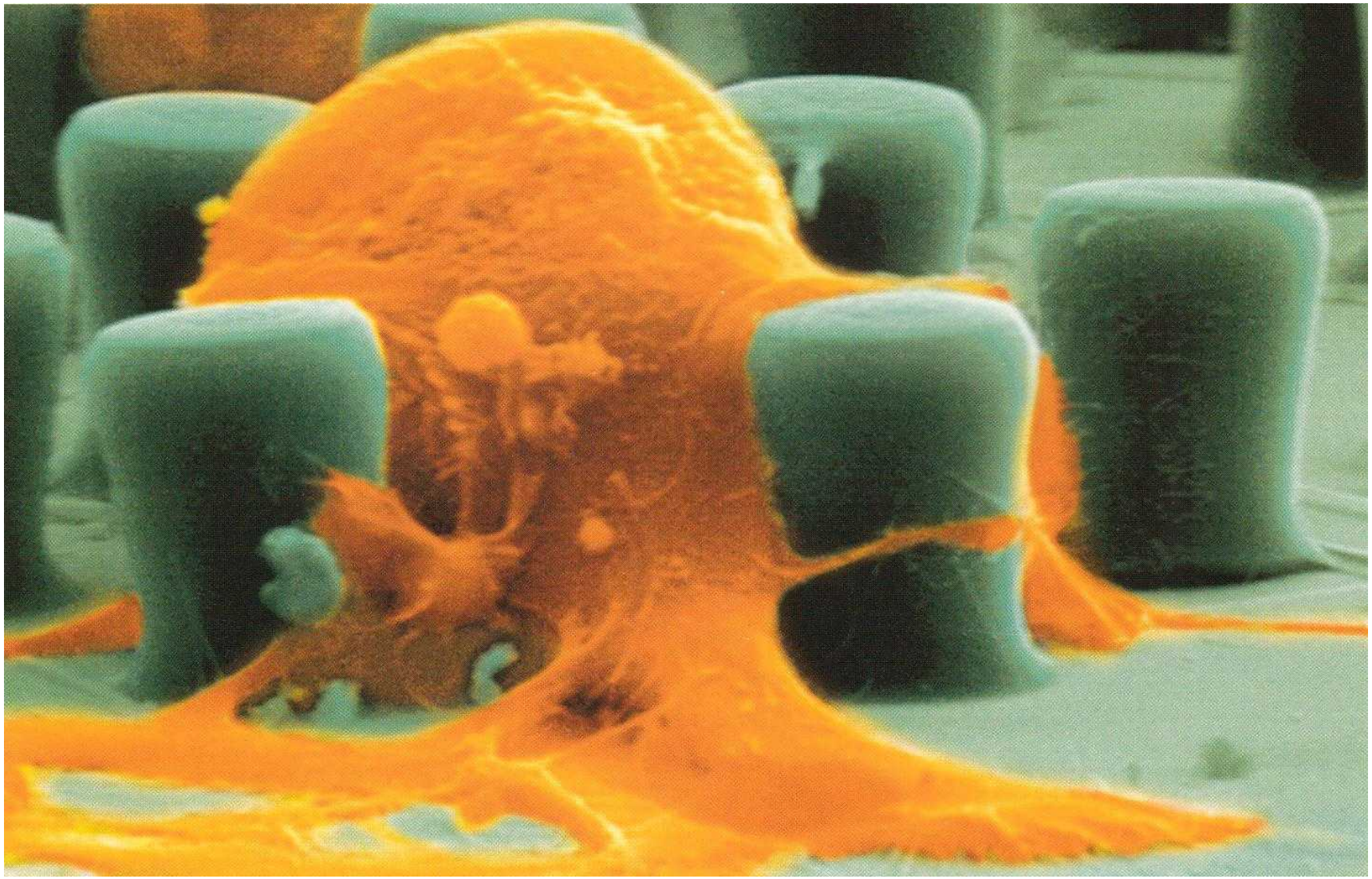


Surface plasmons



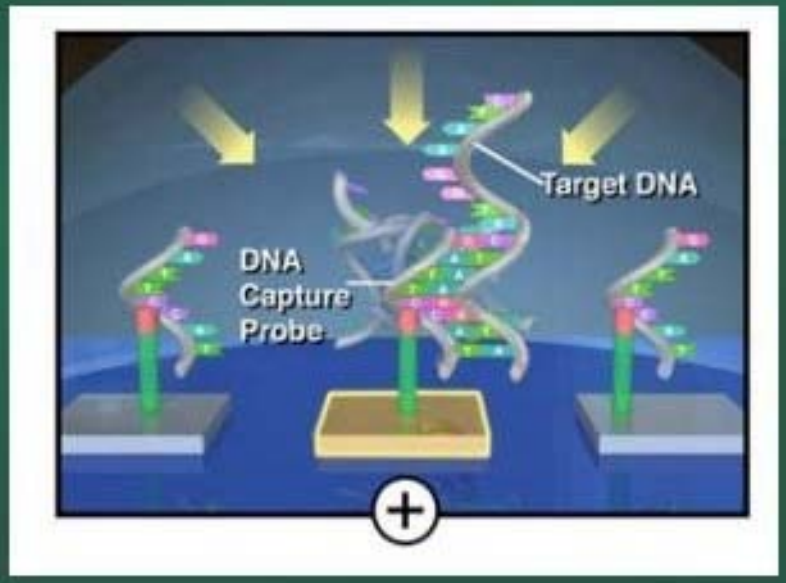
Quantum dots

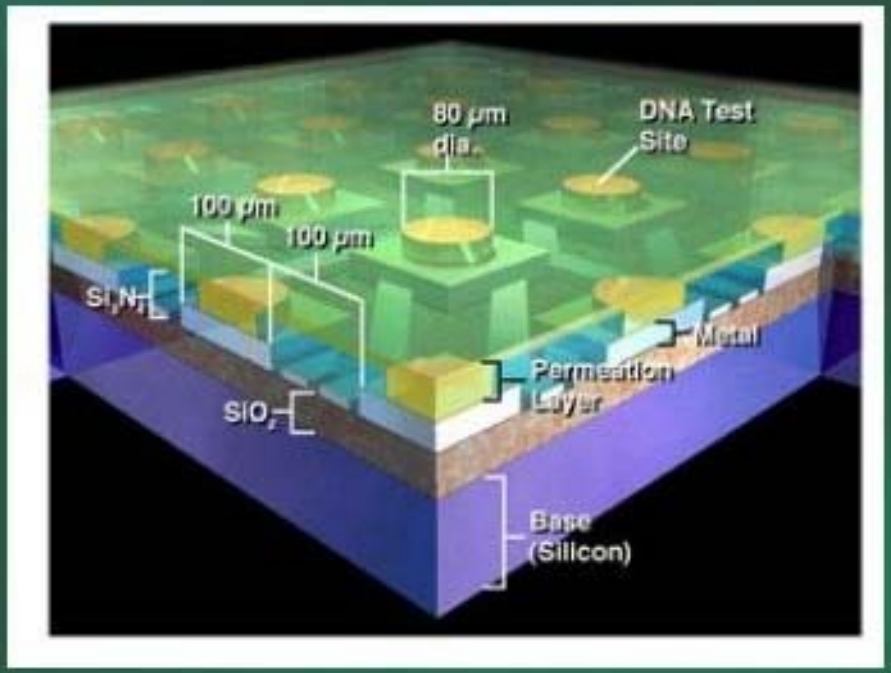
NERVE CELL ON A SILICON CHIP



DNA CHIP

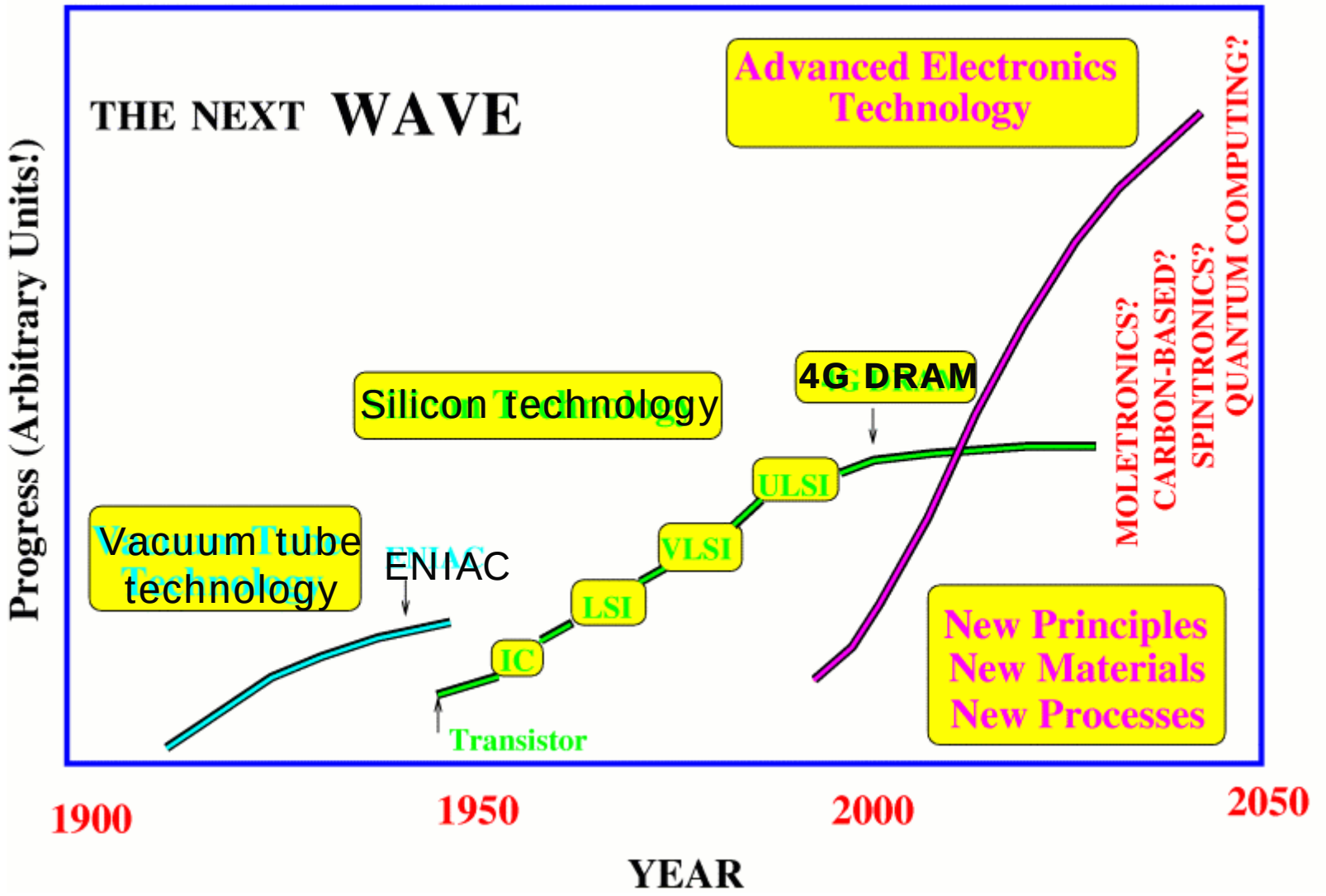
"DNA chip": biomolecules on electronic devices





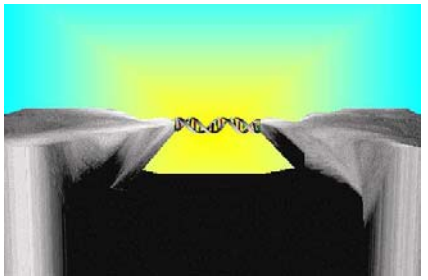
[Nanogen, Inc.]

PROGRESS IN ICT



NEW TECHNOLOGIES = NEW POSSIBILITIES (and challenges)

INFORMATION AND ENERGY



INFORMATION(transfer): PHYICAL QUANTITY

THEREFORE IT HAS ENERGY CONTENT

R. Feynman: To transfer 1 bit information irreversibly in a computational network (at T temperature with ν frequvency on d distance, based on thermodynamical consideration, this energy is

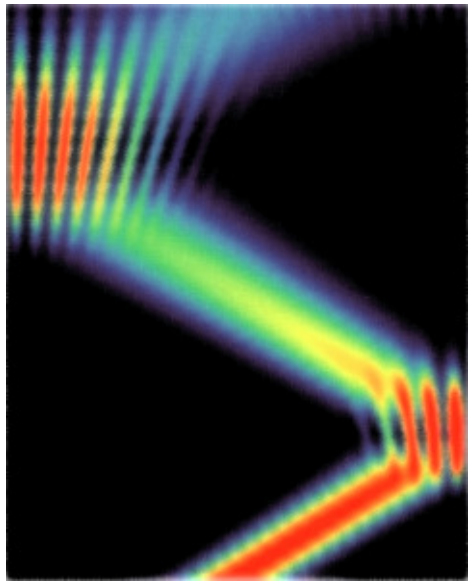
$$E=kTd\nu/c$$

(in 1sec , with 1W power, at room temperature, 10*18 bit information can be transfered to 50nm distance)

SOME CHALLENGES OF INFORMATION TECHNOLOGIES

1. PROCESSOR PERFORMANCE (heatload; multiprocessor chip,new architectures [massive parallel processing], lower operational voltage, new materials, watercooling, etc.)
2. CHIP MINIATURIZATION (70nm $\rightarrow$ 64 bit and below, RAM ON $1\mu^2$)
3. ARTIFICIAL INTELLIGENCY (word processing, computer based learning, robotics)
4. CYBER-PHYSICAL TECHNOLOGIES
5. OPTICAL (PLASMONIC) TECHNOLOGIES

ALL-OPTICAL INFORMATION TECHNOLOGY SYSTEMS?



INFORMATION GENERATION (LASERS)

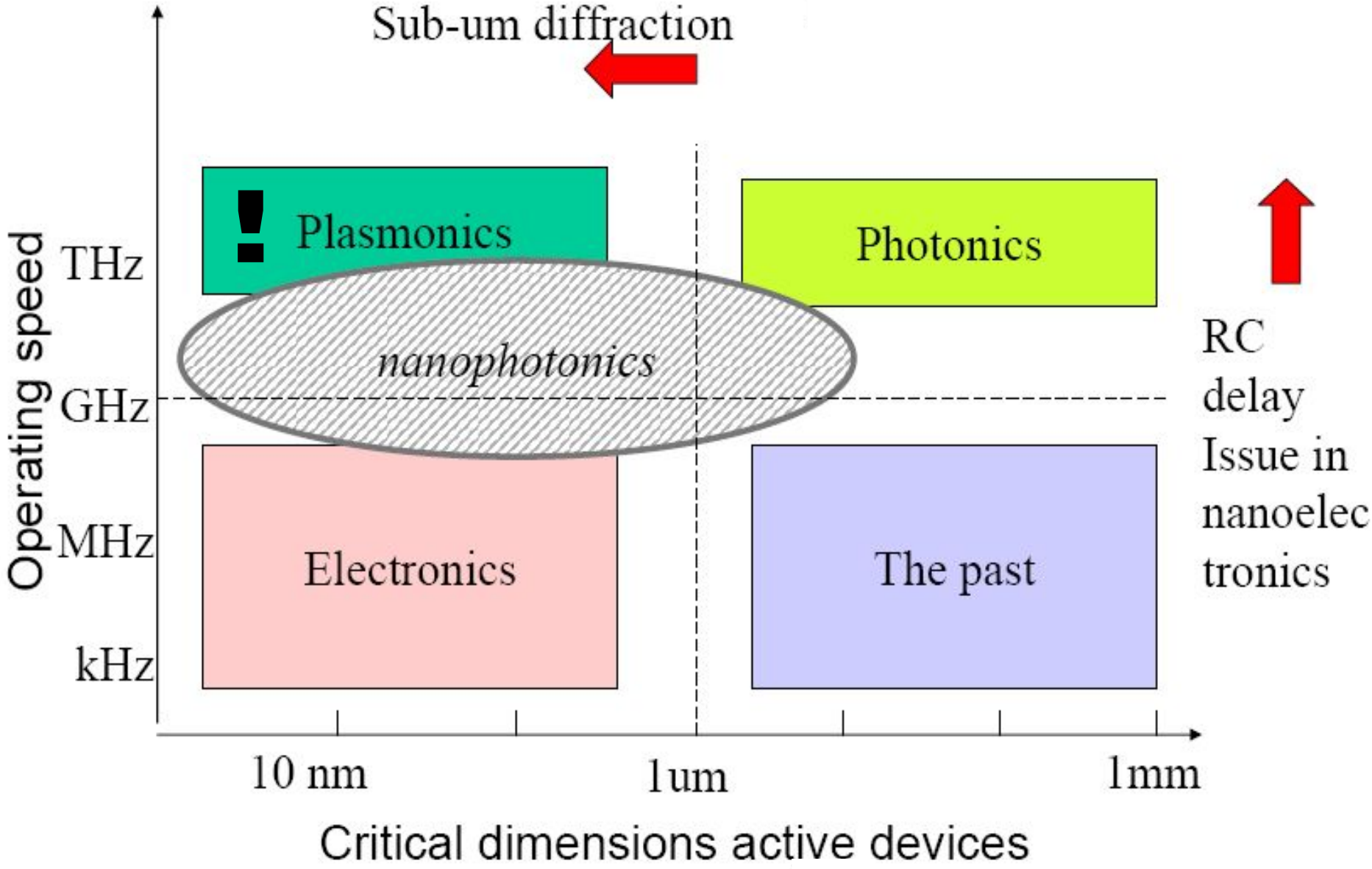
INFORMATION TRANSPORT (OPTICAL FIBERS)

INFORMATION STORAGE (HOLOGRAPHIC MEMORY, CD,DVD)

INFORMATION PROCESSING (OPTICAL CHIP?)

(Surface Plasmon Oscillations)!!!

Operating speed and critical dimensions



DRAMATIC CHANGES IN SCIENCE DRIVEN ICT

(E-INFRASTRUCTURES)

-THE VOLUME AND DIVERSITY OF DATA MASSIVELY INCREASE;

-GRID, WEB, SENSORIC DATA, MODELLING OF VIRTUAL OBSERVATIONS

-THE NEED FOR LABELLING AND QUALITY ASSURANCE OF DATA

WHY NOT GOOGLE?

INHOMOGENEOUS, NOT RELIABLE, DATA NOT INTEROPERABLE, INEFFICIENT, THE LACK OF LONG TERM DATA STEWARDSHIP

SOME OF THE BENEFITS OF E-EINFRASTRUCTURES

- THE BOOST TO CREATE **VIRTUAL, COLLABORATIVE COMMUNITIES** OF RESEARCHERS
- THE DEVELOPMENT OF WORLD LEADING **NETWORKS** WITH GLOBAL PERSPECTIVE (e.g. in Europe GEANT, GRID, …). **ECE INTEGRATION!**
- THE DEVELOPMENT OF TRUSTWORTHY **MANAGEMENT SYSTEMS** (ACCESS TO RESOURCES: HIGH POWER COMPUTING
- IT PUTS IN PLACE **EDUCATION AND TRAINING PROGRAMMES**
- DEVELOP COHERENT **ACADEMIC RESOURCES** AND ADDRESSES THE ISSUES OF ESTABLISHING, MANAGING, JOINING UP **RESEARCH REPOSITORIES**

OPEN ACCESS:

Making digital content available free of charge without restrictions (a complete version of the work is deposited, and this means published).

OA repositories and electronic journals are subject to the same **Peer Review** process as the traditional journals

Peer Review carried out by the scientific community

The paradoxical cases:

(Nature, Science ??)

OPEN ACCESS AS PART OF THE DIGITAL REVOLUTION

- **A hot topic in the research community, and in the publishing business, of growing concern among politicians, academic leaders, and librarians**

- **The main driver behind it all: in the world of digital technologies open access is a common feature**

- **It is enabled by the digital revolution and stimulated by the www-experience. Public interest: Research, funded by public money should be available to the public.**

E-SCIENCE IS MUCH MORE THAN OPEN ACCESS

- THE DIGITAL MODE OFFERS MUCH MORE THAN A DIGITAL METAMORPHOSIS OF TRADITIONAL WAYS OF PUBLISHING AND SCHOLARLY COMMUNICATING
- DATA SHARING, VIRTUAL LABS, COL-LABORATORIES, WIKI'S BY AND FOR ACADEMICS, MULTI-MEDIA, E-LEARNING – THERE IS MUCH MORE INNOVATIVE POTENTIAL THAN HAS BEEN REALIZED THUS FAR
- WE NEED PROJECTS AND EXPERIMENTS TO SHOW IT CAN BE DONE
- AND FORERUNNERS LIKE THE UNIVERSITY PRESSES CONSORTIUM AND SCIENCE INNOVATORS

PILLARS OF EUROPEAN SCIENCE POLICY

- BASED ON THE KNOWLEDGE TRIANGLE

(EDUCATION, RESEARCH, INNOVATION)

- THE LISBON STRATEGY

Knowledge-based economy – competitiveness and jobs

- *THE EUROPEAN RESEARCH AREA (ERA) VISION*

Harmonization, freedom of researchers, knowledge, technology.

ERC! and ESFRI! (EIT, Tech. Platforms,…)

- THE LJUBLJANA PROCESS

Joint programming; Fifth freedom; ERA governance

- THE BOLOGNA PROCESS

European Higher Education Area (EHEA)

- STRUCTURAL FUNDS FOR RESEARCH

Potentially decreasing the handicaps of the ECE countries

BASIC INSTRUMENTS

GLOBAL COMPETITION:

-ADDED VALUE: HIGHER QUALITY RESEARCH

COOPERATION, NETWORKING:

-CRITICAL MASS (INTELLECTUAL AND FINANTIAL)

-LESS DUPLICATION, FRAGMENTATION

SUPPORT OF EXCELLENCE:

-GOOD FOR ALL (inclusive the potential loosers)

PROPER RESEARCH INFRASTRUCTURE

-POTENTIAL ADVANTAGE IN NEW TECHNOLOGIES

E-INFRASTRUCTURES
(being of basic significance for ERA)

-Enormous change in the world of science-data :

-exponentially increasing amount of data

-GEANT, Grid, modelling

-the need for labeling of data and quality assurance

-The need to structure scientific data more carefully

-An instrument to support networking of RI-s (and research)

EUROPEAN RESEARCH COUNCIL

ONE OF THE KEY INSTRUMENTS TO REALIZE THE GOALS OF FP7:THE “IDEAS”SPECIFIC PROGRAMME

BY PROMOTING EXCELLENCE IN ALL AREAS OF SCIENCE

BY COMPETITIVE FUNDING, SOLELY ON THE BASIS OF EXCELLENCE

BY SUPPORTING GROUP RESEARCH BUT INDIVIDUALS TOO (FIRST OF ALL YOUNG RESEARCHERS, HIGH RISK, INTERDISCIPLINARY RESEARCH)

WITH MINIMAL BUREAUCRACY. OPEN ON GLOBAL SCALE!

EARLY STAGE INDEPENDENT INVESTIGATOR SCHEME

ESTABLISHED INVESTIGATOR GRANT SCHEME

MASTERED BY ERC AND ITS SCIENTIFIC COUNCIL

ERC GRANTS

(Principles of support)

- **All fields of science and scholarship are eligible**
  - ☞investigator-driven, bottom-up
- **Excellence is the only valid criterion**
  - ☞Individual or team + research project
- **Investment in research talent (7.5 B€)**
  - ☞Attractive, flexible grants, up to five years
  - ☞under control of the lead researcher (PI)
- **Independent individual teams in Europe**
  - ☞nationality of researchers is not relevant
  - ☞host organization to be located in EU or AS

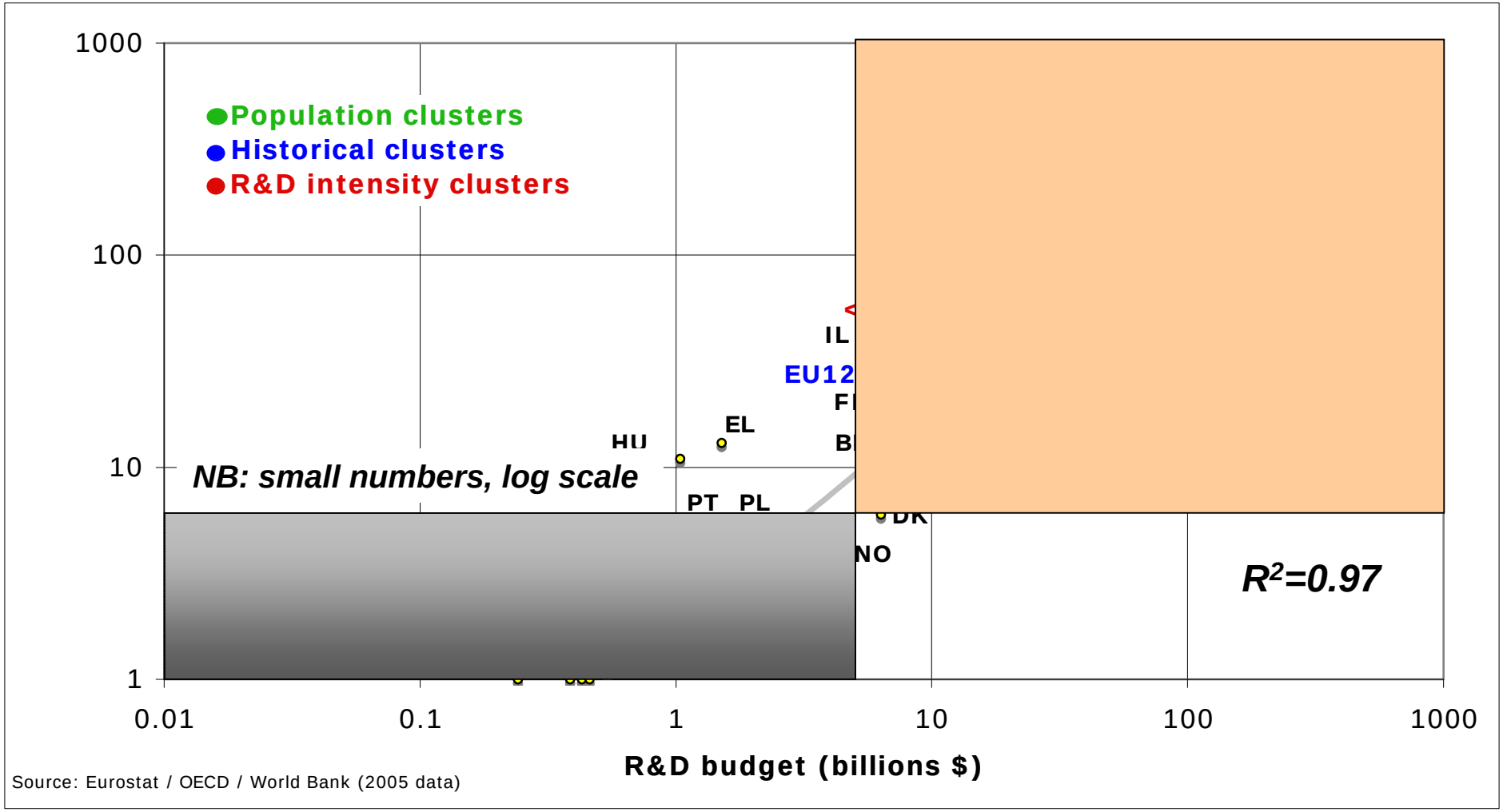
STRATEGIC AIMS OF ERC

Boost European excellence in "Frontier Research"

- by investing in the best researchers and ideas
- through competition at European level
- on the basis of scientific excellence as the sole criterion
- raising incentives towards quality and aspirations of individual researchers
- providing benchmarks and leverage towards broader (structural) improvements in European research

THIS IS PART OF A BROADER VISION REMAINING ACTUAL BEYOND FP7 TOO.

Success scales with country's R&D investment (grants to nationals)



Source: Eurostat / OECD / World Bank (2005 data)

ON THE EU 2020 VISION (POST FP7)

(based on a Common Strategic Framework)

PRIORITIES:

1. Smart growth (economy based on knowledge and innovation)
2. Sustainable growth (more resource efficient, greener and more competitive)
3. Inclusive growth (high employment economy, social and territorial cohesion)

FLAGSHIP INITIATIVES:

1. Innovation Union;

2. Youth on the move;

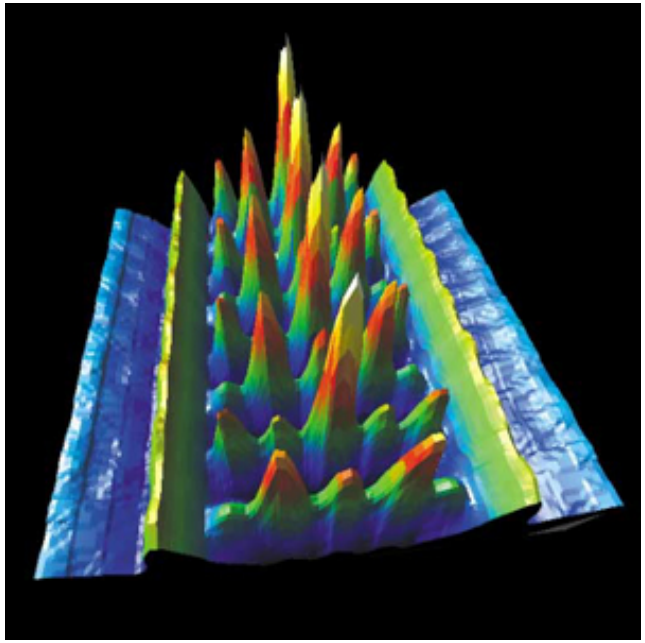
3. A digital agenda for Europe;

4. Resource efficient Europe;

5. Industrial policy for the globalization era;

6. An agenda for skills and jobs;

7. European platform against poverty.



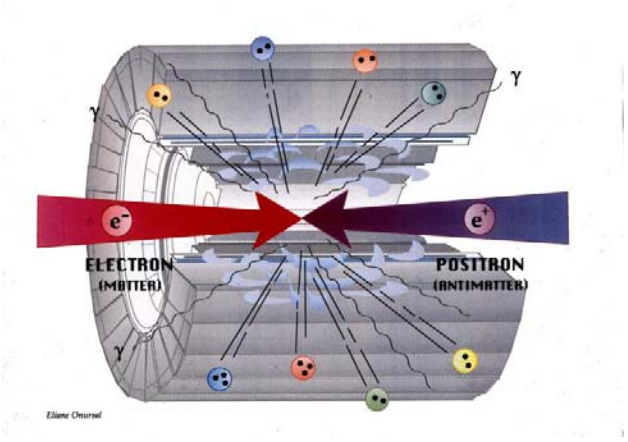
Scope of the Common Strategic Framework

- **Covering current funding for:**
- The **7th Framework Programme** (FP7) for research, technological development and demonstration
  - €53 billion (2007-13). 4 main programmes on Ideas, Cooperation, People and Capacities.
- The **Competitiveness and Innovation Framework Programme (CIP)**
  - €3.6 billion (2007-13). 3 programmes on enterprise & innovation, intelligent energy, and ICT policy support.
- The **European Institute for Innovation and Technology (EIT)**
  - Autonomous EU body bringing together higher education, research and business to stimulate innovation in Knowledge and Innovation Communities. EU budget contribution of €309 million (2007-13)
- **And strengthening complementarities** with the **Structural Funds**
  - €86 billion allocated (2007-13) to R&D and innovation, enterpreneurship, ICT and human capital development

HORIZON 2020

Horizon2020 should concentrate:

-both on curiosity driven and demand driven research
-furthermore on cross disciplinary research
-on activities of testing and demonstration
-on transnational cooperation and mobility between business, institutes and academia
-on improving knowledge transfer, and efforts to make scientific knowledge broadly accessible, and
-on creation and growth of knowledge intensive SMEs **AND:…**



THE SIGNIFICANCE OF EDUCATION

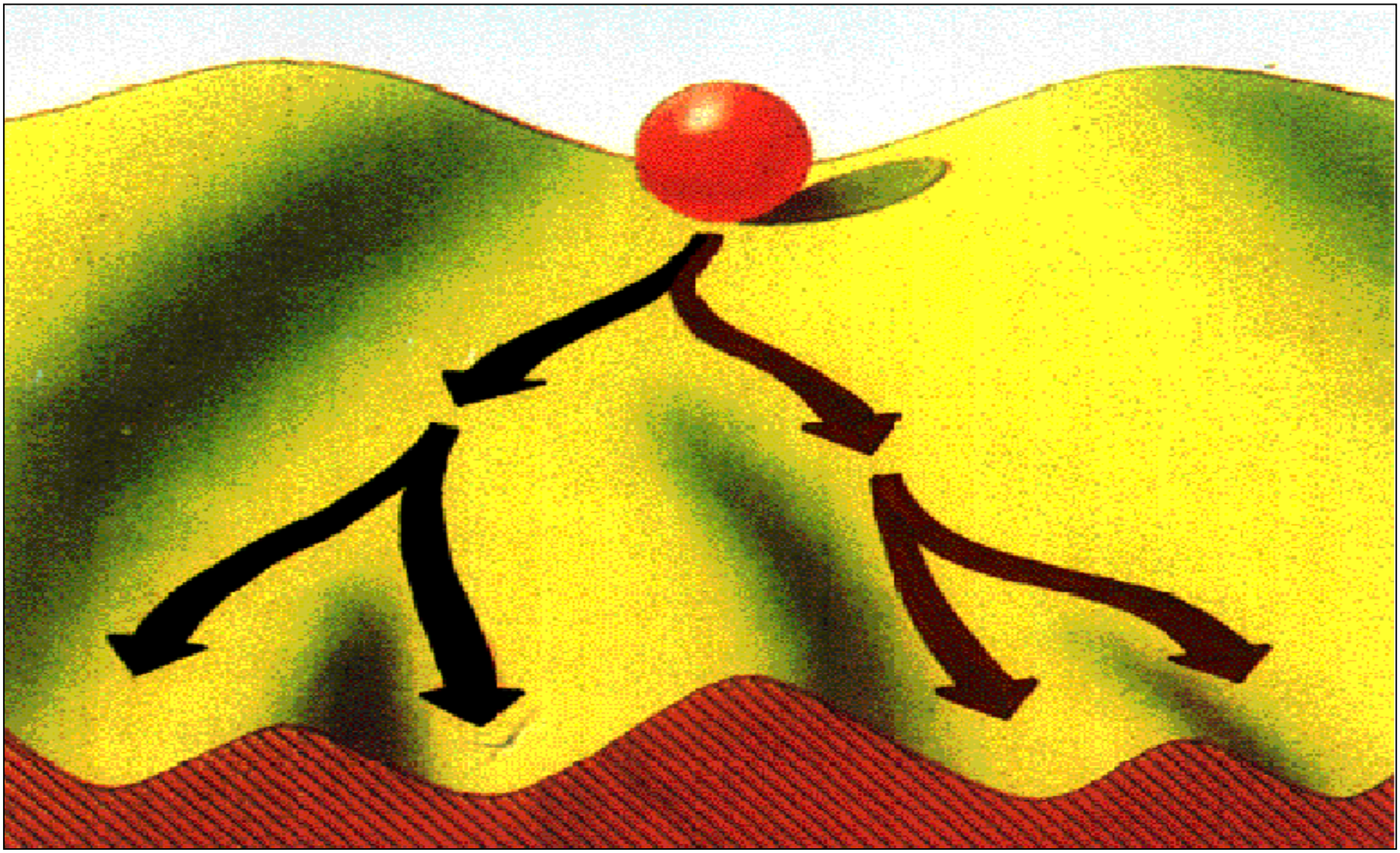
If you plan for a year,
sow a seed

If you plan for a decade,
plant a tree

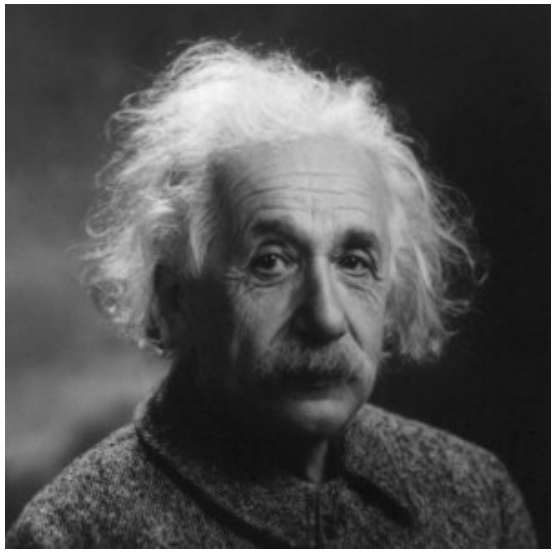
If you plan for a century,
educate the people.

Chuang Tzu
(Third Century, B.C.)

THE FUTURE CAN NOT BE PREDICTED...
BUT MAY BE INFLUENCED



THE PROBLEMS WE ARE FACING TODAY CAN NOT BE SOLVED WITH THE SAME WAY OF THINKING BY WHICH WE CREATED THEM



THE STATE OF UNSTABLE (METASTABLE) SYSTEMS CAN BE INFLUENCED WITH RELATIVELY SMALL FORCES TO PROPAGATE INTO THE REQUIRED DIRECTION

THANK YOU!

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http://erc.europa.eu