# A Perspective on Open Source Approach; the NNIN Experience

Sandip Tiwari

Cornell U., Georgia Tech., Harvard U., Howard U, NCSU/TL, Penn State U., Stanford U., U.C. Santa Barbara, U. Michigan, U. Minnesota, U. New Mexico, U.T. Austin, U. Washington





### Science, Engineering & Open Source (a personal view)



### Time, Funds & Bright People

Nano: Expensive resources, specialized knowledge, interdisciplinary & skilled people



Open Source addresses each one of the issues by sharing resources and knowledge and by helping develop the ideas and the people that make the science to society succeed

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### **NNIN as an Open Distributed Support Network**



Zip codes of research users from academia and industry



**NNIN User Community** 



Network Users by Discipline - 3/2006 - 2/2007



# Industry





Nanogen)

### Network-Based Research: MRS Bulletin (Invited Publications)



Articles from NNIN users





During 2006, 8/12 of issues of MRS Bulletin had strong NNIN enabled research contributions

INNIN INSEGRATE Dec2007



### Academic: Applied Physics Letters (2006) (Cover Graphics from Articles)



*Microcontact Insertion Printing* T. J. Mullen et al. **APL 90**, 063114 (2007)



Nanospherical Silicon Particles Tomography A. Yertsever et al. **APL 89,** 151920 (2006)



Evanescent-Coupled Semiconductor Lasers A. Khalili et al. APL 89, 041105 (2006)



Gas Sensors Using Tungsten Oxie 3D Nanowire Network A. Khalili et al. **APL 88**, 203101 (2006)



Temperature Strain Phase Diagram of BaTiO<sub>3</sub> thin films Y. L. Li et al. **APL 88,** 072905 (2006)



*T Junction Trap for Ion Shuttling* W. K. Hensinger et al. **APL 88,** 034101 (2006)



In 2006, 6/52 issues of APL featured NNIN serviced research on its cover

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## **NNIN Openness**

#### **Open Culture**

- External user focus
- User training, open access to equipment and knowledge of the lab
- Staff support
- Remote usage
- Interdisciplinary: between disciplines and between theory and experiments
- IP ownership with the user
- Extensive web-based resources for training, use and education from anywhere
- Hands-on workshops



# Sampling of Supported NNIN Computational Codes



### **Experiment-Theory Coupling (a set of examples)**



Photonic Bands code of MIT coupled to Genetic Algorithm to evolve a structural form for coupling specific frequencies intensely at nano-micro interface. Fabricated structure followed theory closely.



A. Gondarenko et al., PRL (2006)

#### Photoshop for realistic simulation and with code developed elsewhere

Simulations show significance of cooling in the presence of gate bias and Kondo nature of conductance stripes verified with thermal studies.

A. Vidan et al., PRL (2006)

### Hands-on Short Courses

- Intense and rigorous hands-on introduction to science and technology required to undertake research in nanoscience area
- Technology and Characterization
  - Three days
    - Lectures in the morning
    - Laboratory demonstrations in the afternoon
  - 40-60 participants/event
    - Large Universities
    - Smaller Universities
    - Small and Large Companies
    - Government Labs

NNIN conducts >15 large and rigorous multi-day workshops per year which reach out to technical community that would otherwise not have such an open access opportunity





### **Cross-Disciplinary Workshops in Computation**



Modeling the nanoscale world: Cornell 11/2005

www.nnin.org Nanoscale Science.

Engineering & Technology

### NNIN Impact



### NNIN





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