Overview of NIH Networking and IT Priorities, Programs and Funding

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Characteristics of Modern Research

- **Biocomplexity**
- **Integrative research approach more dependent on advanced technologies which generate vast data sets**
- **Need research directed by hypothesis-driven and integrative/team approaches**
- **Information management and communication at core of biomedical research for 21st century and beyond**

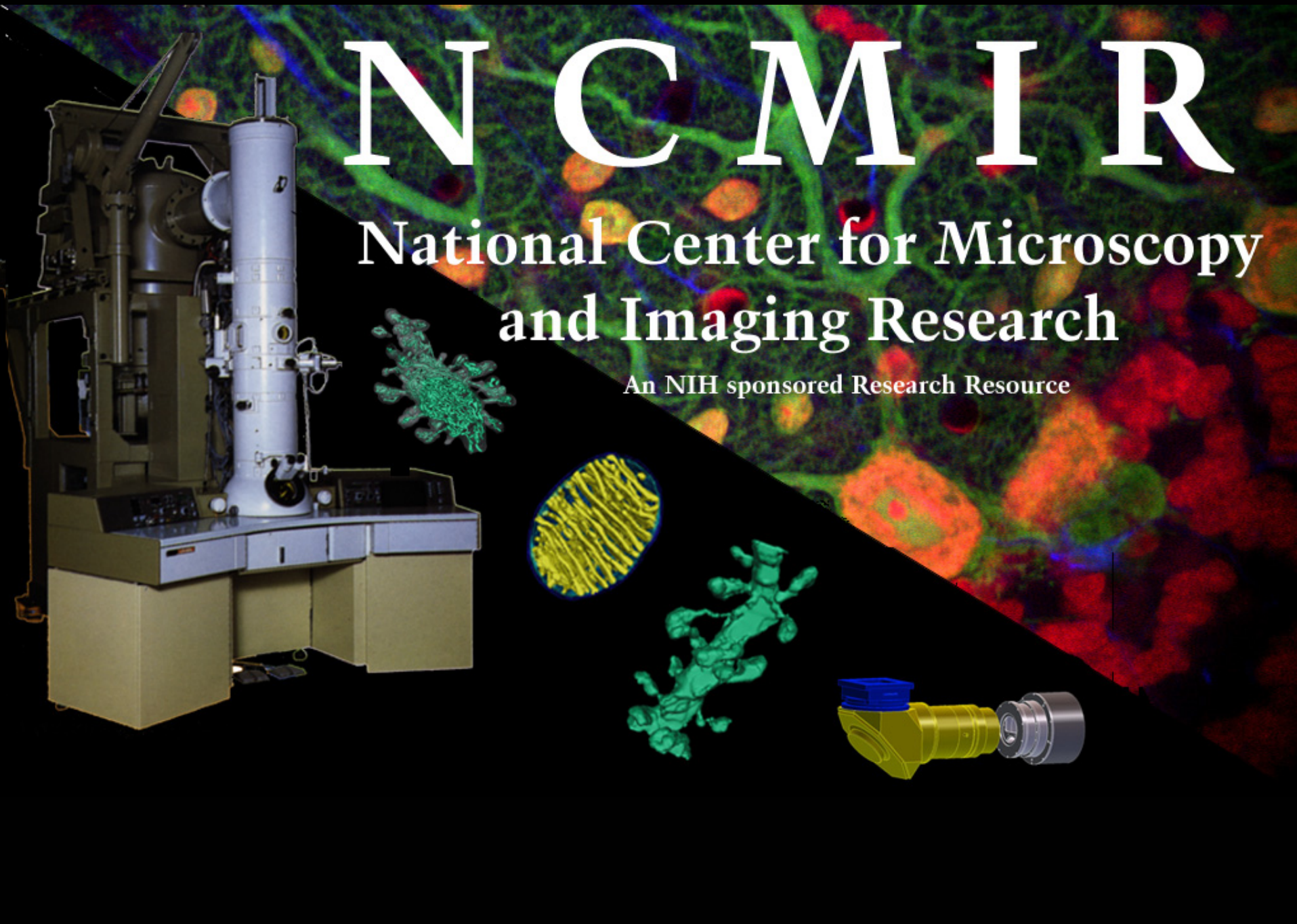
Networking and Information Technology
National Institutes of Health Investments

- **NIH Support**:
  - ✓**FY 2002 $325.5M**
  - ✓**FY 2003* $359.4M**
  - ✓**FY 2004* $385.7M***

***Estimates**

Virtual Laboratories

- **Investigators pressed for time; cannot learn all the technologies they need**
- **Need for modified and new functional information technology tools and access to scalable computing**
- **Remote access to technologies and research expertise to facilitate research… ”laboratories working together apart”**
- **Reflects changing paradigm for research--- biocomplexity**

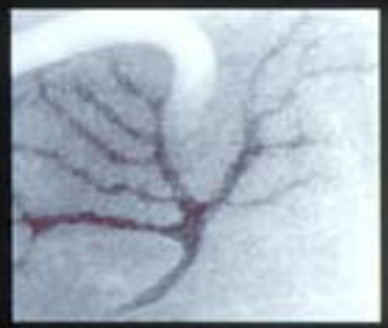

NCMIR
National Center for Microscopy and Imaging Research
An NIH sponsored Research Resource

Trans-Pacific Telemicroscopy
San Diego-Osaka
April 1999

3 million volt Ultra-high Voltage Electron Microscope at Osaka University

Hitachi Model H-3000
Height 13.5 m
Weight 140 tons

Network links between Japan and San Diego



UHVEM image of neuronal dendrite obtaine remotely from San Diego

Computer-generated reconstruction of dendrite and dendritic spines

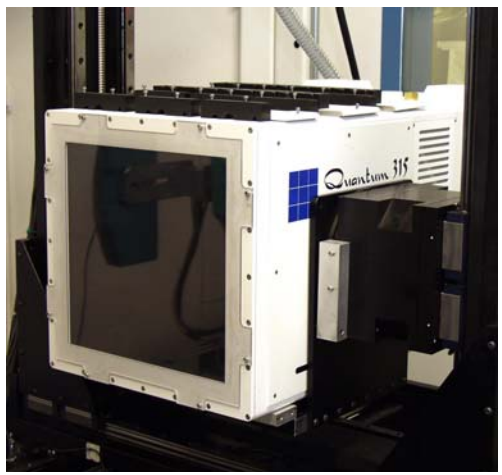
Increase Efficiency of Beamlines

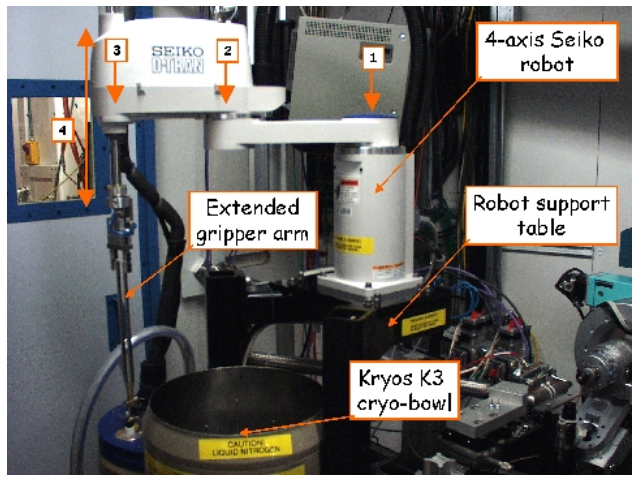
Increase throughput of beam line 10 fold:

- Large format area detectors
- In-hutch robotics (SSRL)

Enhance access:

- Remote (Fed-Ex) data collection (NSLS)
- Shared technical resources (NSLS, SSRL)





Virtual Laboratories and Collaboratories Feasibility and Acceptance

- **Telemicroscopy: Remote site access to scarce, costly equipment (e.g. 400 KeV IVEM) (UCSD)**
- **Crystallography: "Mail in" crystals to SSRL, MacChess, Brookhaven sites.**
- **Molecular Modeling: Structure-based drug design and protein engineering among collaborators at remote sites (UCSF)**
- **Imaging Algorithms: New algorithms to minimize measurement variances for imaging studies (human, mouse) across collaborative sites. For exampple, intervention for degenerative brain disease**

Investigator Pressures

- **Investigators pressed for time---committees, teaching, health care, administration, peer review**
- **Time constraints limit learning complex technologies; many with limited access to advanced technologies**
- **Need for modified and new functional information technology tools and access to scalable computing**
- **As the research paradigm evolves for biocomplexity and vast data sets, infrastructure must evolve as well.**

NIH Networking & IT

- **NIH Roadmap---what is it?**
  - ✓ **Innovative approach to accelerate discovery and translation to new therapies, diagnostics, more…**
  - ✓ **Focus is on providing cross-cutting research tools and technologies that transcend the collective missions of the 27 Institutes and Centers**
  - ✓ **Need for novel cross-cutting research tools and other infrastructure---not bounded by categoric research disciplines--- lends this undertaking to partnerships across the NIH Institutes and Centers.**

NIH Roadmap

- **Impacts Broad Areas**:
  - ✓ **New Pathways to Discovery**
    - ❖ **Examine complex biologic systems, molecular libraries, nanotechnology…..**
  - ✓ **Research teams of the future**
    - ❖ **Interdisciplinary teams; high risk research; public-private partnerships**
  - ✓ **Re-engineer the Clinical Research Enterprise**
    - ❖ **NECTAR; bioinformatics; networks; standardize regulatory requirements, reporting, workforce training**

NIH Roadmap

- **Where is the "Road" for my institution or laboratory?**
  - ✓ **Website: http://nihroadmap.nih.gov**
  - ✓ **RFAs and PAs posted on Roadmap website:**
    - **Metabolomics Technology Development**
    - **Exploratory Centers for Interdisciplinary Research**
    - **National Technology Centers for Networks and Pathways**
    - **National Centers for Biomedical Computing**
    - **Others -TBA**

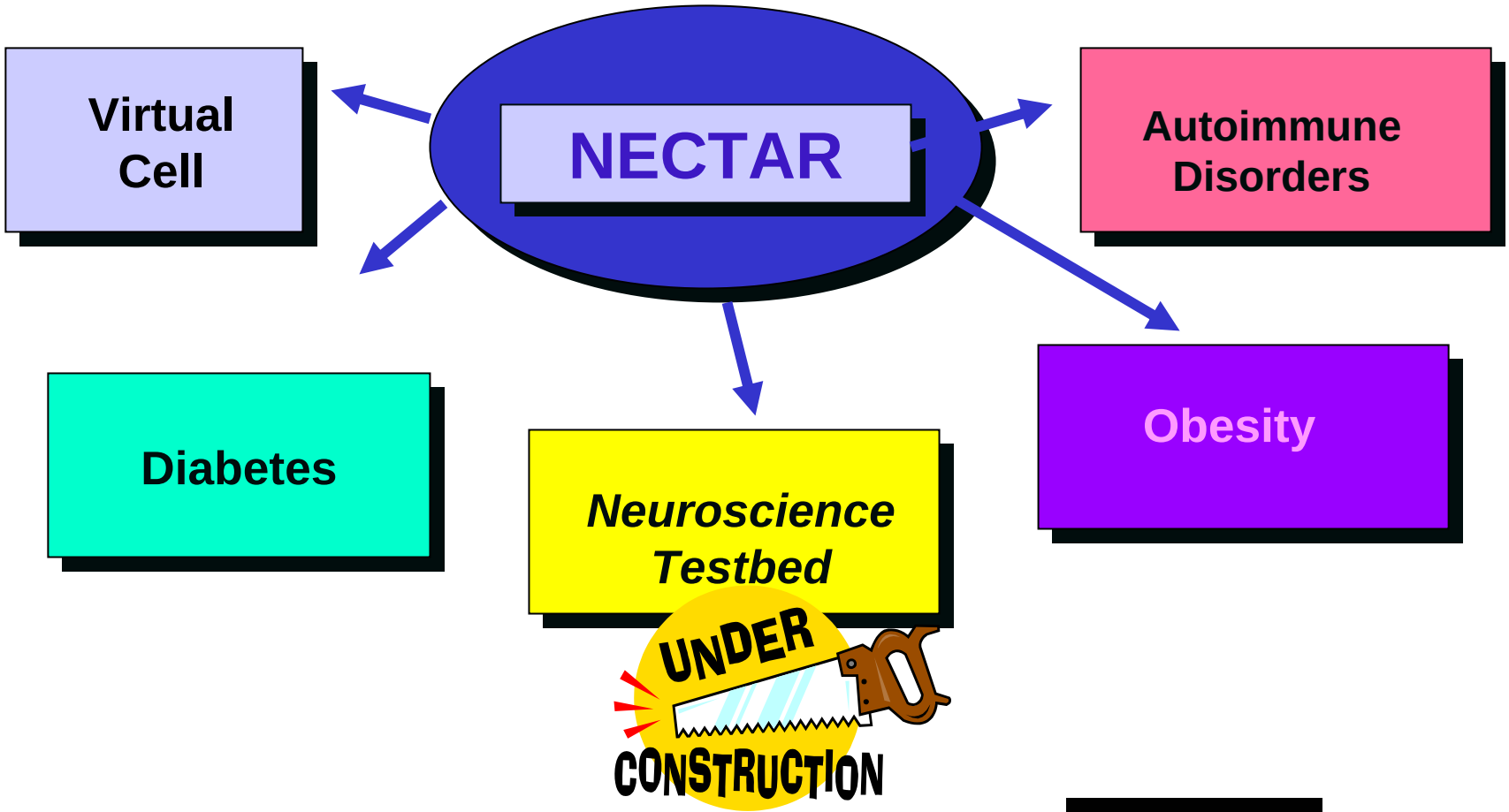
Biomedical Informatics Research Network (BIRN)

- Fosters collaborations, data sharing, remote access to databases, technologies
- Enhance telecommunications and telemedicine efforts for research
- Partners include NSF, SDSCC, UCSD, UCLA, Stanford, Duke, New Mexico, Johns Hopkins, Minnesota, Iowa, Cal Tech, UC-Irvine and Internet2
- Bioinformatics tools, Federated databases; remote access to scalable computing up to the teraflop level; computation grids

BIRN Project Objectives

- Using Internet2/Abilene, establish a high performance network linking key research sites
- Establish distributed and linked data collections for investigators' research projects.
- Enable access to heterogeneous "grid-based" computing resources for research project analyses.
- Provide data mining tools to search multiple data collections or databases
- Develop the software and hardware infrastructure that will allow scientists to conduct valid multisite neuroimaging studies, for example.

Research Networks



Clinical research tools to facilitate studies of disease or biologic function

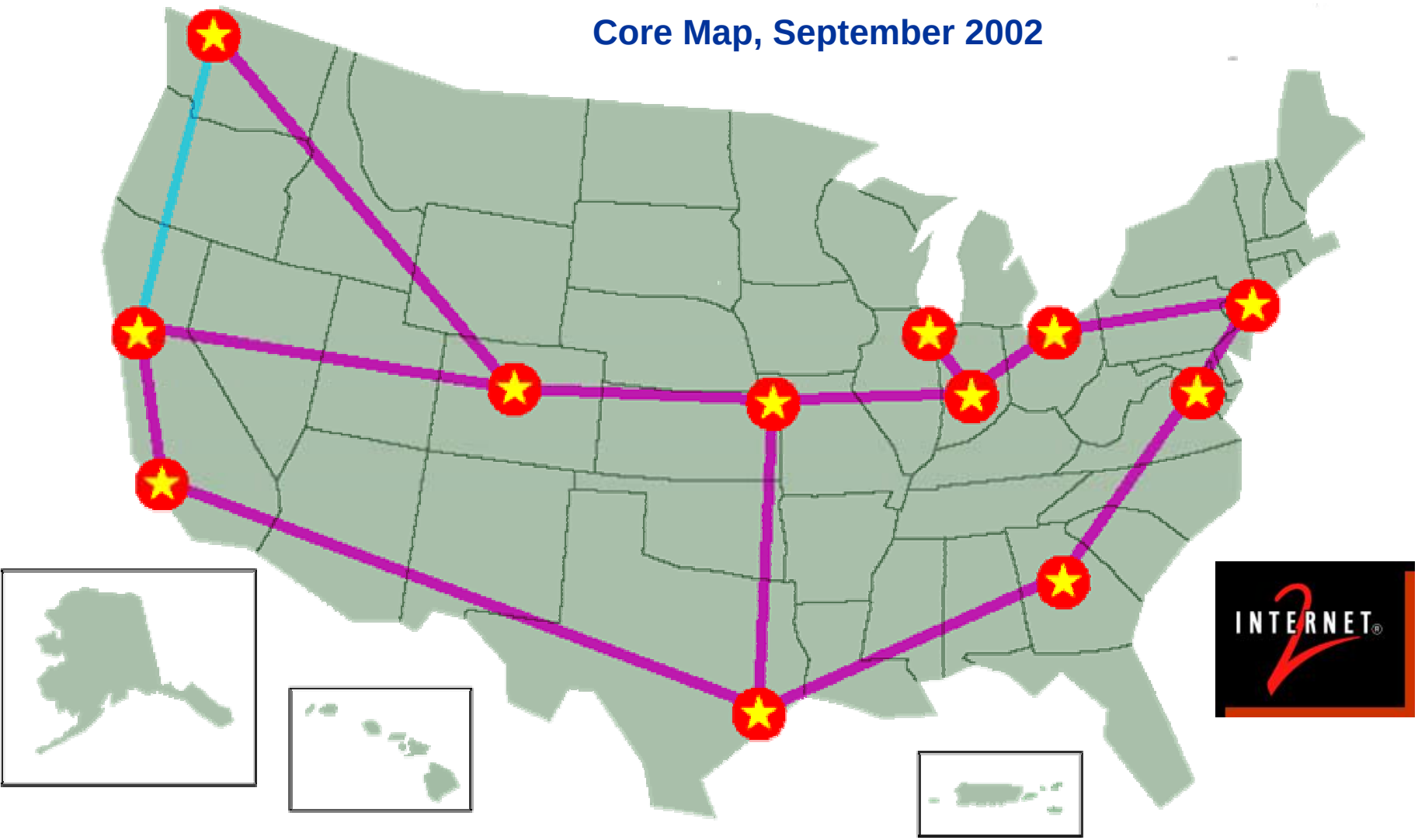
INTERNET 2®

Internet2 Universities

200 University Members, September 2002

Abilene Network

Core Map, September 2002



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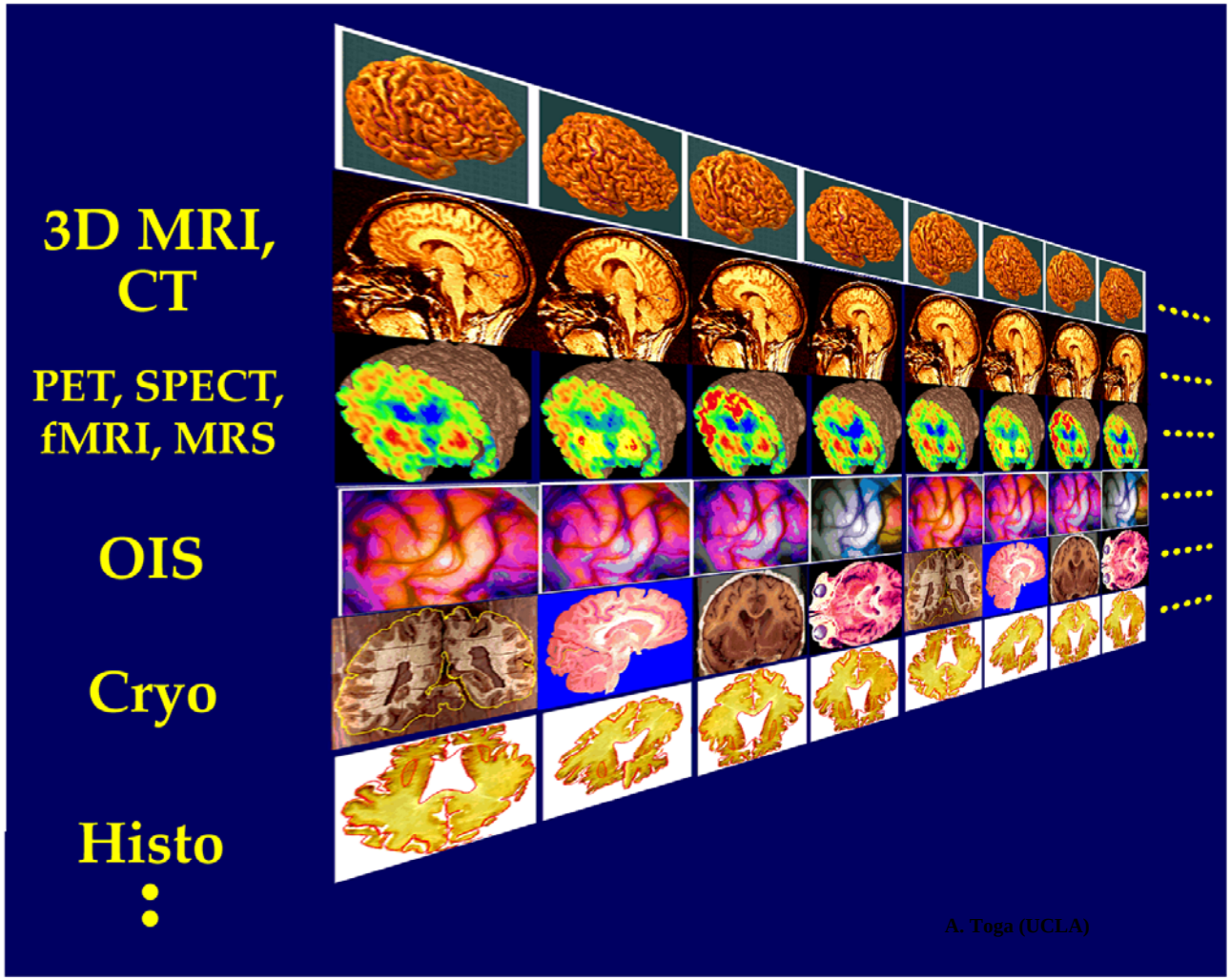
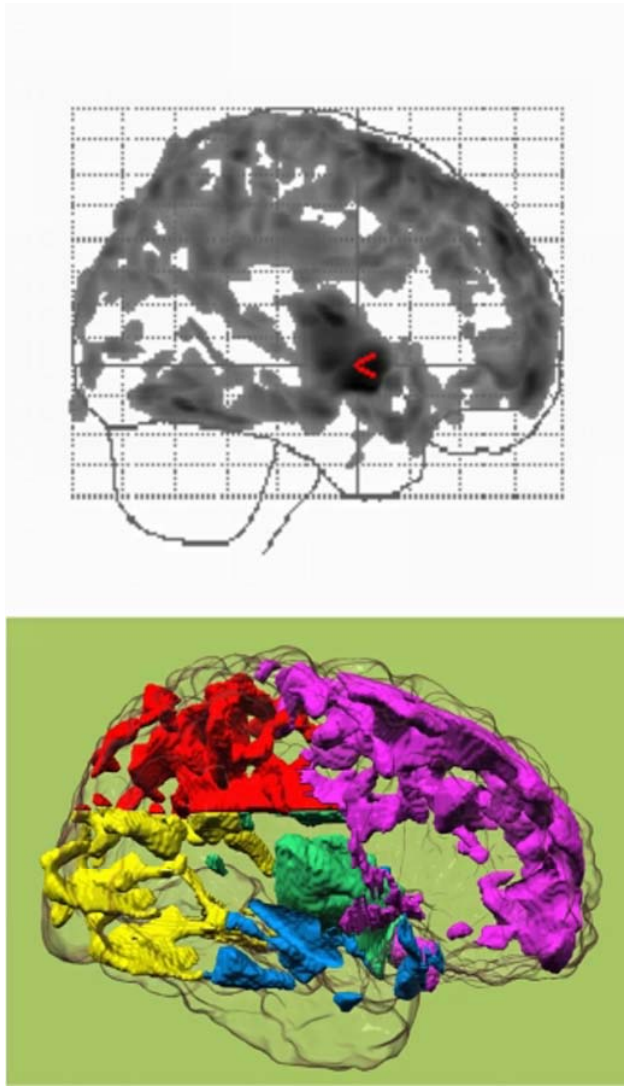
3D Brain Mapping

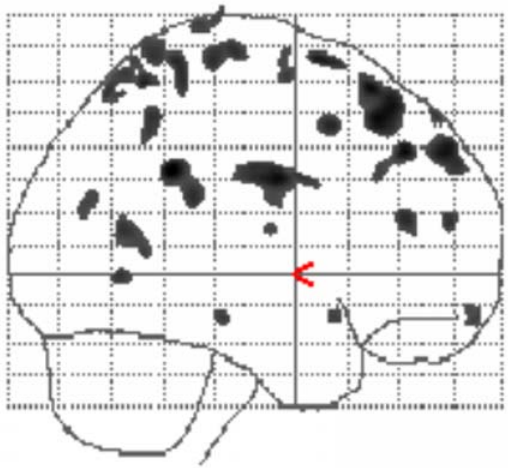


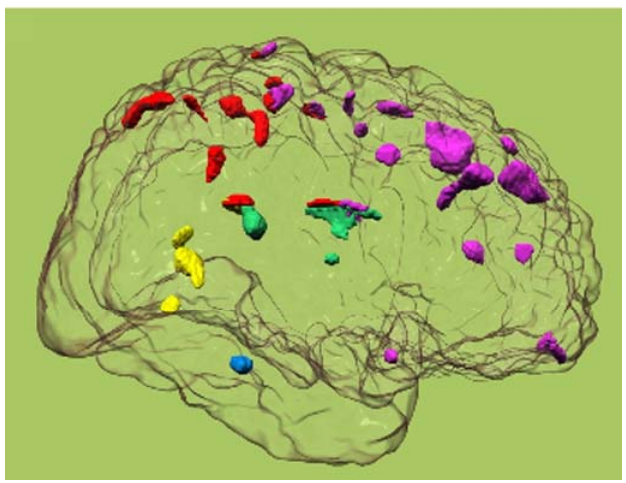
Statistical Parametric Map of Gray Matter Loss Between Ages 7 and 30 years.



purple: frontal
green: striatal
blue: temporal
red: parietal
yellow: occipital

Statistical Parametric Map of Gray Matter Loss Between Childhood and Adolescence





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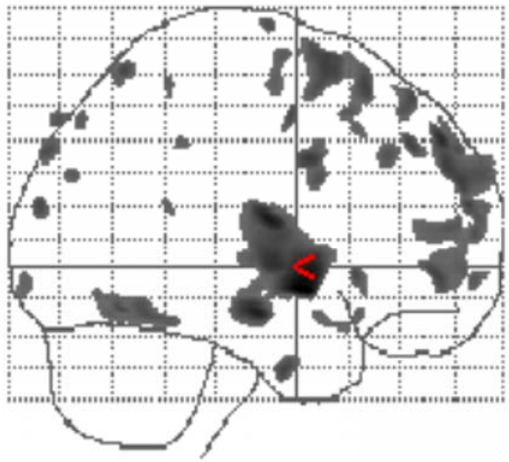
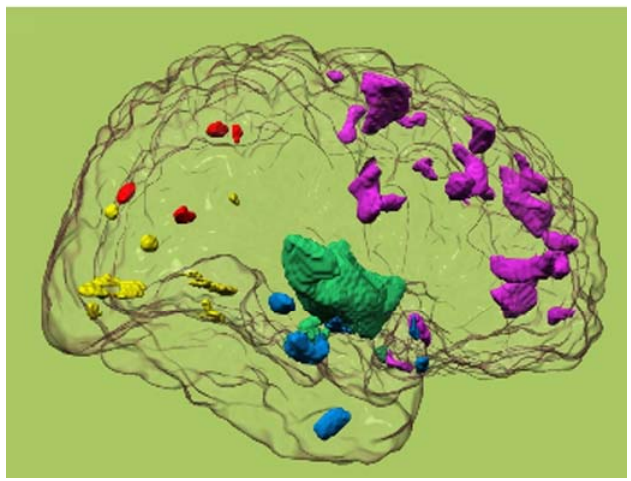
Statistical Parametric Map of Gray Matter Loss Between Adolescence and Adulthood





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Federated Databases

- Allows each participating site to maintain own data in its own database
- Allows heterogeneous data collection over a wide range
- Allows queries across distributed databases --- seamless to individual
- Data security – patient records (HIPAA), intellectual property

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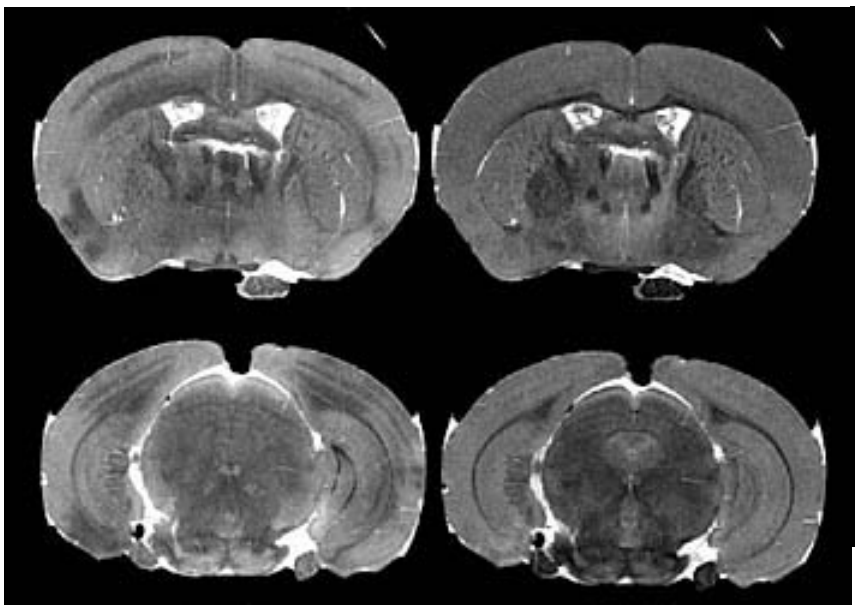
Neuroscience Testbed

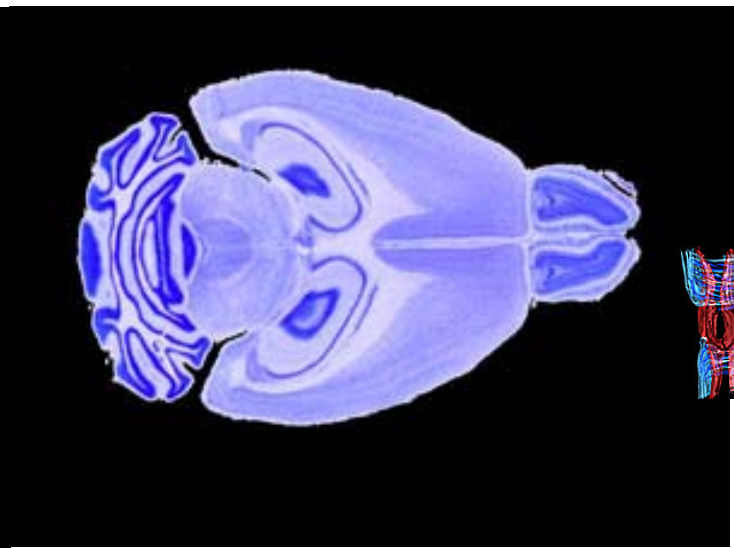
Three groups have developed partnerships

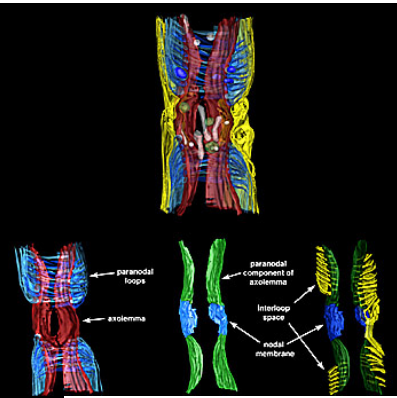
- **Mouse BIRN** - ***Animal Models of Disease / Multi Scale/Multi Method - MS Mouse and DAT KOM (a schizophrenic and otherwise interesting mouse animal model)***
- **Brain Morphology BIRN** - ***Targets: neuroanatomical correlates of neuropsychiatric illness (Unipolar Depression, mild Alzheimer's Disease (AD), mild cognitive impairment (MCI)***
- **BIRN Functional Imaging Project** - ***Human Imaging - Merging data from multiple functional methods: fMRI, MEG, EEG/ERP - with a focus on schizophrenia***

Mouse BIRN

- Animal Models of Disease **/Multi Scale/Multi Method - MS Mouse and DAT KOM (a schizophrenic and otherwise interesting mouse animal model)**
- **Looking at different resolutions by combining data from multiple modalities**
- **Duke, UCLA, UC San Diego, Cal Tech**







Functional BIRN

- **Developing a common fMRI protocol to study regional brain dysfunction related to the progression and treatment of** schizophrenia

- **Correlating functional data with anatomical data acquired from the Morphology test-bed to study if there are neuroanatomical correlates with cognitive dysfunction across disorders**

- **UCLA, UC San Diego, UC Irvine, Harvard (MGH and BWH), Stanford, Minnesota, Iowa, New Mexico, Duke/U. North Carolina**

Rare Diseases Clinical Research Network

- Use existing infrastructure: GCRC resources; Biomedical Informatics Research Network (BIRN) tools.
- Develop efficient Web-based, scalable, clinical trials (CTs) networks for Phase 1-4 CTs
- Establish a pilot Coordinating Center to support study design, data collection, bioinformatics, DSMBs
- Goal is to provide a **National Electronic Clinical Trials and Research (NECTAR**) infrastructure to accelerate research subject enrollment so that the fruits of research more rapidly reach patients, the intended targets of our research.

Rare Diseases Clinical Research Network (RDCRN)

- **Cooperative Centers – each consortium to focus on a related group of Rare Diseases**
- **To streamline research, increase collaboration among rare disease organizations, investigators, and patients**
- **Pilot Coordinating Center: provide infrastructure for web based, electronic, scalable, collaborative clinical and research management systems; provide portal and integration with existing research datasets, i.e., genomic, microarray, SNPs,….more biostaticians**
- **To enhance infrastructure, upgrade existing research tools; develop new research tools with direct input from end users**
- **Collaborative effort---Office of Rare Diseases, NCRR, NICHD and several investigators from academia. Effort complements Roadmap**

Internet-based Clinical Trial Data Flow Model

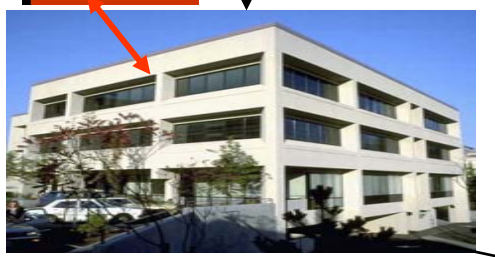
Clinical Sites

NECTAR

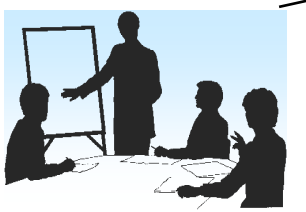
INTERNET 2

DSMB

Resource Laboratories



TDN Coordinating Centers



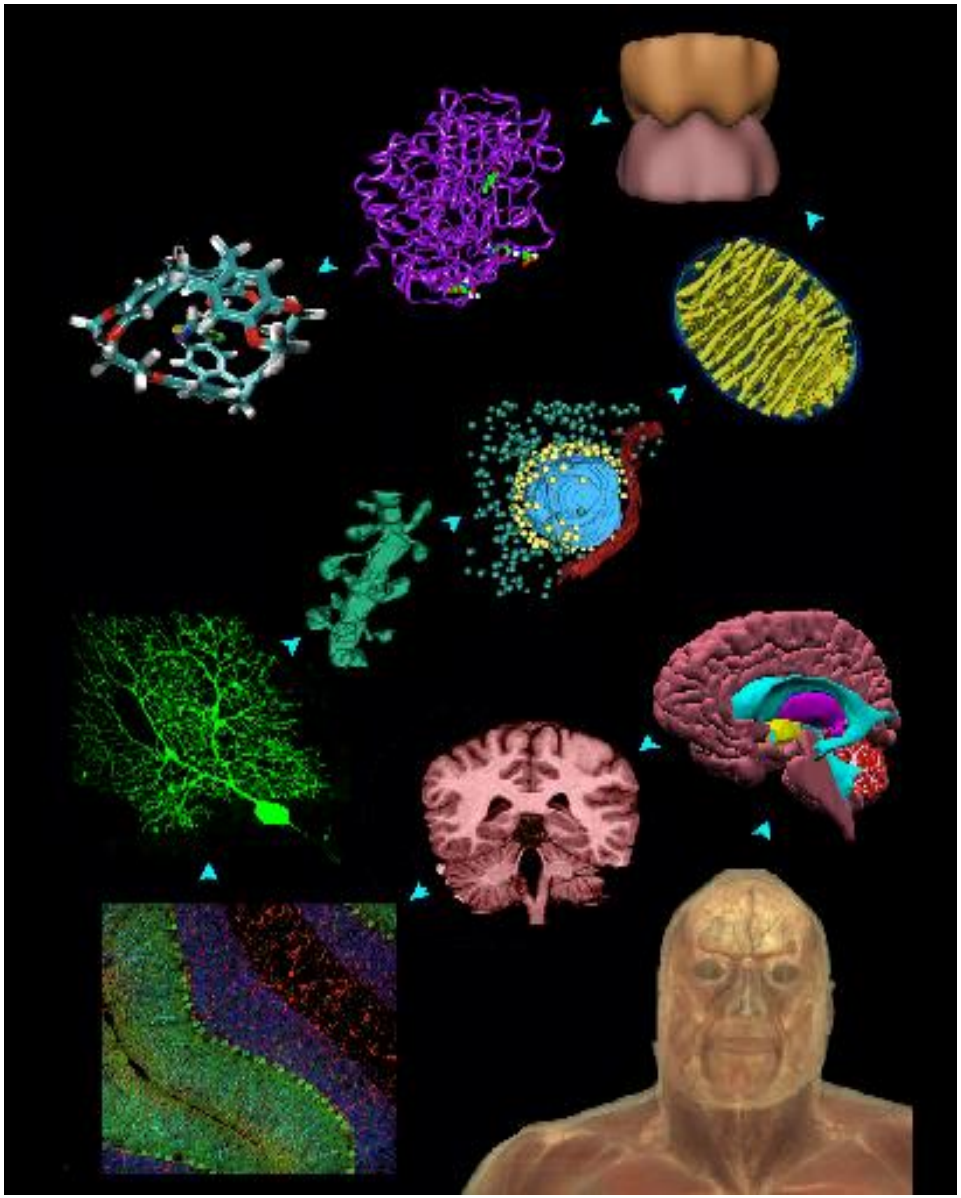
CTU

DMU

AU

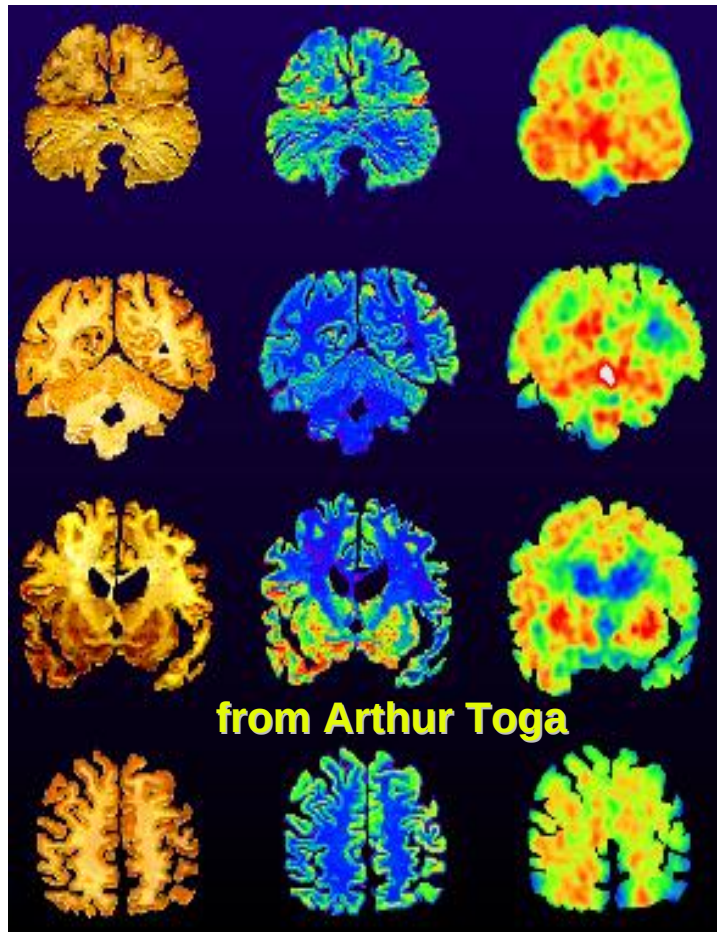
SAU

BRAIN STRUCTURE AND FUNCTION



THE CHALLENGE OF MULTIPLE SCALES

THE CHALLENGE OF BRIDGING BRAINS



technique species discipline modality

Cells

Molecules