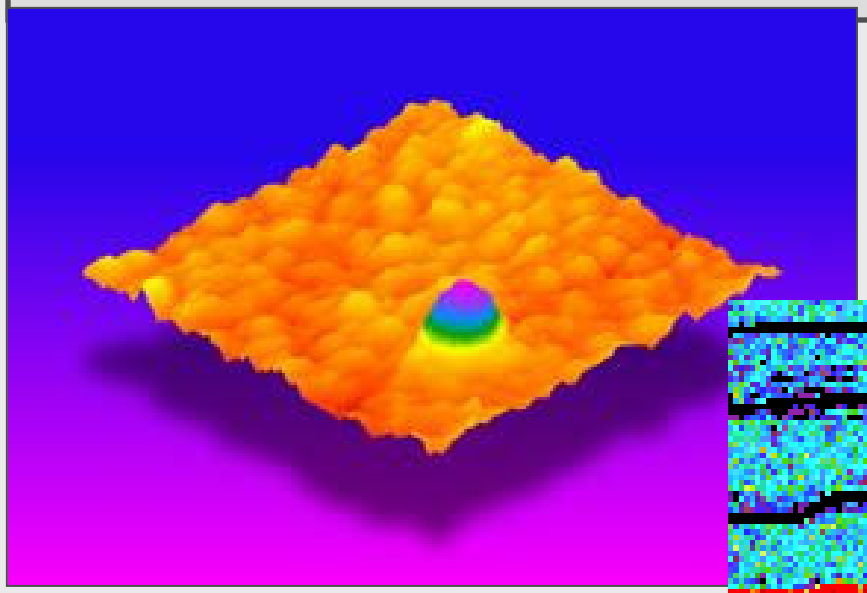
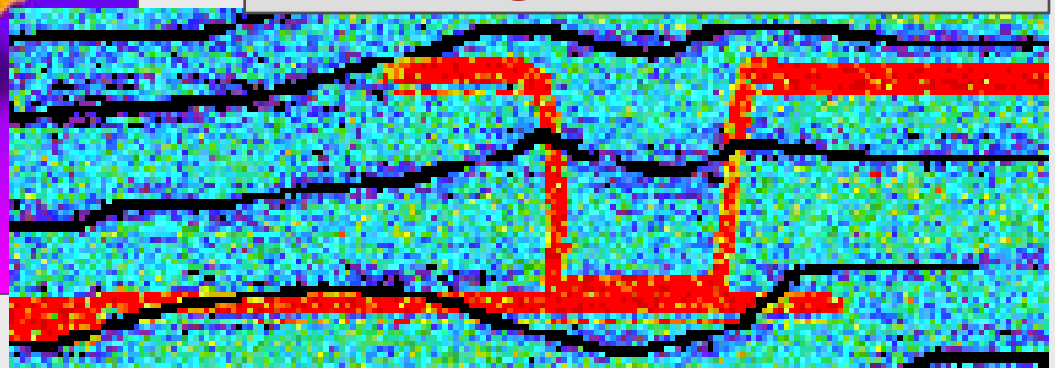
At the Forefront of Advanced Technology

A Spectrum of Metrology

Arden L. Bement, Jr., Director
National Institute of Standards and Technology



NCSLI Symposium
August 18, 2003



Measurement

“Set of operations having the object of determining a value of a quantity”

International Vocabulary of Basic and General Terms in Metrology (1993)

Measurement Services

A critical need for:

- **Excellence in metrology**
- **Traceability & legal metrology**

leads to measurement services

THE NATION'S FIRST "NATIONAL LAB"

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; JOSEPH LE CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; WILLIAM H. WELCH, Pathology; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, MARCH 29, 1901. *THE EMBRYOLOGICAL BASIS OF*

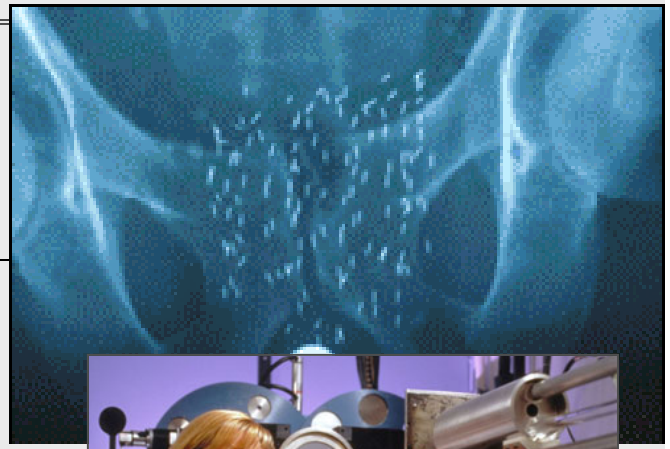
SCIENTIFIC NOTES AND NEWS.

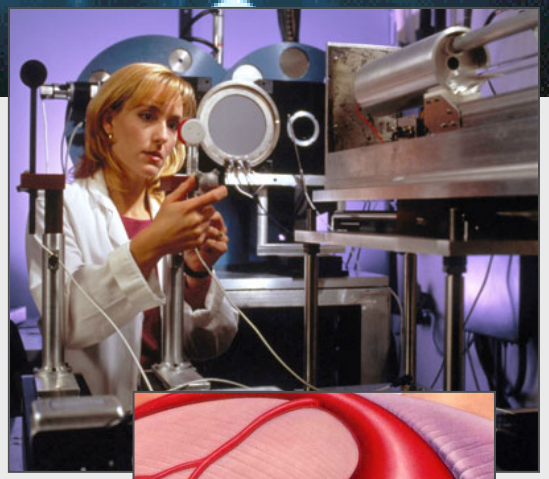
PROFESSOR S. W. STRATTON has, in view of his appointment as director of the Bureau of Standards, resigned his professorship in the University of Chicago. He will go abroad soon to study similar institutions in foreign countries.

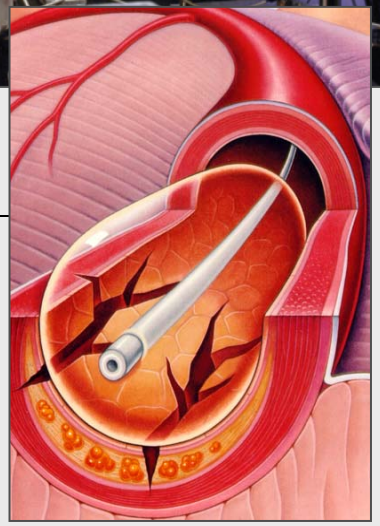
Science,
March 1901

NIST Measurement Services

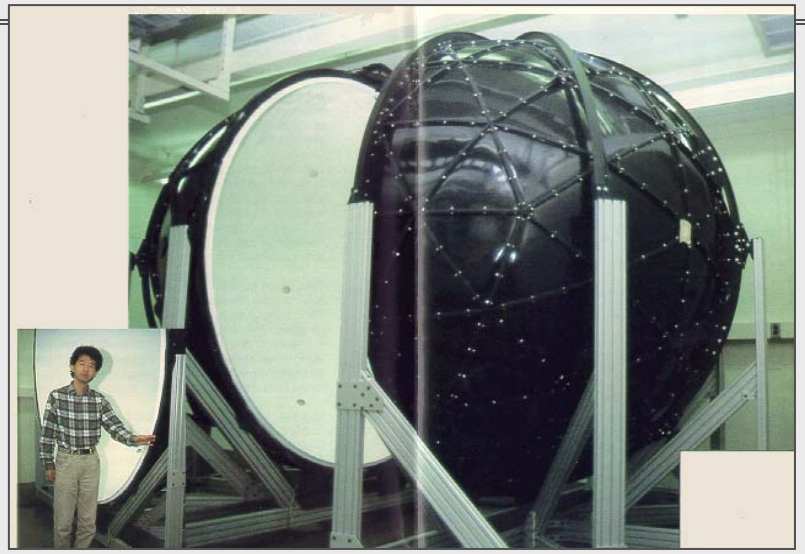
- Calibration Program
- Standard Reference Materials
- Standard Reference Data
- Laboratory Accreditation (NVLAP)





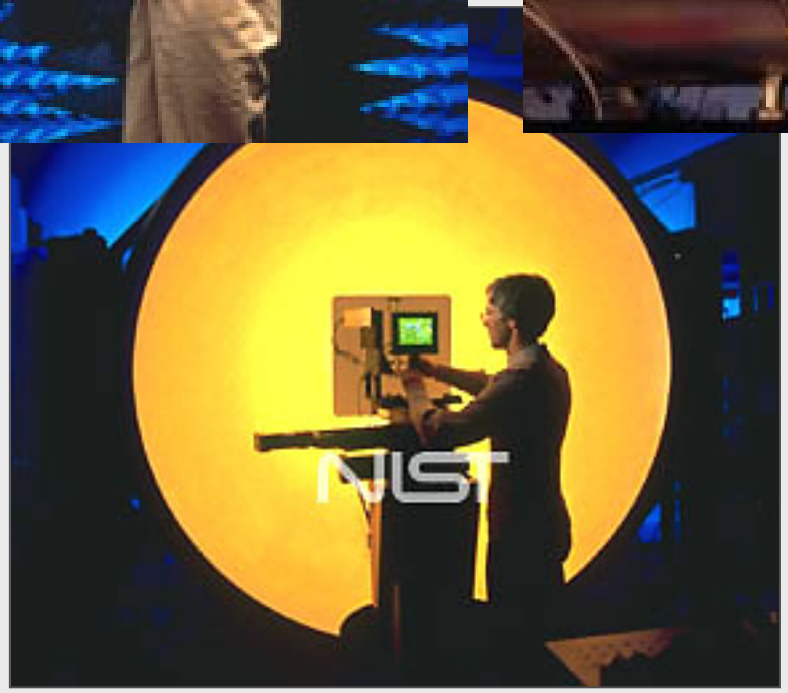


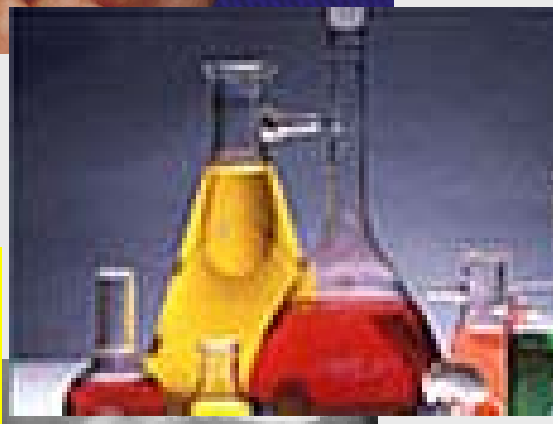
NIST Measurement Services

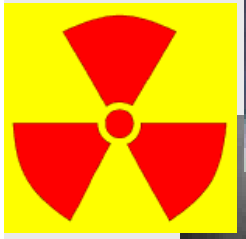


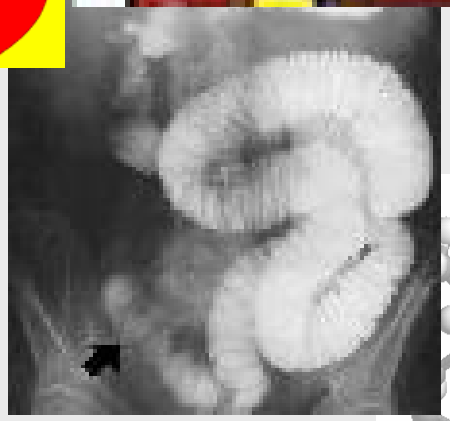
- **Calibrations and Tests**
  - 500 tests available
  - 3,000 items calibrated/year
- **Standard Reference Materials**
  - 1,300 products available
  - 31,000 units sold/year
- **Standard Reference Data**
  - 90 types available
  - 5,500 units sold/ year
- **Laboratory Accreditation**
  - 819 accreditations
- **Standards Committees**
  - 440 NIST staff
  - 970 committees
- **Measurement Research**
  - 2,200 publications/year

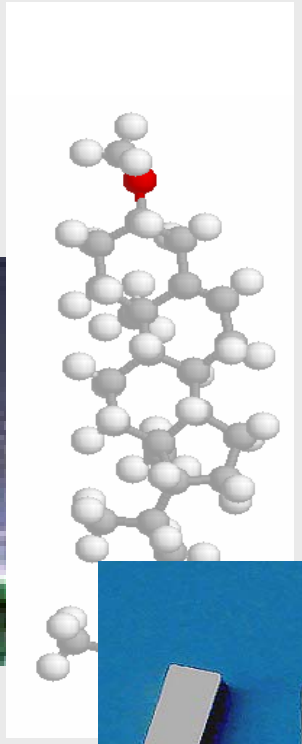
NIST Calibration Program

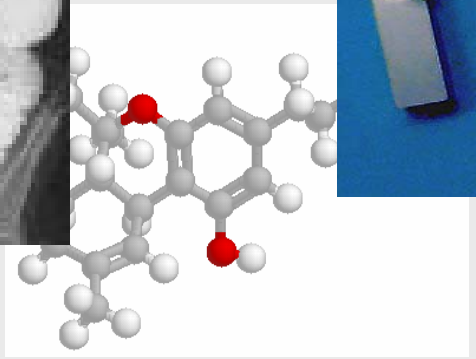


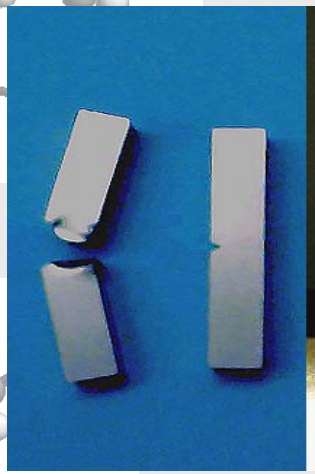


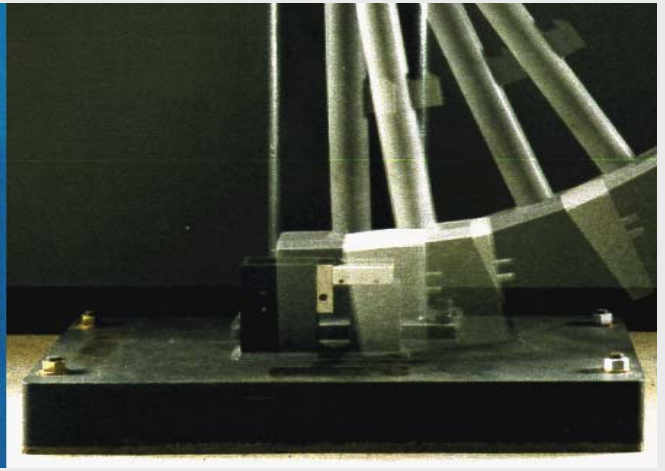


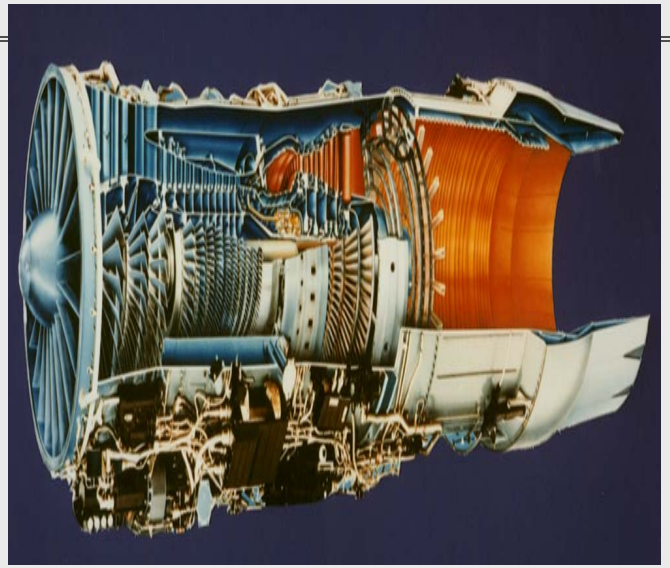




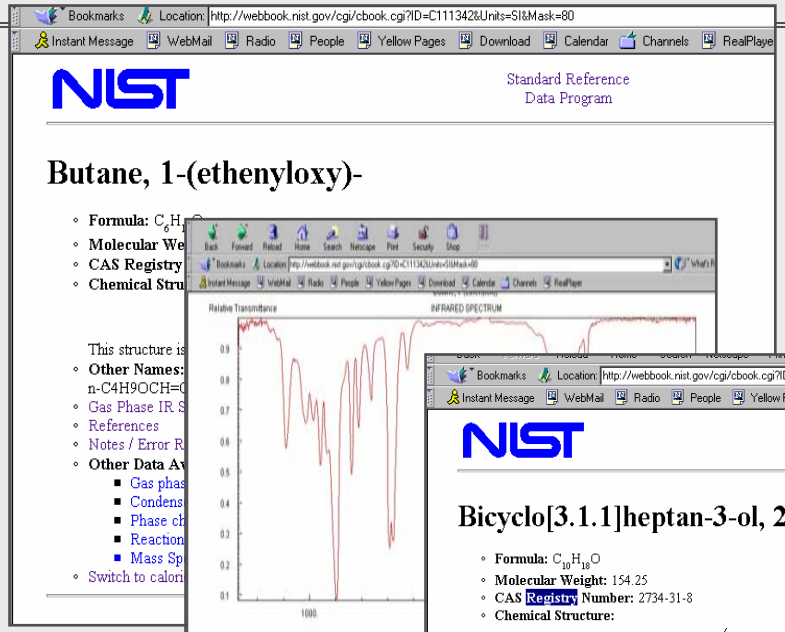








SRD Program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Standard Reference Data Program
Butane, 1-(ethenyloxy)-
Formula: C6H
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Additional Data
View Large Spectrum Image

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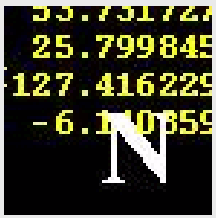
Standar
Data
Bicyclo[3.1.1]heptan-3-ol, 2,6,6-trime
Formula: C10H18O
Molecular Weight: 154.25
CAS Registry Number: 2734-31-8
Chemical Structure:
OH
This structure is also available as a 2d Mol file.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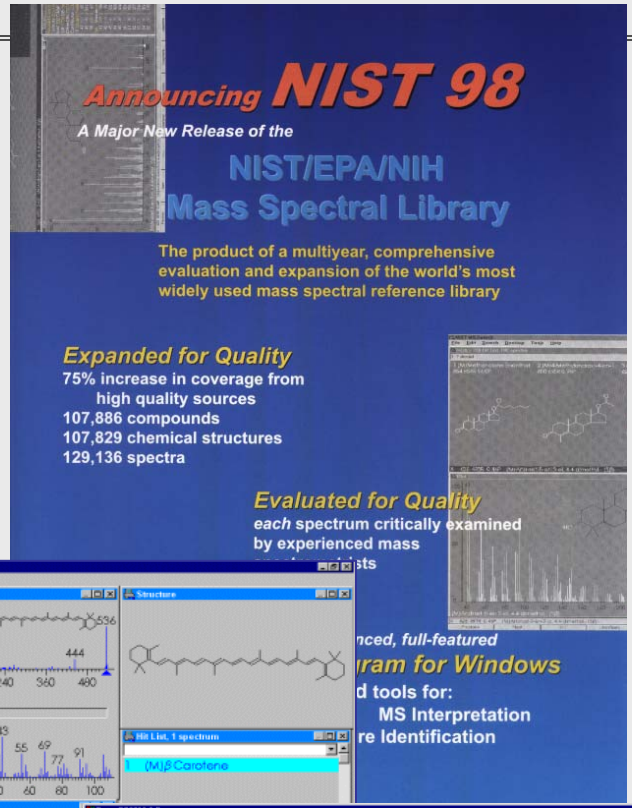
Announcing NIST 98
A Major New Release of the
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Mass Spectral Library
The product of a multiyear, comprehensive evaluation and expansion of the world's most widely used mass spectral reference library
Expanded for Quality
75% increase in coverage from high quality sources
107,886 compounds
107,829 chemical structures
129,136 spectra
Evaluated for Quality
each spectrum critically examined by experienced mass
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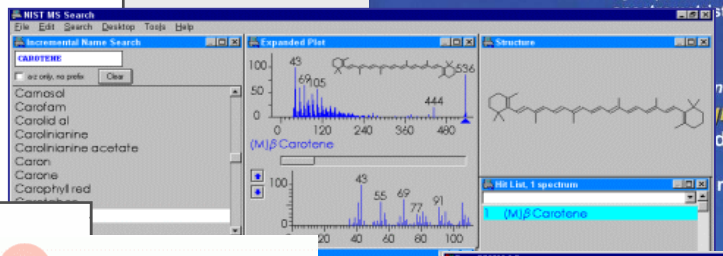
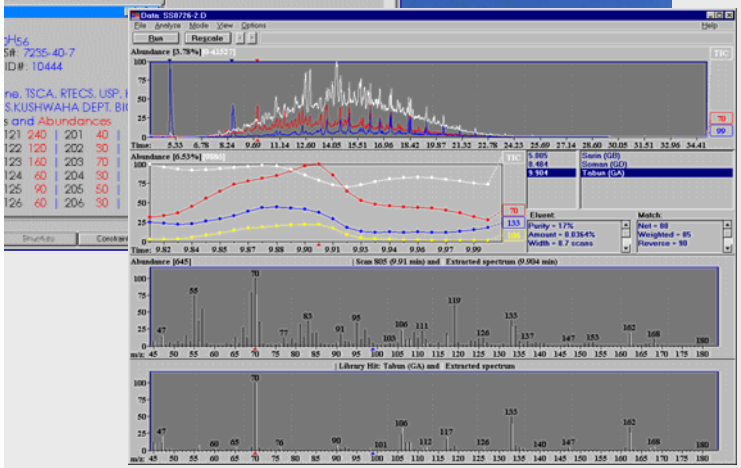
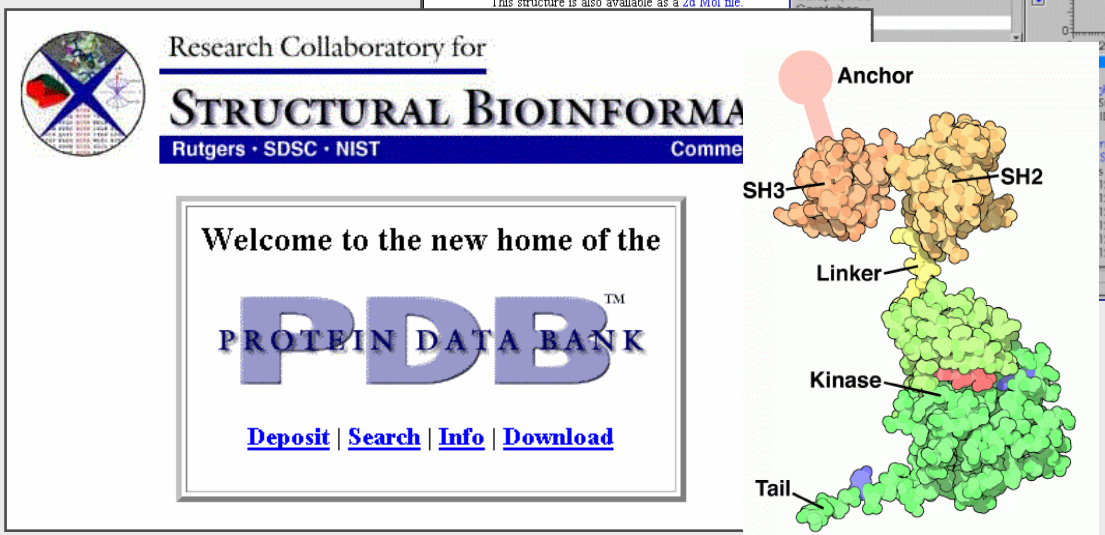
d tools for:
MS Interpretation
re Identification


NIST MS Search
Incremental Name Search
Expanded Plot
Structure
Hit List, 1 spectrum
(M),β Carotene

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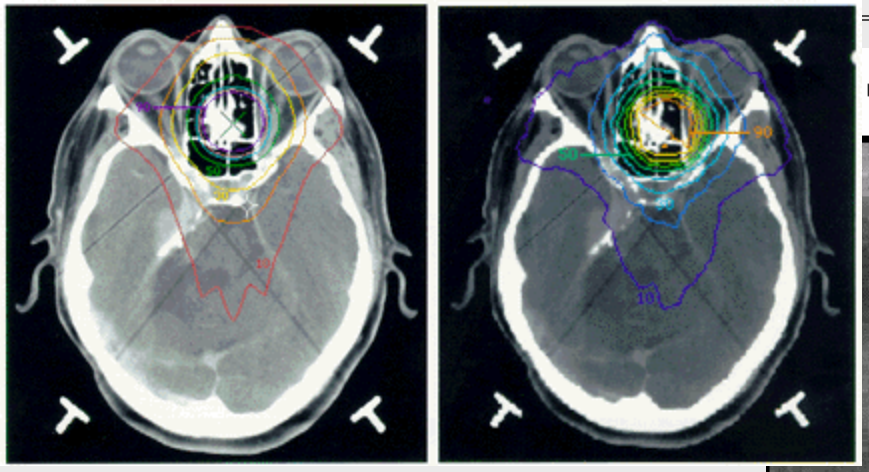
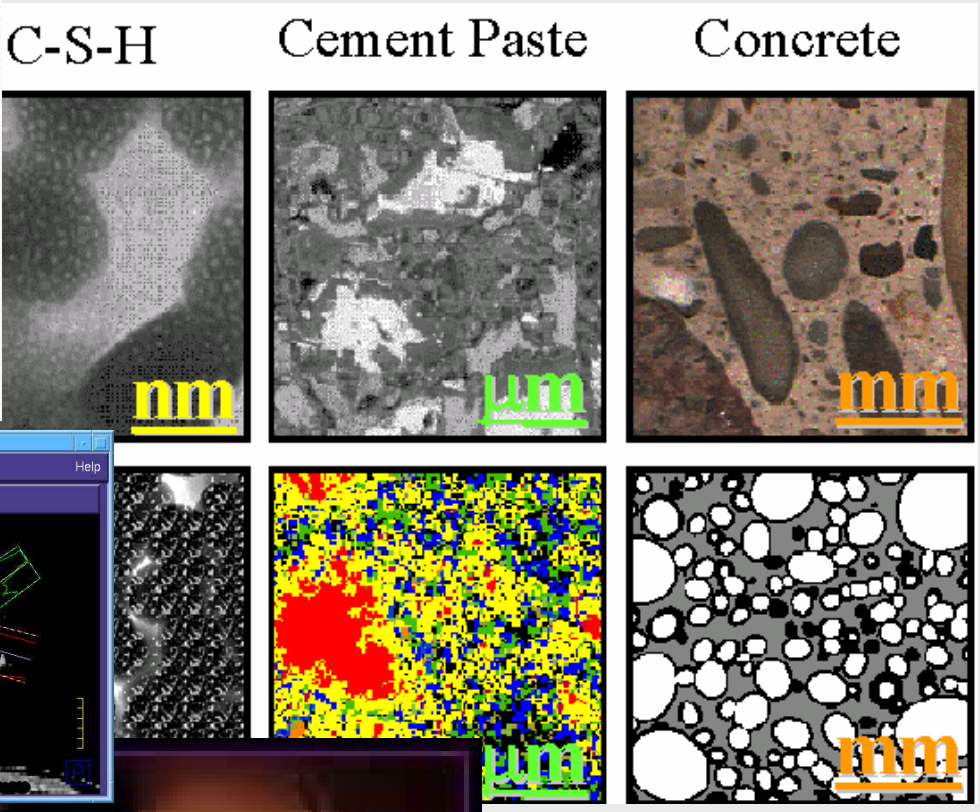
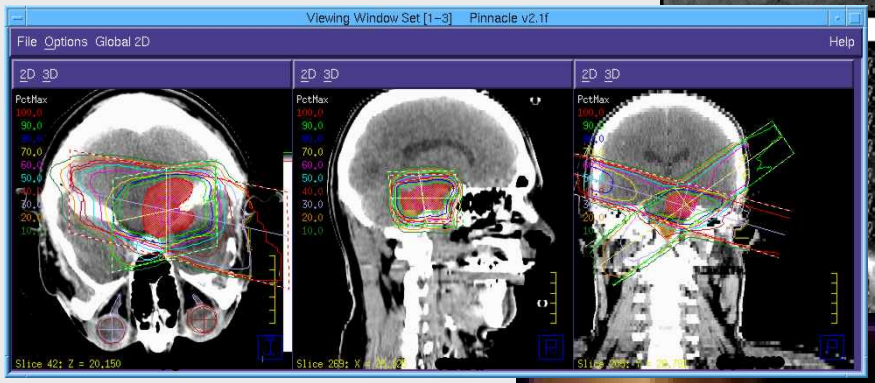
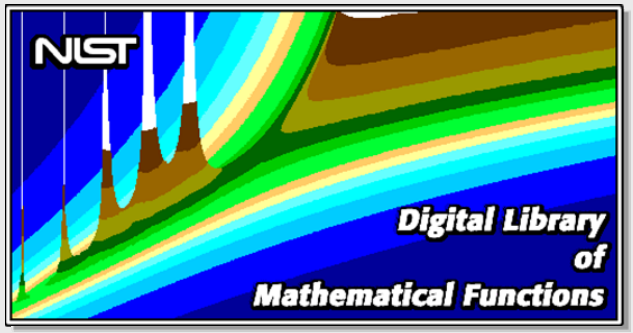
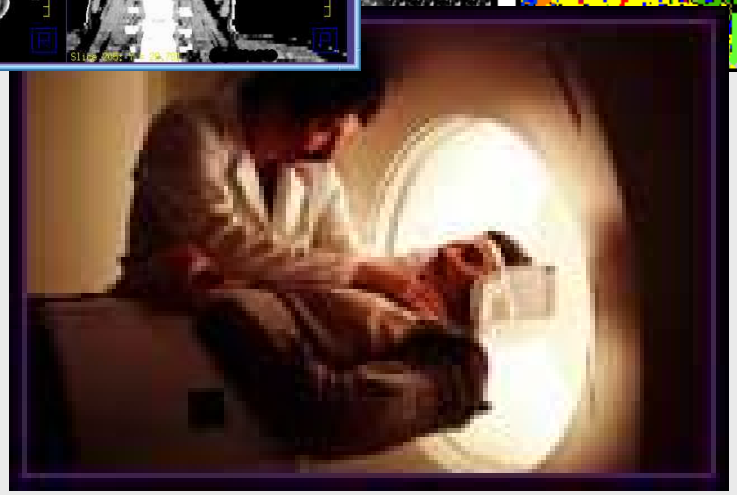
Data: From Brains to Concrete









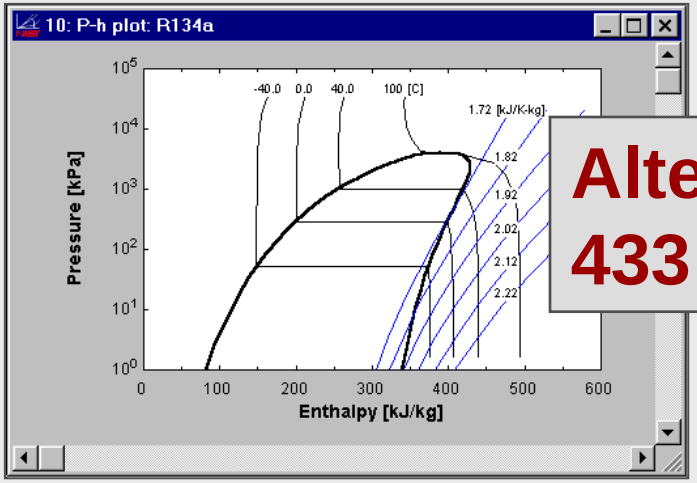


Laboratory Accreditation

NVLAP®

Leverage & Economic Impact

Radiopharmaceutical standards
97:1 benefit-to-cost ratio



Alternative refrigerants
433 percent internal rate of return

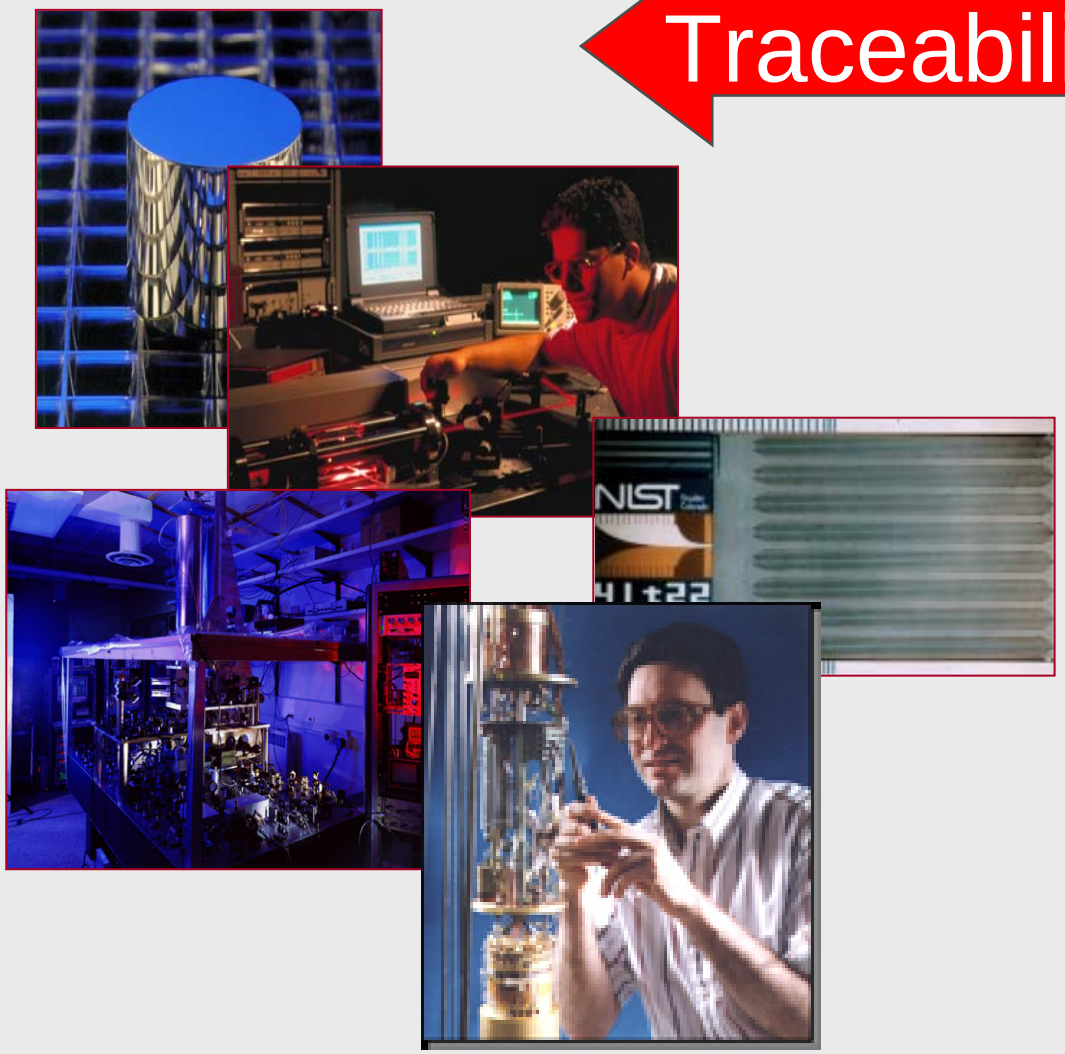
Sulfur in fossil fuels
$ 409M net present value,
$ 3.6M NIST investment

The National Measurement System

National Standards

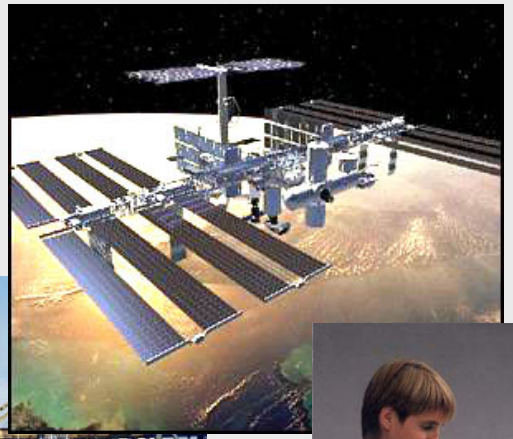
Customer's equipment & transfer standards

Traceability



The National Measurement System

Measurement Services
Supporting National Interests



The Role of Measurement Services

- Quantify measurement uncertainty & traceability
- Provide a basis for decision making
- Enable interoperability / interchangeability
- Verify scientific theory

NMS: A Public-Private Partnership

President's Information Technology Advisory Committee

Optoelectronics Industry Development Association

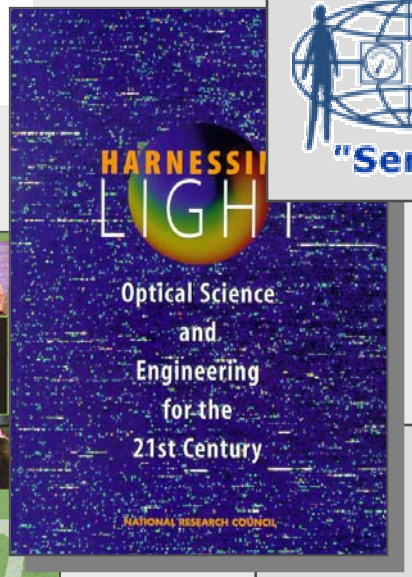
OIDA

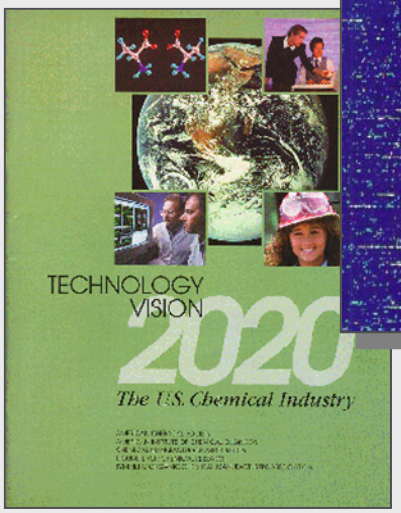
ANSI

American National Standards Institute

NCSL International

"Serving the World of Measurement"



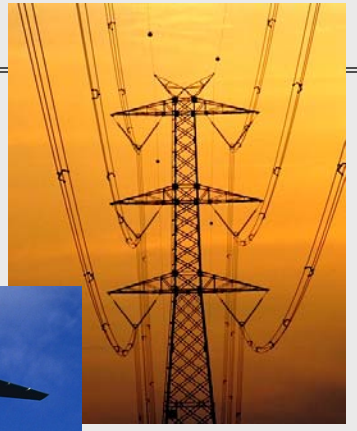


NCMS

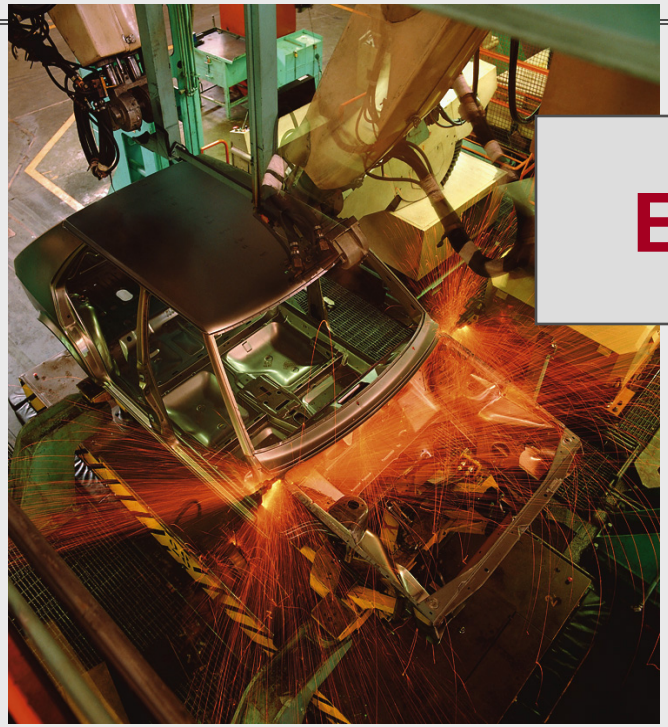
National Center for Manufacturing Sciences

NIST's Role in the NMS

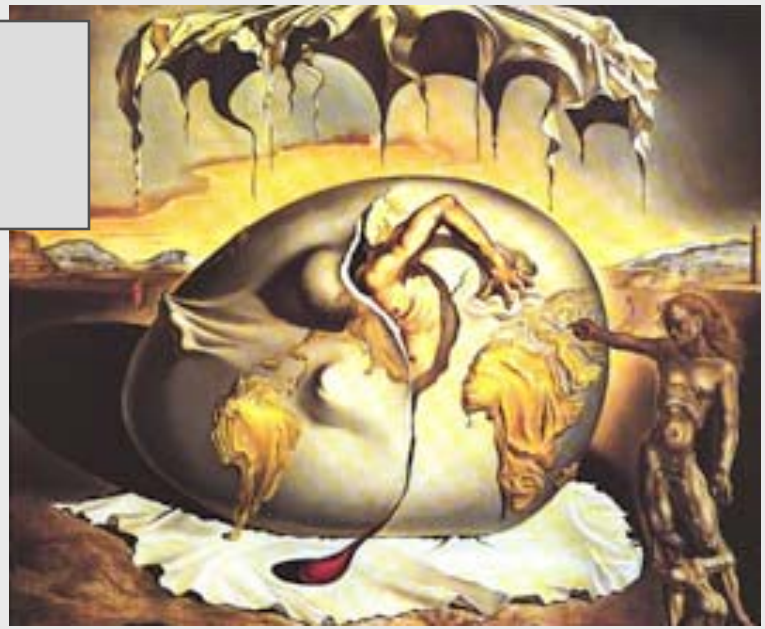
- The US National Metrology Institute
- Meeting industry needs
  - ✓ Definitive metrology
  - ✓ Traceability
- Promote enabling technologies
- Infrastructure for technology transfer
  - ✓increased return on taxpayer dollars



Drivers of New Measurement Services

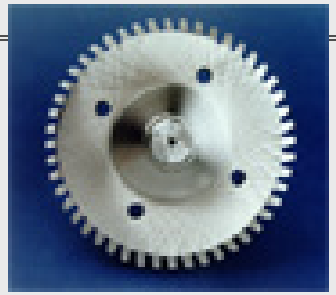


Economy



- Needs of emerging industries
- Better customer service
- Impact of information technology
- Interoperability

Drivers of New Measurement Services



Technology

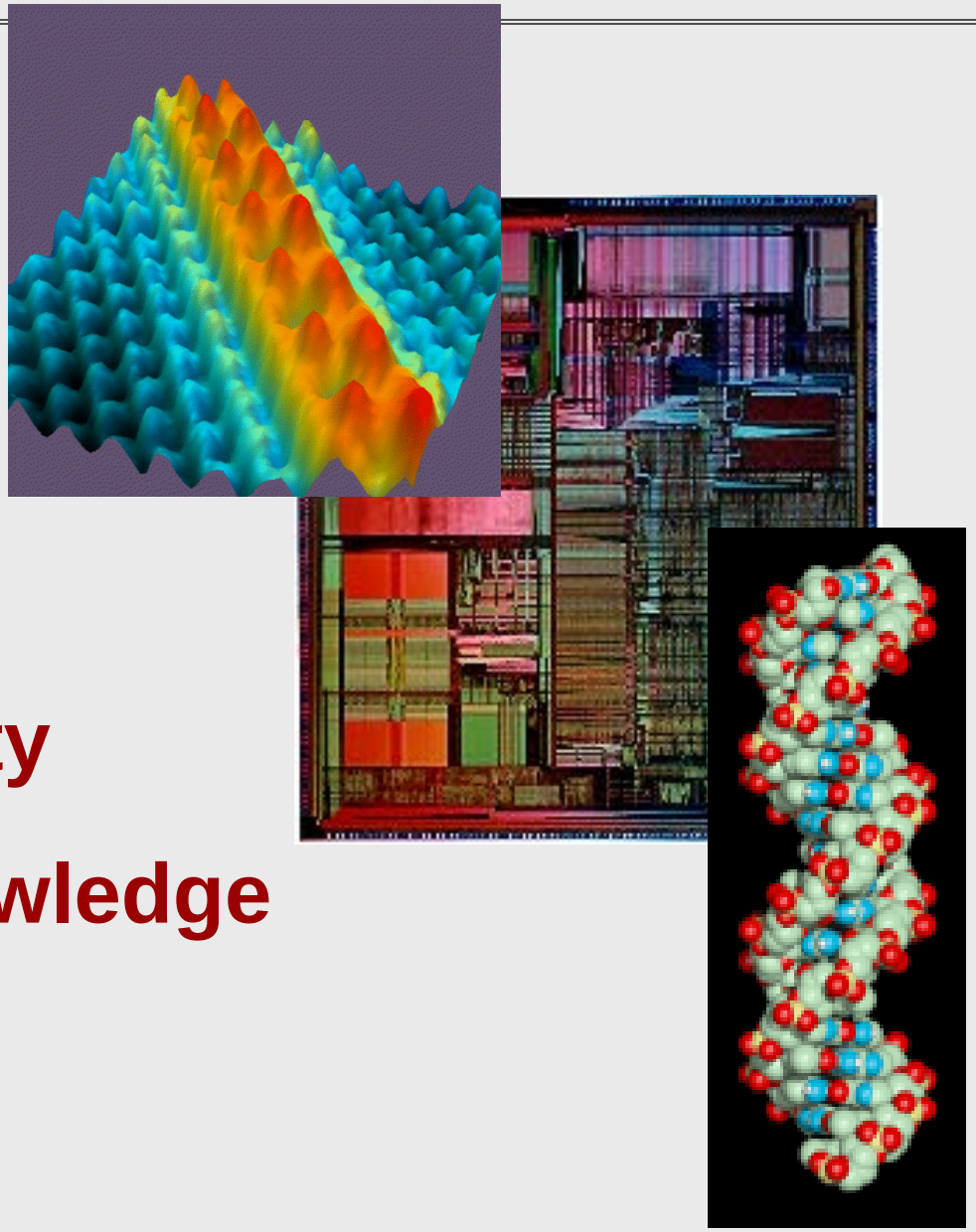
- Smaller and larger dimensions
- Finer scales,

  tighter tolerances
- Shorter time intervals
- Self-realized standards
- New measurement requirements

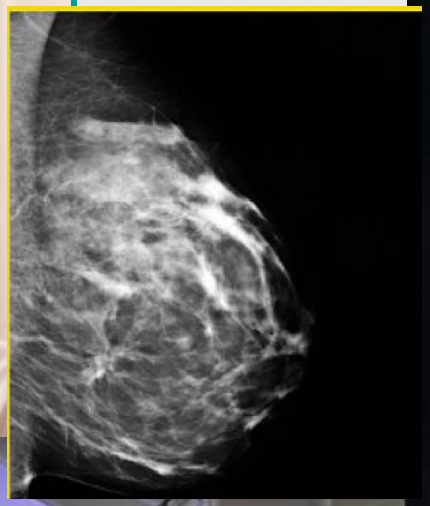
Strategic Focus Areas

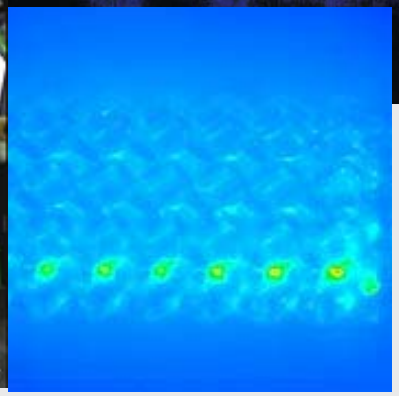
NIST 2010

- Health Care
- Nanotechnology
- Homeland Security
- Information / Knowledge Management

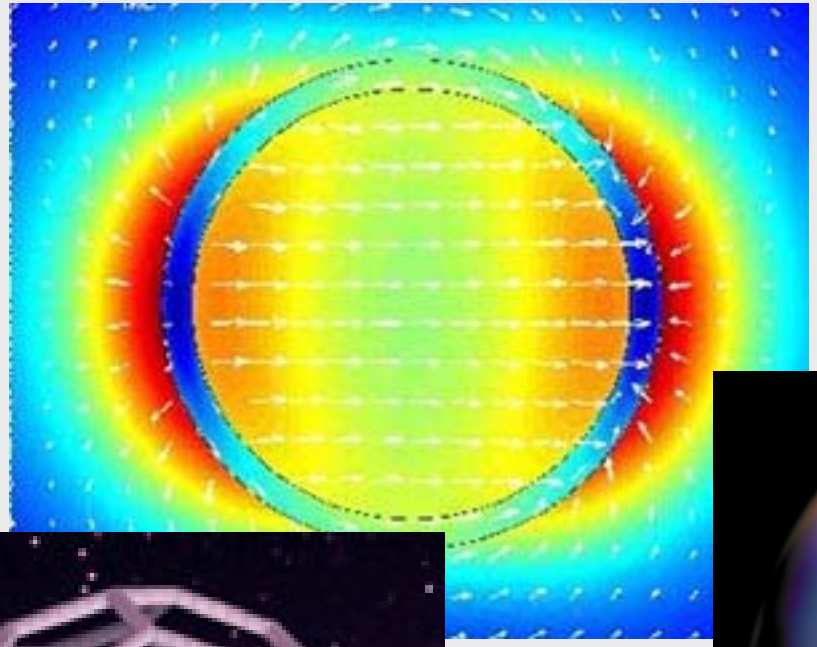


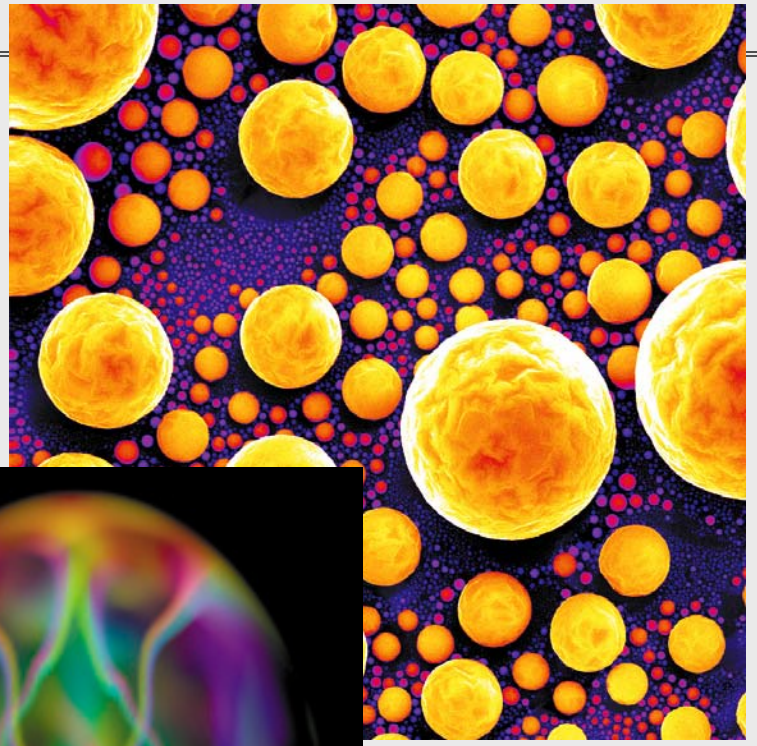
Health Care

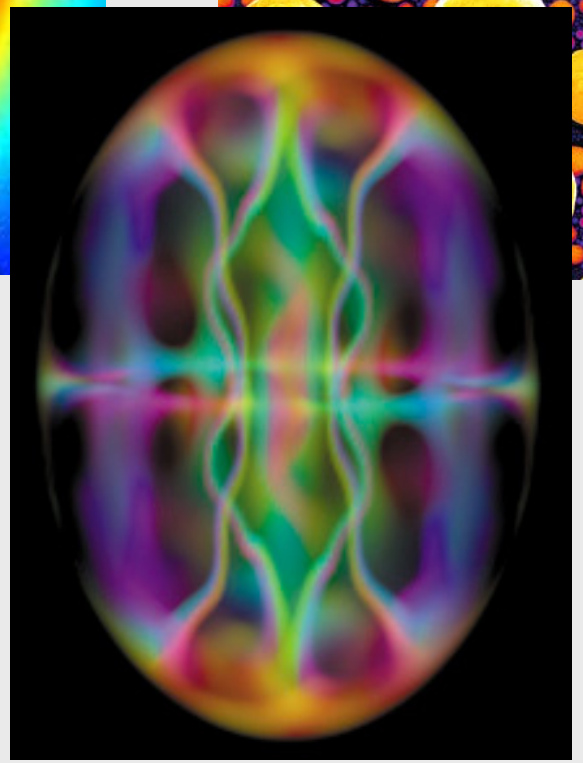




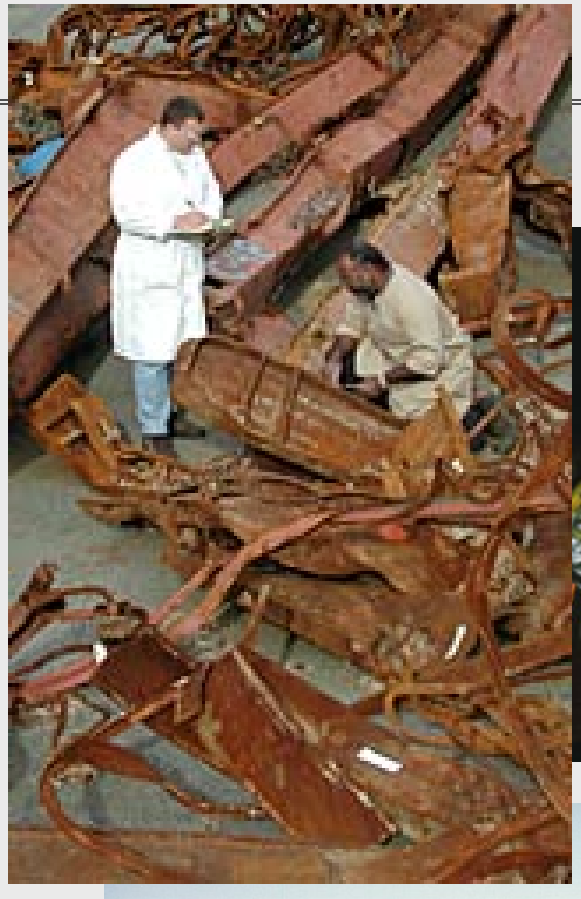
Nanotechnology

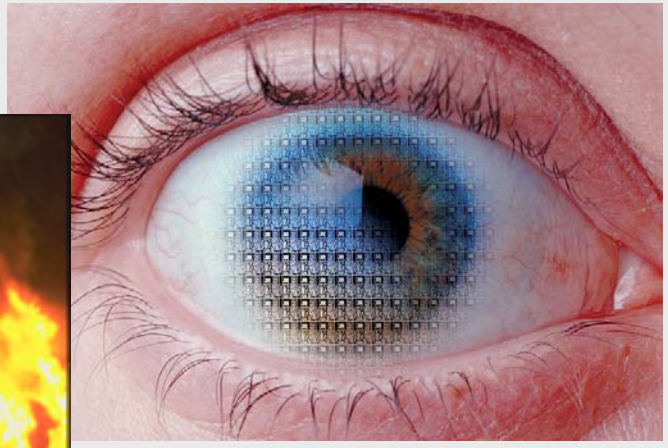


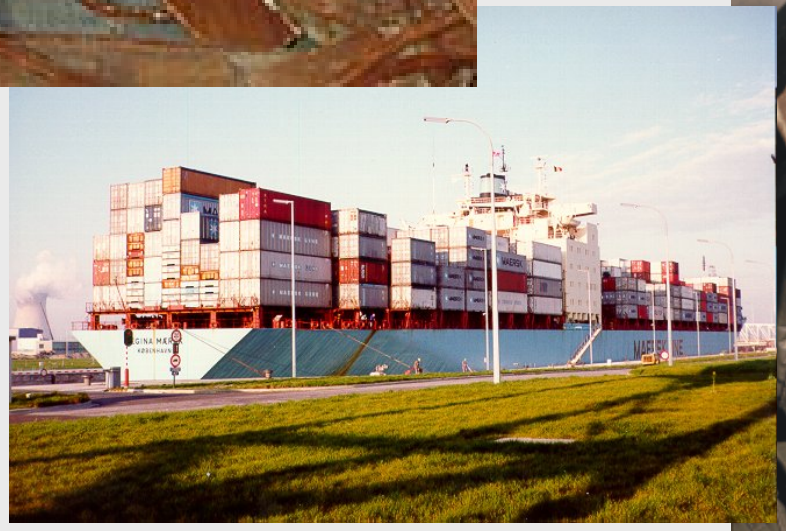




Homeland Security

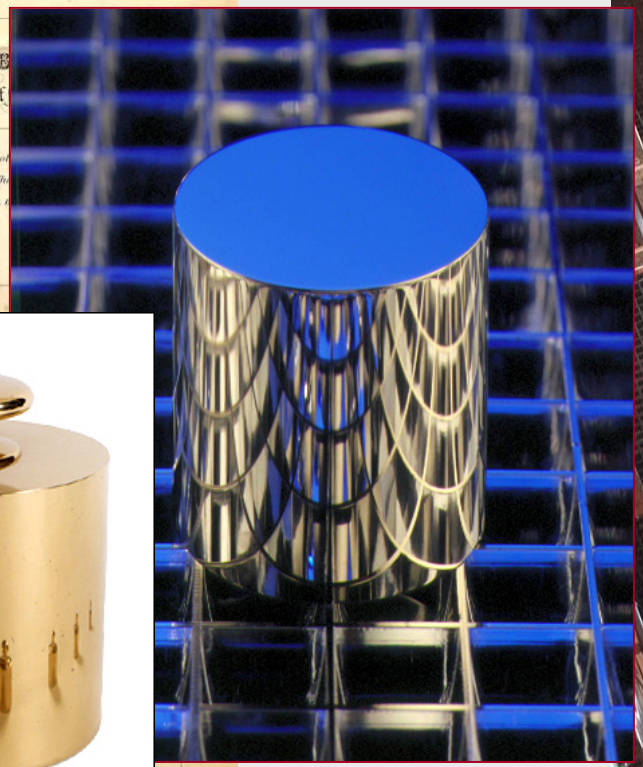


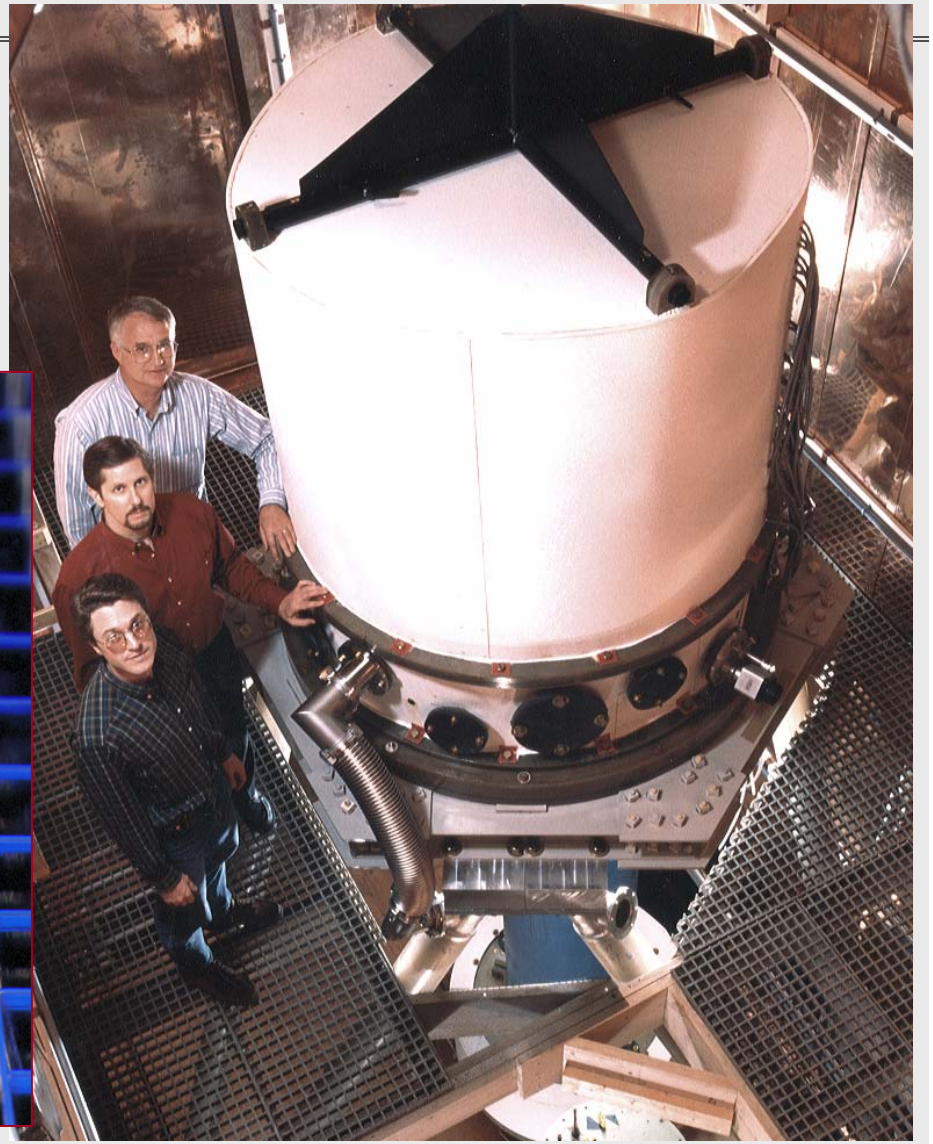




Information / Knowledge Management

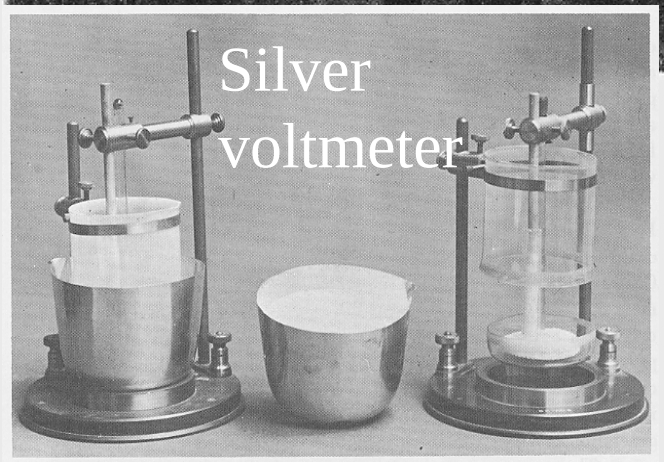
Advanced Standards: The Electronic Kilogram



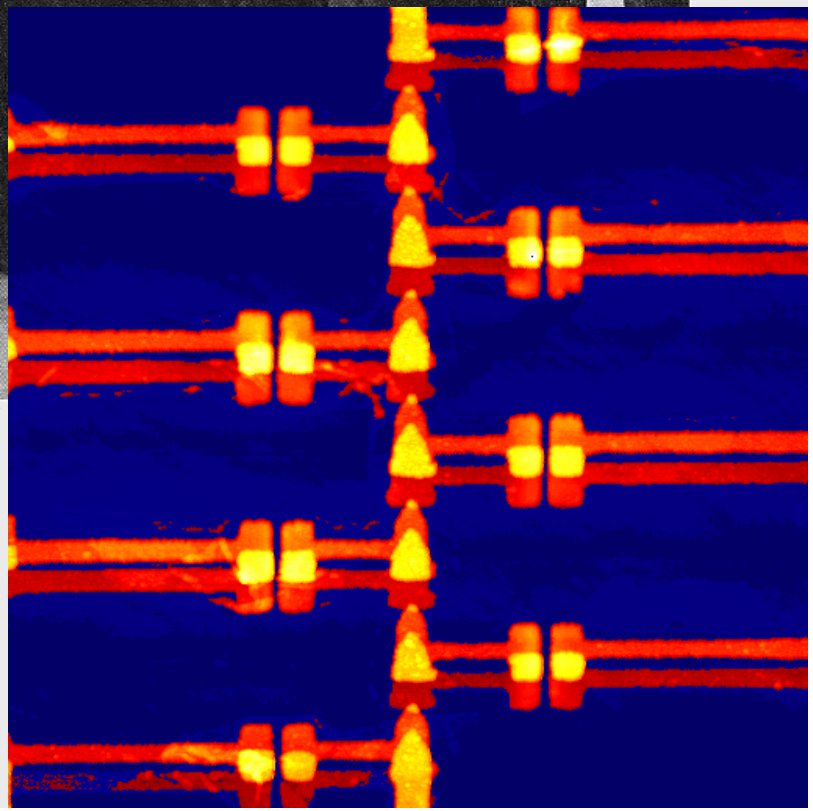


High Precision Electrical Standards

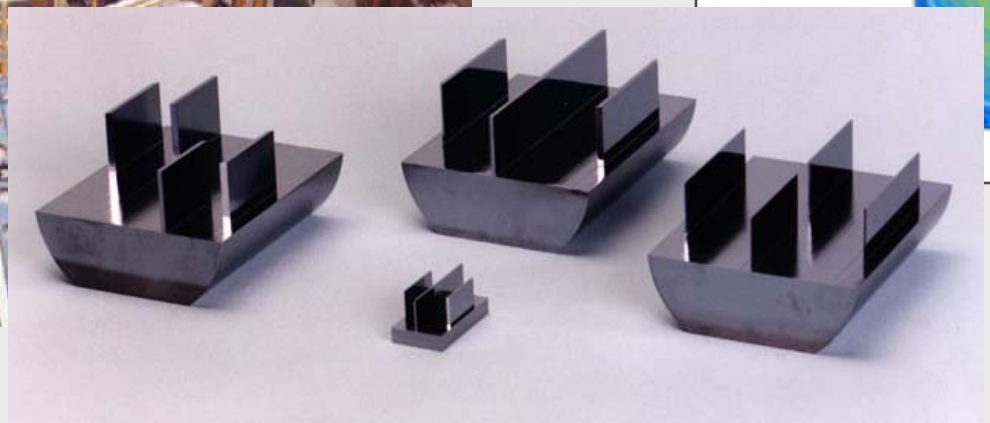
The International Technical Committee of 1910 assigned new values to the international ampere, ohm and volt.

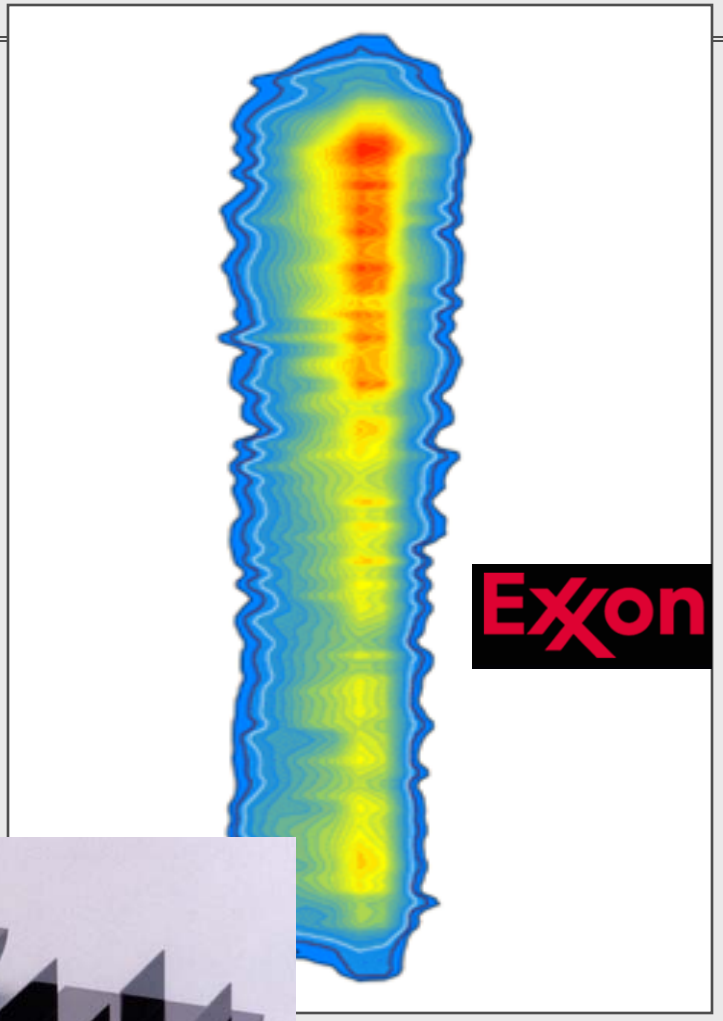


Silver voltmeter



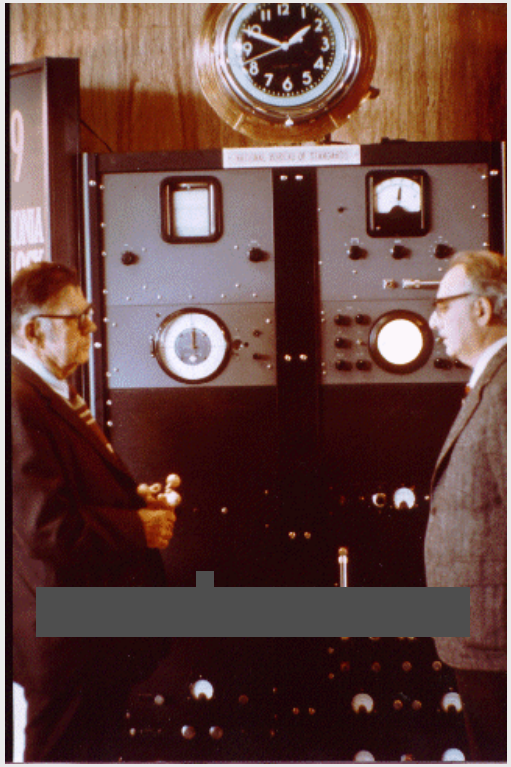
Supporting the Hydrogen Economy

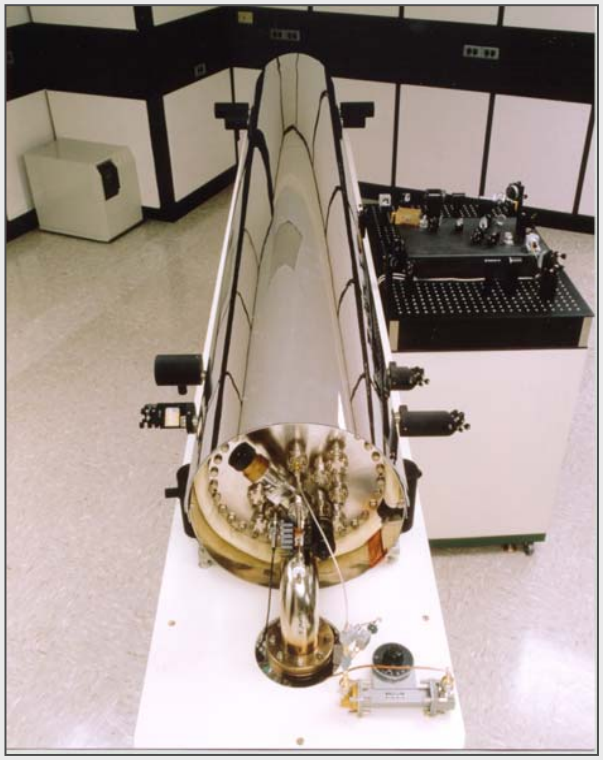




Genesis of Atomic Clocks

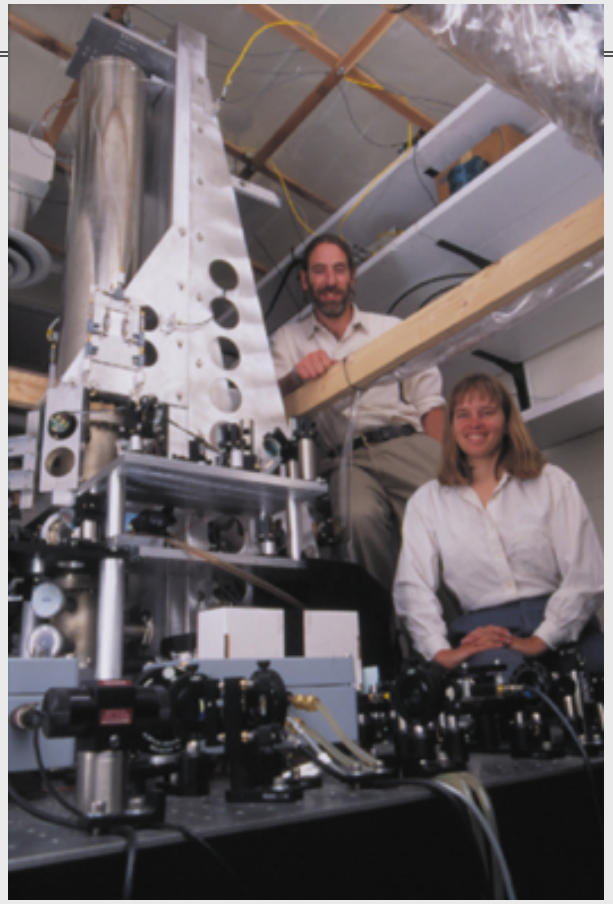
Ammonia resonator
1 s in 300 years (1949)





NIST 7

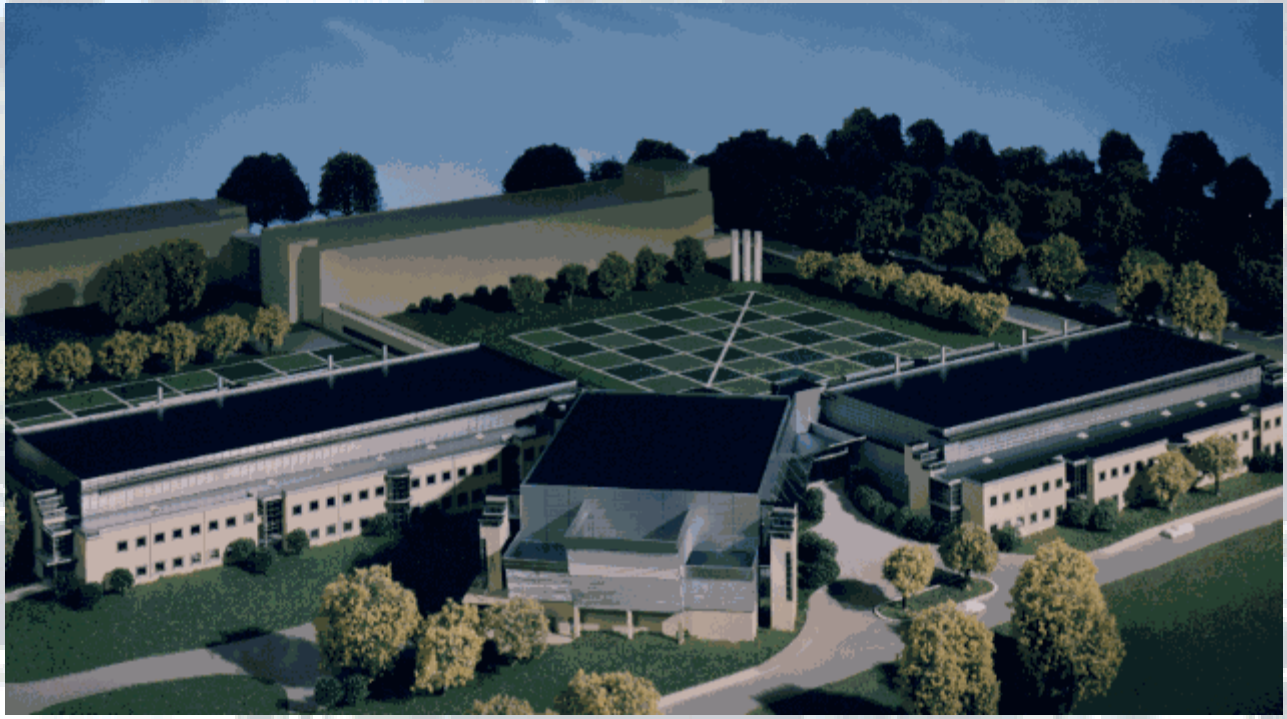
1 s in 6 million years (1993)



NIST F1

1 s in 30 million years (1999)

Advanced Measurement Laboratory



- **Air Quality:** 2 – 4 x 10^6 to ~1,000 particles/ft^3 General Laboratory Space Class 100 in Cleanrooms
- **Vibration:** 3 - 20 μm/sec to 0.2 to 3 μm/sec
- **Temperature:** ± 2 ºC to 0.010, 0.100 & 0.25 ºC
- **Humidity** ± 20% to ± 1% -- 5%
- **Electrical Power:** Improved Quality/Reduced Outage Effects for Critical Instruments (Building UPS)

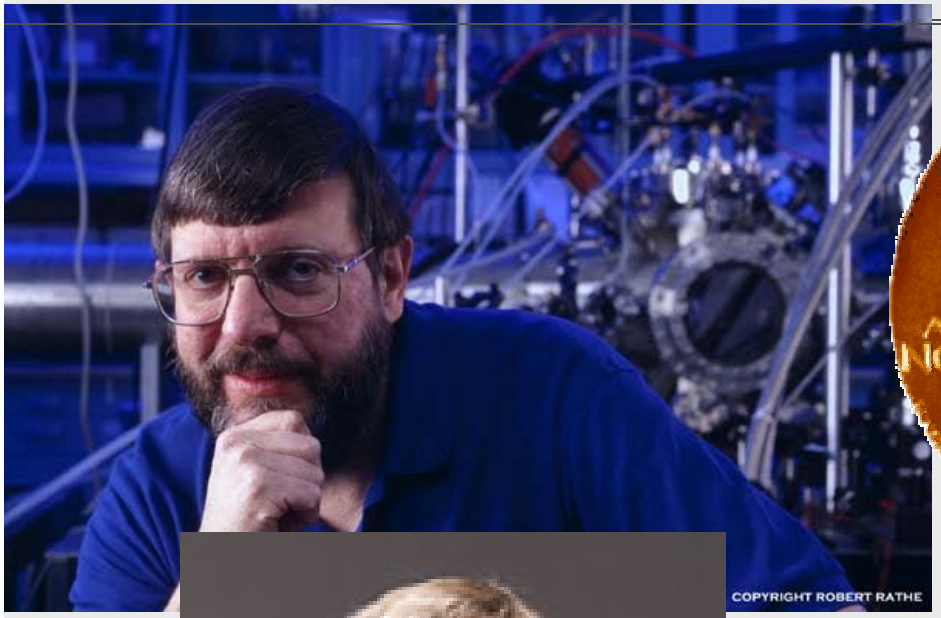
NMS: Supporting A Global Economy

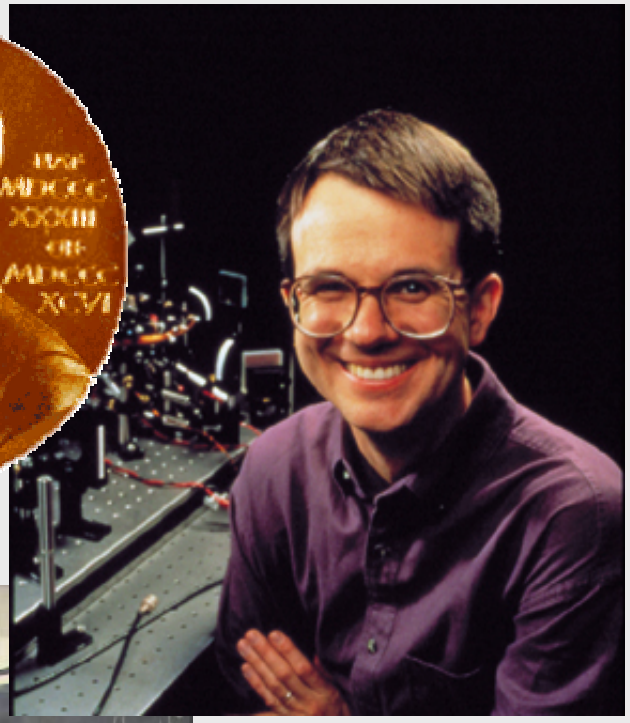
Global forces changing the landscape of measurement services

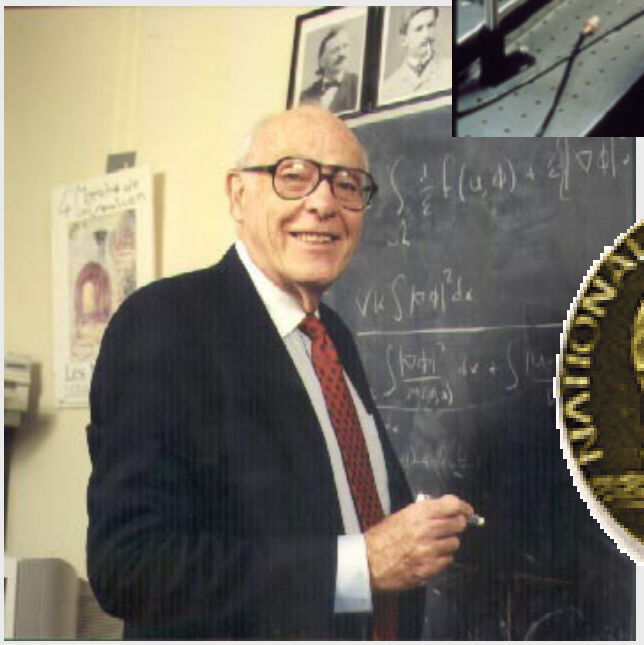
Traceability

Interoperability

NIST Today: World Class Science







Convergence Through Measurement