A wide-angle photograph of the Stanford University campus. The central focus is the redwood quad, a large green lawn with a central flower bed and two paths leading to the main building. The building is a large, multi-story structure with a red-tiled roof and a central tower with a mural. The sky is clear blue, and there are palm trees and mountains in the background.

Nanotechnology as an Enabler for Neuroscience, Neuroengineering, and Neural Prosthetic Systems (Nano for N3)

A National Nanotechnology Infrastructure Network (NNIN) Workshop

**Paul G. Allen Center for Integrated Systems
Stanford University**

Organizers:

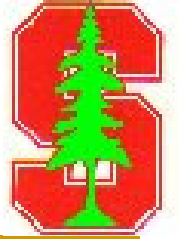
Prof. Yoshio Nishi

Prof. Krishna Shenoy

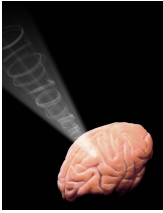
December 11-12, 2008



Brief Workshop Intro



- **For the network junkies:**
 - login: nano4n3
 - password: nanoaccess
- **Special thanks to: Speakers, participants, Paul Rissman, Gabrielle Brits, Cindy Chestek**
- **High-level overview of workshop:**
 - Goals
 - Talks (today)
 - Breakout sessions (tomorrow) to promote discussion time
- **Paul Rissman: quick logistics overview**



Goals

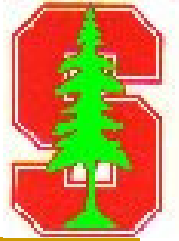


Major workshop goals (next slide) arise from the following observations:

- What is nanotechnology?
 - Technology using engineered materials or devices with the smallest functional organization on nm scale in at least 1 dimension (typically 1-100 nm)
 - Implies some aspect of the material / device can be manipulated and controlled by physical and/or chemical means at nm resolution
 - Results in functional properties that are unique to the engineered technology, not shown by its constituent elements.
- Nanotechnology has already had a substantial impact on neuroscience (the study of the brain and nervous system) and entails specific interactions with neurons and glial cells
 - Current research examples: better interactions with neurons, advanced molecular imaging, materials and hybrid molecules used in neural regeneration, neuroprotection, and targeted delivery of drugs and small molecules across the blood–brain barrier.
 - E.g., Silva, “Neuroscience nanotechnology: Progress, opportunities, and challenges,” *Nature Reviews Neuroscience*, 2006)
- Perhaps this is “just the beginning” and its worthwhile considering (1) future needs and emerging opportunities, and (2) “real-world” factors such as characterizing the robustness of nano-neural interfaces *in vivo*.



Goals



Major workshop goals:

- Share recent advances and thinking on how nanotechnology might help enable next-generation neuroscience, neuroengineering & neural prostheses (neuro-X)
 - Quite interdisciplinary, so just understanding each other's language and needs is half the battle!
- Help identify specific needs and opportunities for nanotechnology to help with precision measurement and stimulation in neuro-X applications:
 - From basic neuroscience, at all scales (molecular, cellular, circuits, systems)
 - Through clinically-viable neural prostheses (implantable stimulation / recording systems, multiple-decade lifetimes, zero risk!, zero cost!, etc.)
- Help build (language) bridges and promote collaborations between nanotechnology community and neuro-X communities
- Help identify how NNIN might leverage its tools, user base, and staff expertise to address needs / accelerate solutions.