TelePresence Microscopy, Collaboratories and the DoE 2000 Program

Challenges, Requirements , and Tools

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TelePresence Microscopy Collaboratory

Vision of the Future

The key to the understanding the TelePresence Microscopy Collaboratory and it's role is to remember that ultimately, it is not simply the presence of instrumentation which produces new ideas, better students or new science.

Instead, advances results from the work of individuals who learn from their interactions with others. These individuals continue to interact, to formulate ideas or execute "experiments" to solve vexing problems, expand their knowledge and understanding , and this carried out using the tools which we have placed at their disposal.

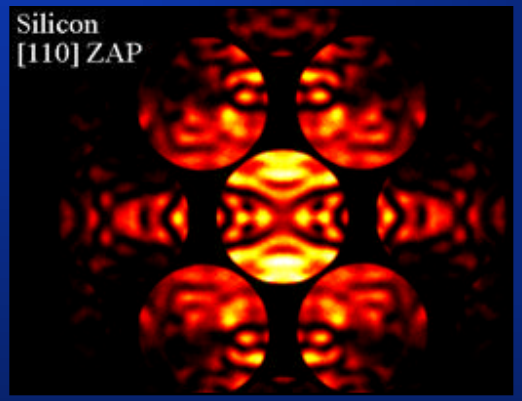
In TPM, the Collaboratory is the tool which we are developing.

TelePresence Collaboration

TelePresence Collaboration

Key to All Scientific Experiments is the Interaction of Investigators with:

Instrumentation

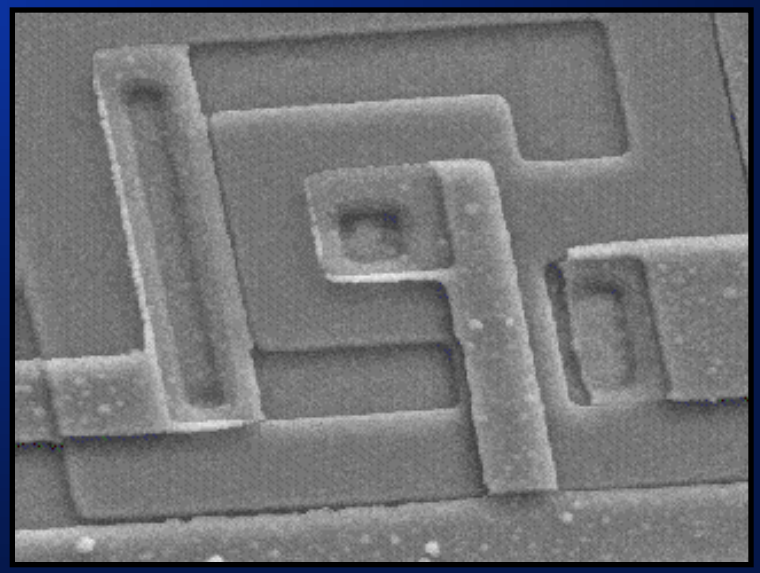


Data

Collaborators

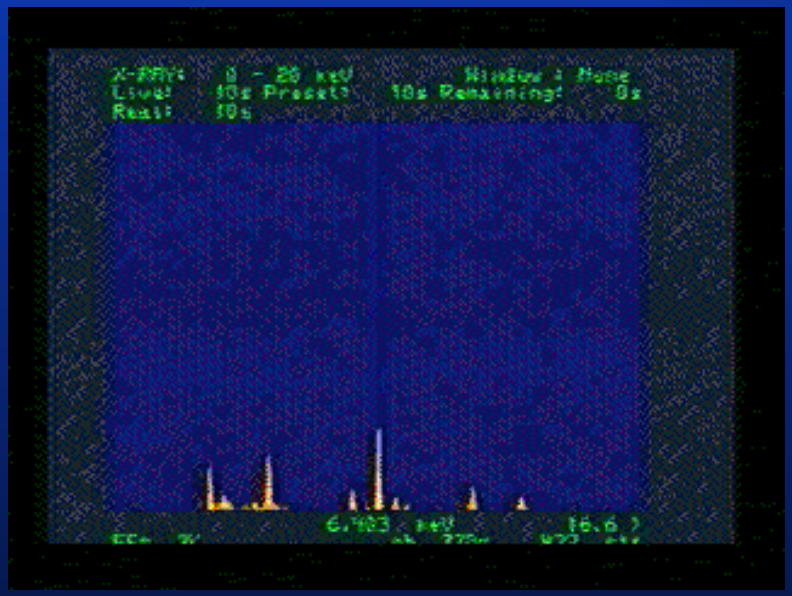
TelePresence Collaboration

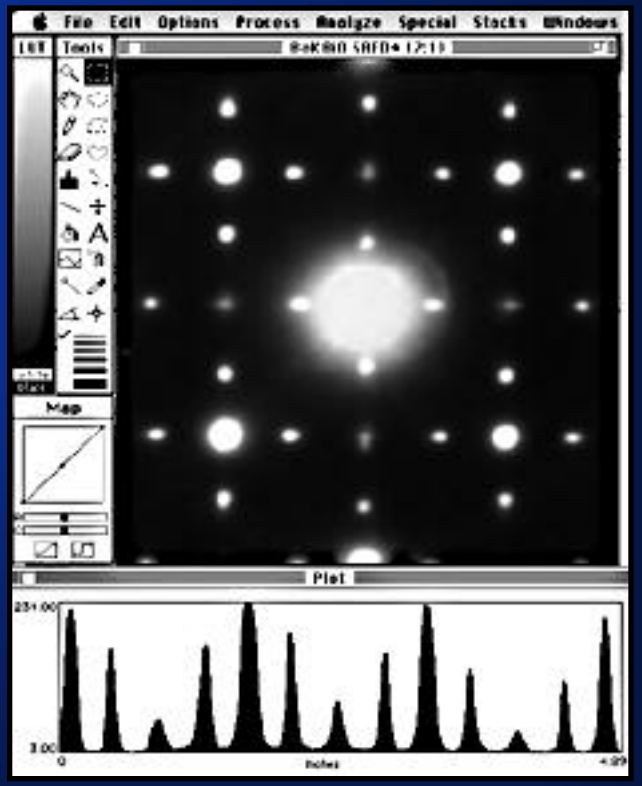
- **Working with Instruments the Experimentalist Needs:**
  - Monitor the Progress of the Experiment
    - Dials, Knobs, Gauges, Conditions, Images, Spectra.....
  - Real-Time Control of the Experiment
    - Ability to Interact with the Instrumentation



TelePresence Collaboration

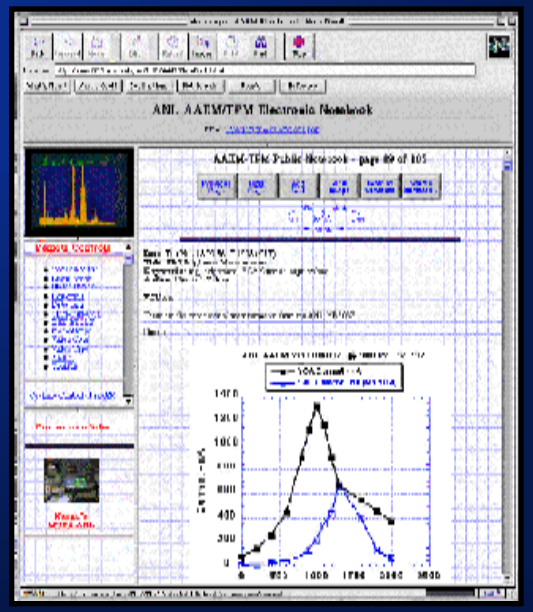
- **Working with Data**
  - Real-Time Access to Current Results
  - Analysis Tools
  - High Performance Data Engines





TelePresence Collaboration

- **Working with Collaborators , Investigators Need to:**
  - **Discuss the Experimental Progress**
  - **View Data While It is Being Acquired**
  - **Sketch Out Trends**
  - **Access Supporting Documentation**



TelePresence Collaboration

The Challenge

Controls

Instrumentation, Data, Standards,
Legacy Platforms, Human Factors, Time, Budget

Input

- Users
- Enablers

- New Paradigm for Interactive R&D and Education

Output

Networks, Servers,
Browsers, Tools

Mechanisms

Functional Requirements for Collaboration

- Persistence
- Sharable Entities
- Sharing Techniques, Methods, Protocols
- Session/Access Control
- Discovery Mechanisms
- Transport Mechanisms
- Resource Management
- Real World Interfaces

Functional Requirements for Collaboration

Key Issues

Collaboration Functions

Virtual Workspace
- Real Time Data
- Asynchronous Data
- Observation Areas
- Private Meeting Rooms

Digital Media Sharing

Tele/Video Conferencing

Data Sharing

Library/References/Archives

Application Sharing
- Data Analysis Tools

Persistence Functions

Data Archiving

Session Archiving

Electronic Notebooks

Data Mining

Device Interactions

Instrument Interface

Legacy Systems

Perphiperal Systems

Functional Requirements for Collaboration

Key Issues

- **Security**
  - Instrument
  - Data
- **Enabling Functions**
  - Client Access Tools
  - Network Connectivity
  - Quality of Service

Persistent Electronic Space

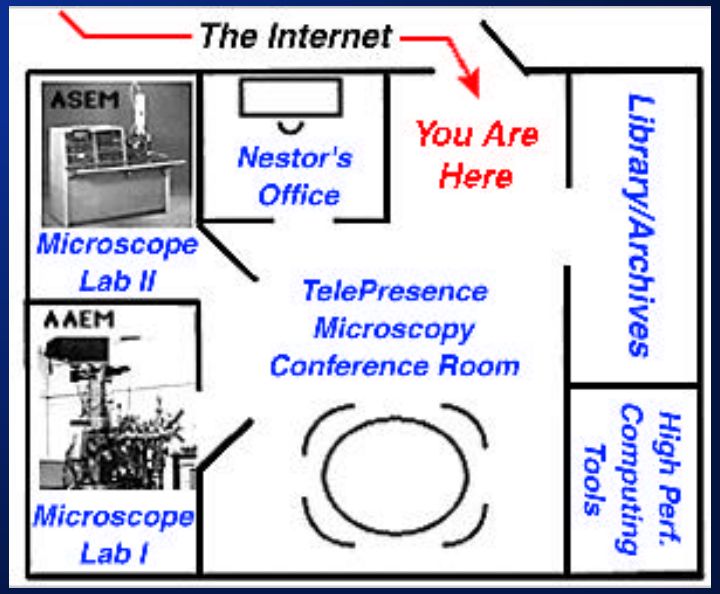
WWW Site is an Ideal Proto-type Model of a Persistent Electronic Space

- Observational Modes
- Capabilities for both Dynamic and Static Data
- Can Host both Private and Public Areas
- Completely Digital Media
- A/V Compliant
- Enables Data Sharing with minimal work
- Extensible to Application Sharing

Persistent Electronic Space

Characteristics of a Persistent Electronic "Lab"

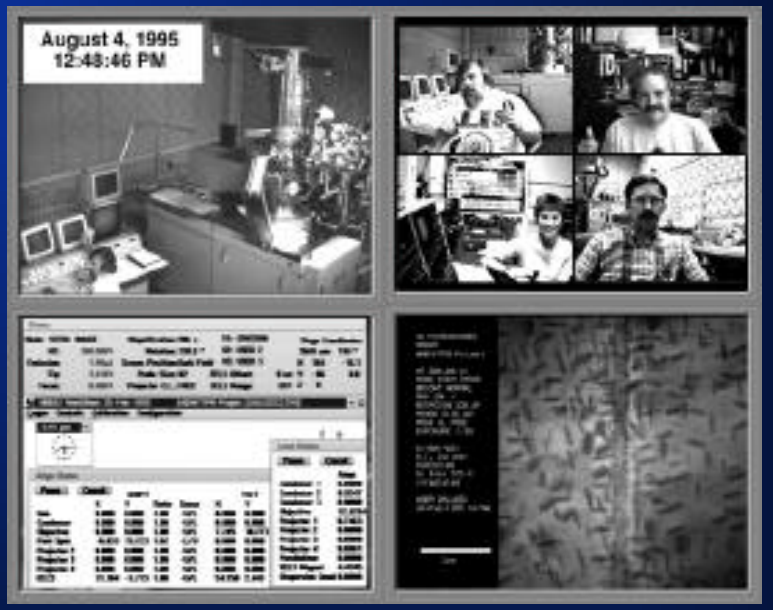
- **Always There**
- **Collaboratory Interaction Zone**
  - Offices, Work Areas, Labs, Mailboxes
- **Access Control**
  - **Active**
    - Public/Private/Restricted
    - Real Time Interactions
    - Editable
  - **Passive**
    - Public/Private/Restricted
    - Viewable not Editable
- **Scalability**



Sharable Enties

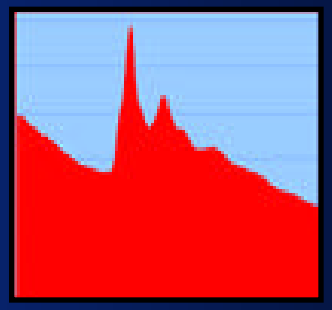
Items in the Collaboratory which may be "Sharable"

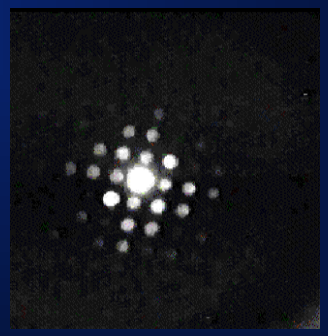
- **People / Expertise**
  - On-Line Expertise & Knowledge -> Non-Linear Interaction
- **Data**
  - Text/Graphics Documents
  - Images, Spectra
- **Instrumentation**
- **Application Programs**
- **Sessions**



Sharing Techniques

- ***Laboratory/Office Environment***
  - Tele - Video Conferencing
  - Lab Environment
  - Instrumentation
- ***Fixed Data***
  - Items which do not change with Time
    - Archived Text, Graphics....
    - Archived Data Sets
- ***Time Sensitive Data***
  - Real Time Images / Spectra
  - Real Time Analyses
  - Real Time Documents





Session Control / Discovery

- ***Session Control***
  - How big is the Collaboratory / User Base
  - Access Levels (Administrative/Security)
  - Must not get in the way of doing work.
    - Access Control Lists (ACL)- passwords
    - User Certificates - Encrypted Keys

- ***Discovery***
  - Searchable for the Various Sharable Entities
  - State Sensitive
    - Changes with the availability of the Entity
    - Changes with access control levels
  - Directory Services

Security

- We are putting valuable and complicated facilities or data online to the whole world
- The data generated using these facilities may be proprietary
- If security “gets in the way” it will not be used.
- If security is too weak, valuable assets are at risk.

Security

- **Secure a Web-based prototype**
  - Client and server certificates — authentication
  - SSL encryption
  - Host data protection via directory access
- **Use the Entrust security context to**
  - Encrypt communication channels
  - Create secure control applications
  - Create certificate issuing programs
- **Create a security services engine**

Transport Mechanisms
Infrastructure Requirements

Hardware

- Transport Medium
  (i.e. the lines)
- Network Protocols
  - LAN, WAN.....
    (Speed, Speed and More Speed)
  - Quality of Service

Software

- Data Protocols
  - Real TimeStreaming Protocols
    - Server Type
    - Data Type (Lossy/Lossless)
    - Client Hardware/Software
  - Fixed Data Set Protocols
    - Time Sensitive /Insensitive
    - Size
    - Format
- Commerical vs Custom vs Shareware

Resource Management

- ***Availablity of the Resource*** *(People/Instruments)*
  - **On-Line/Off-Line**
- ***Access Control***
  - **Safety**
  - **Expertise**
  - **Proprietary data**
- ***Floor Control***
  - **Who is in Control**
  - **How is control passed to others**

Real World Interfaces

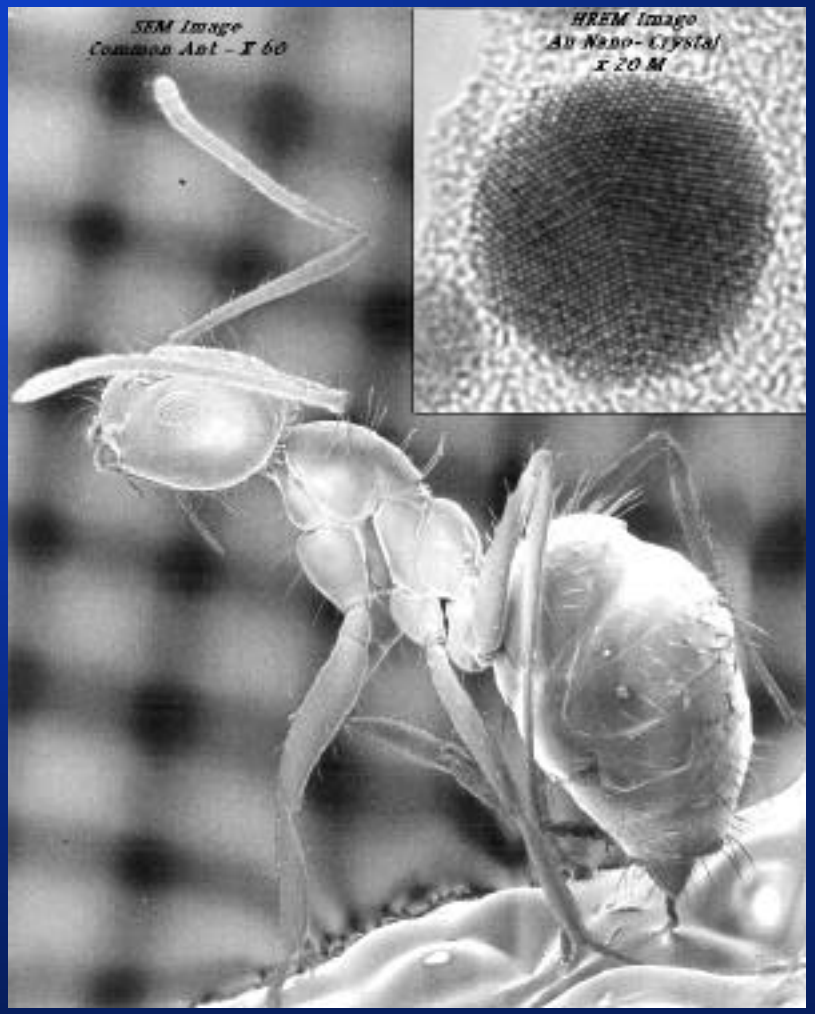
- **Hardware Interfaces**
  - –Adaptable to different sharable entities
  - –Platform independent communications protocols
  - –Client/server visualization hardware
- **Software Interfaces**
  - Security Aware
  - User & Network Friendly
  - Adaptable
  - Scalable
- **Computational Interfaces**
  - –Data object definitions
  - –Data passing
  - –Legacy Systems

TelePresense Microscopy

Microscopy is one of the few methodologies applied to nearly every field of science and technology in use today.

A microscope can be as simple as a hand held optical device or as complex as a multi-million dollar research tool.

Using these instruments, both scientists and students can explore the synergistic relationships of structure and properties of a wide variety materials in both the Physical and the Life Sciences.



Microanalysis & Materials Research

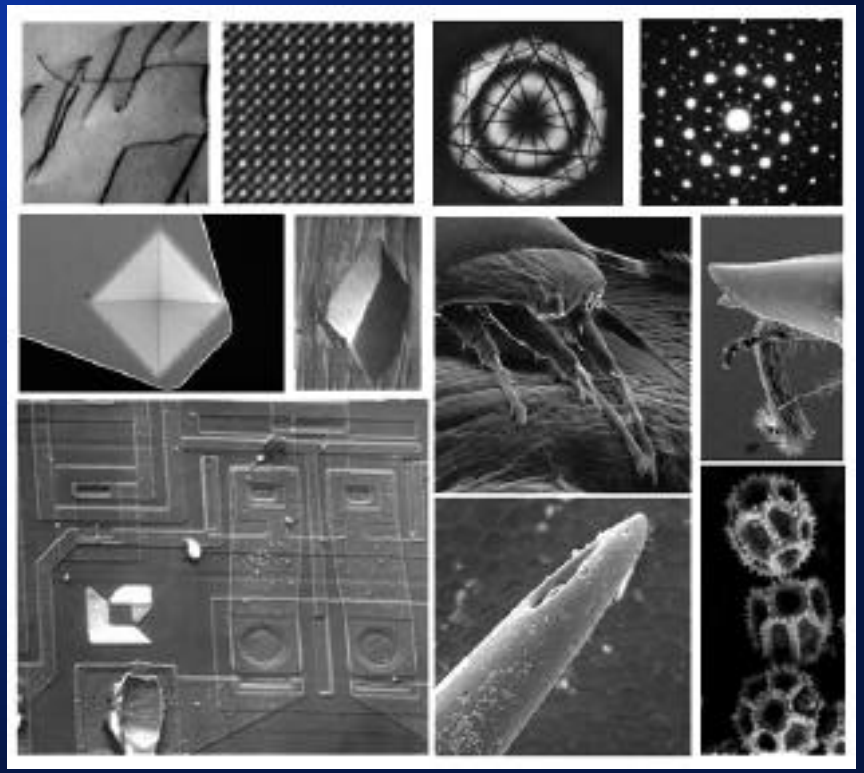
Materials Science

Determine the relationship of Structure to Properties, because the macroscopic properties of any material can be ultimately traced to the synergistic relationships of its constituent phases and any defect structures contained therein.

Microscopy/Microanalysis

Methodologies used to determine the structure of matter at a resolution better than that of the unaided eye using photons, charged particles, or mechanical probes.

- –Morphology
- –Crystallography
- –Elemental Composition
- –Chemical Composition
- –Electronic Structure



Electron Microscopy & Microanalysis

Experimental methodologies which employs electron-optical instrumentation to spatially characterize matter on scales which range from tenths of a millimeter to tenths of a nanometer. The principle modalities employed are:

Imaging

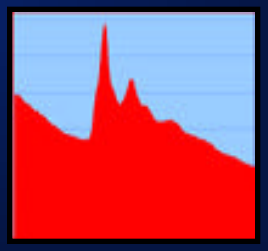
- Transmission Electron Microscopy
- Scanning Transmission Electron Microscopy
- Scanning Electron Microscopy

Diffraction

- Convergent Beam Electron Diffraction
- Selected Area Electron Diffraction
- Reflection High Energy Electron Diffraction

Spectroscopy

- X-ray Energy Dispersive
- Electron Energy Loss
- Auger Electron

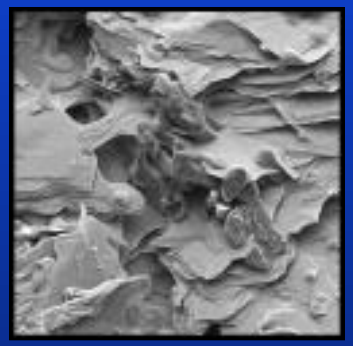


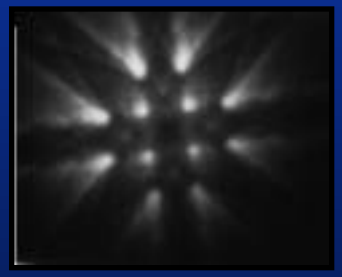
MicroCharacterization via Electron Microscopy

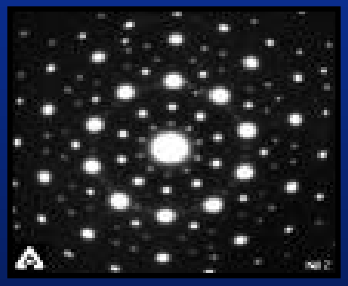
SEM
Scanning Electron Microscopy

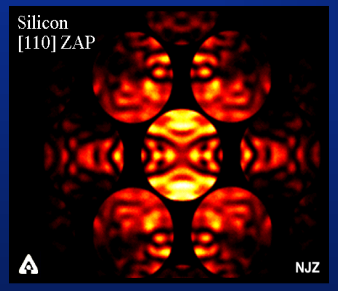
TEM - STEM - HREM
Transmission - Scanning Transmission - High Resolution Electron Microscopy

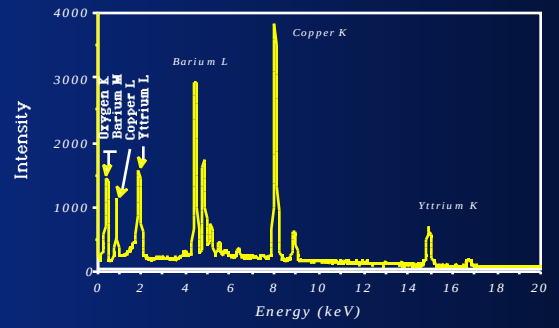
AEM
Analytical Electron Microscopy

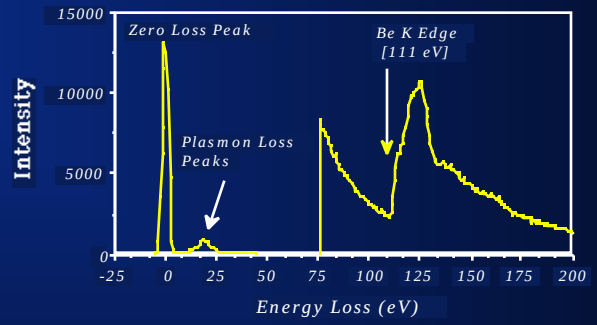








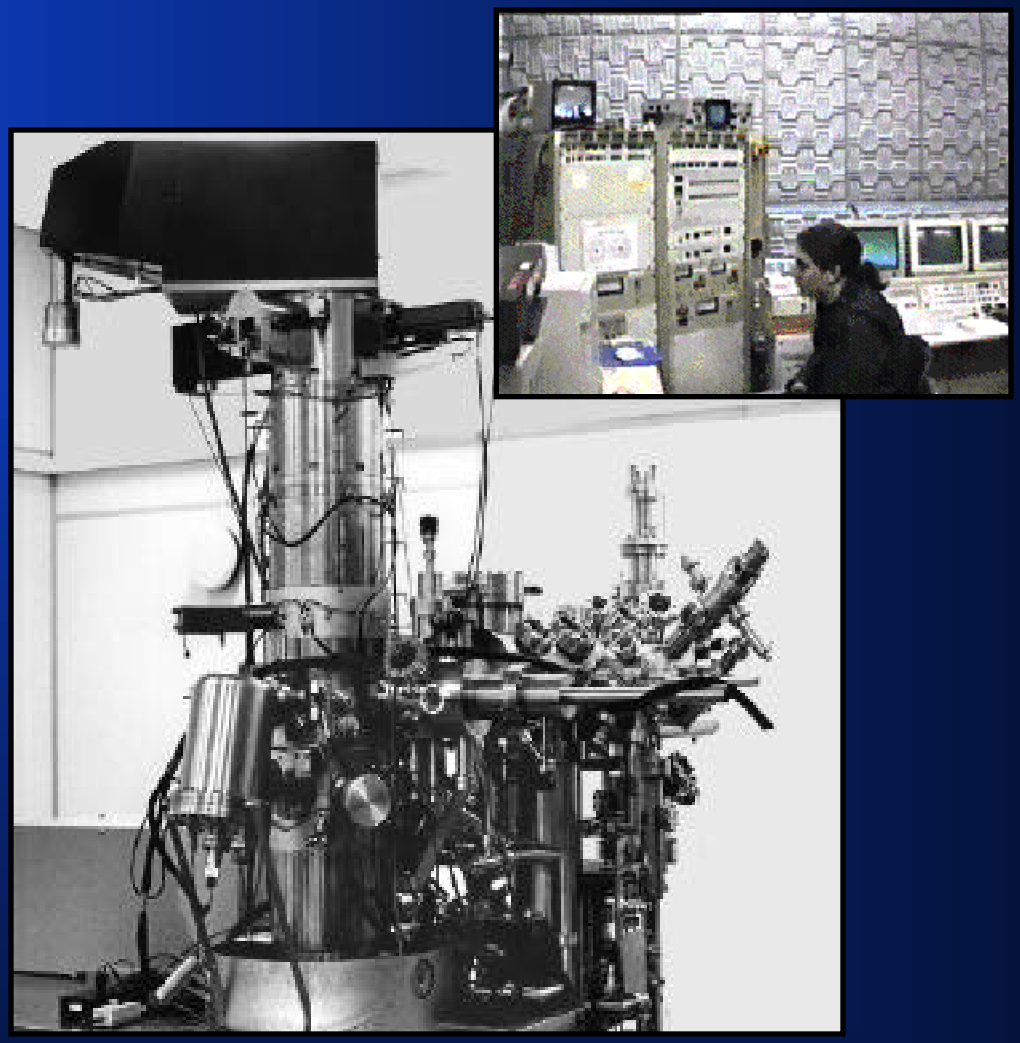




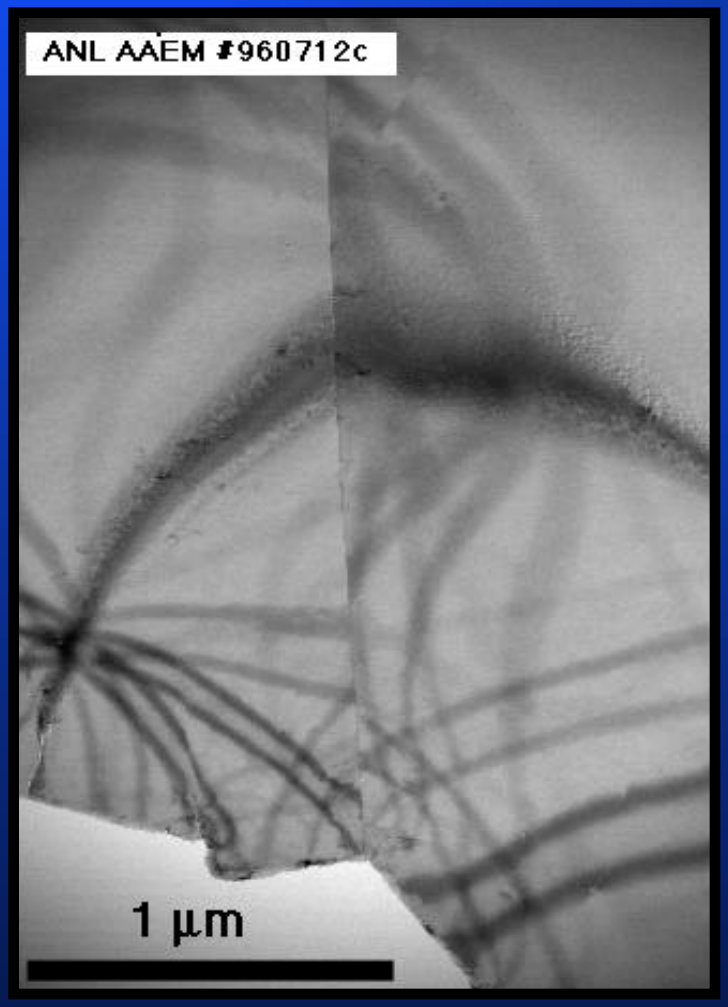
Morphology, Crystallography, Elemental , Chemical , Electronic Structure

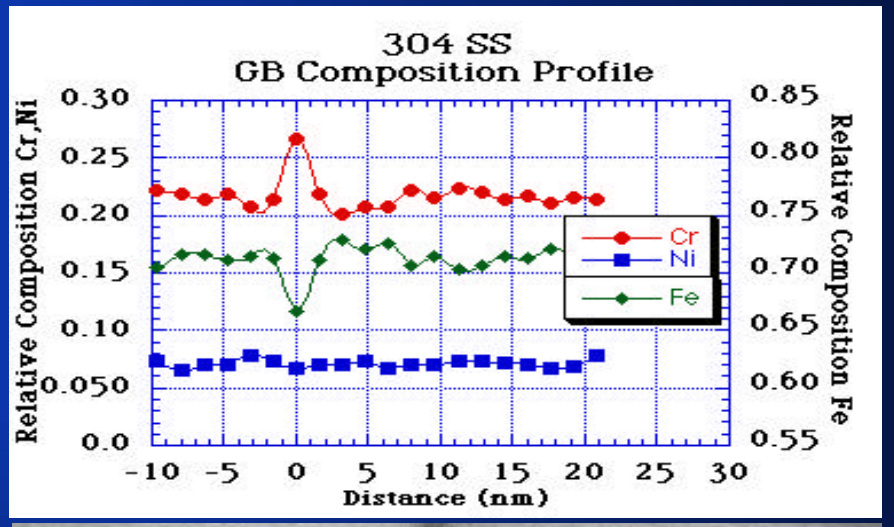
ANL - Advanced Analytical Electron Microscope

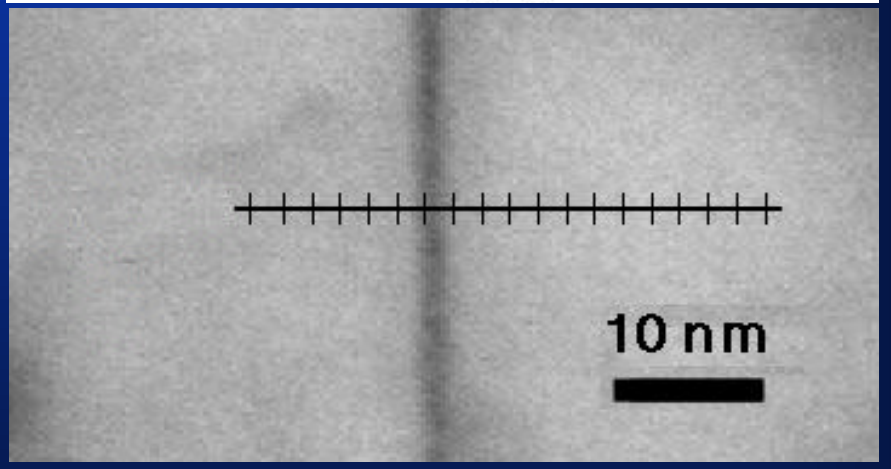
- **Cold Field Emission Electron Source**
  - Vo: 50 - 300 kV
- **Ultrahigh vacuum (UHV) environment**
  - ~ 1 x 10^{-11} torr - Gun, < 2 x 10^{-10} torr - Column
  - < 5 x 10^{-10} torr - Specimen Preparation Chamber
- **Electron Optics capable of :**
  - STEM / SEM:
  - TEM:
  - CBED/SAED:
  - Other Modes: TSEM, TSED, RHEED
- **Side Entry Goniometer Stages**
  - RT Double Tilt Beryllium:
  - LN2 Cooled Double Tilt Be Stage:
  - Single Tilt Heating Stage:
- **Analytical SubSystems on the E/O Column**
  - XEDS , EELS, AES
- **Specimen Preparation Chamber**
  - High Pressure/Temperature Gas Reaction Cell
  - Thin Film Evaporation Chamber
  - Mini-SIMS system - Gallium LMIS, Quad Mass Analyzer
  - RV LEED & Vacuum Transfer Vessel
  - ANL MultiPort Station for development work.
- **Computer Control**
- **Special Objective Lens Port Configuration**
  - 7 Experimental Ports on Objective Lens for Analytical Equipment
  - 3 Additional Ports for Electrical Feedthrus etc...



High Spatial Resolution Measurements of GB Segregation for IASCC Studies in 304 /316 SS







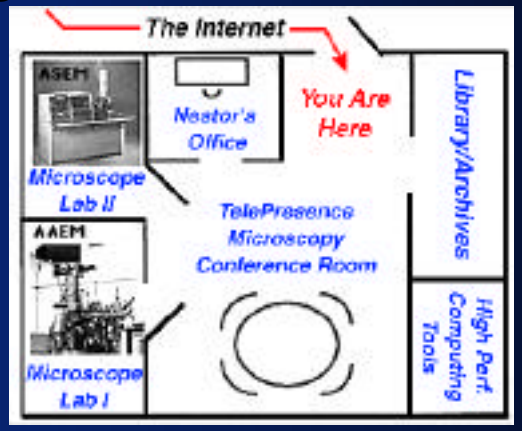
TelePresence Microscopy Collaboratory

- **Create a Persistent Virtual Location around Centers of Scientific Interest**
- **Integrate Operation & Control of Scientific Experiments**

  Allow *Remote Users* to have either *passive* or *active* participation to experimentation with access to both Expertise and Instrumentation

  via a platform independant GUI

  - **Experimental Windows, Electronic Notebooks**
  - **Meeting Rooms/Offices/ TeleConference Links**
  - **Libraries/Data Archives**
  - **Access to High Performance Data Engines for data processing**



- **Provide Opportunities for Distance Learning and Remote Collaboration at all levels**
  - **Research and Industrial Collaborations**
  - **Middle / High / and Univeristy Levels**
- **Provides a set of requirements which taxes the limits of the Internet**

  Imaging, Spectroscopy, Real-Time Control, Conferencing, ...

TelePresence Microscopy Collaboratory

Goals

- To Integrate these three key elements (Instruments, Data, and Investigators) into a collaboratorative framework by creating an Interactive Multi-Disciplinary Persistent Electronic Space focussed around Areas of Scientific Excellence/ Expertise
  - Physical Sciences: Physics , Materials , Mechanical, Electrical & BioEngineering,.....
  - Life Sciences: Biological Sciences, Pathology, Medicine , ...
- Establish the Enabling Factors which govern operation & control of scientific instruments over high speed networks using the Current and Next Generation Internet as the transport backbone, while using TPM Collaboratory as focus/tool of the interaction.
- Incorporate TPM into the Research Environment as well as in Distance Learning

TelePresence Microscopy Collaboratory

Benefits

- **Access to Unique Research Tools**
  - On-Line Shared **Resources** and **Expertise**
  - Permanent and Natural GUI Interface to Instruments and Data
  - Service & Diagnosis of Instrumental Problems
- **Persistent Electronic Laboratories**
  - Setup and Continue Experiments within a Collaboratory
  - Maintain Contact with Colleagues Regardless of Location
- **Education, Teaching, Training to/from Remote Sites**
  - Interfaces for Novice, Operator & Expert Users
    - Government / Industry/ University/ K-12

TelePresence Microscopy Collaboratory

Architecture

User Workstation

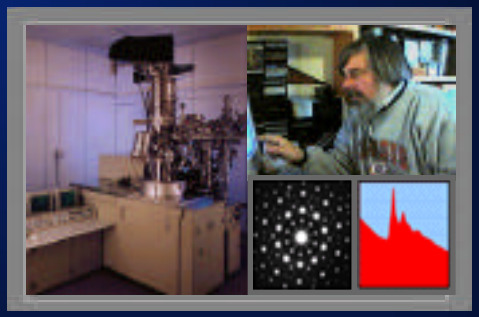
Collaboratory Server

Inter- System Communications

Resource:
Instrumentation,
Data, Expertise

Control Systems

Interface Electronics



TPM Collaboration Demographics

	Edu	Com	Gov	Org	Individuals
Organization	51%	24%	19%	3%	3%

	USA	Rest of the World
Location	67%	33%

Platform:	USA Only	World Wide	Operating Systems
PC Based	206 (41%)	293 (47%)	Win 95 (~98%),Win NT(<1%), Win 3.1(<1%)OS/2 (< 1%)
Mac Based	251 (49%)	279 (45%)	Mac OS V 7.5xx (100%)
Unix Based			
SUN	32 (~6%)	36 (~6%)	Solaris Note: 2 sites account for 20 systems!
SGI	9 (~2%)	10 (~2%)	SGI
IBM RS	6(~1%)	6(~1%)	not specified
DEC	2 (<1%)	2 (<1%)	not specified
HP	1(<<1%)	1(<<1%)	not specified
NEXT	1(<<1%)	1(<<1%)	Next
Total CPU's	508	628	

Fall -1997

TPM Collaboration Demographics

	Edu	Com	Gov	Org	Individuals
Organization	51%	24%	19%	3%	3%

	USA	Rest of the World	Totals
Location	67%	33%	100%
CPU's	508 (81%)	120 (19%)	628 (100%)

	Modem	ISDN	≥T1	SiteWide (Speed Unknown)
Internet Connection	13(13%)	7(7%)	28(28%)	51(52%)

	Yes	No or Unknown
Firewall On-Site	26%	74%

	CuSeeMe	Intel ProShare	PicTel	Vic/Vat	All Others
Video Conferencing	17	3	3	2	3

	NetScape	MicroSoft IE	All Others
Browser	87%	12%	3%

(some sites run multiple types of browsers hence totals exceed 100%)

Functionality

- Platform Independent
- Intuitive GUI
- Responsive to the User
- Adaptable to Wide Range of Instruments
- Provides What the User Needs to Do the Experiment

TelePresence Microscopy

Approach

- Develop an Intuitive Natural Environment -> WWW Based
- Develop Navigation/Browsing Tools
- Establish High Capacity Protocols for Data Archiving, Recording, and Indexing
- Interfaces Workstation Model Development
- Scaleable Interfaces to Scientific Instruments

Test Bed Sites

ANL Analytical Electron Microscopy Instrumentation (1994 →)

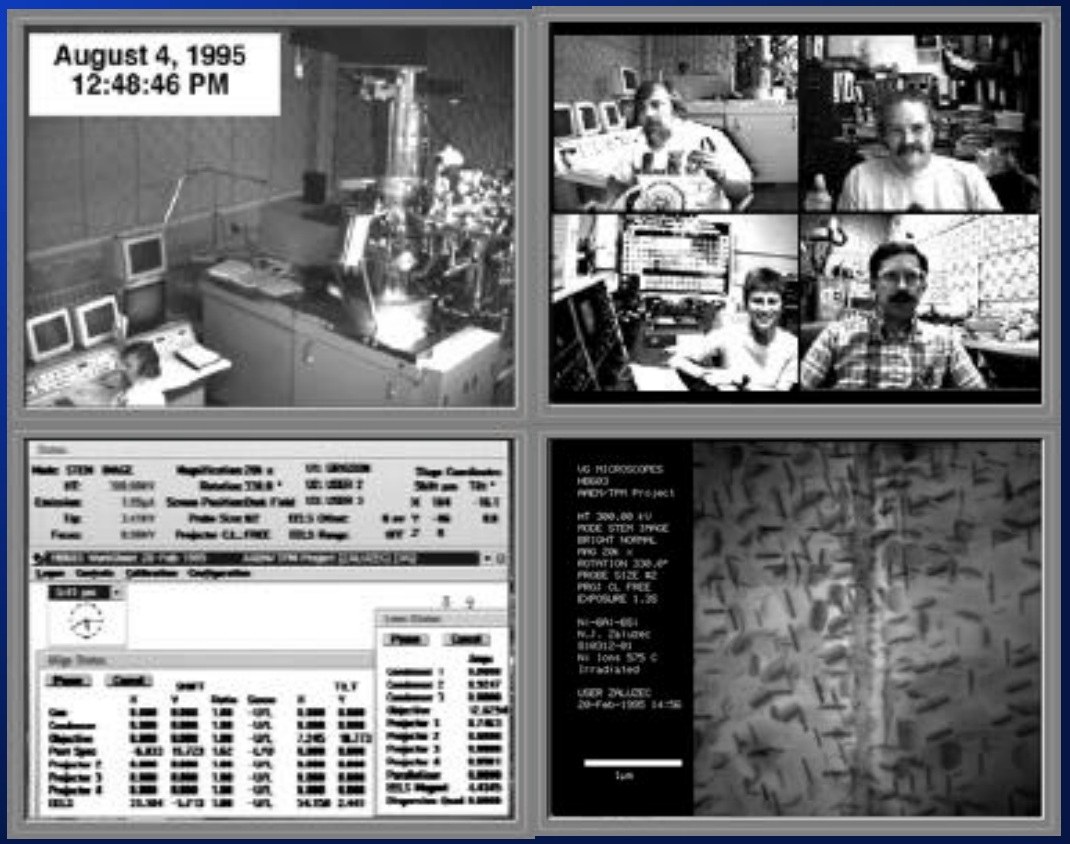
DoE 2000 Materials Microcharacterization Collaboratory

ANL, LBNL, NIST, ORNL, UofI (1997 →)

TelePresence Microscopy

Provides Access to:

- Instrument Room
- Instrument Status
- Experimental Data
- On-Line Control
- Video Conferencing
- Electronic Notebooks



Device Interactions
User/Instrument Interfaces

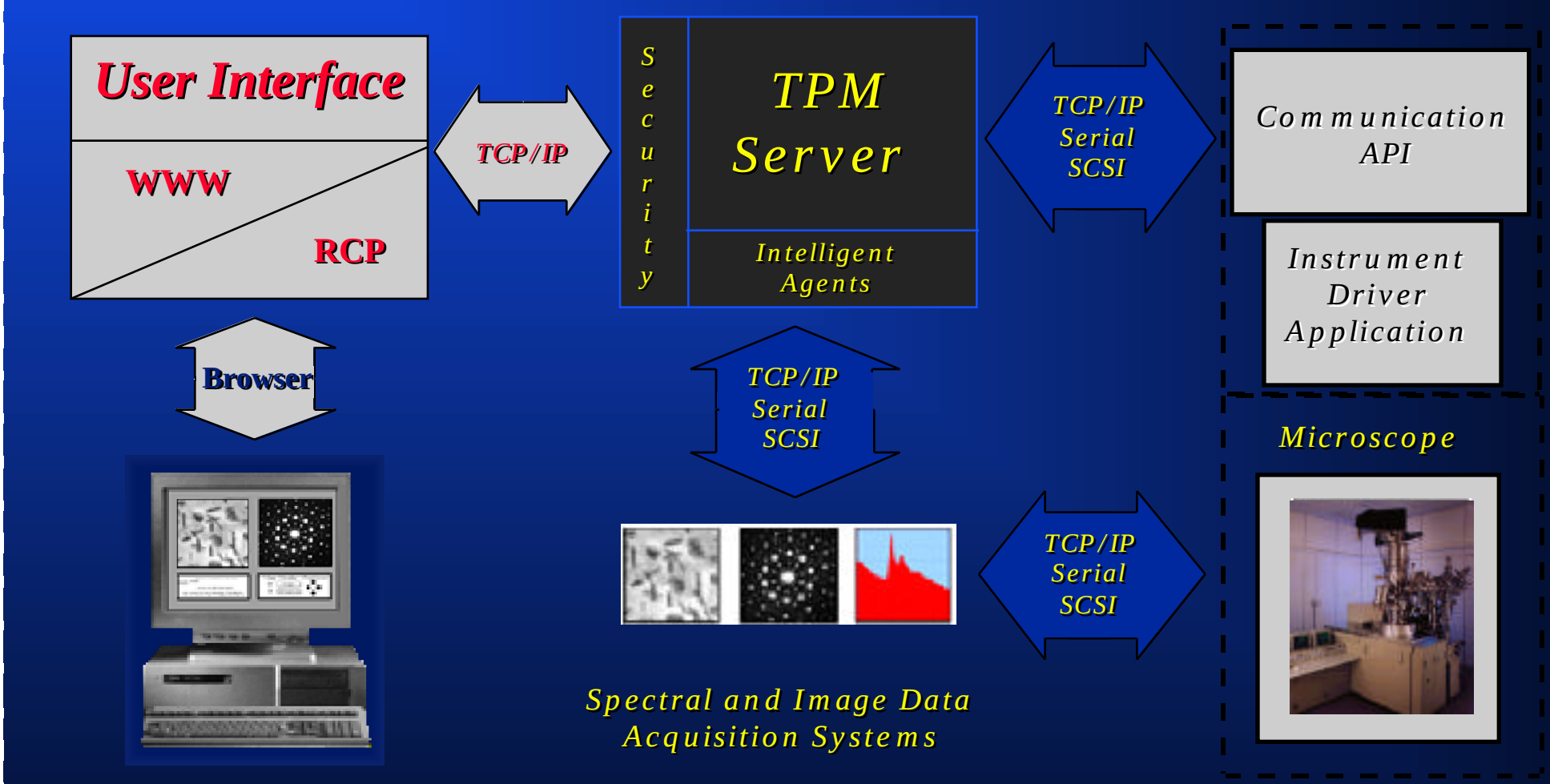
Instrument Interactions

Multiple Vendors & Custom Protocols

Perphiperal Systems

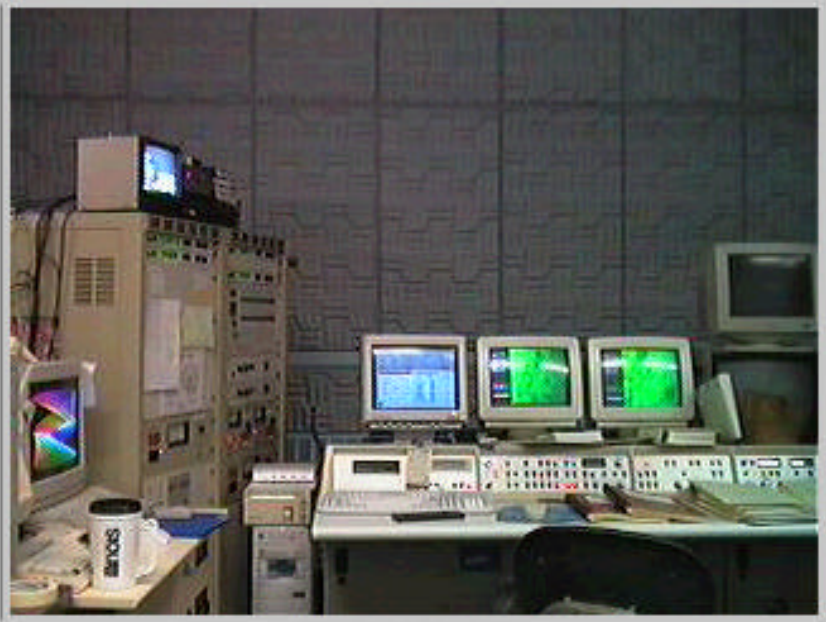
Legacy Systems

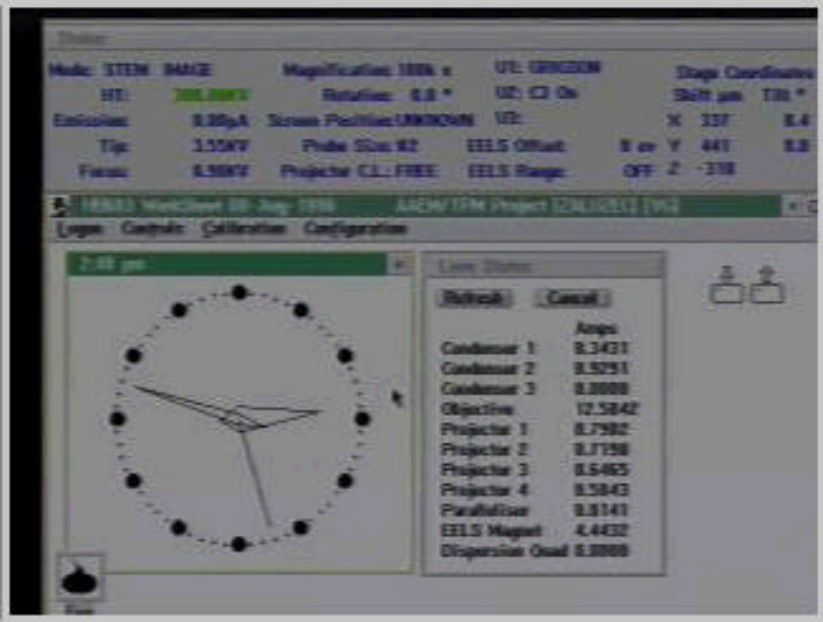
Current Architecture
Instrument Access/Control

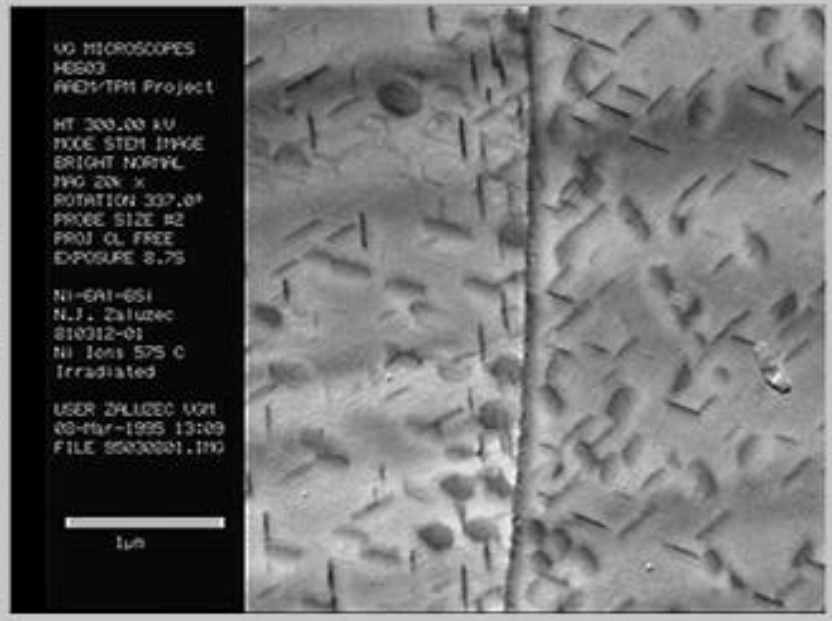


ANL - WWW TPM Server

Provides Platform Independent Access






UG MICROSCOPES
HB603
AMEM/TPM Project
HT 300.00 kV
MODE STEM IMAGE
BRIGHT NORMAL
MAG 20k x
ROTATION 337.0°
PROBE SIZE #2
PROJ CL FREE
EXPOSURE 8.7S
Ni-6Al-6Si
N.J. Zaluzec
810312-01
Ni Ions 575 C
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USER ZALUZEC VGM
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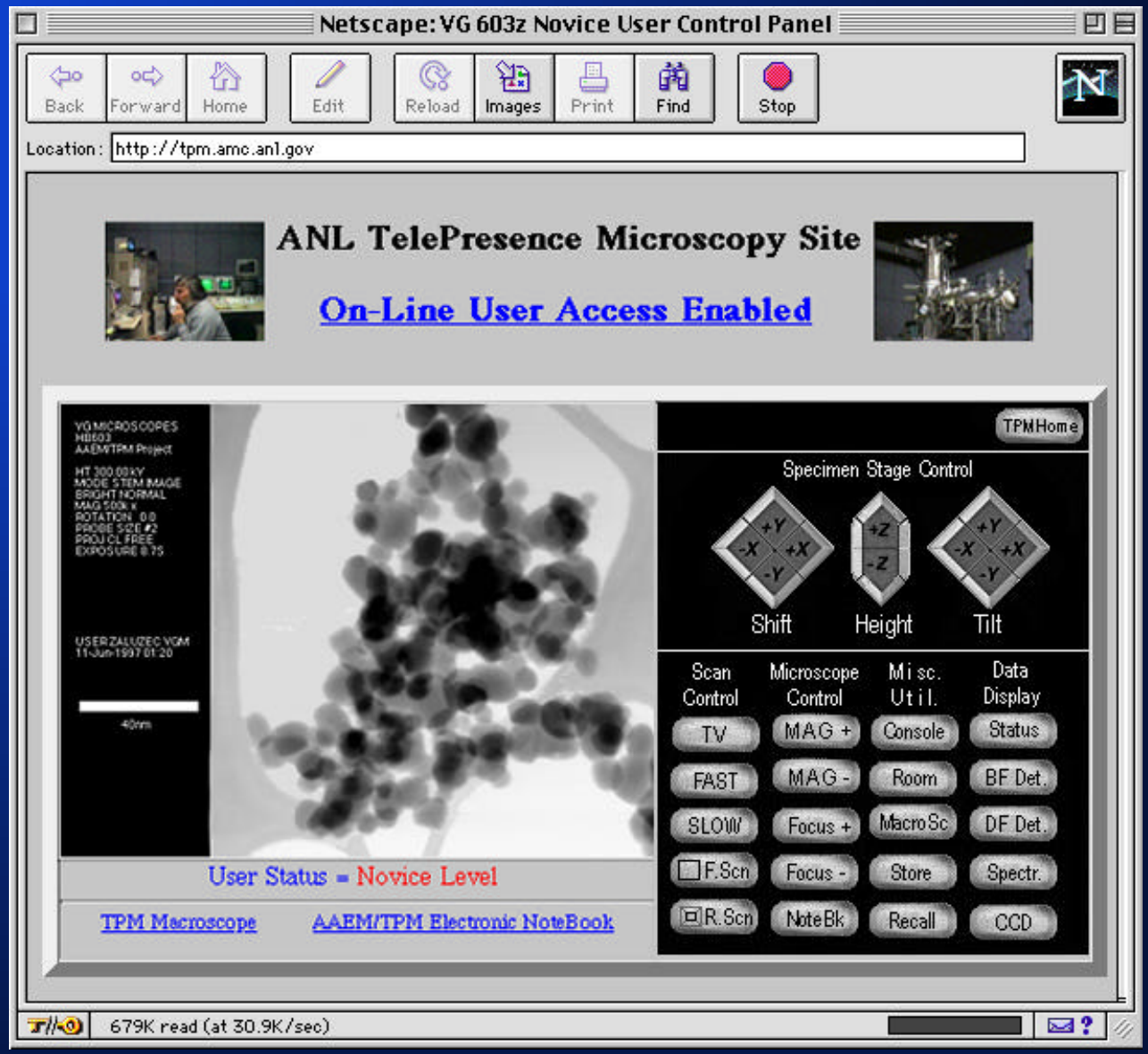
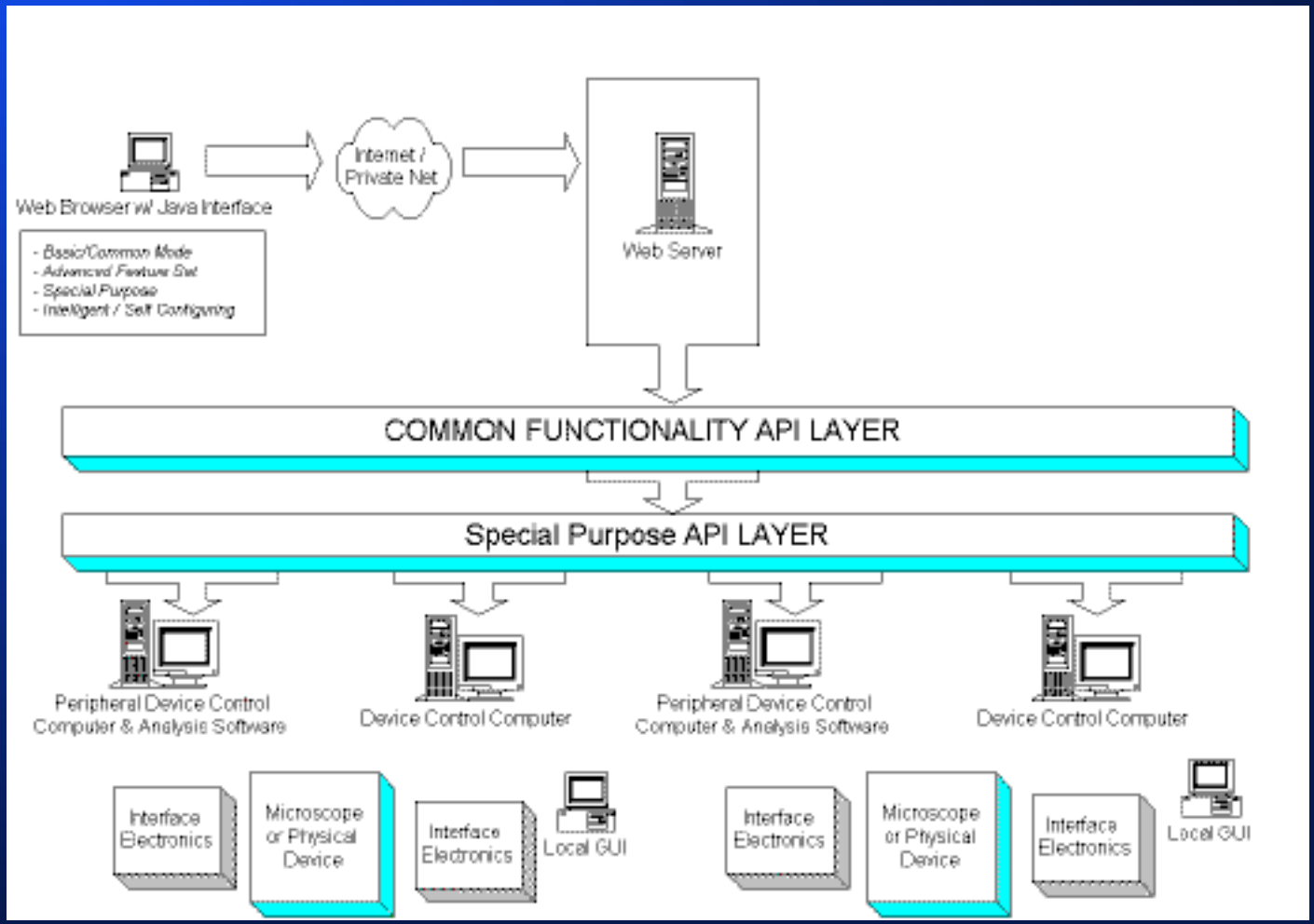
FILE 95030801.IMG
1μm

On-Line Instrument Control

Platform Independent WWW Interface

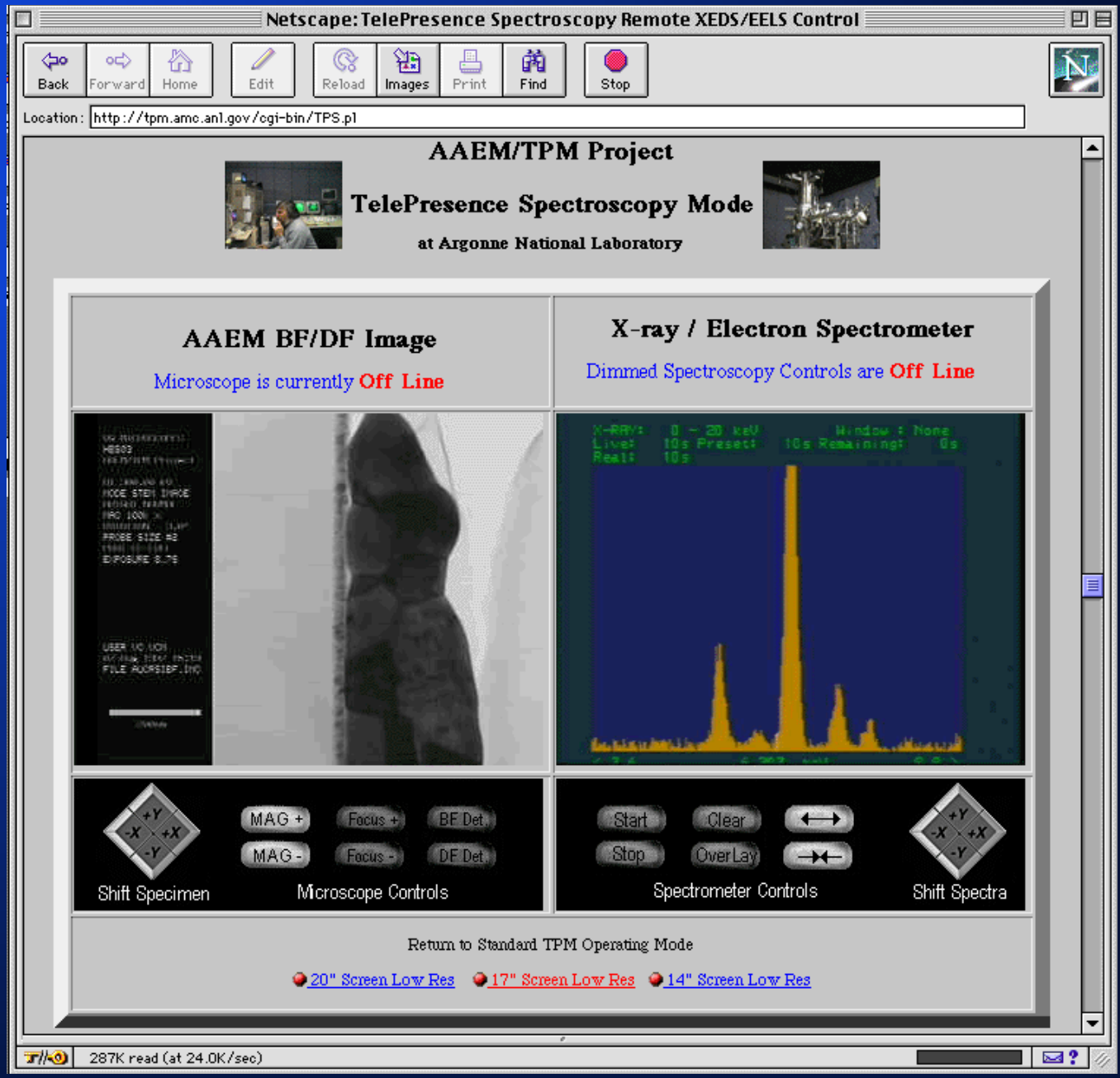


Hardware Architecture



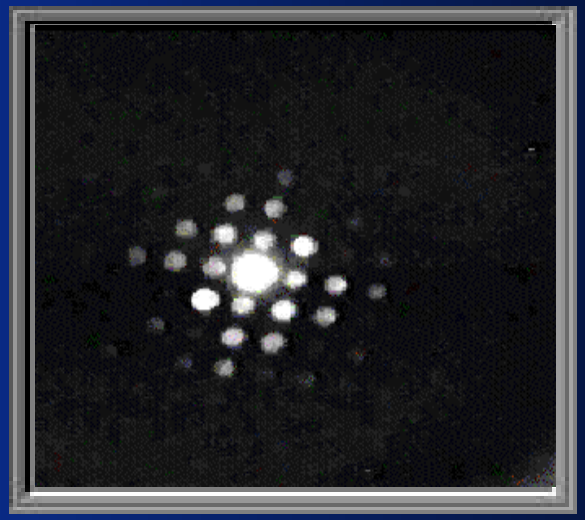
On-Line Instrument Control

Platform Independent WWW Interface

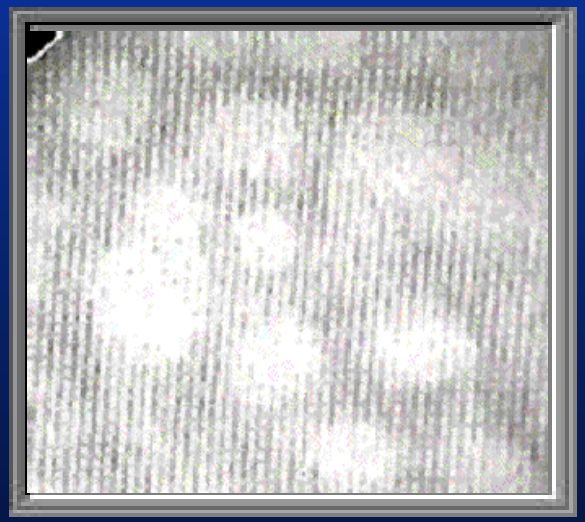


TelePresence Microscopy
Remote Operations

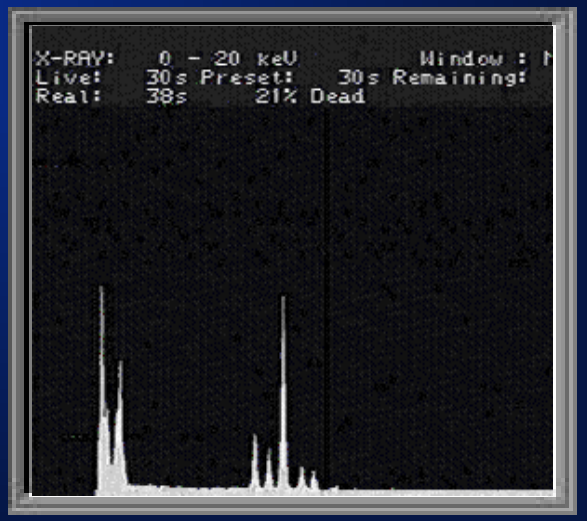
Conventional Imaging



Diffraction

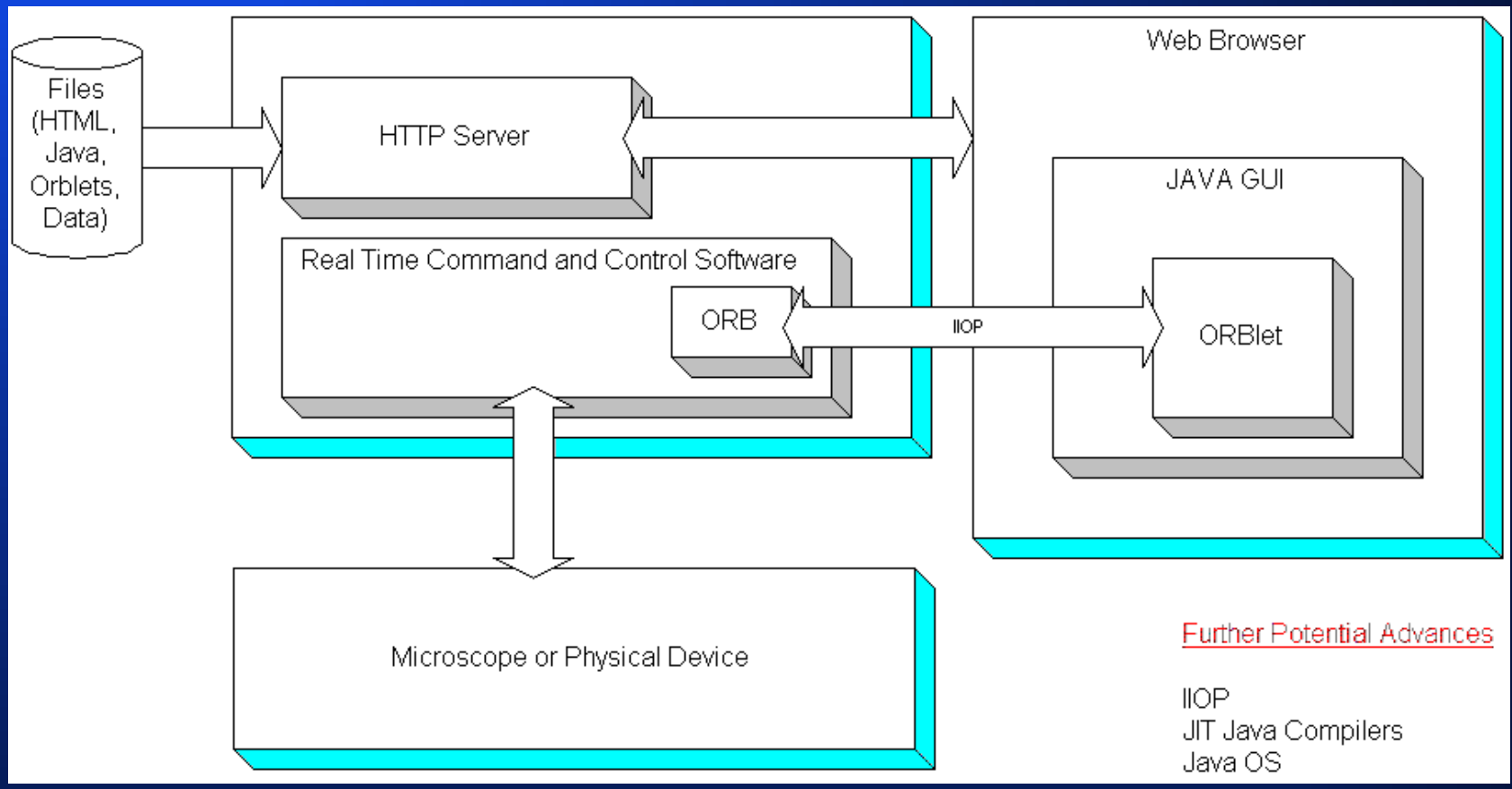


High Resolution Imaging



Spectroscopy

Next Generation: Software Architecture



Persistent Electronic Space Tools

- Data Archiving
- Session Archiving
- Data Mining

➪ Electronic Notebooks

Persistent Electronic Space Tools

An Electronic Notebook is a repository for objects that document scientific research.

Input Data

Retrieve Data

Query Data

Basic objects are: text, numerical data, images , drawings

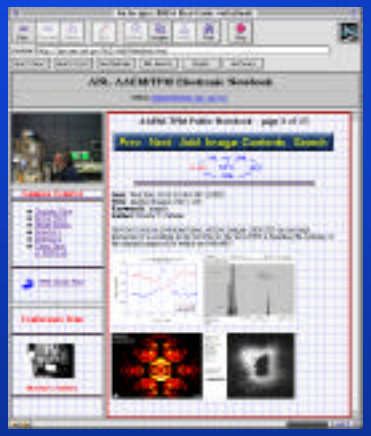
Persistent Electronic Space Tools

Why an Electronic Notebook?

- Virtual Laboratories encourage shared remote access to expensive, one-of-a-kind / state-of-the-art resources.
- Remote control of scientific instruments logically requires on-line documentation of capabilities and data.
- Collaboration of distributed researchers is enhanced by a common record keeping device.

Notebook Architecture

WWW - User Interface



Submit / Retrieve Requests

NoteBook Engine

CGI
Java, Perl

Input Modules

Text
Forms
HTML Editors
Java Applets
Live Data

Storage

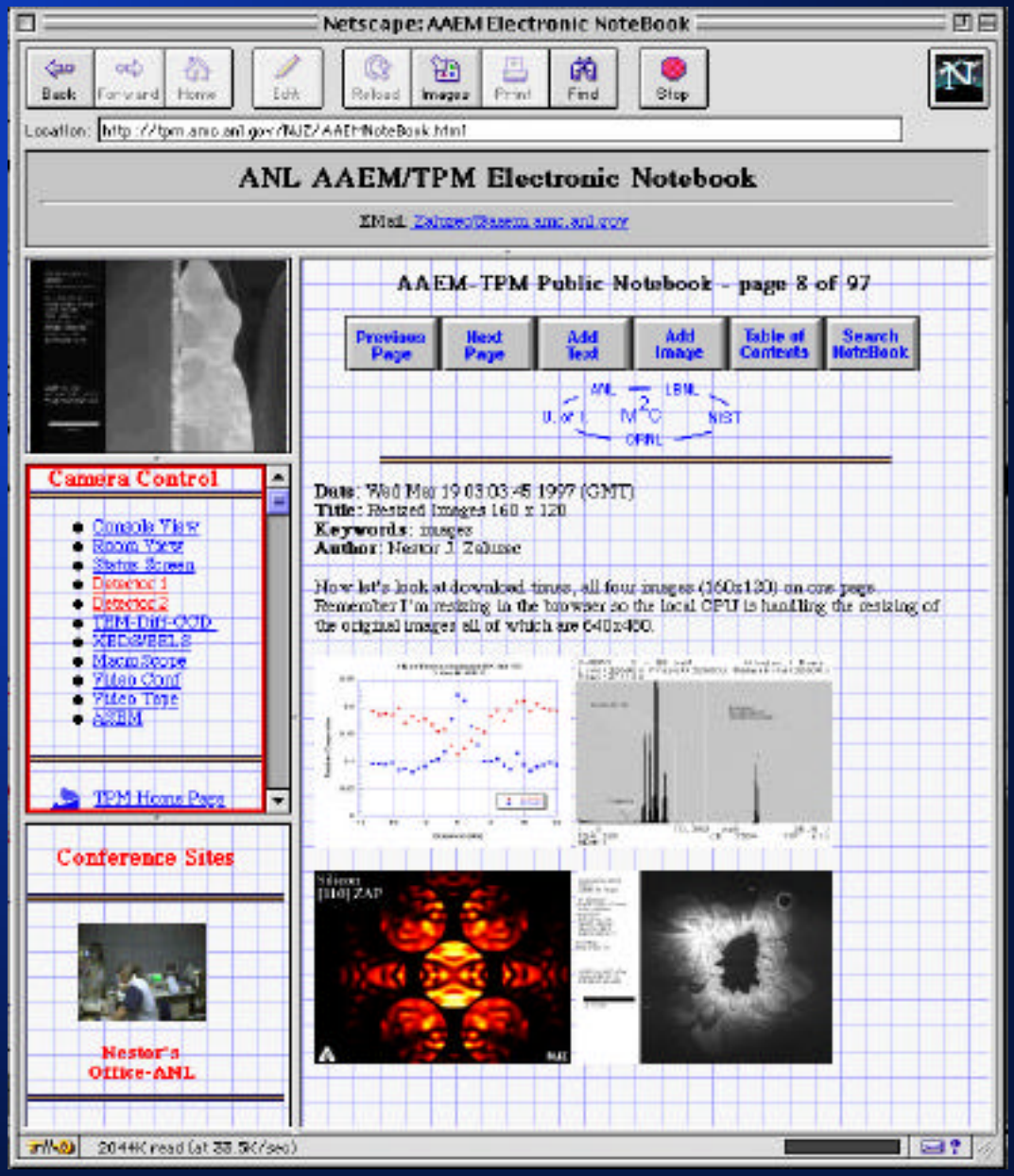
Flat File Storage

Store
Retrieve
Time Stamped

TelePresence Microscopy

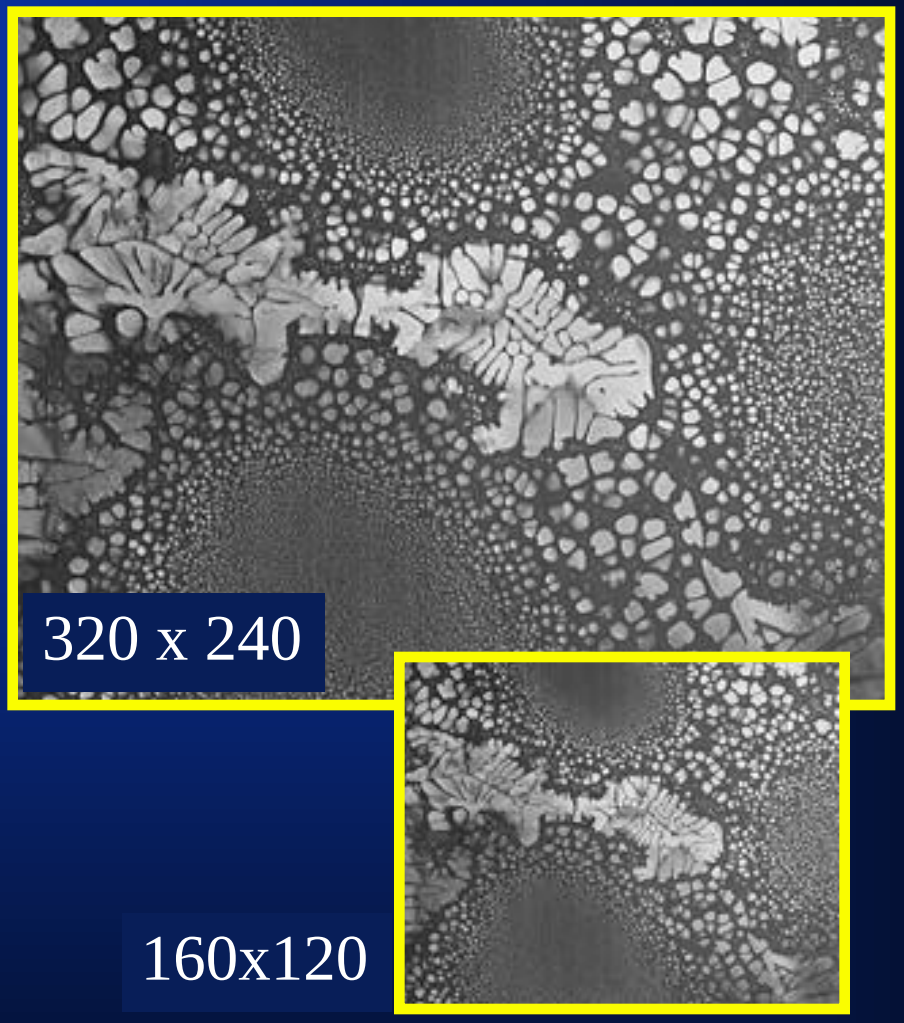
Electronic NoteBooks

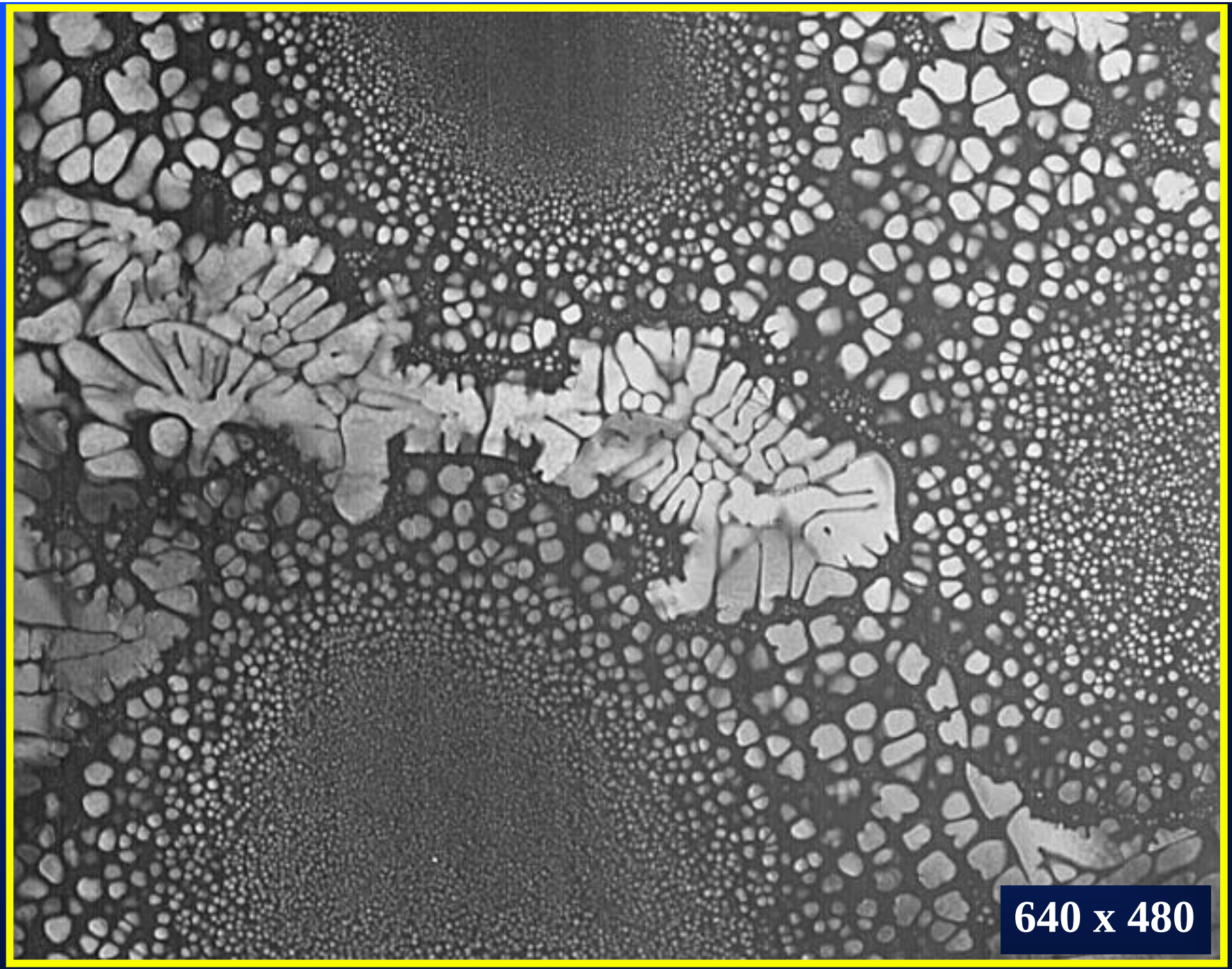
On-Line
Data Sharing
and
Collaboration



Imaging over the Net : Bandwidth Issues

JPEG Quality	*Image Size (Kb)*		
	160x120	*320x240*	*640x480*
10	2.6	6.8	20
20	3.1	7.6	22.4
30	3.6	8.5	24.7
40	4.1	9.3	27.1
50	4.6	10.2	29.4
60	5.0	11.0	31.8
70	5.5	11.9	34.1
80	6.0	20.7	**53.0**
90	8.8	28.0	**78.7**
100	22.3	74.9	**229.2**




640 x 480

Imaging over the Net : Bandwidth Issues

Maximum Aggregated Frames per Second 640x480 Image

JPEG Quality	Bandwidth					
	28.8 Kbps	*56Kbps*	*1.5 Mbps*	*10 Mbps*	*45 Mbps*	*100Mbps*
10	1.03	2.51	69	449	2018	4485
20	0.88	2.14	59	382	1721	3824
30	0.77	1.87	51	333	1500	3332
40	0.68	1.65	45	295	1329	2953
50	0.61	1.48	41	265	1193	2651
60	0.55	1.35	37	240	1082	2405
70	0.51	1.23	34	220	990	2021
80	0.47	1.14	31	202	913	2028
90	0.32	0.78	22	140	629	1367
100	0.13	0.31	9	56	251	557

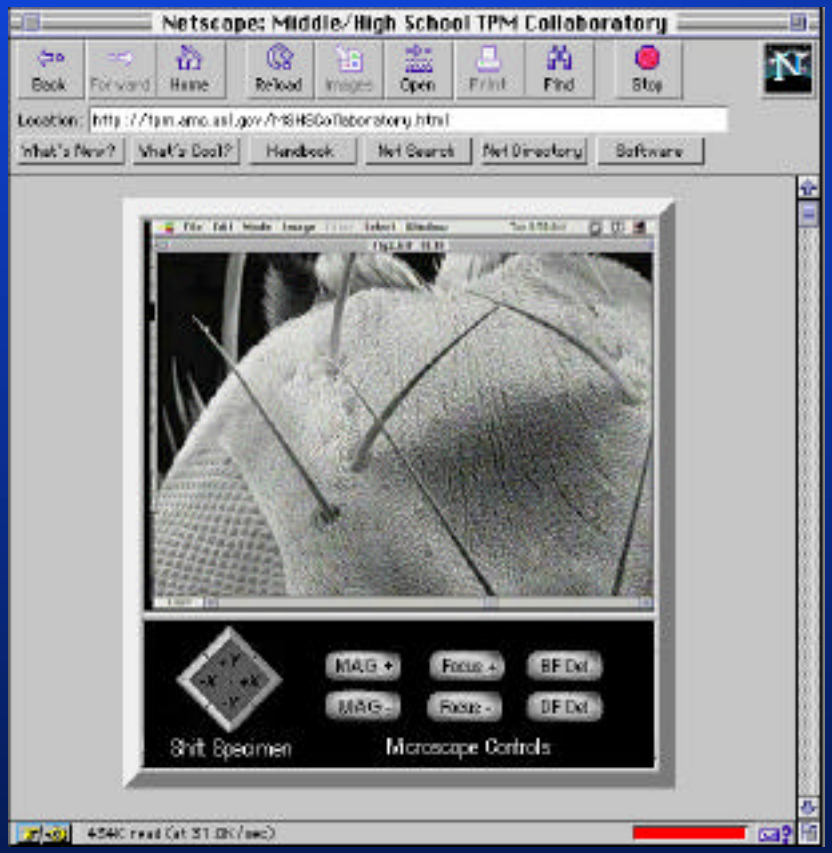
TelePresence Microscopy

Benefits

- **Access to Unique Research Tools**
  - On-Line Shared Resources and Expertise
  - Permanent and Natural GUI Interface to Instruments and Data
  - Service & Diagnosis of Instrumental Problems
- **Persistent Electronic Laboratories**
  - Setup and Continue Experiments within an ***eLab***
  - Maintain Contact with Colleagues Regardless of Location
- **Education, Teaching, Training to/from Remote Sites**

TelePresence Microscopy

Middle/High School Collaboratories

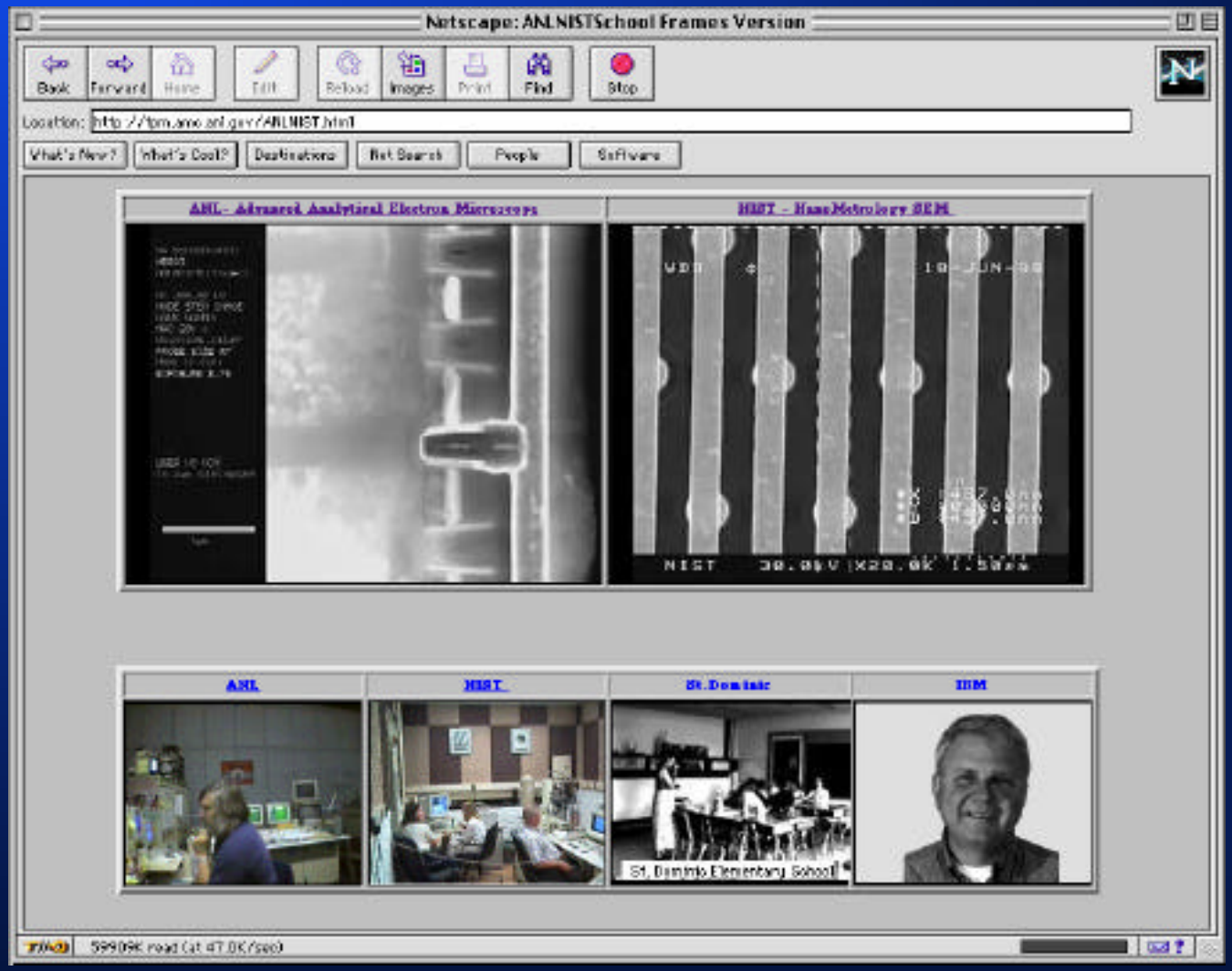


Netscape Client on Mac's & PC's in Classroom provides simple and inexpensive interface where students and remote instructors can interact with Microscopes.

Live Video Conferencing using "CuSeeMe" provides low cost interactions between Instructor and Students

Middle/High School Collaboratories

Middle/High School Collaboratories



Educational Outreach / Distance Learning

- **Electronic collaboratories are a natural and accessible educational resource**
- **Web-based, schools should not require specialized software / hardware**
- **Teaching should be interactive**
- **Learn to “collaborate” remotely**

DOE 2000
Materials MicroCharacterization Collaboratory

DOE 2000

- *DOE 2000 seeks to usher in a new era of scientific collaboration that transcends geographic, discipline, and organizational boundaries.*

- *The vision of DOE 2000 is to accelerate the ability of the Department of Energy to accomplish its mission through advanced computing and collaboration technologies.*

DOE 2000 Goals

- Improved ability to solve DOE's complex scientific problems
- Increased R&D productivity and efficiency
- Enhanced access to DOE resources by R&D partners

DOE 2000 Strategies

- Build National Collaboratories
- Build an Advanced Computational Testing and Simulation (ACTS) toolkit
- Provide an authentication and security infrastructure
- Foster partnerships
- Use off-the-shelf solutions whenever possible
- Conduct R&D when necessary to meet objectives

DOE 2000 National Collaboratories

- *Put unique or expensive DOE research facilities on the internet for remote collaboration, experimentation, production, or measurement.*
- *Provide collaborative tools: videoconferencing, shared electronic notebooks, shared whiteboards, shared document creation, shared data-viewing and analysis tools.*
- *Provide tools for sharing and integrating DOE scientific information.*

DOE 2000 Program Components

- *Advanced Computational Testing and Simulation*
- *Collaboratory Technology Research Projects*
- *Collaboratory Pilot Projects*

DOE 2000
Technology Research & Development Projects

- Collaborative Integration Framework
- Electronic Notebooks
- Collaborative Session Management
- Shared Virtual Spaces
- Scalable Security Architecture
- ESnet Quality of Service
- Floor Control

Many DOE Scientific Facilities Have Common Requirements

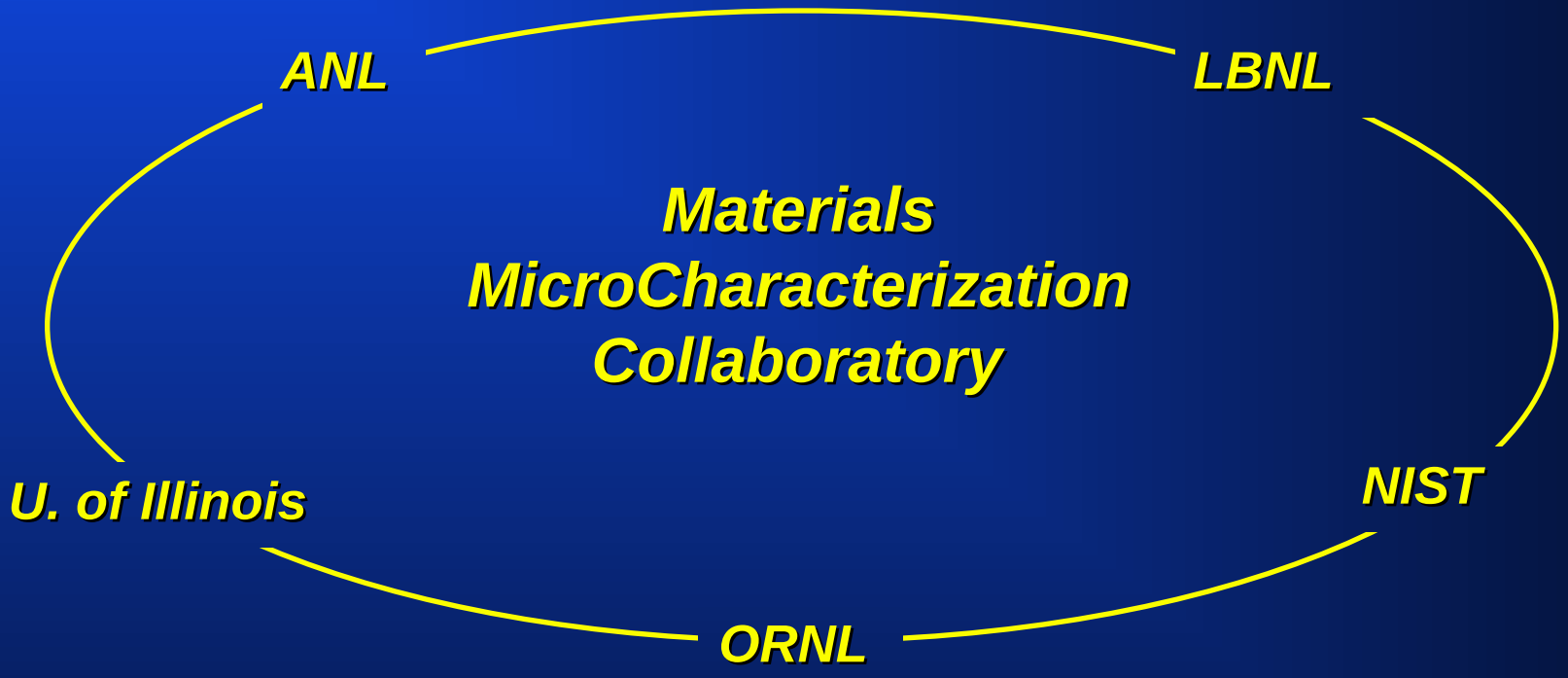
- ***Remote collaboration***
  - Shared data processing and analysis via internet
  - Video conferencing
  - Security for proprietary information
  - Utilization of licensed databases and software
- ***Remote instrument control***
  - Platform independent interfaces for axes & accessories
    - Web or internet based control
    - Collision protection and safeguards
  - Video image server feedback on system condition
  - Security for instruments and data

DOE 2000 Collaboratory Pilot Projects

- ***The Diesel Combustion Collaboratory***
  - **Science Area:** Diesel engine emissions control
  - **Partners:** SNL, LBNL, LLNL, Univ. of Wisc.
  - **Industrial Partners:** Cummins Engine Co.; Caterpillar, Inc.; Detroit Diesel

- ***The Materials MicroCharacterization Collaboratory (MMC)***
  - **Science Area:** Microstructure of technologically advanced materials, with focus on interface characterization
  - **Partners:** ORNL, LBNL, ANL, NIST, Univ. of Illinois
  - **Industrial Partners:** Gatan, Inc.; RJ Lee Instruments Ltd.; EMiSPEC Systems, Inc.; Philips Electron Optics; NSA - Hitachi Scientific Instruments; JEOL USA, Inc.; Sun Microsystems, Inc.; Graham Technology Solutions, Inc.

DOE 2000



URL: http://tpm.amc.anl.gov/MMC

EMail: MMC@aaem.amc.anl.gov

Collaboratory Members/Principle Investigators

- ***Argonne National Laboratory***
  - **Nestor J. Zaluzec**
    - MSD/AAEM TPM Collaboratory
- ***Lawrence Berkeley National Laboratory***
  - **Michael A. O'Keefe**
    - National Center for Electron Microscopy
- ***National Institutes of Standards and Technology***
  - **Michael Postek**
    - National Advanced Manufacturing Tesbed / Nano-Scale Metrology Program
- ***Oak Ridge National Laboratory***
  - **Kathi Alexander , Edward Kenik**
    - Shared Research Equipment (SHaRE) & Users Facility Program
  - **Edgar Voelkl**
    - HTML Materials Analysis Program
  - **Michael Wright**
    - Neutron Diffraction
- ***University of Illinois***
  - **Jim Mabon**
    - Center for Microscopy & Microanalysis

MMC Goals

- To extend, improve and mold the electronic laboratory environments already in place at each of these Centers into a single cohesive virtual laboratory, accessible from anywhere on the Internet.
- To use the extended capabilities of the virtual Collaboratory to address materials sciences research problems related to interfaces and surfaces in economically important materials of interest to DOE programs.
- To develop a functional, interactive electronic collaboratory having the necessary tools for operation by the microanalysis community; *leading to a truly new paradigm in scientific research*.

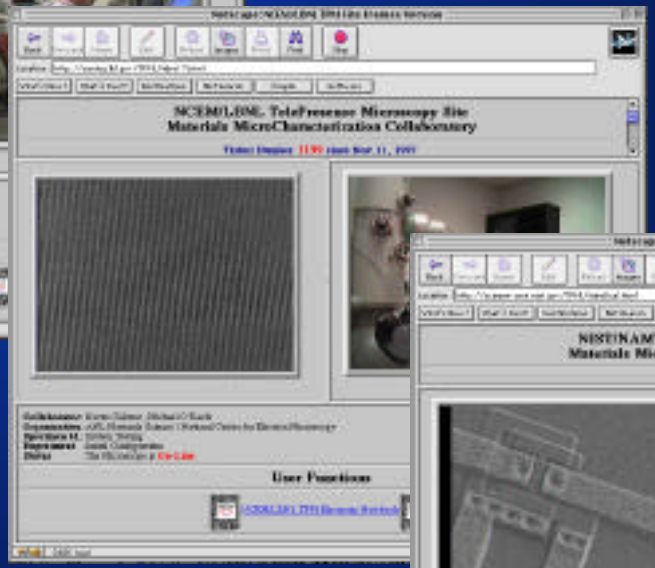
Materials MicroCharacterization Collaboratory

http://tpm.amc.anl.gov/mmc

Materials MicroCharacterization Collaboratory

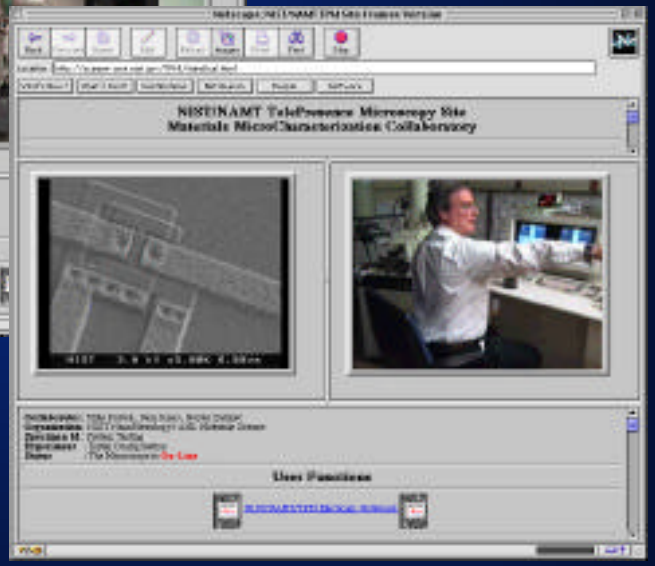
Univ. of Illinois

ORNL



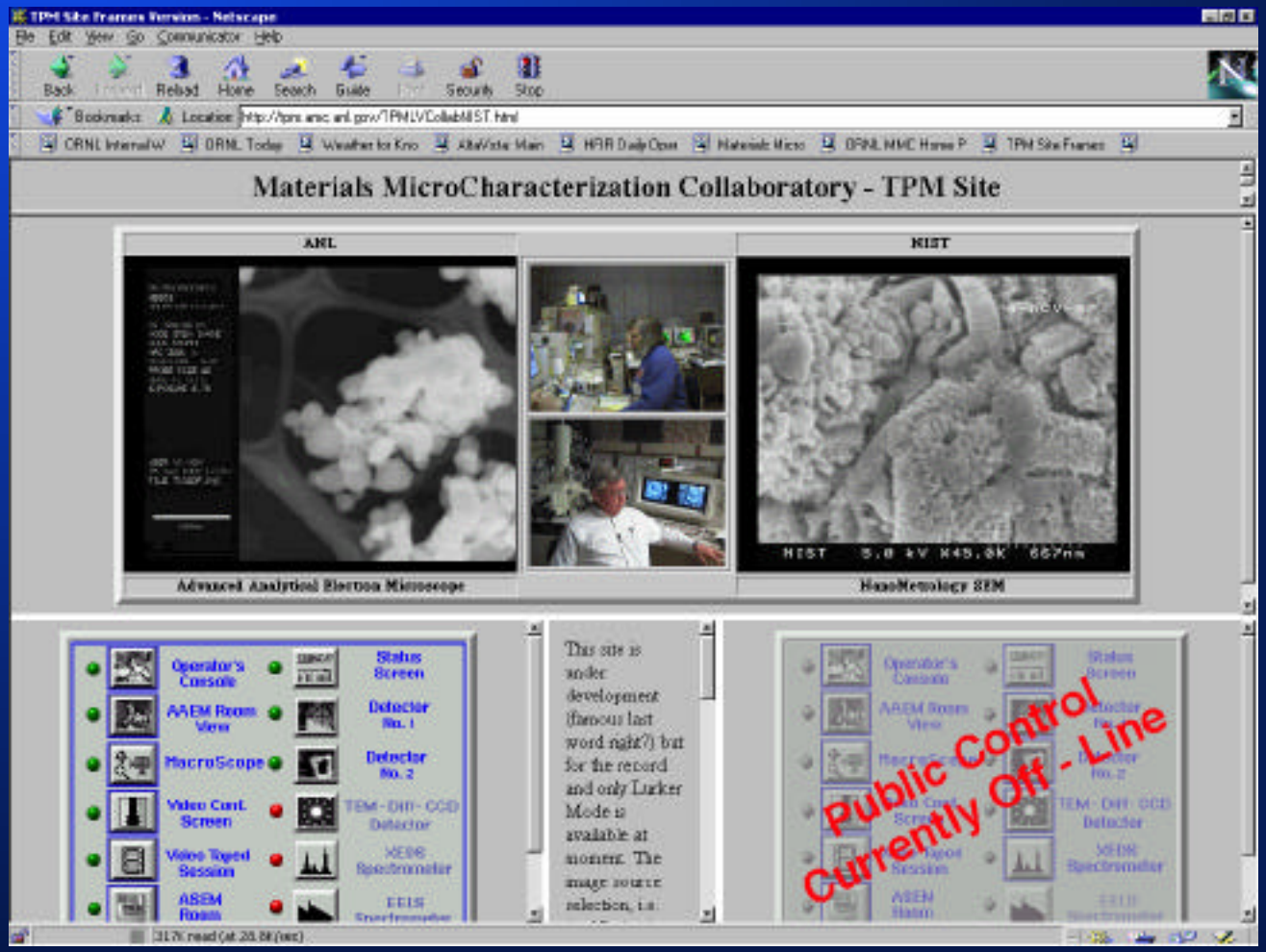
LBNL

ANL



NIST

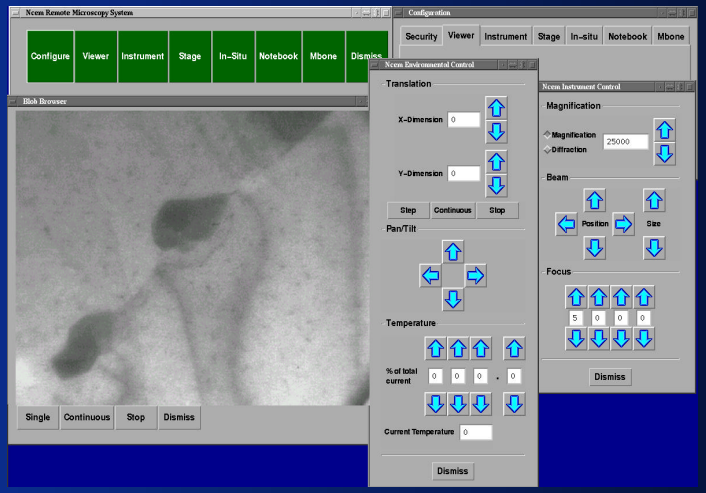
MultiSite Collaboration



MMC Instrumentation Resources

Site	Instrument	Online	Uniqness	Vendor
ANL	Analytical SEM	**WWW**	SEM, Outreach	Philips
ANL	Advanced AEM	**WWW & Java**	HR AEM, EDS,EELS, AES	VG
LBNL	EM-1500	**Custom Unix & Java**	1.5 MV HVEM, *in situ*	Kratos
LBNL	CM300FEG	**WWW**	1Å resolution TEM	Philips
LBNL	DEC Alpha		Image Simulations	DEC
U of I	DSM-960	**WWW**	Analytical/Teaching SEM, EDS, cathodoluminescence, EBSP texture	Zeiss
U of I	S-4700	**WWW**	HR low voltage FEG-SEM, EDS	Hitachi
U of I	H-9000		HR TEM (300 kV)	Hitachi
U of I	LEEM		UHV Low Energy EM, *in situ*, UHV connection to EPI-Center	
NIST	S-4500	**WWW**	NanoMetrology	Hitachi
ORNL (EE)	HF-2000	**Timbuktu & Digital MicroG**	Holography, EFI, EDS, FEG TEM	Hitachi, Gatan
ORNL (EE)	S-4500	**Timbuktu & Digital MicroG**	HR-SEM, EDS	Hitachi, Gatan
ORNL (ER)	CM200FEG		FEG TEM, spectrum imaging	Philips, EMiSPEC
ORNL (ER)	XL30	**WWW**	FEG SEM, texture mapping, WDS/EDS	Philips
ORNL (ER)	SGI		3D atom probe visualization	SGI
ORNL (EE)	HFIR beamline	**WWW LabView**	Neutron diffraction	
ORNL (EE)	NSLS/APS beamlines		Xray diffraction	

One Solution is Not Always the Answer!



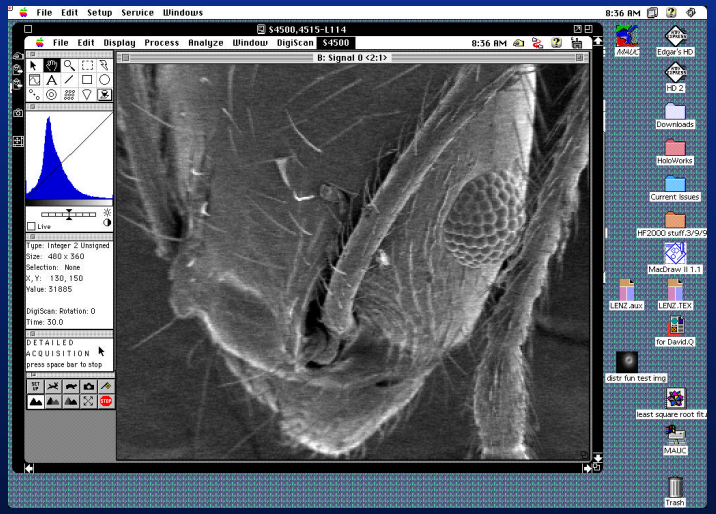
Lawrence Berkeley National Laboratory

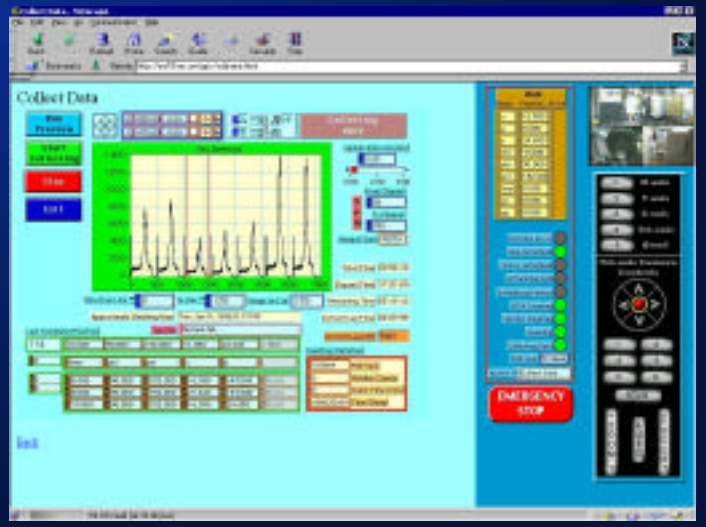
HVEM In-Situ Microscopy,
Unix Client/Server

Oak Ridge National Laboratory

Remote Electron Microscopy - Mac, Timbuktu

Neutron Residual Stress Mapping Facility - PC, LabVIEW Client/Server





Materials MicroCharacterization Collaboratory

ANL

LBNL

U. of Illinois

NIST

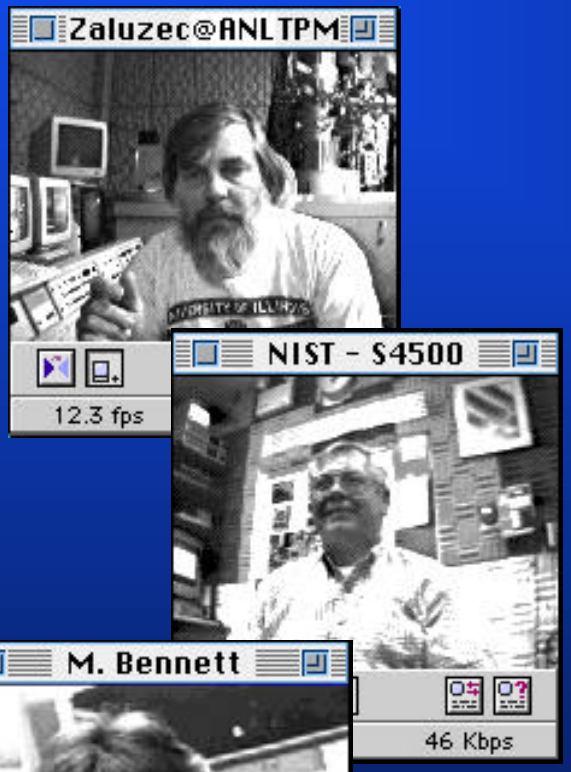
ORNL

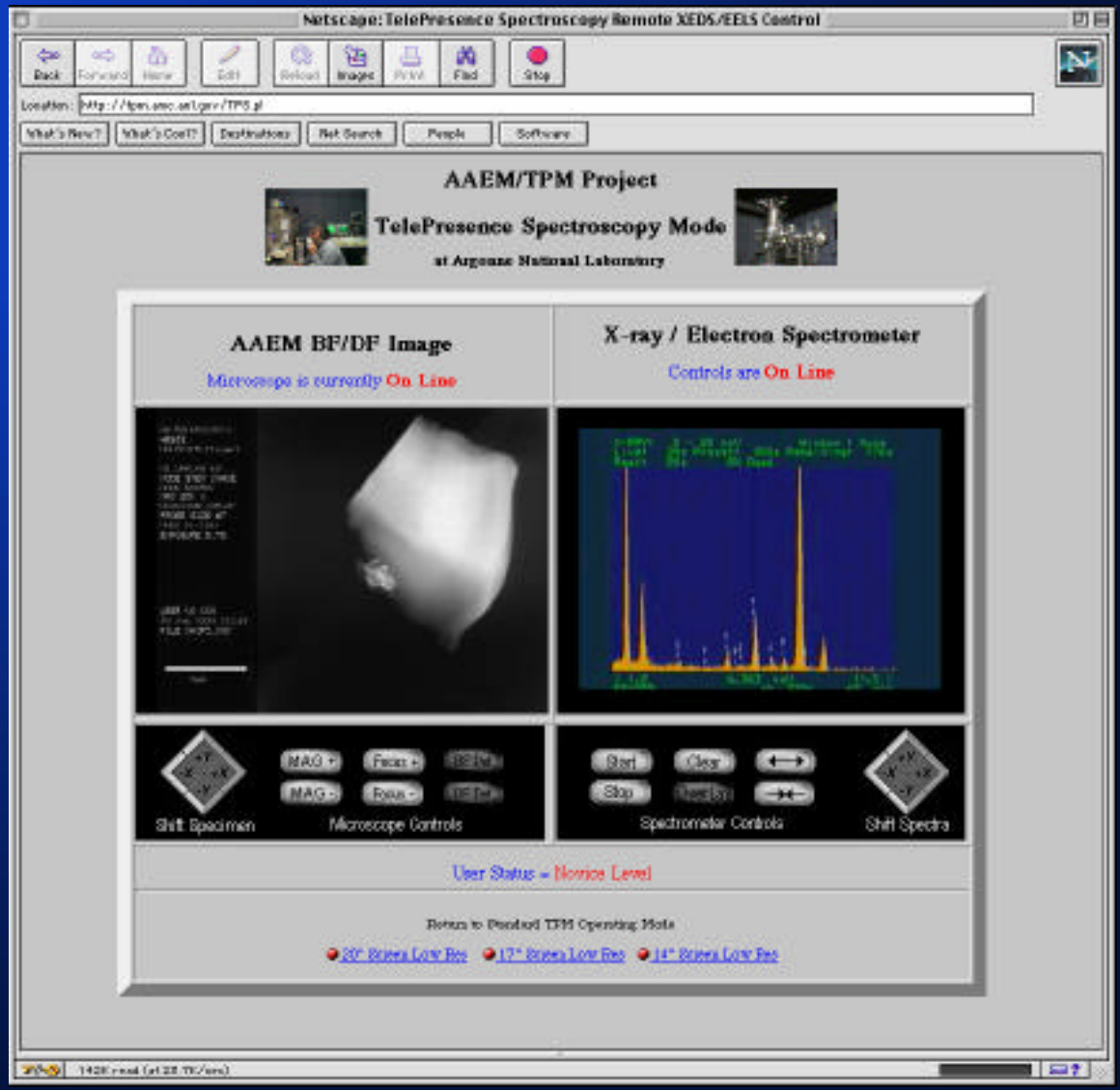
Out Year Affiliates

Users

Industrial Collaborators

MultiSite Collaboration

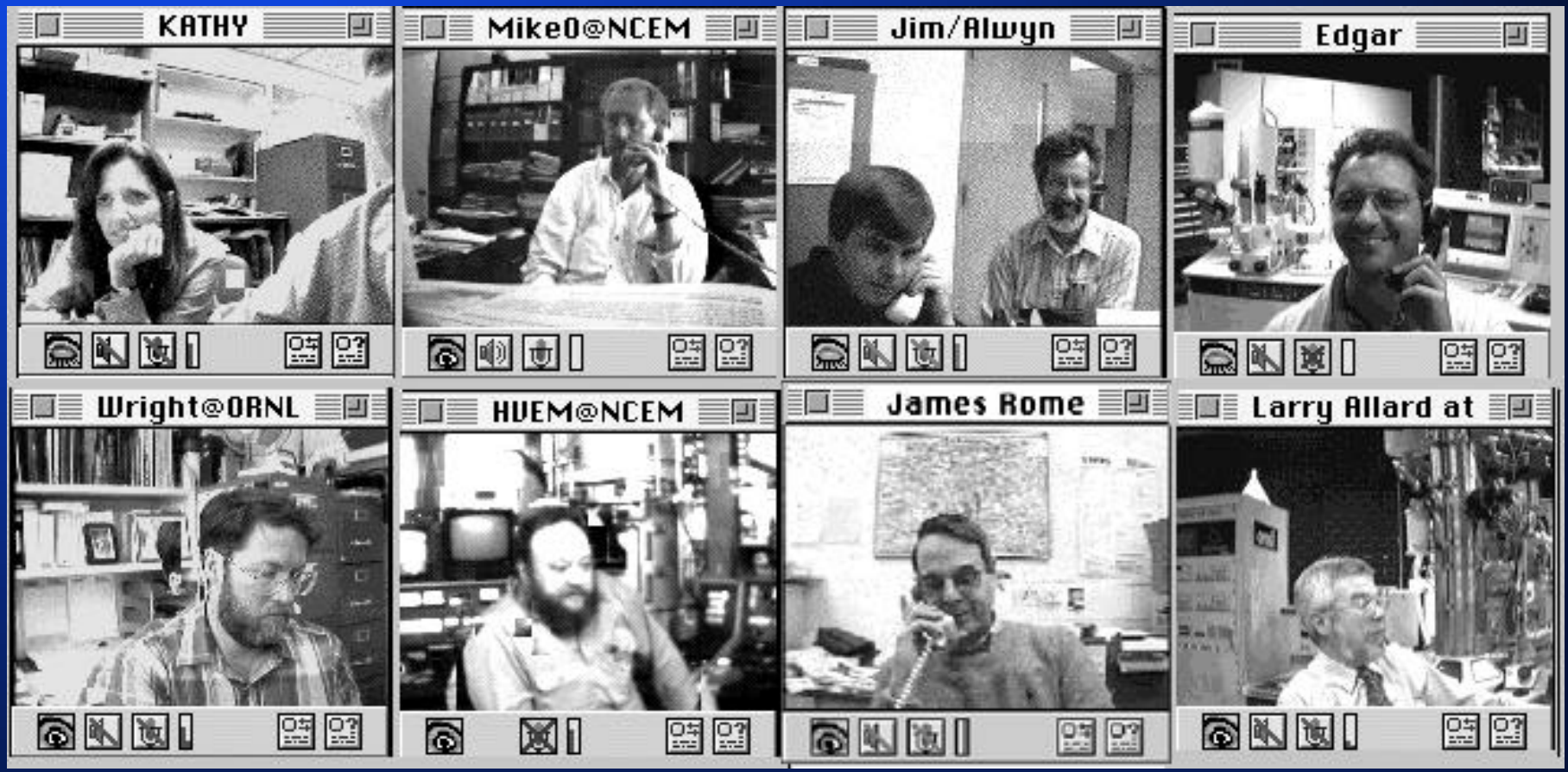




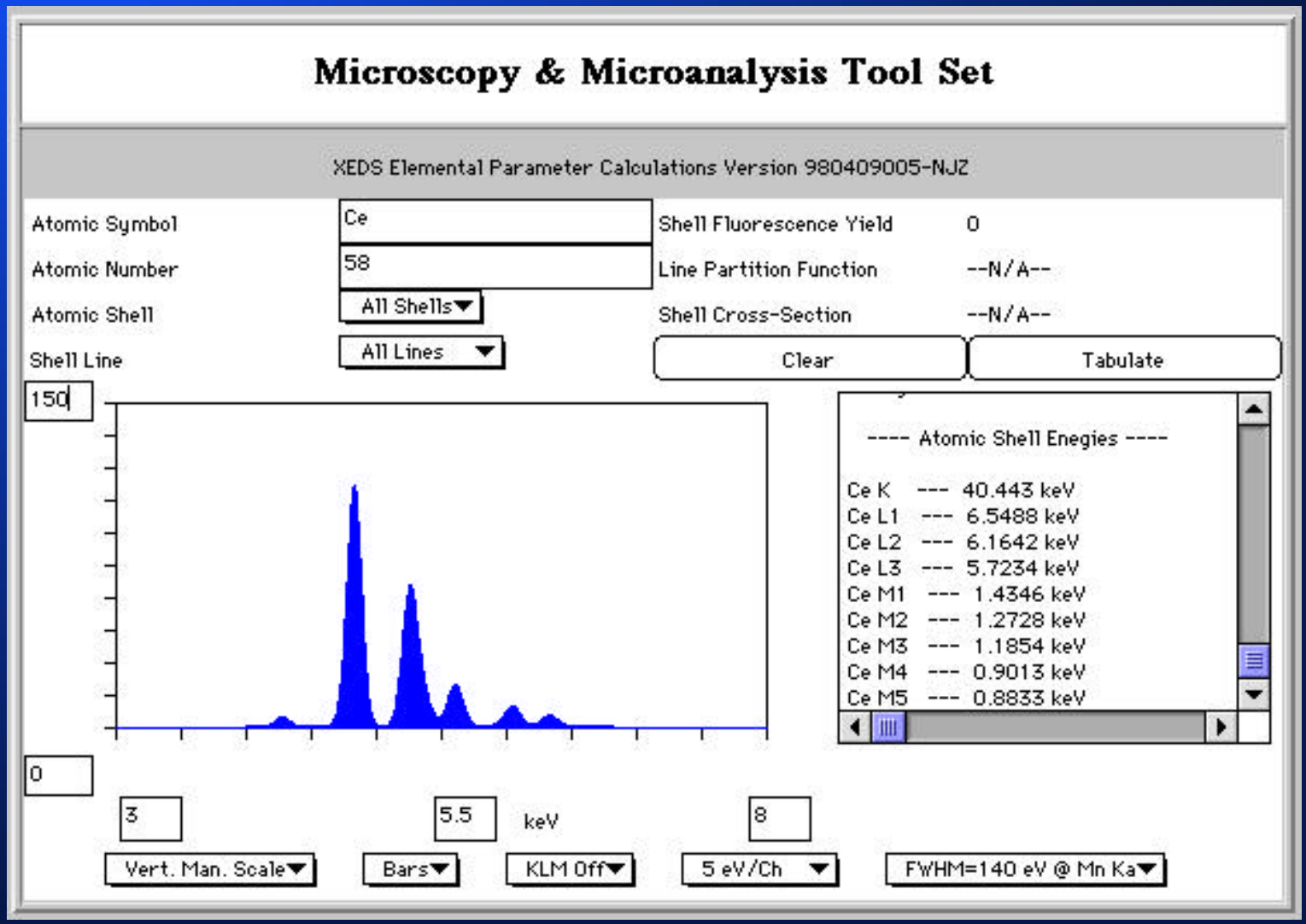
Network Based Video Conferencing

- Establish a Suite of Video Conferencing Tools which are compatible with the hardware and Software in the Collaboratory
- Determine the Applicability to Needs of the Site
- Determine their Limitations:
  - Accessibility
  - Ease of Use
  - Bandwidth
  - Platform Dependencies
  - Functionality
- Evaluate and Develop a Scheme for Harmonization
- Integration into the Inter-operability Framework

Network Based Video Conferencing is Possible, but Immature



Java - Based Tools



Interactive Collaboratories

Collaboratories focus on *Resources* in an interactive persistent electronic space.

In the MMC / TPM Collaboratory we are exploring and developing an electronic virtual environment equipped with state-of-the-art resources (consisting of both expertise as well as instrumentation) which revolves around a common theme of Microscopy and Microanalysis applied to both Education and Research.

Interactive Collaboratories

By placing creative scientists having varying yet complementary expertise together in a new environment which allows convenient, rapid and dynamic interactions to flow unencumbered by the limits of time and distance, we expect to not only foster, but enhance, the ability of these individuals to conceive and execute scientific research.

It is essential to remember that, at the end of the day, it is not the instrumentation which produces the science but rather the individuals who formulate and execute experiments designed and carried out using the "tools" which they have at their disposal.

Acknowledgements

Funding: U.S. DoE (BES,OTT, MICS) & ANL, NIST

Collaborators:

MMC: K. Alexander, E. Voelkl, M. Wright, M.Postek, M. O'Keefe, J. Mabon

DoE2000: R. Stevens, A. Geist, N. Nachtigal, D. Agarwald .....

MMC Industrial:

Philips Electronic Inst., Hitachi Scientific Inst., JEOL-USA, R.J. Lee, Gatan Inc, EMiSpec Inc, Sun MicroSystems, Graham Technology

ANL TelePresence Microscopy Collaboratory

Zaluzec @ AAEM. AMC.ANL.GOV

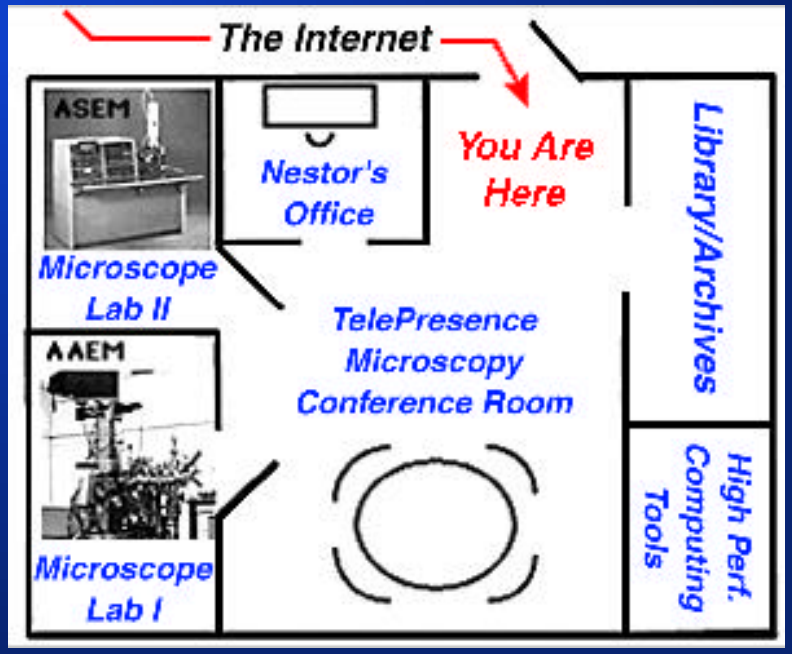
URL = http://tpm.amc.anl.gov

DoE 2000
Materials MicroCharacterization Collaboratory

MMC@AAEM.AMC.ANL.GOV

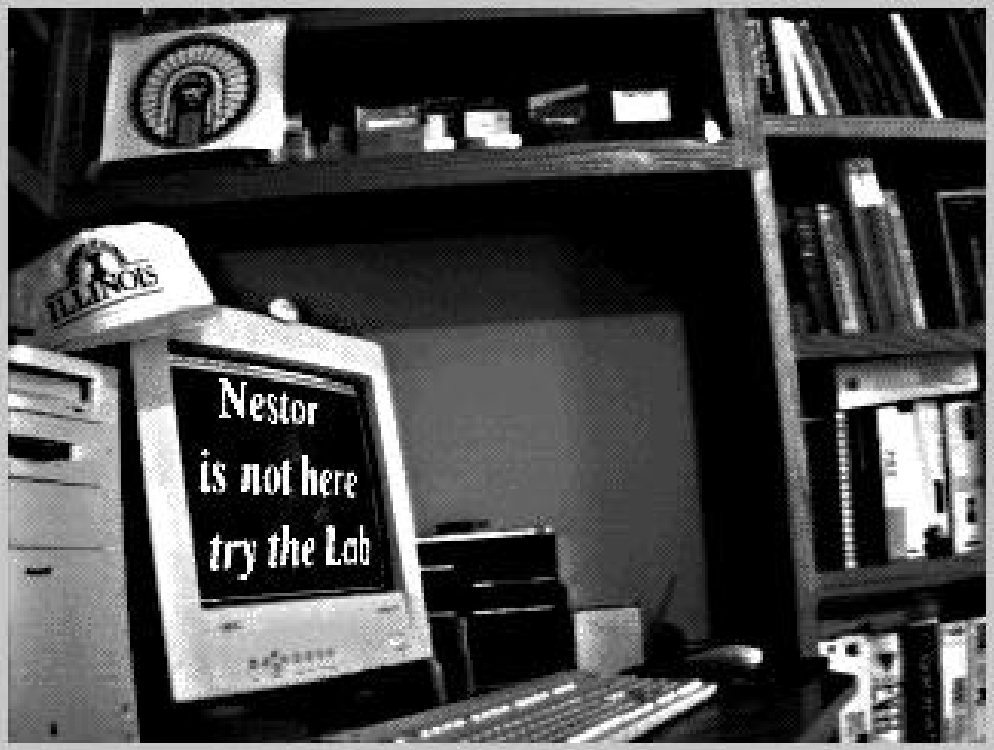
URL = http://tpm.amc.anl.gov/mmc

TelePresence Microscopy Collaboratory



http://tpm.amc.anl.gov

Connection to Nestor's Office



Demonstration
Connection to ANL TPM Site

Accessing the TPM Collaboratory from your DeskTop Computer

- **Install a copy of NetScape Version 2.0 or 3.0 on your Computer**
  - The TPM Server software is computer platform independent you may use any **Macintosh, Intel/PC, or Unix** computer. The faster your CPU the better the performance, a high resolution 17" (800 x 600 pixel) monitor is recommended but not required.
  - Microsoft ***Internet Explorer (IE) software*** **is *not compatible*** with the TPM server
- **Using your WWW Browser login to the TPM Public Site**
  - http://tpm.amc.anl.gov
  - Use the fastest connection to the Internet you can obtain
    - Fast Modems are usable but not recommended
    - ISDN is acceptable, T1 connections are fine
- **To Operate the Microscope over the Internet**
  - You must login to the TPM Private Site.
  - This requires authorization and is password protected.
  - Video Conferencing software is recommended but not necessary a Telephone may substitute
  - Contact Nestor Zaluzec to discuss your experiment and/or needs
    - Email: Zaluzec@aaem.amc.anl.gov
    - Tel: 630-252-5075 or -7901