Knowledge Dissemination at ICTP

Nuclear and Allied Sciences

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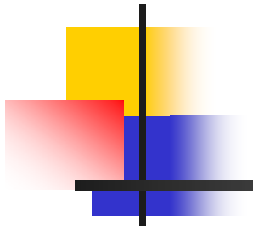
Management of Nuclear Knowledge: Applications of Nuclear Science



Nuclear science for sustainable development (many fields of application)

- energy
- agriculture
- nutrition
- human health
- water resources
- climate change
- environment
- new materials
- industrial applications
- safety and security

Issues

- Nuclear Data
- Scientists and technologists for nuclear physics applications
- Standards, Quality, …
- Access to information
- Access to facilities and instruments

Nuclear Data

- IAEA (International Nuclear Data Committee)
  - Data Base needs:

[work needed over the next decades (2000-2020) on the measurement, calculation and evaluation of improved nuclear data for emerging applications, IAEA 2000]

- Nuclear Reaction Data Base for Accelerator Applications (e.g. Ion Beam Analysis – NRA, …).
- Nuclear Data for Actinides (e.g. Th-U fuel cycle, ADS)
  - Neutron cross sections
  - Fission yields
  - Decay data
- Low-energy neutron data for light nuclei for controlled fusion studies
- Database of Generalized Nuclear Constants for Activation Analysis

Nuclear Data (cont.)

- IAEA (International Nuclear data Committee)
  - Data Base needs (cont.):
    - Charged particle and neutron nuclear data for medical isotopes (diagnostic & therapeutic)
      - Excitation functions and thick target yields up to 100 MeV
    - In radiation therapy, protons, ^{4}He and heavy ions find increasing applications → several types of reaction cross section data are needed.

34,400 patients
treated with ions
(IAEA, 2002)

Nuclear Data (cont.)

IAEA (International Nuclear data Committee)

- Data Base needs (cont.):
  - Low-energy charged particle and neutron data for astrophysics
  - Data Base for nuclear reactions used in thin layer activation (for wear, corrosion and erosion measurements)
  - Shielding of semiconductors for space applications
  - Single-event upsets and radiation hardening in microelectronics (reliability in satellites, aerospace, nuclear plants and nuclear weapons)

Nuclear Data (cont.)

- IAEA (International Nuclear Data Committee)
  - Training and Technology Transfer
    - Radiation shielding
    - Activation analysis
    - New fuel concepts
    - Accelerator-driven systems
    - Calculation methods for therapy and diagnosis
    - Astrophysics
    - Cosmogenic investigations
    - Nuclear security and safety

Access to facilities and instruments

- accelerators
  - ions
  - synchrotron radiation
- research reactors
- nuclear instrumentation & methods
  - detectors & front end electronics
  - Remote access

Scientists and technologists for nuclear physics applications

- To bridge the gap between the studies of basic and applied nuclear science. In particular, we need motivating new evaluators of nuclear data by providing them with the necessary background in theory, experimental methods and evaluation methodologies.

Promote application of advanced methodologies

- Neutron scattering
- Accelerator mass spectrometry
- Heavy ion microprobes
- Synchrotron radiation microscopes

Access to knowledge and information

- ICTP & UNESCO help cyber connectivity
  - eJournals Delivery Service
  - Monitor internet connectivity in institutions located in developing countries
  - Low cost wireless networks

Science Dissemination: Unit at ICTP

http://sdu.ictp.it

ICTP has pioneered the implementation of Web technologies in developing countries since 1993 to transfer knowledge and e-Journals to scientists in remote areas having low-bandwidth access to the Internet.

ICTP-RADIONET
Programme of Training and System Development on Networking and Radiocommunications

Objectives: to provide some technical assistance and training to academic and scientific institutions in developing countries needing help to establish:
i) small area computer networks and their connection to the Internet, either directly or through national networks;

ii) data communication services in rural or remote areas.

Since 1989 the ICTP carries out intensive training activities on-site and in Trieste for university professionals from developing countries through a Programme of Training and System Development on Networking and Radiocommunications.

Both wireless and computer networking have been used to help building up the ICT infrastructure and the ability of academic and research institutions to access Internet.

Besides, the ICTP has also organized since 1999 hands-on Workshops on Web-enabling technologies for scientific reasearch, publishing and e-Learning.

eJDS: Free electronic Journals Delivery Service

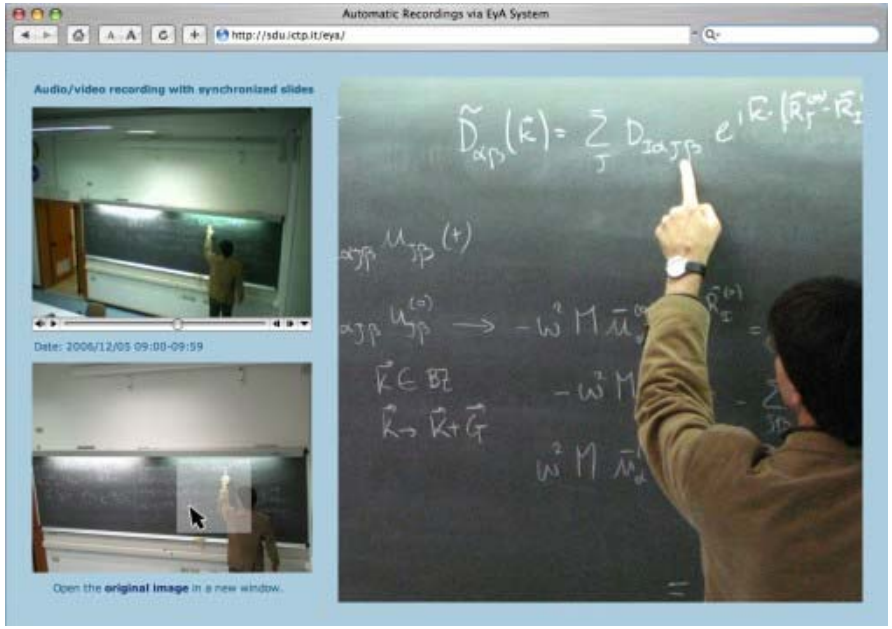
•The eJDS is a prototype programme geared to facilitate the access to current scientific literature free of cost. The goal is to distribute individual scientific articles via e-mail to scientists in institutions in Developing Countries who do not have access to sufficient bandwidth to download material from the Internet in a timely manner and/or cannot afford the connection

•The eJDS was made possible through agreements with several important scientific publishing companies and societies who provide access to their journals for free (the use is restricted to scientists from Developing Countries, subject to the particular conditions of each publishing company). Among them are: American Physical Society, Elsevier, World Scientific, Optical Society of America, American Mathematical Society, Proceedings of the National Academy of Sciences, Institute of Physics.

Internet video chat for scientific collaboration

•The i-Rooms project of the Science Dissemination Unit of ICTP aims to establish dedicated links via Internet between ICTP and its Federated Institutions world-wide to help fostering the exchange of knowledge and collaboration among scientists using state-of-the-art and low cost technologies. This new network can also allow future exchanges of information among the Federated Institutes themselves.

•The first prototype phase of the i-Rooms, to be carried out throughout the years 2005 and 2006, will include audio and video broadcasting of ICTP scientific activities, delivery of invited talks, ICTP speaker's corner seminars and support of real-time interaction between interested ICTP scientists, diploma students, etc. via audio/video chat, easy document exchanges and collaborative editing.



Web Enabling Technologies & Strategies for Scientific research, publishing and e-Learning

•The growth of the Internet in the Universities in developing countries has to face two problems:

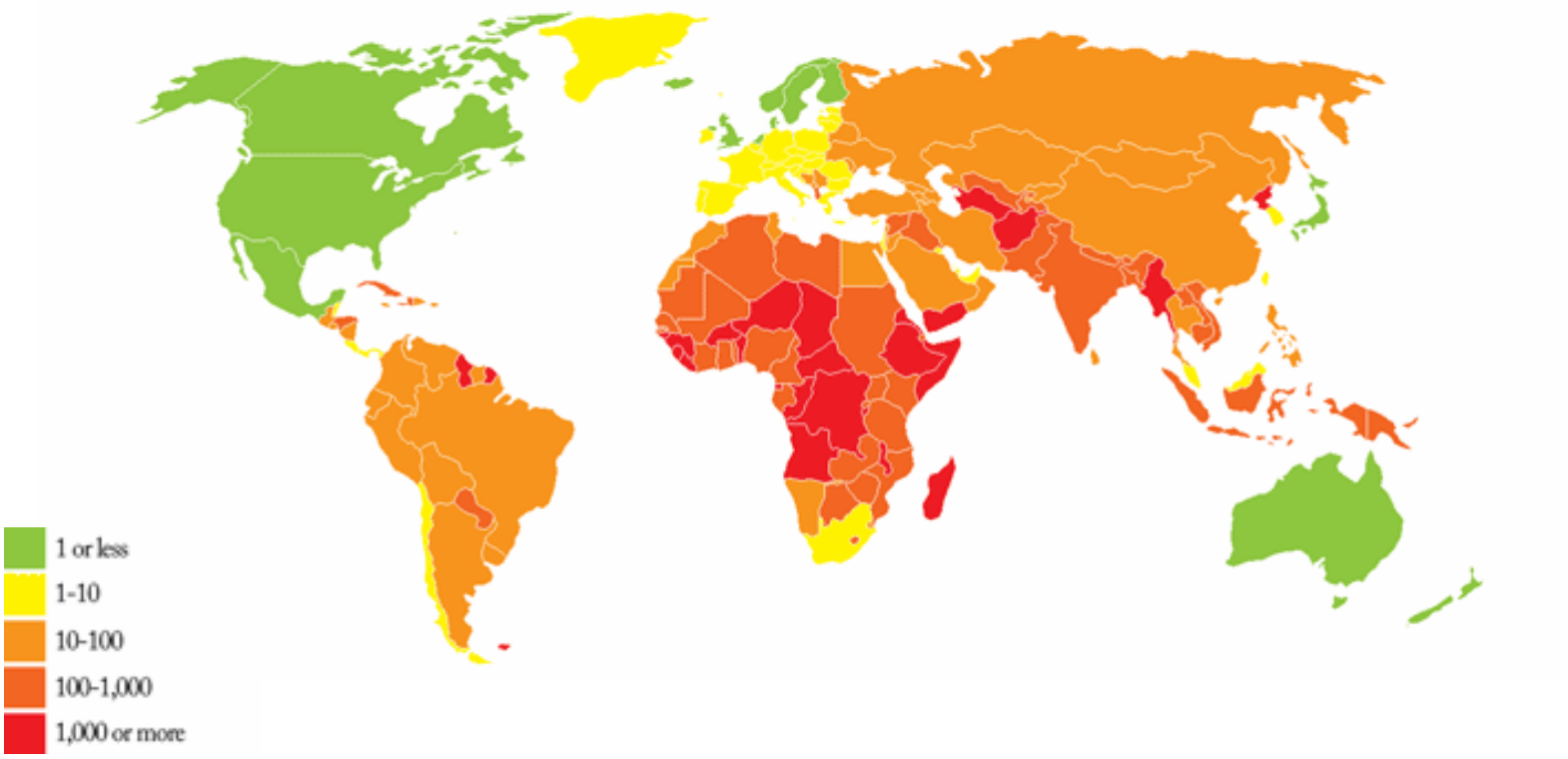
•- limited bandwidth of available telecommunication lines, causing line congestion and making access exceedingly slow, often beyond the limits of usability;

•- insufficient computer literacy/expertise of the academic community, with the consequent insufficient understanding of the potential of the network as a tool for spreading information (contrasted with its use for accessing information generated elsewhere), promoting collaboration and enhancing knowledge transfer.

•Both problems reduce drastically the effectiveness of Internet access as a tool to overcome scientific isolation. Moreover, emphasizing passive access only, with respect to an active diffusion and contents of information as the only purpose of the Internet reduces its usefulness for national development (… still *knowledge* is more than just *information*).

Measuring the *Digital Divide*

Number of IP address available per capita



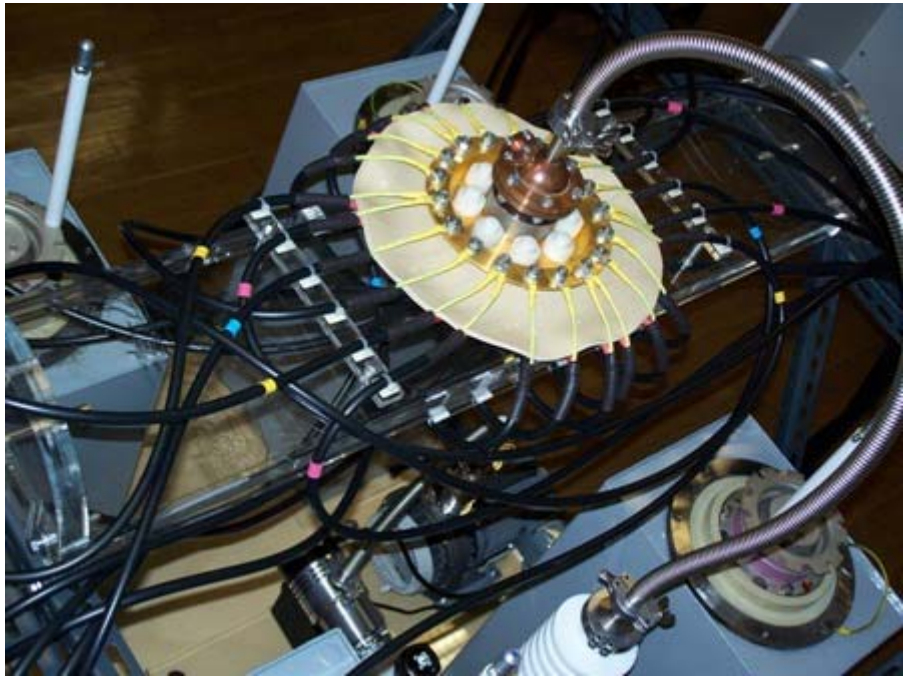
New directions and ideas

Enhance links to other research institutions

Solutions of scientific problems, particularly in areas of socio-economic interest, require an **interdisciplinary** approach, but all the needed expertise cannot be found in a single institution
(…and sometimes neither in a single country)

- **health care** combines biophysics, genetics, imaging, nuclear physics, etc.
- **environmental emergency** (e.g. tsunami) needs physics, earth sciences, oceanography, etc
- **nanotechnology** is at the intersection of physics, chemistry, biology and engineering

Plasma Focus Laboratory

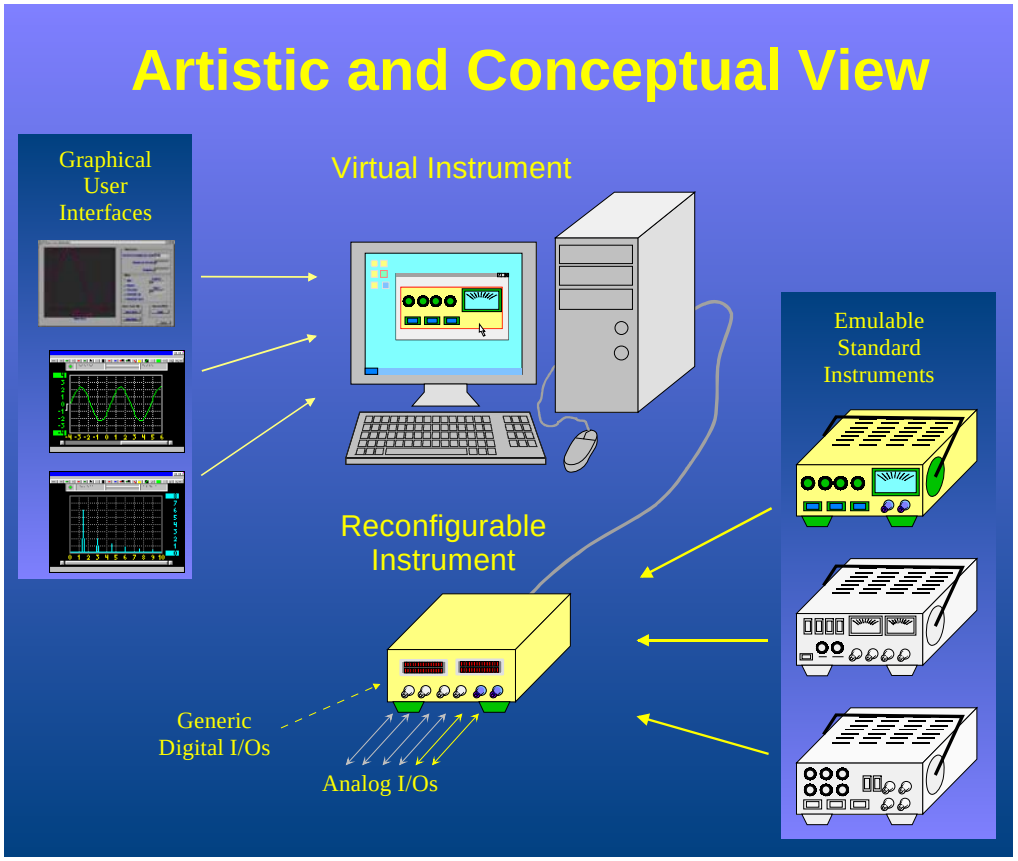


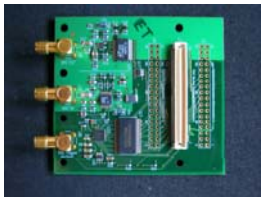
- Source of neutron and x-rays
  - Training
  - Biomedicine
  - Materials science
  - Cultural heritage

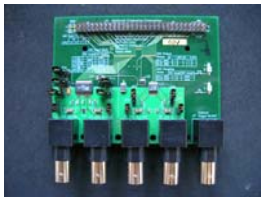
(with ENEA, Pirelli, Poland, Chile, Russia, AAAPT….)

Reconfigurable Virtual Instrumentation

- an open source soft/hardware approach -







Standard Instrumentation

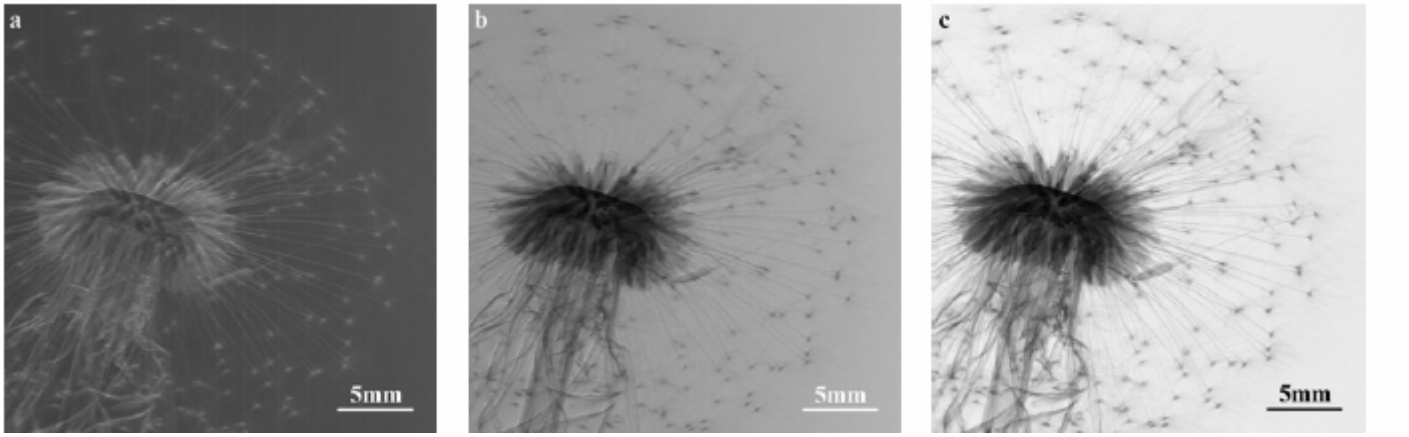
* Wave Form Generators
* Digital Oscilloscopes
* Transient Recorder
* High Precision Multimeter
* Spectrum Analysers
* Logic Analysers
* ...

Ad hoc Custom Instrumentation

* Custom Digital Filters
* Process Monitor and Control
* Reconfigurable Computing
* High Performance Digital Signal Processing
* Remote Access to Experimental and Laboratory Facilites
* ...

…In cooperation with several groups worldwide

International Consortium for Advanced X-Ray Imaging



- Phase Contrast Microscopy
- Micro-tomography
- Micro-XRF
- ….

[with Sincrotrone Trieste, CSIRO (Australia), ….]

Urgent needs

- Web-based access to nuclear data
  - Medicine
  - Accelerator analysis (elemental, isotopic, structure)
  - Environment
  - Agriculture
  - Nutrition

  (regional nuclear data centres)

Urgent needs (cont.)

- IAEA/ICTP Ph. D. and Post-doctoral training
  - to reverse the trend of diminishing expertise in a number of nuclear data disciplines (nuclear structure, cross sections, nuclear reaction analysis, particle and radiation detection)

Conclusion

- Development and dissemination of good quality nuclear data, education of nuclear experts, access to reliable nuclear facilities are critical to ensure credibility, safe operation and application of a wide range of nuclear methods that can contribute in a unique way to sustainable development.
- IAEA, ICTP, NEA, UNESCO, national nuclear institutions and others have a critical role.