

NEBRASKA NANOSCALE FACILITY: NNF

Annual Site Report: 2017

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*Director: NNF and NCMN

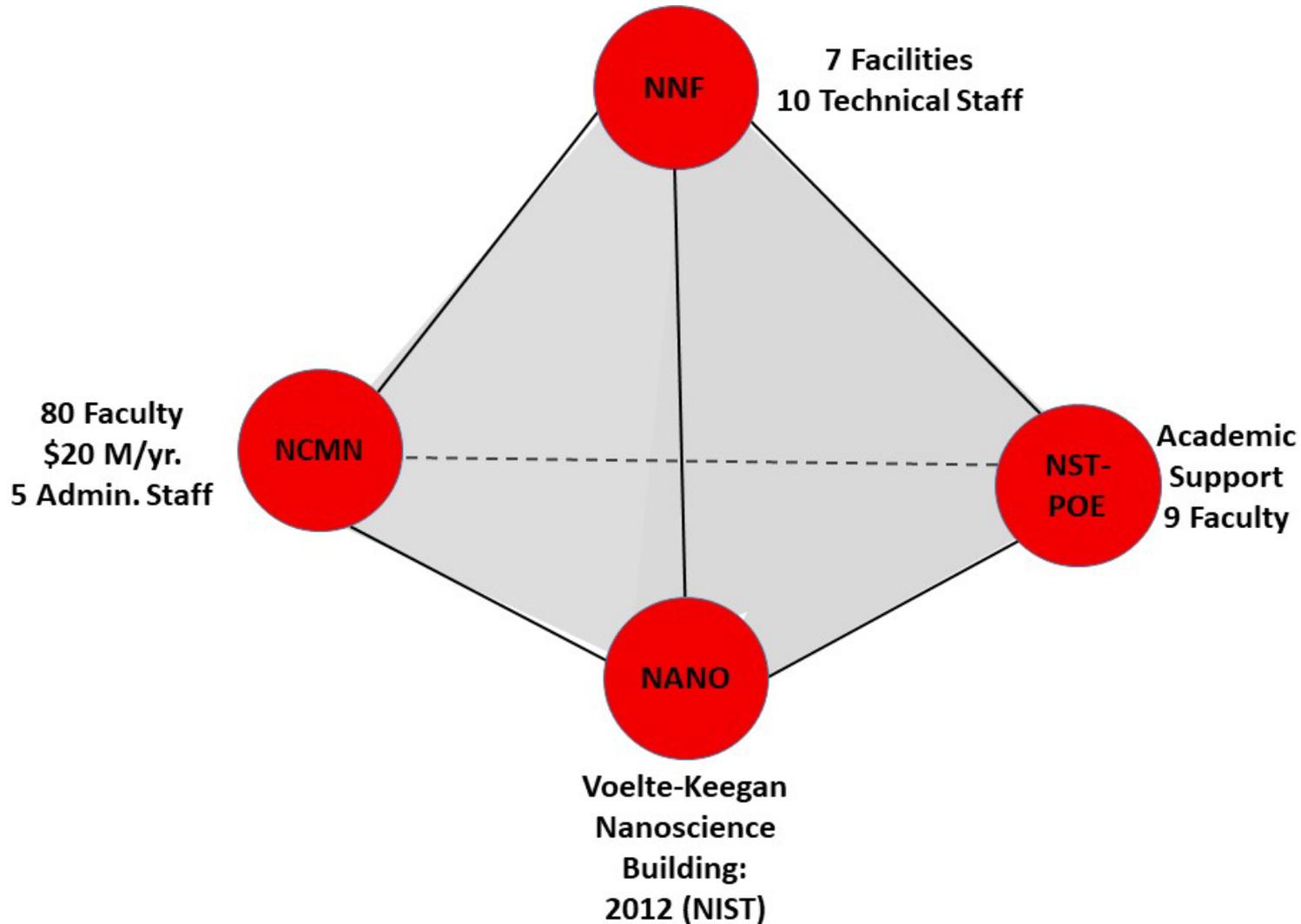
† Coordinator and Program Manager: NNF

§Education and Outreach Coordinator: NNF

Nebraska Center for Materials & Nanoscience
University of Nebraska

NNCI 2nd Annual Conference
University of Pennsylvania
October 16-17, 2017

Site Overview: Structure



Research Focus Areas



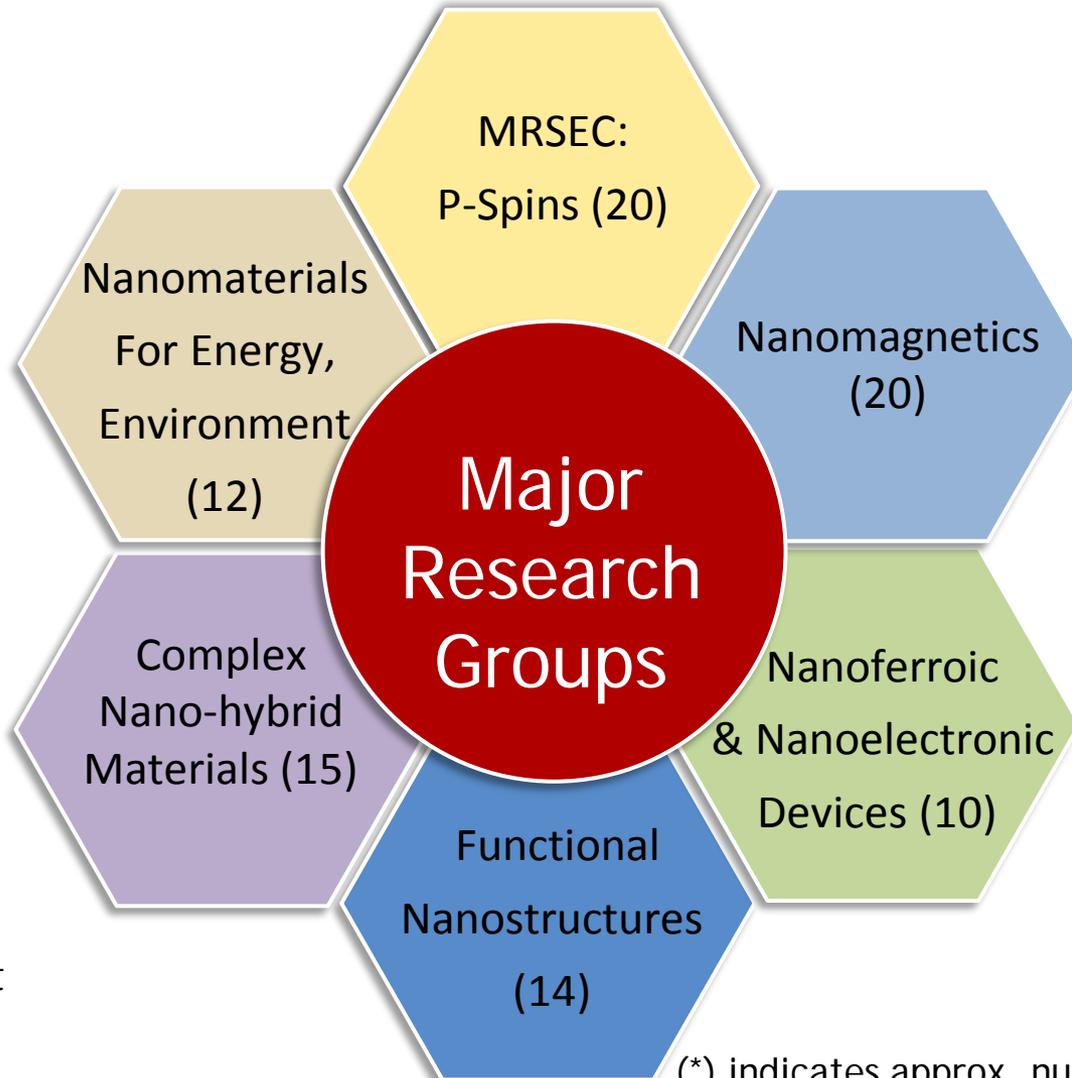
Evgeny Tsymbal



Michael Nastasi



Mathias Schubert



David Sellmyer



Christian Binek



Yongfeng Lu

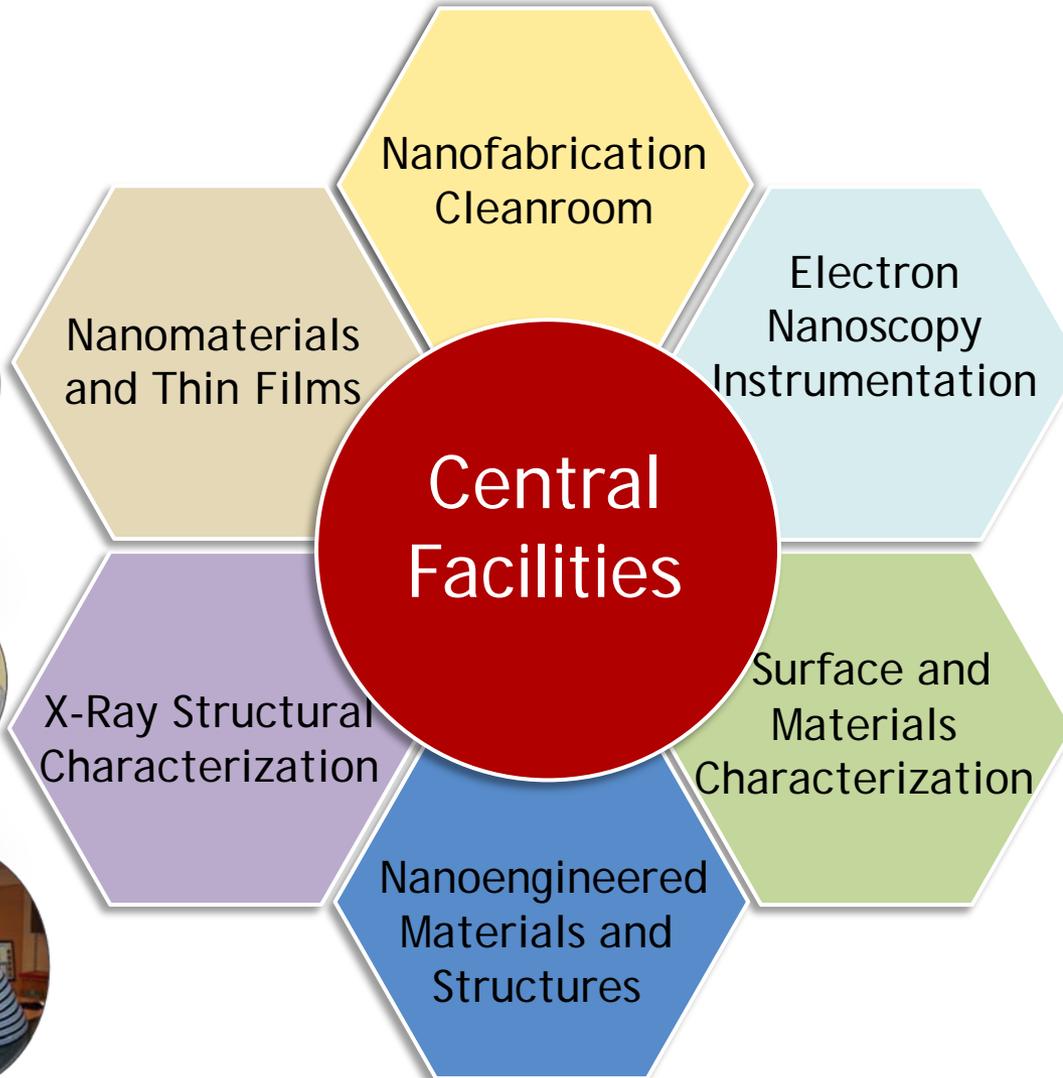
(* indicates approx. number of faculty involved)

NNF Facilities

Technical Staff



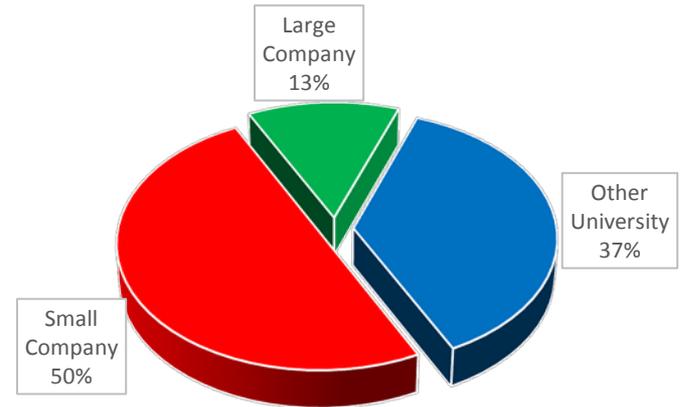
Technical Staff



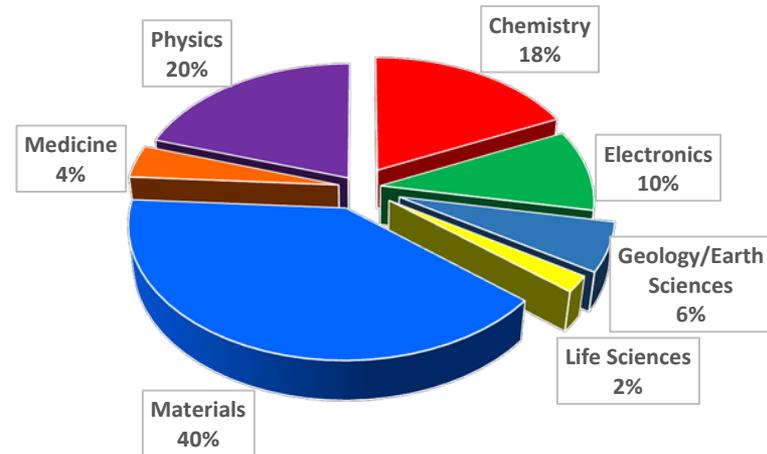
User Statistics

Yearly User Data Comparison		
	Year 1 (12 months)	Year 2 (6 months)
Total Users	314	230
Internal Users	297	213
External Users	17 (5%)	17 (7%)
Total Hours	23,446	10,218
Internal Hours	23,122	10,065
External Hours	324 (1%)	153 (2%)
Average Monthly Users	97	110
Average External Monthly Users	1 (1%)	5 (4%)
New Users	314	88
New External Users	17 (5%)	10 (11%)

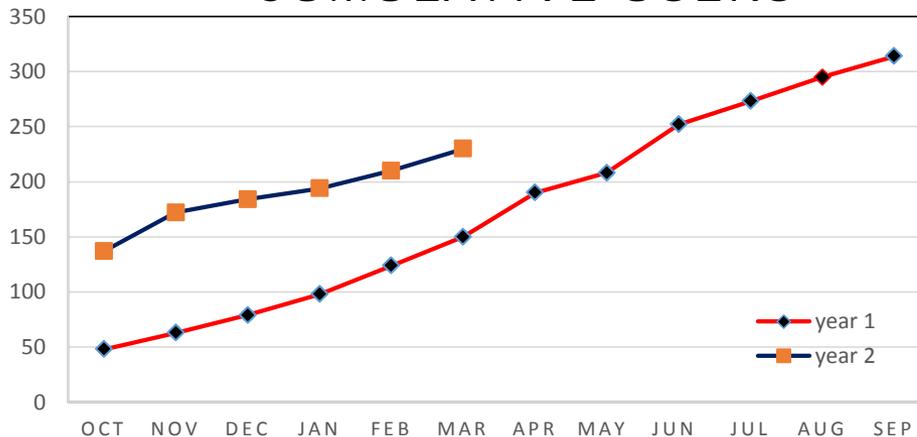
External Users



All Users



CUMULATIVE USERS



New Capabilities / Tools

X-Ray Photoelectron Spectrometer X-Ray Fluorescence Spectrometer



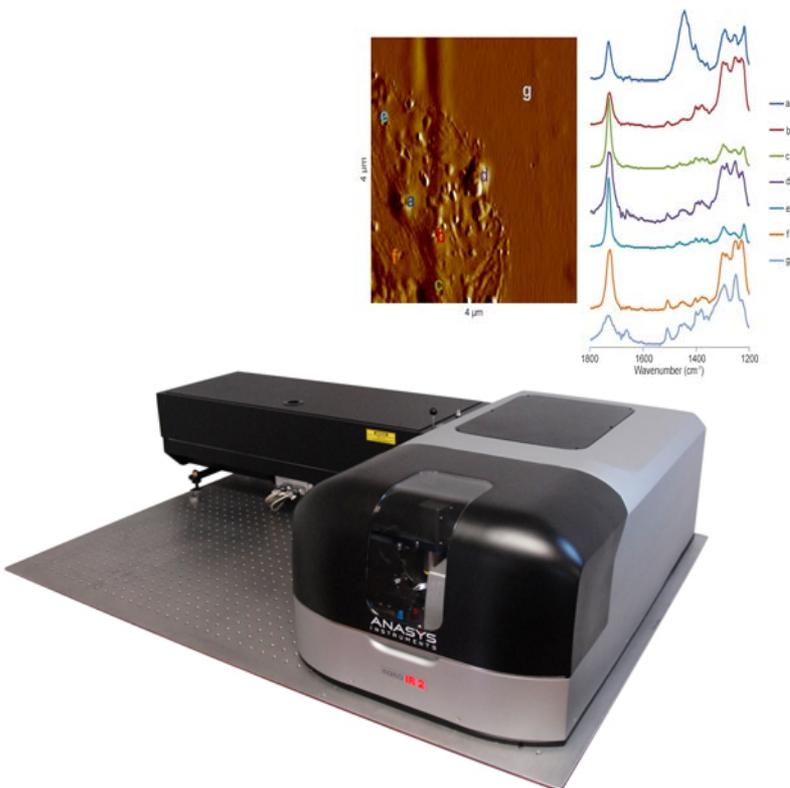
**ThermoFisher K-Alpha+
XPS/UPS System**



Rigaku Supermini200 WDXRF

New Capabilities / Tools

Nanoscale IR Absorption Spectroscopy + AFM



Anasys nanoIR2

4.5 T Annealing System

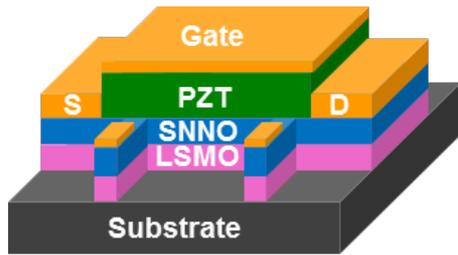


Cryomagnetics, Inc.

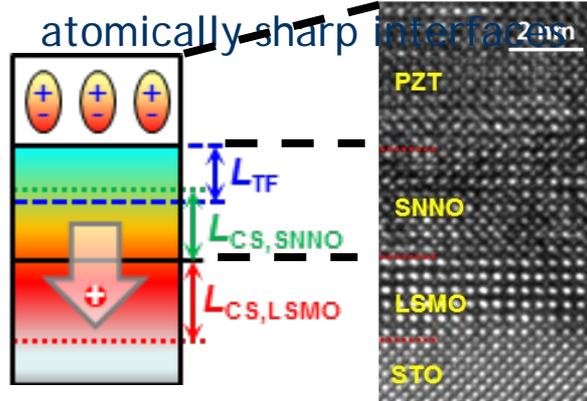
Interfacial Charge Engineering for Ferroelectric-Control of Strongly Correlated Oxides

Chen, X., Zhang, X., Koten, M.A., Chen, H., Xiao, Z., Zhang, L., Shield, J.E., Dowben, P.A., Hong, X., Adv. Mater. 29, 1701385 (2017)

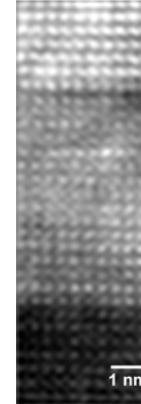
Pb(Zr,Ti)O₃-gated ferroelectric FET



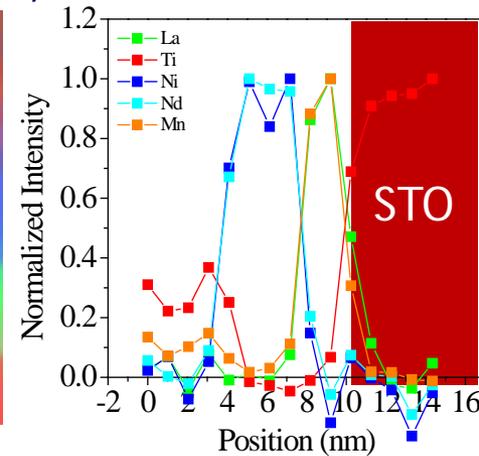
Complex oxide heterostructures with atomically sharp interfaces



HAADF STEM image w/EELS chemical map overlay



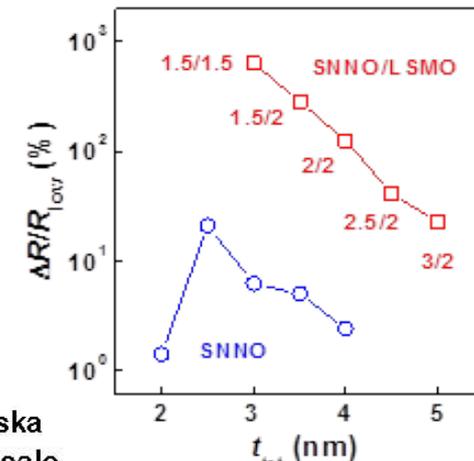
EELS chemical line scan



Interfacial charge transfer between

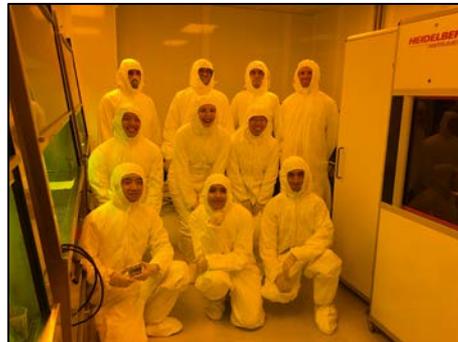
Sm_{0.5}Nd_{0.5}NiO₃ and La_{0.67}Sr_{0.33}MnO₃, to achieve enhanced FE field control in a Mott transistor

SNNO/LSMO bilayer channel exhibits up to 100X enhanced resistance switching



NNF Education and Outreach

- ❖ **Traveling Nanoscience Exhibit:**
7 Nebraska museums (30,000 people)
- ❖ **Workshops:** Introduce NNF to industry and university reps (100 participants)
- ❖ **Minicourse:** 3-day course for new regional users (20 participants)
- ❖ **Advanced Classes:** Focused on specific instruments, e.g., electron microscopy (50 students)
- ❖ **REU's:** Individual students and Prof/Student pairs, 10 weeks (4 professors/7 students)
- ❖ **High School Intern Program:** Summer research for 10 weeks (15 students)
- ❖ **K-12 Diversity Programs:**
 - Title I After School and Summer Programs**
6-8th grade (150 students)
 - Title I Teacher Conferences/Workshops**
(15 schools)
- ❖ **College Prep Academy Program:** 2-day Nanocamp for 1st generation, college-bound high school students (65 students)



Network Activity

- ❖ **NNCI Metrics Committee (David Sellmyer)**
 - Initial set of metrics recommended
 - Network cooperation and metrics in development
- ❖ **NNCI Workforce Development Committee (Terese Janovec, David Sellmyer)**
 - Contributed to study of local CC needs/interests
- ❖ **NNCI NSF RET Proposal (Jeff Shield, S. Ducharme)**
 - Six-week summer research experience (ASU, GA Tech, MN, Louisville, NE)
- ❖ **NNCI Working Group Members (J. Hua, S. Valloppilly, L. Yue, J. Li, T. Janovec)**
- ❖ **U.S. Senate and Congress Contacts (David Sellmyer)**
 - 5 Letters for NSF>NNCI budget support, 2 responses

Resource Allocation and New Equipment Acquisition

- ❖ **NNF External Advisory Board Recommendation**
 - Persuade university administration to establish an annual Equipment Replacement Fund.
- ❖ **Build F & A Return Fund as Match for University Funds**
 - Occasional year-end funds (\$200-400K) become available.
- ❖ **Write NSF-MRI or Other Large Equipment Proposals Annually**
 - Workhorse instruments CAN be funded (TEM, XRD at Nebraska) if well justified by broad usage.