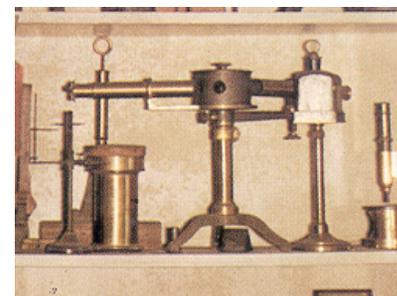
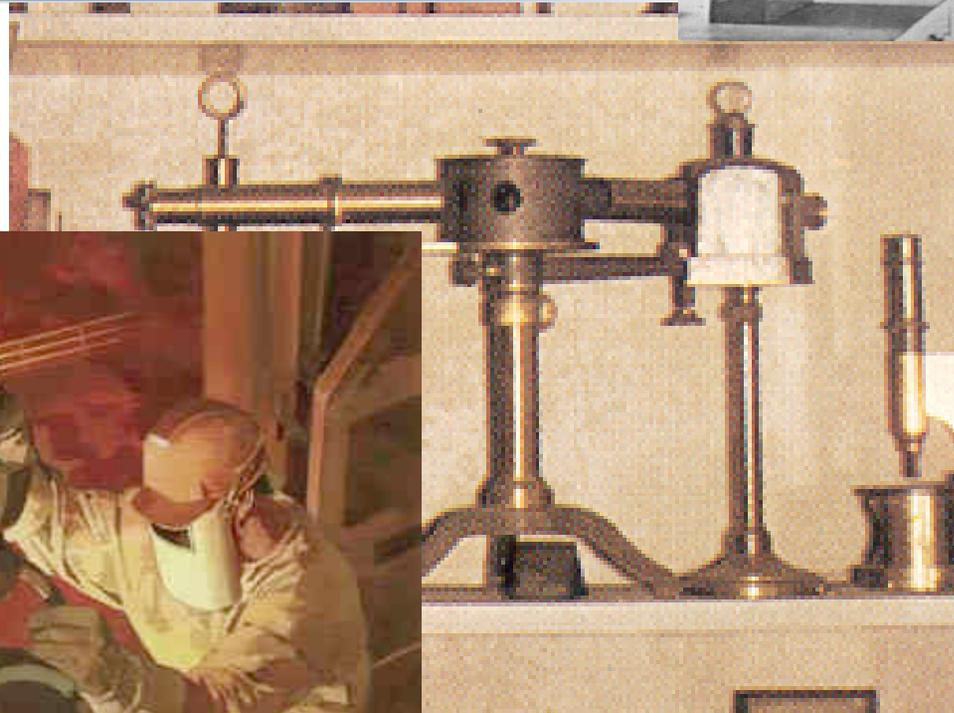


# *The Molecular Foundry*

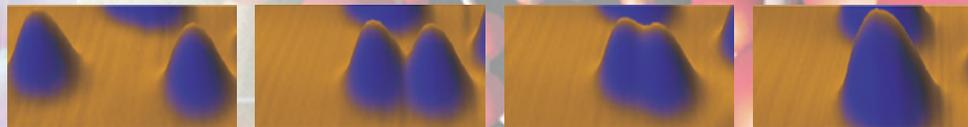
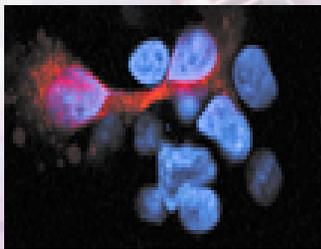
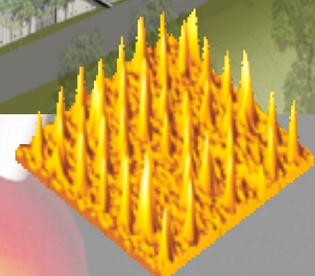




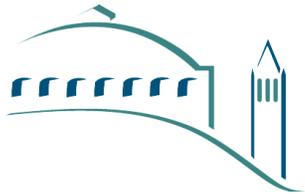
**Molecular FOUNDRY**  
A NANOSTRUCTURES USER LABORATORY

# THE MOLECULAR FOUNDRY

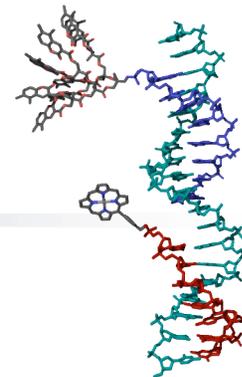
**A Nanostructures User Laboratory**



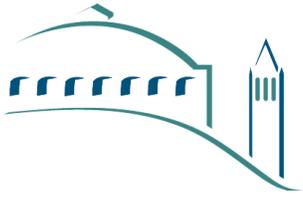
**Office of  
Science**  
U.S. DEPARTMENT OF ENERGY



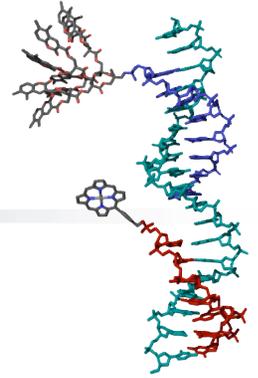
# The Molecular Foundry



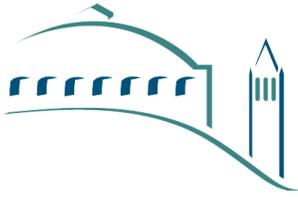
**To provide facilities and expertise to  
enable good science**



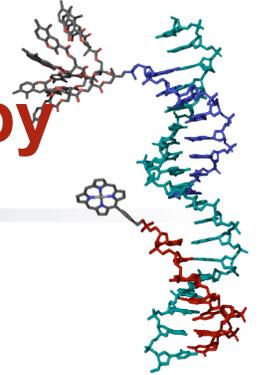
# National Center for Electron Microscopy



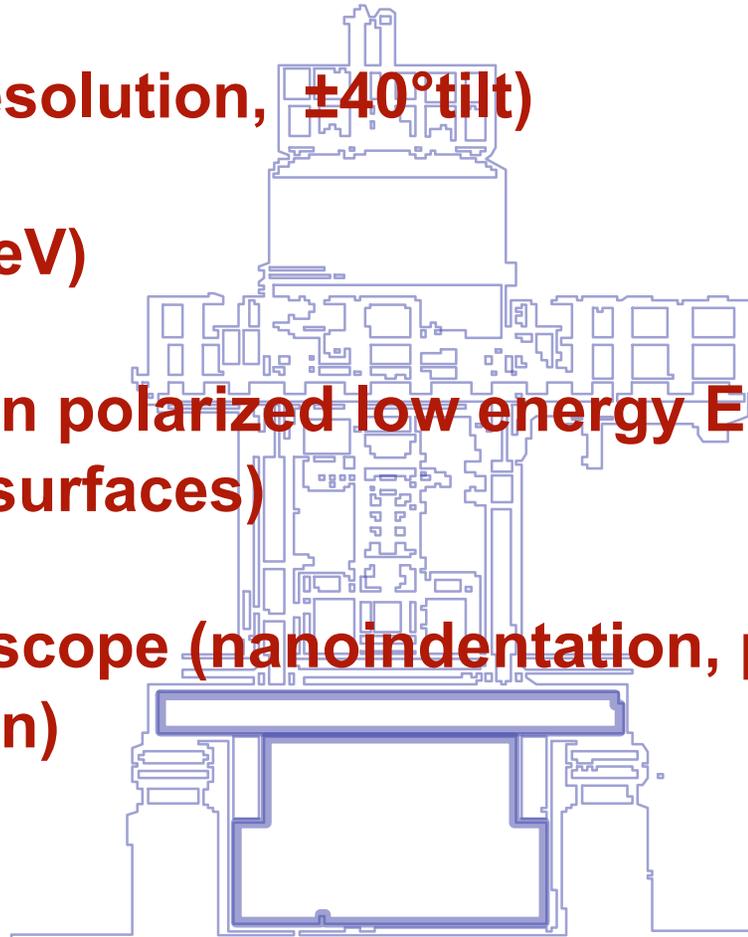
MOLECULAR FOUNDRY—LAWRENCE BERKELEY NATIONAL LABORATORY

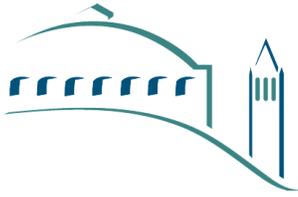


# National Center for Electron Microscopy

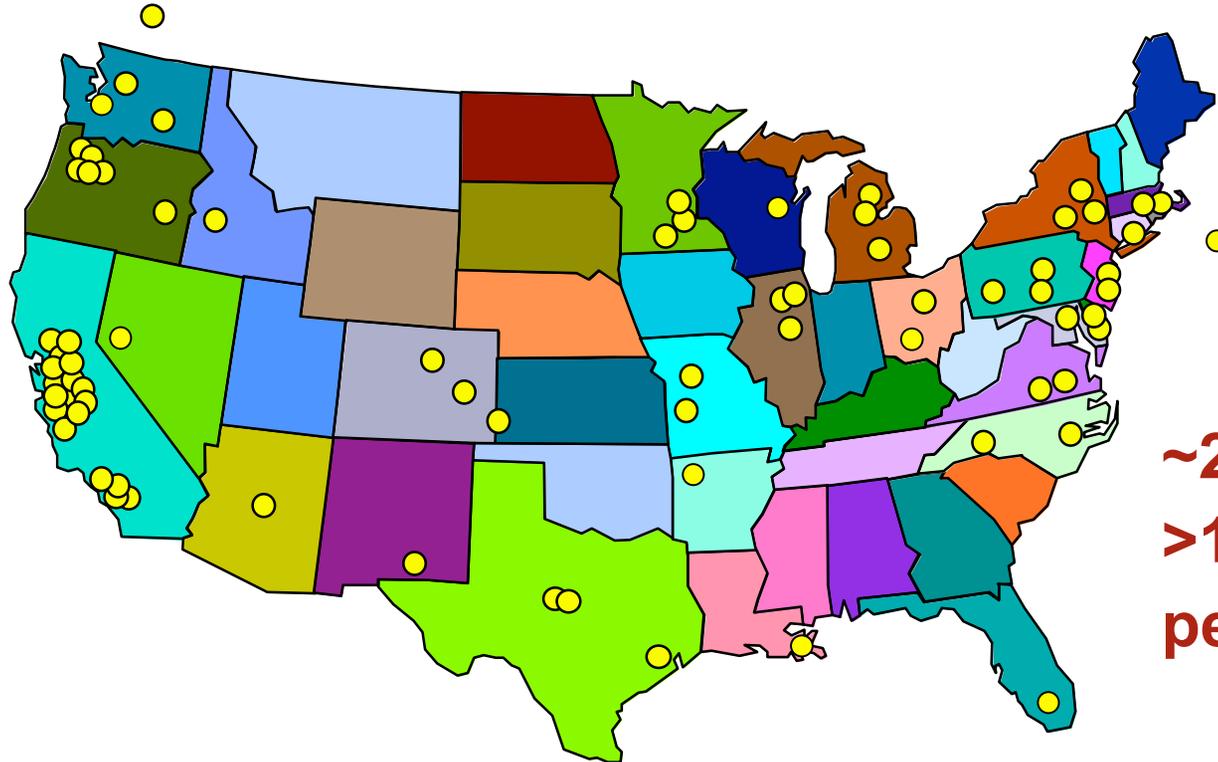
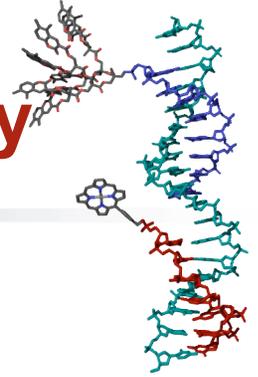


- OAM (better than 1Å resolution, holography)
- ARM (1.6Å resolution,  $\pm 40^\circ$  tilt)
- HVEM (1.5 MeV)
- SPLEEM (spin polarized low energy EM: dynamic imaging of magnetic surfaces)
- In-situ Microscope (nanoindentation, piezo-drift compensation)

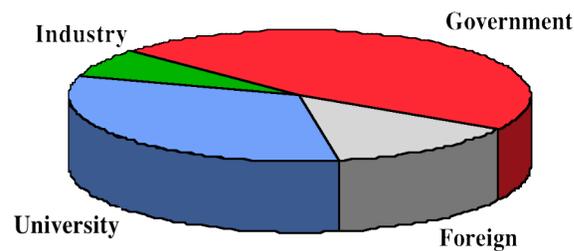
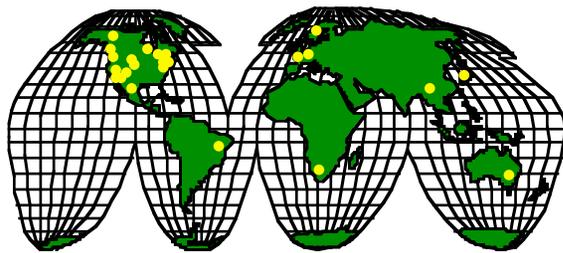


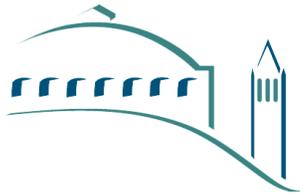


# NCEM: National Research User Facility

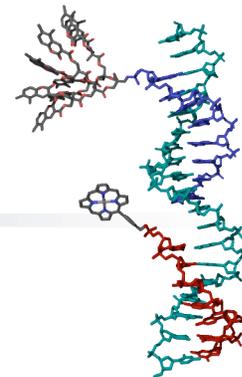


**~250 users**  
**>110 publications**  
**per year**





# NCEM Proposal Review



**D. Howitt (UC Davis), chair**

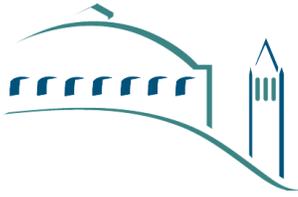
R. Mishra (GM),

C. Allen (ANL), D.J. Smith (ASU),

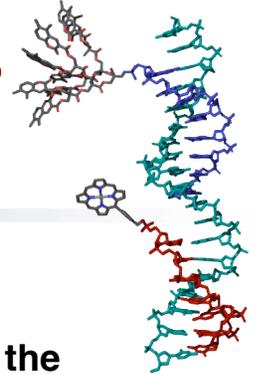
P. Alivisatos (UCB), G. Thomas (UCB),

K. Westmacott , F. Ross (IBM),

K. Downing (LSD)

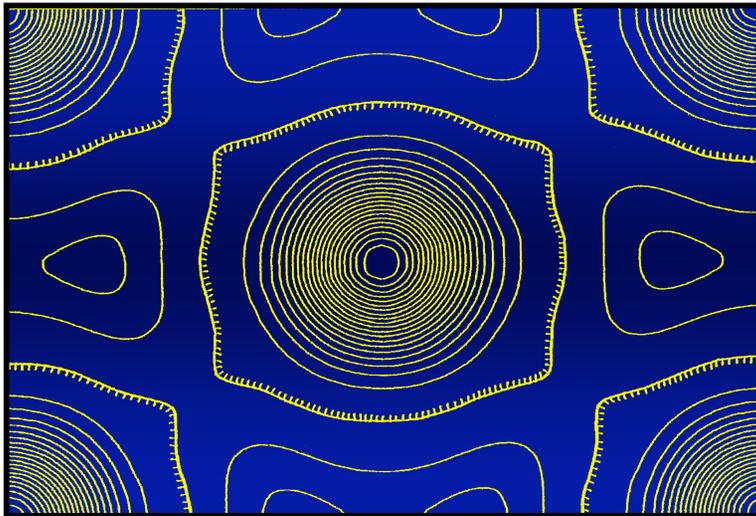


# High Energy Electron Diffraction Reveals Bonding in Metals and Alloys



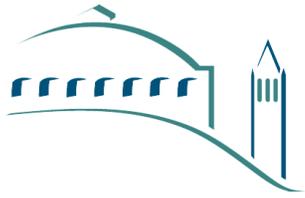
**A.G. Fox**

**Center for Materials Science and  
Engineering, Naval Postgraduate  
School, Monterey, CA93940**

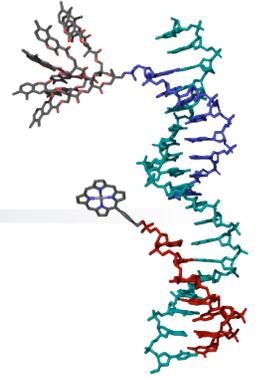


- Many important properties of engineering materials depend on the spatial distribution of the electrons responsible for atomic bonding. The electron charge distribution can be obtained from low angle structure factors. This work has made extensive use of the Berkeley 1.5MeV HVEM to measure the low-angle structure factors and temperature factors of simple metals and alloys with unprecedented accuracy (better than 0.1%) by employing the critical voltage technique. In conjunction with theoretical calculations, this has uncovered the bond distribution in many elements and binary alloys of interest in materials science.

*Z.W. Lu, A. Zunger, E.S.K. Menon  
and A.G. Fox,*

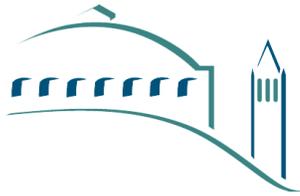


# NCEM Collaborative Postdoctoral Fellow

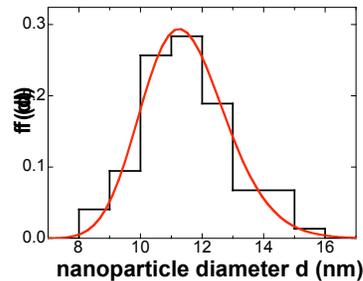
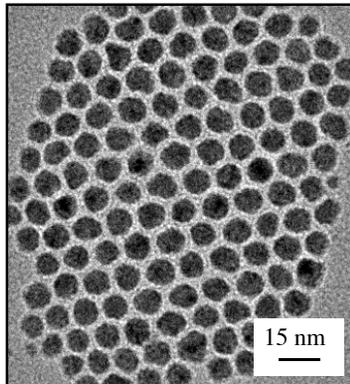
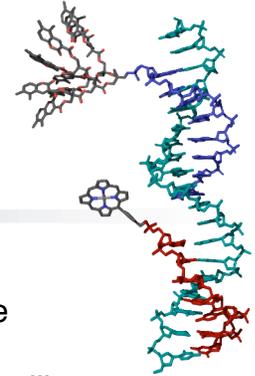


**Outstanding postdocs who:**

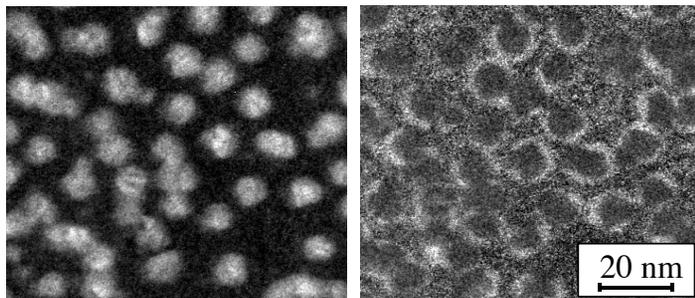
- collaborate with non-expert NCEM users**
- pursue individual research projects**



# Colloidal Bimetallic Ag/Co Nanocrystals



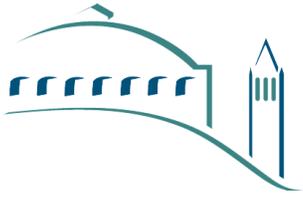
TEM micrograph and particle size analysis



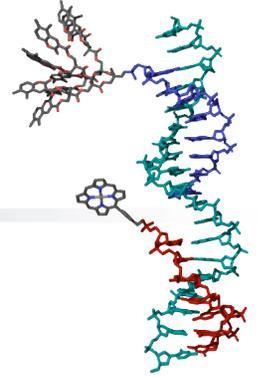
Elemental maps of Ag and Co using energy-filtered imaging

- Monodisperse bimetallic Ag/Co composite nanocrystals were prepared by colloidal methods. TEM showed well-isolated bimetallic particles with mean diameter of 12nm. The particles were characterized by localized EDX and EELS spectroscopy combined with selected area diffraction, revealing a structure of a Ag core surrounded by a Co shell.
  - *Hahn-Meitner Institut, Berlin*
  - *University of Braunschweig*

N.S. Sobal, M. Hilgendorff, H. Möhwald, M. Giersig, M. Spasova, **T. Radetic**, M. Farle, *Nanoletters* 2, 621 (2002)



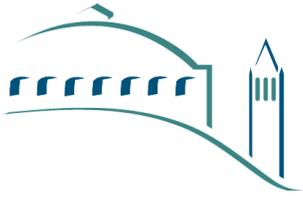
# Intellectual Property



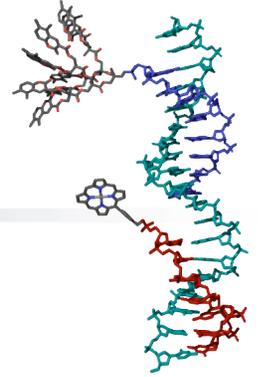
**The University of California retains no rights to subject inventions created solely by a user of the National Center for Electron Microscopy.**

# The Molecular Foundry





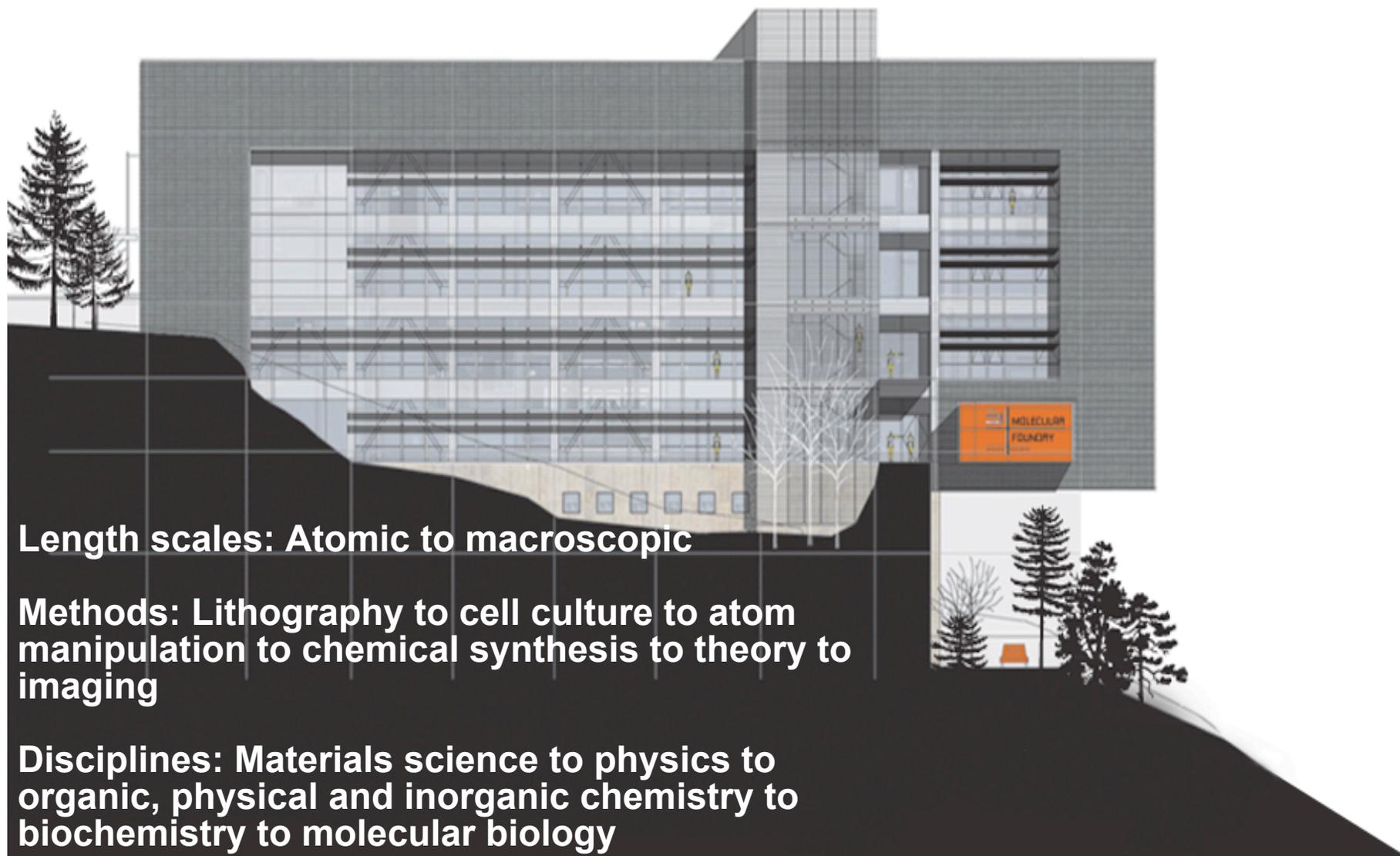
# The Molecular Foundry



**National user facility for research for  
nanoscale science and engineering**

# THE MOLECULAR FOUNDRY

**A Comprehensive Nanostructures User Laboratory**



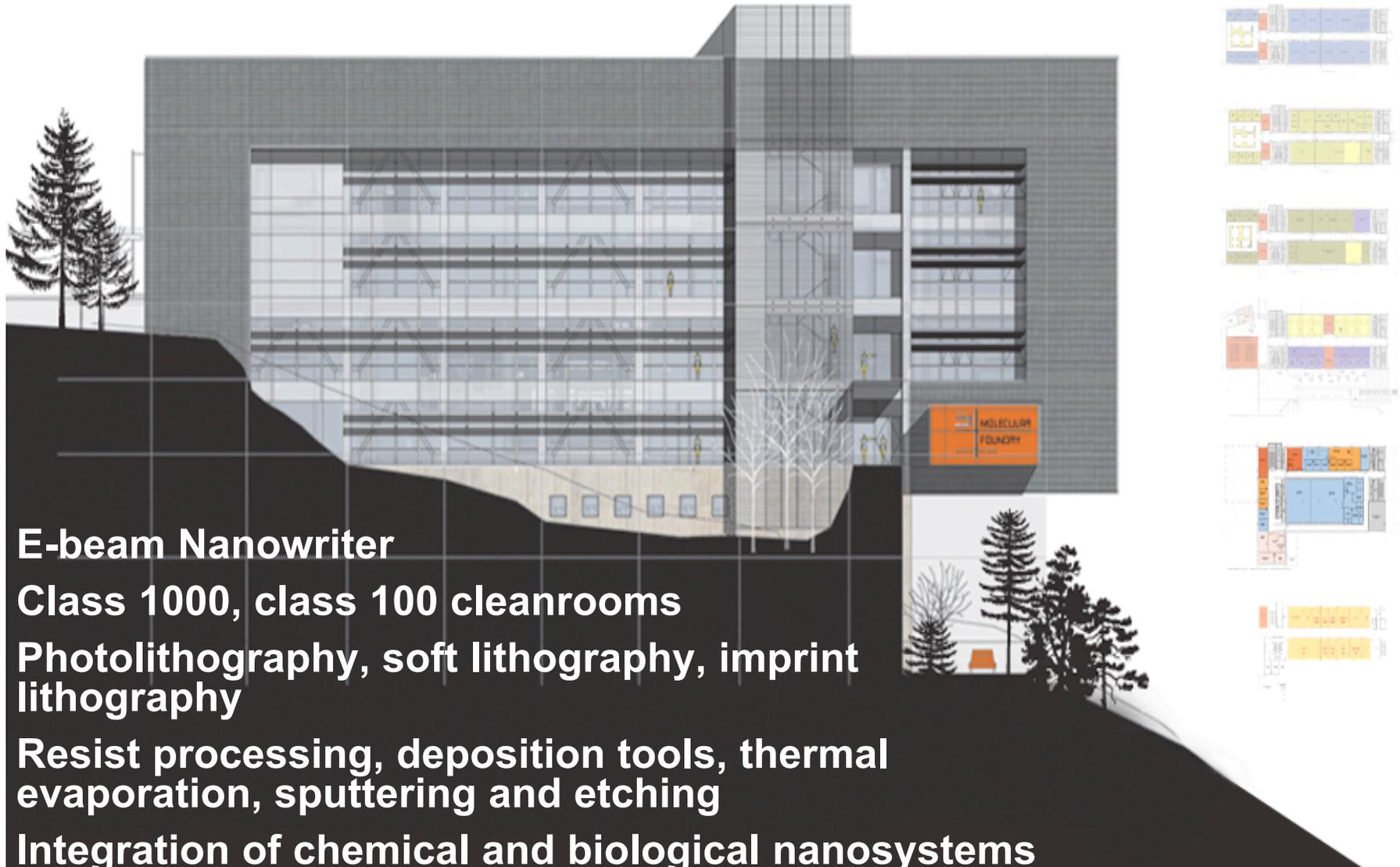
# THE MOLECULAR FOUNDRY

## Six Tightly Coupled User Facilities



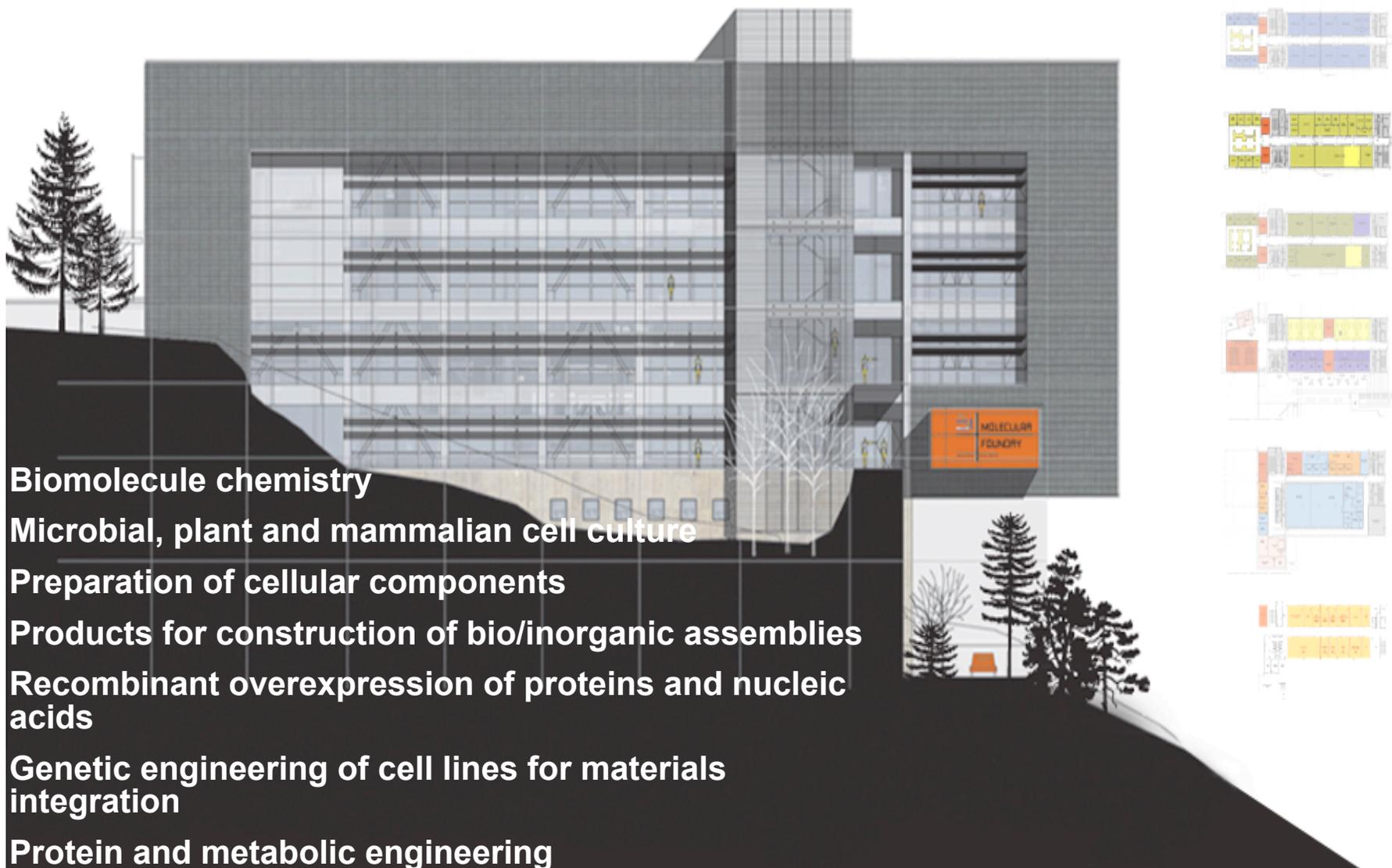
# THE MOLECULAR FOUNDRY

## Nanofabrication



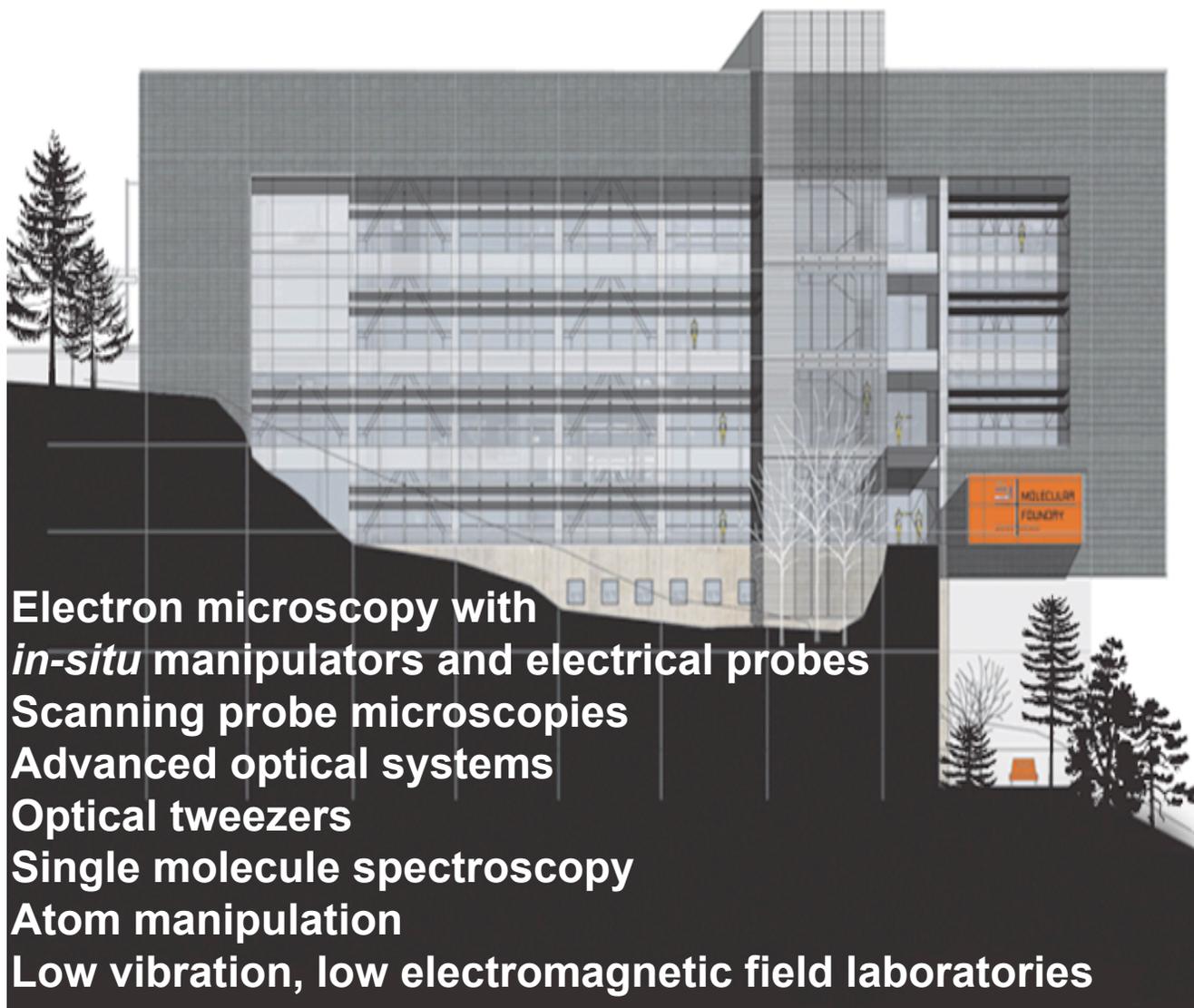
# THE MOLECULAR FOUNDRY

## Biological Nanostructures



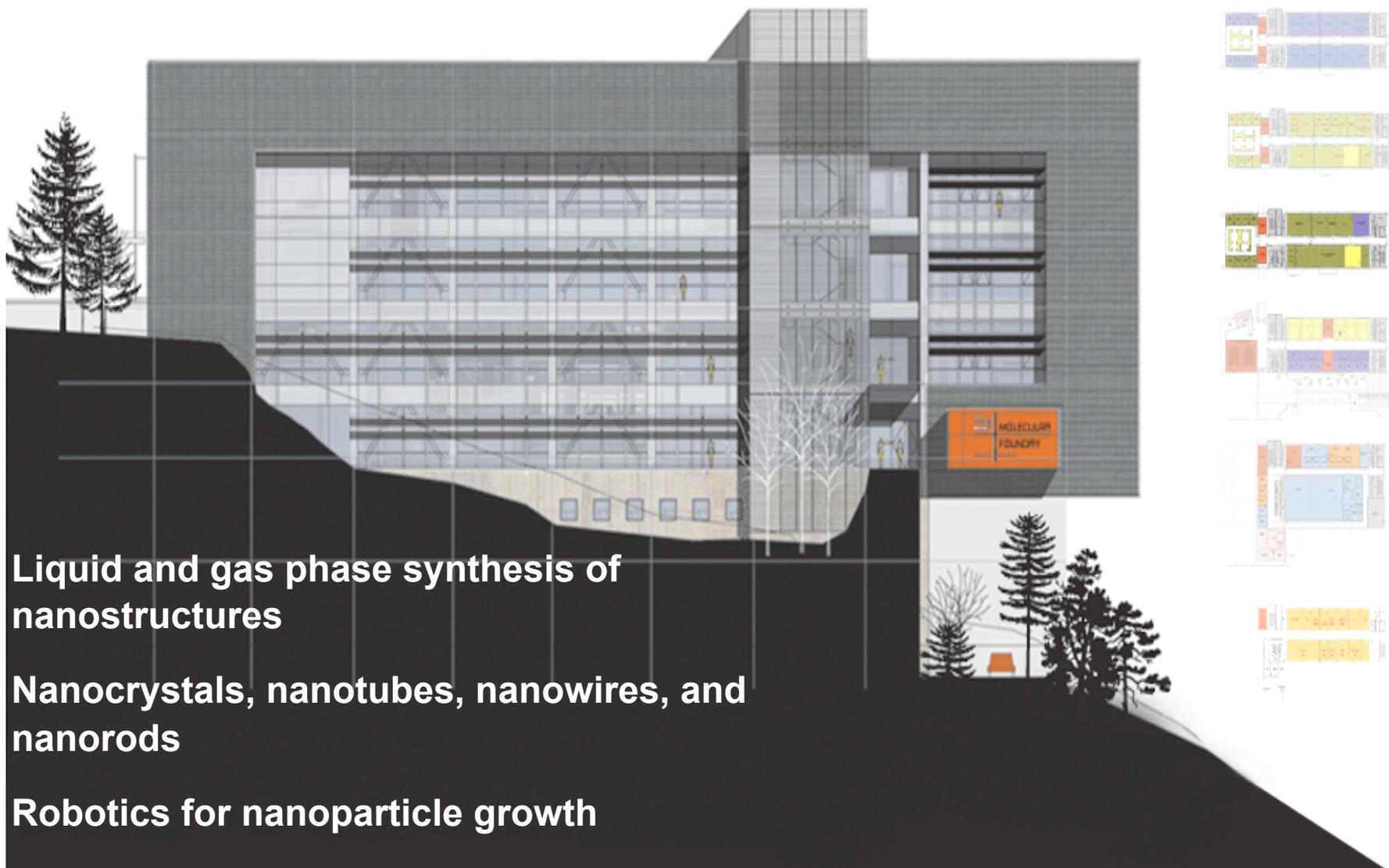
# THE MOLECULAR FOUNDRY

## Imaging and Manipulation



# THE MOLECULAR FOUNDRY

## Inorganic Nanostructures



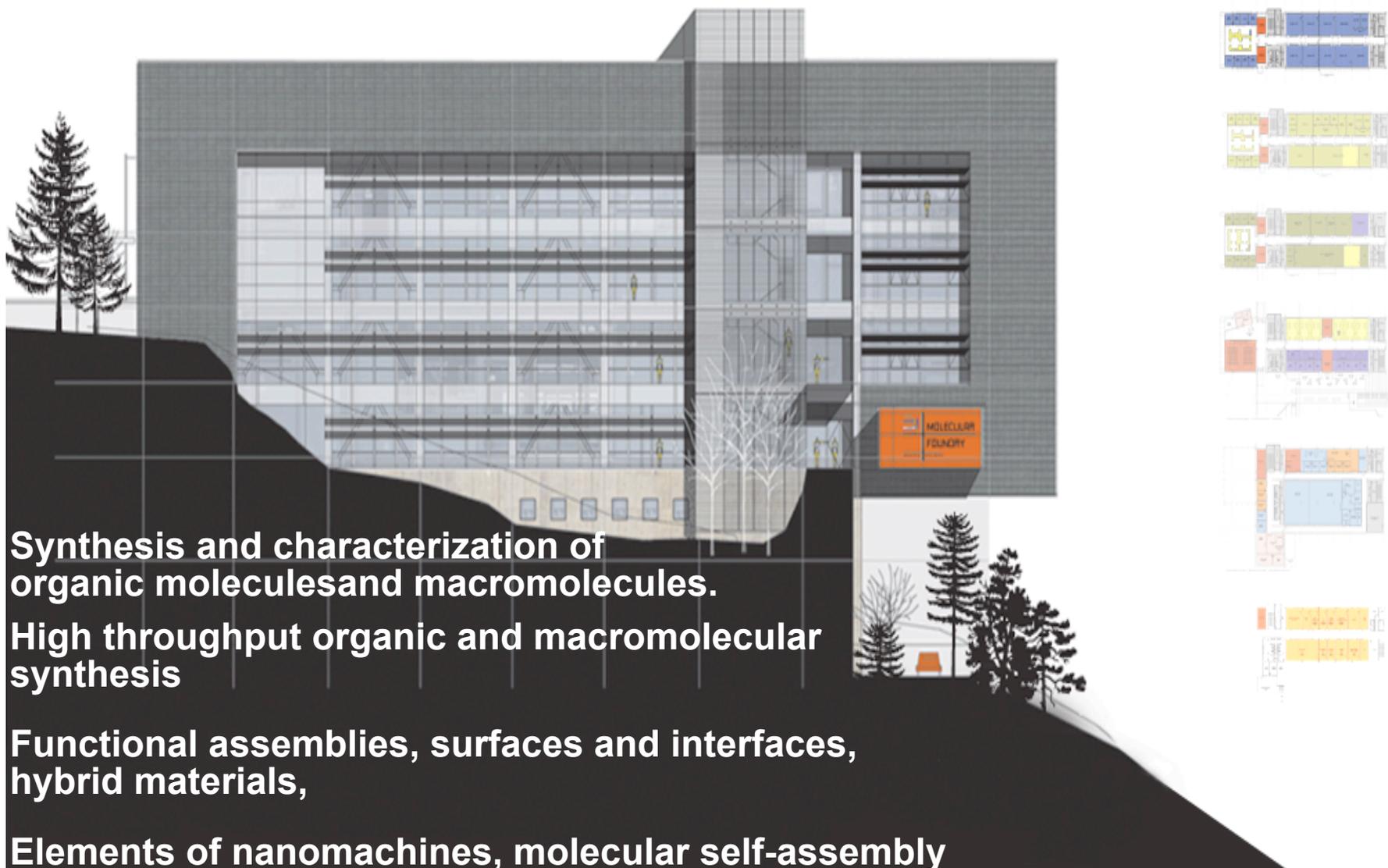
**Liquid and gas phase synthesis of nanostructures**

**Nanocrystals, nanotubes, nanowires, and nanorods**

**Robotics for nanoparticle growth**

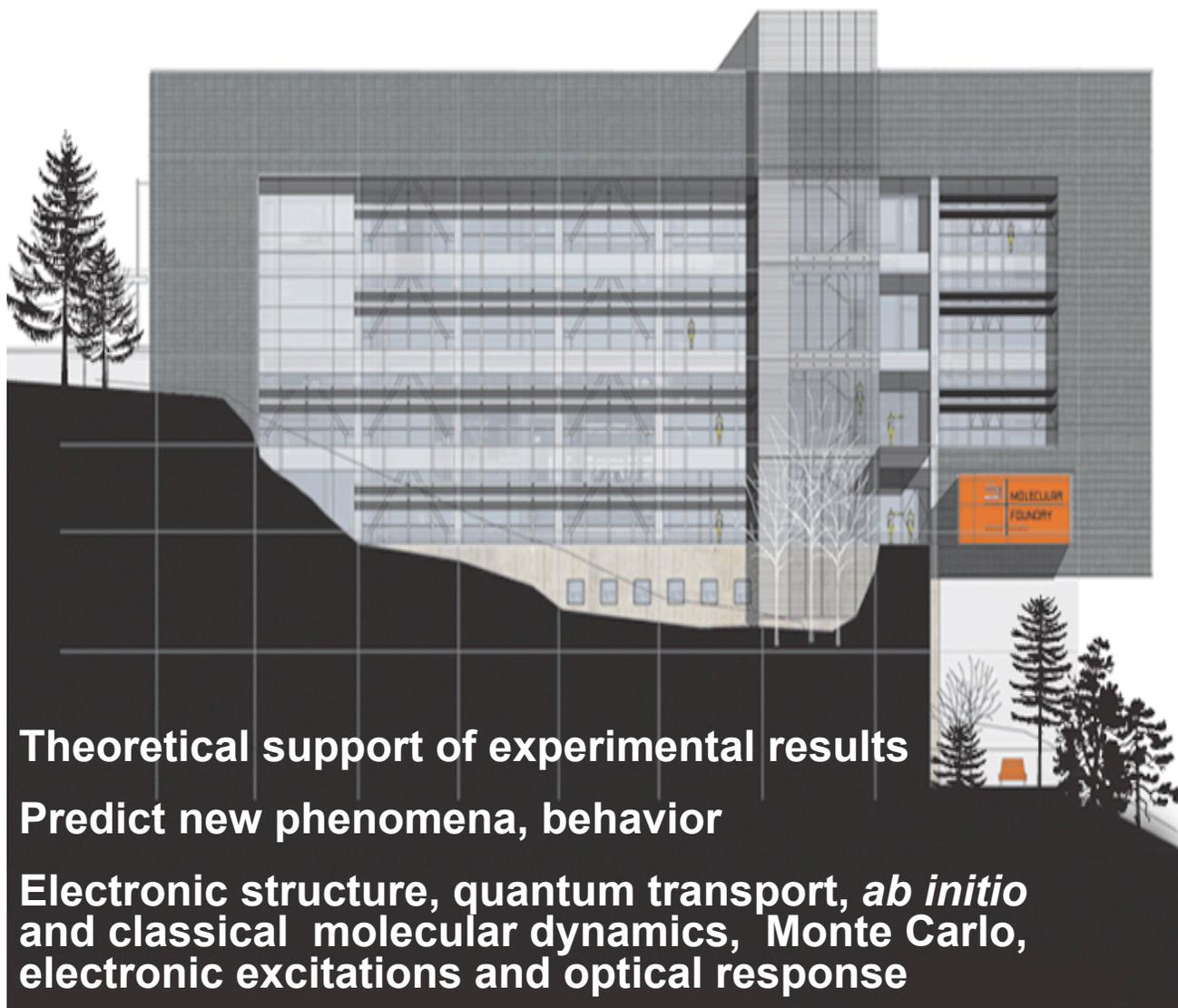
# THE MOLECULAR FOUNDRY

## Organic Polymer/Biopolymer Synthesis



# THE MOLECULAR FOUNDRY

## Theory of Nanostructured Materials



**Theoretical support of experimental results**

**Predict new phenomena, behavior**

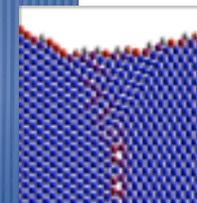
**Electronic structure, quantum transport, *ab initio* and classical molecular dynamics, Monte Carlo, electronic excitations and optical response**

# THE MOLECULAR FOUNDRY

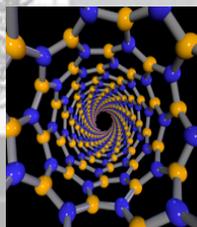
## Facilitated Access to Other LBNL Facilities



THE ADVANCED LIGHT SOURCE



NATIONAL CENTER FOR ELECTRON MICROSCOPY



NATIONAL ENERGY RESEARCH SCIENTIFIC COMPUTING CENTER

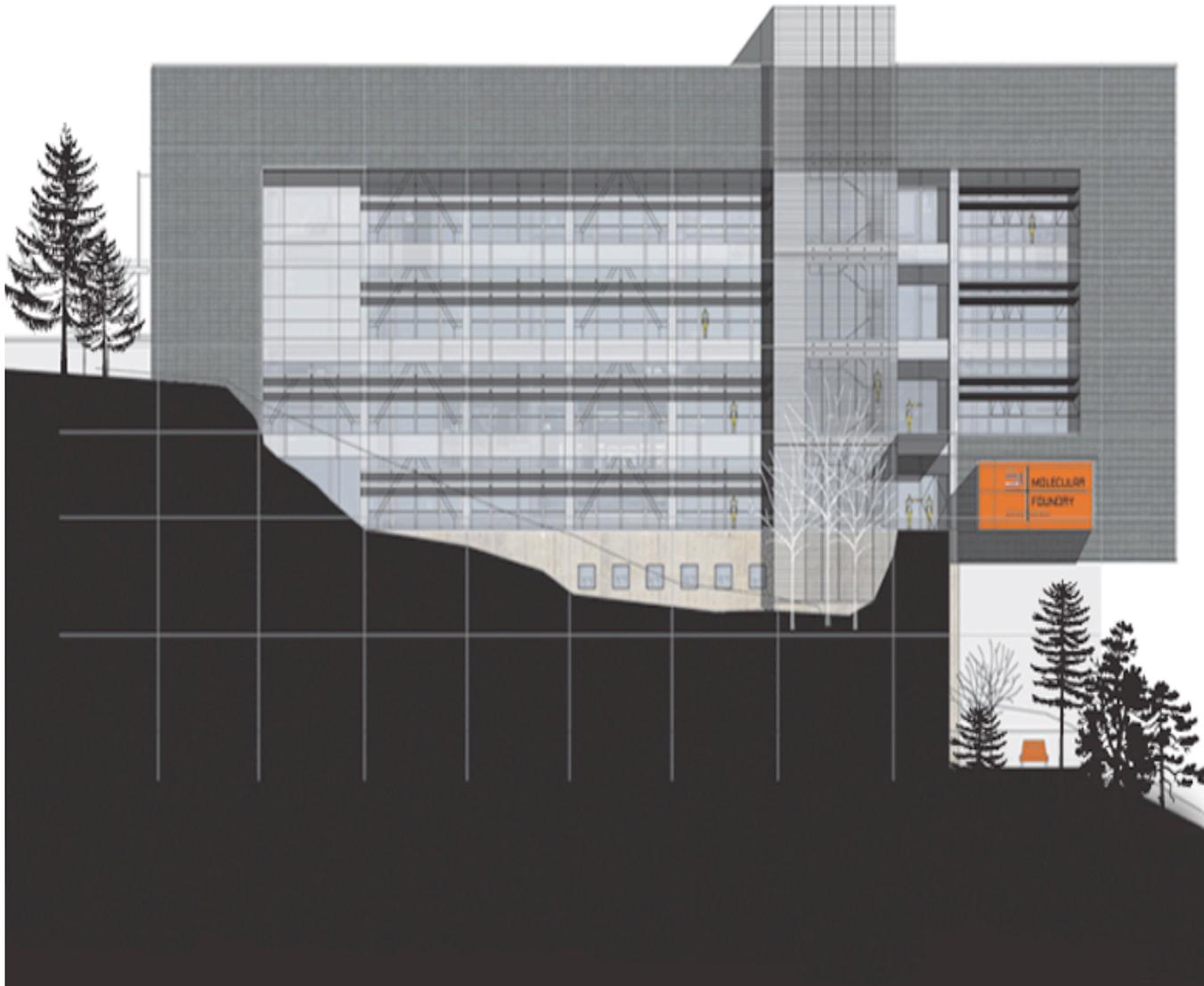


THE LBNL E-BEAM NANOWRITER

Opening in 2006



# THE MOLECULAR FOUNDRY



94,500 square feet

4,000 square feet  
Class 1000 cleanroom

725 square feet  
Class 100 cleanroom

5,500 square feet low  
vibration, low  
electromagnetic field  
laboratory

Offices and laboratories for  
visiting scientists and  
resident technical user-  
support staff.

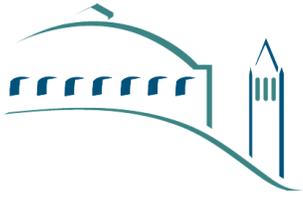
# THE MOLECULAR FOUNDRY

## “□” User Operations 2003–2006

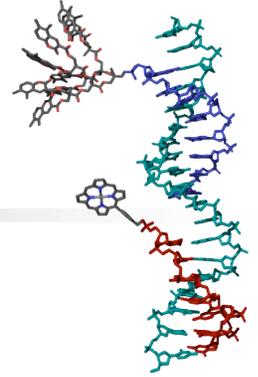


### Limited user operations

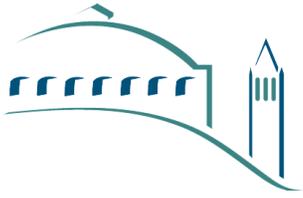
- New postdoc hires
- Existing space
- Call for proposals, Spring 2003



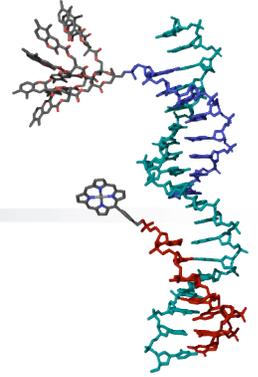
# Profiles of Users



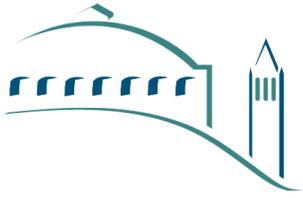
- Use of facility to create samples
- Training in a particular method
- Learn to replicate new instrument/technique
- Develop new methods in collaboration with Foundry scientists
- Long term collaboration with Foundry staff



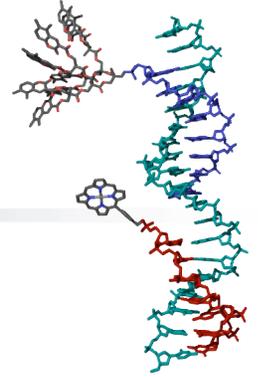
# User Access



- **Prospective users prepare proposal**
- **Proposal reviewed by Proposal Study Panel**
- **Review based on IUPAP criteria:**
  - **scientific merit**
  - **technical feasibility**
  - **capabilities of investigator(s)**
  - **optimal use of facility**
- **Users may work with Foundry postdocs or staff scientist**



# Intellectual Property



**The Molecular Foundry user agreement supersedes the customary University of California, Lawrence Berkeley National Laboratory “guest agreement” ---**

**The University of California will retain no rights to inventions created solely by a user of the Molecular Foundry.**



**Grand Opening, 2006**











