

Welcome to the 3rd Annual NNCI Conference



National Nanotechnology
Coordinated Infrastructure



Welcome to the NNCI Advisory Board



Reggie Farrow
NJIT



Andrew Greenberg
U Wisconsin



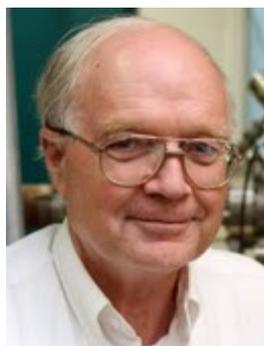
Elaine Hubal
EPA



Angelique Johnson
Entrepreneur



Joe Magno
NC COIN



Richard Osgood
Columbia U



Kurt Petersen
Entrepreneur



Andreas Roelofs
Los Alamos NL
CINT Director



Ken Wise
U Michigan

Program Components

- Presentations from the Coordinating Office
 - Overview, Computation & Modeling, Social & Ethical Implications, Education & Outreach
- Site Reports in 4 Site Report Panels
 - Future Research Directions
 - Workforce Development
 - Commercialization
 - Resource Allocation & New Equipment
- Invited Speakers
 - Dave Wecker, Microsoft Research
 - David Baker, Institute for Protein Design, U Washington
 - Shigeo Tanuma, National Institute for Materials Science, Japan
- Breakout Sessions & Reporting

Listen to our “Neighbors”: Japan

- Dr. Shigeo Tanuma
Managing Director
Center for Nanotechnology Platform
National Institute for Materials Science (NIMS)
tanuma.shigeo@nims.go.jp
- Nanotechnology Platform Japan
 - Advanced Characterization Platform
 - Nanofabrication Platform
 - Molecule & Material Synthesis Platform



Breakout Sessions

Breakout Session I

9/13, 11:00-12:00AM

Education & Outreach

Quinn Spadola, SENIC/CO

Facilities Management & Operation

Shamus McNamara, KY-MMNIN

Comparing Notes on NSF Reviews

Oliver Brand, SENIC/CO

Breakout Session 2

9/14, 11:15AM-12:15PM

SEI

Jamey Wetmore, NCI-SW/CO

Computation

Azad Naeemi, SENIC/CO

User Recruitment & Marketing

Jim Marti, MINIC

Advisory Board Meeting



***National Nanotechnology
Coordinated Infrastructure (NNCI)***



National Nanotechnology
Coordinated Infrastructure



Outline

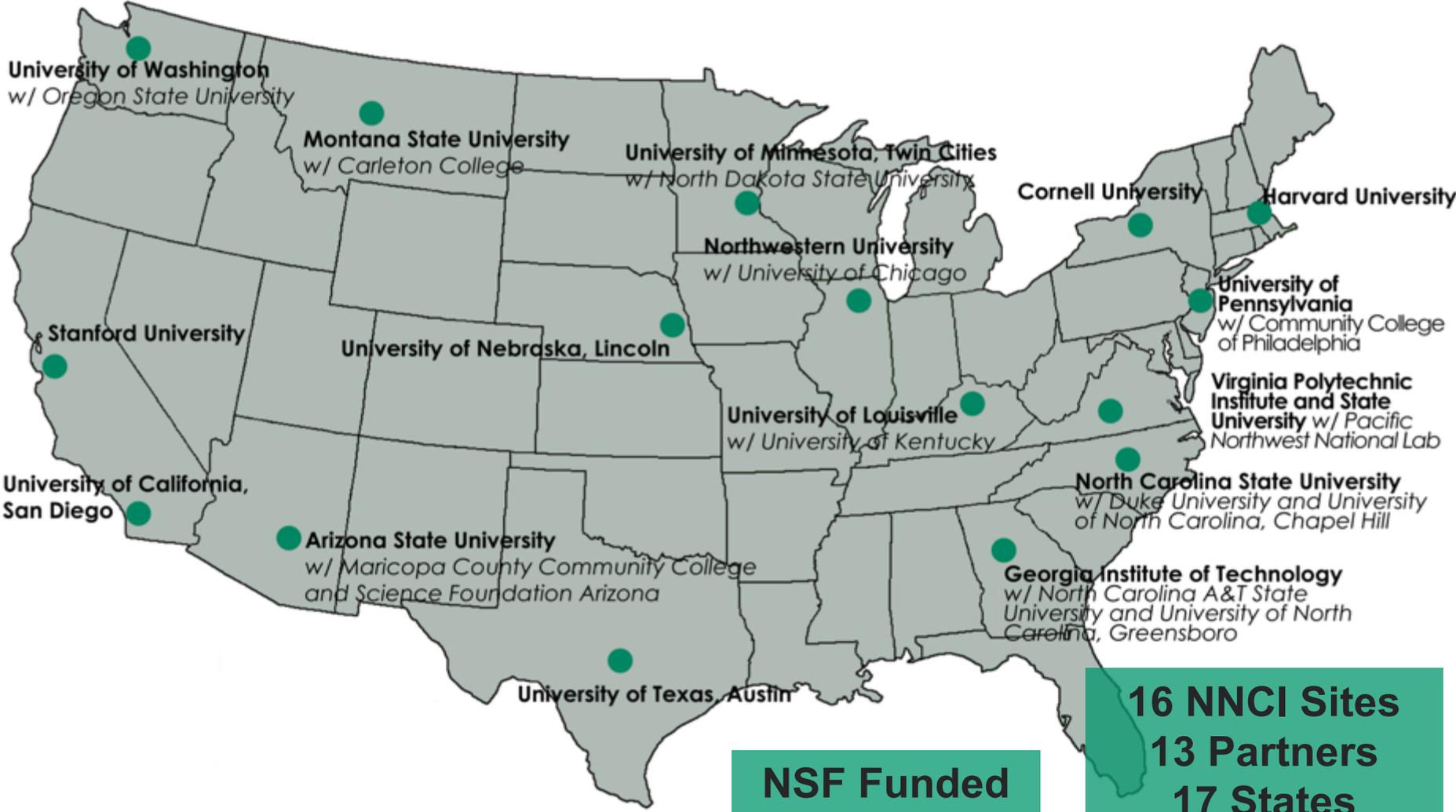
- NNCI Brief Overview
- NNCI Year 3 Facilities Usage
- NNCI Coordinating Office (NNCI CO)
 - Initiatives: Webpage, Sub-Committees & Working Groups, User Survey, Staff Awards
- Questions & Discussion

NNCI Associate Director Reports

- **NNCI Computation & Modeling**
Dr. Azad Naeemi
4:30-4:45
- **Societal & Ethical Implications**
Dr. Jamey Wetmore
4:45-5:00
- **Education & Outreach**
Dr. Quinn Spadola
5:00-5:15



National Nanotechnology Coordinated Infrastructure (NNCI)



**NSF Funded
2015-2020
\$81M total**

**16 NNCI Sites
13 Partners
17 States
68 Facilities
>2000 Tools**



National Nanotechnology Coordinated Infrastructure (NNCI) Goals

- Provide open access to **state-of-the-art nano-fabrication & characterization facilities** and their tools across US and **staff expertise**
- Use these resources to support **education & outreach (E&O)** as well as **societal & ethical implications (SEI)** in/of nanotechnology
- **Network approach to make whole more than the sum of its parts**



NNCI User Statistics Year 1 – Year 3

	Year 1 (12 months)	Year 2 (12 months)	Year 3 (6 months)
Unique Facility Users	10,675	12,452	9,149
Unique External Users	2,561 24.4%	3,176 25.5%	2,140 23.4%
Industry Users	1,413	1,669	1,250
External Academic Users	1,151	1,507	890
Average Monthly Users	4,427	4,911	4,915
New Users Trained	4,116	4,563	2,454
Facility Hours	909,152	939,230	468,744
External Facilities Hours	173,510 19.1%	191,494 20.4%	101,774 21.7%
Hours/User	85	75	51
Total User Fees	\$34.3M	\$37.5M	\$18.7M

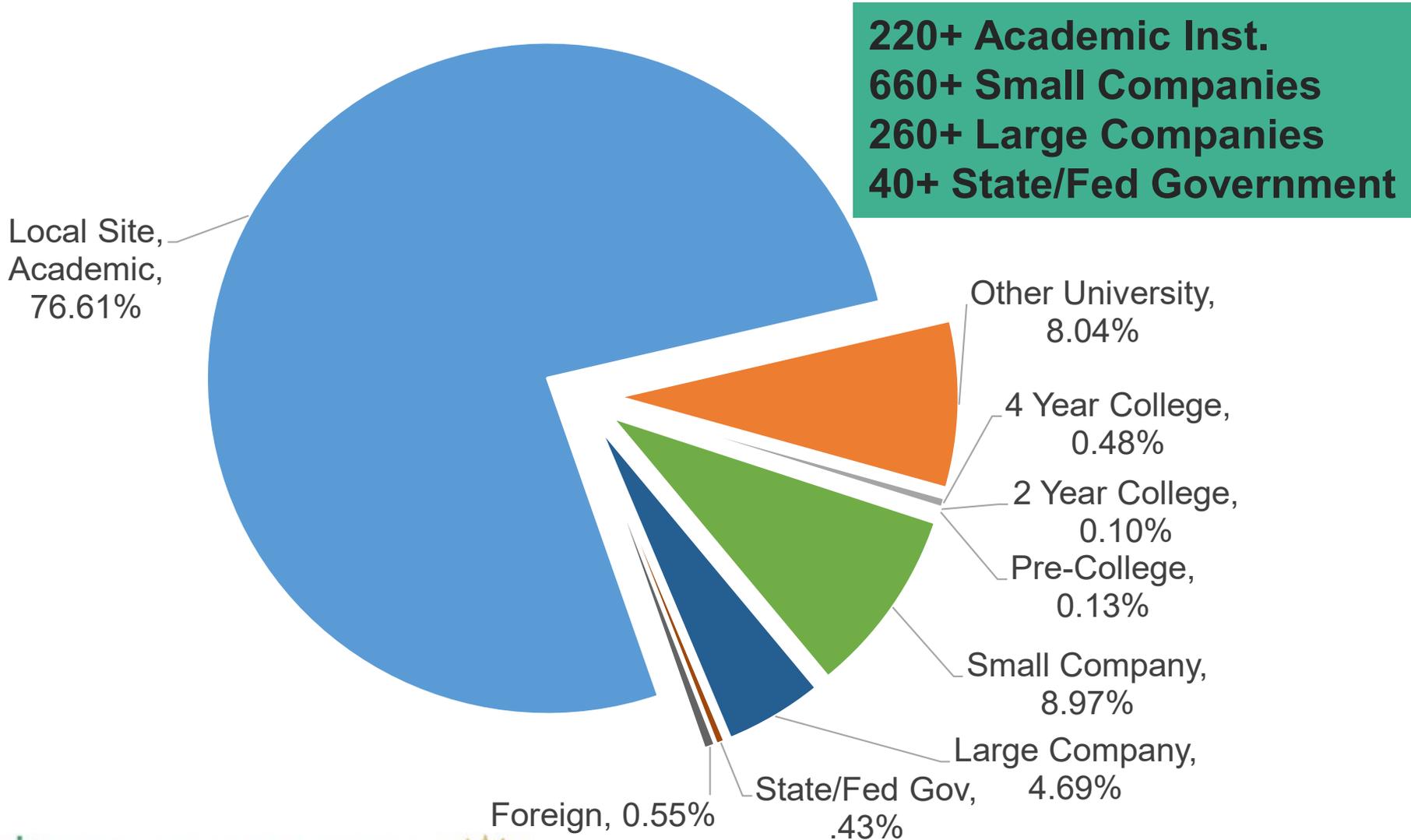
NNCI Year 2 (6 month) vs. Year 3 (6 month)

	Year 2 (6 month)	Year 3 (6 month)	Δ
Unique Facility Users	9,050	9,149	+1%
Unique External Users	1,990 22.5%	2,140 23.4%	+8%
Industry Users	1,122	1,250	+11%
External Academic Users	868	890	+3%
Average Monthly Users	4,753	4,915	+3%
New Users Trained	2,330	2,454	+5%
Facility Hours	434,350	468,744	+8%
External Facilities Hours	89,268 20.6%	101,744 21.7%	+14%
Hours/User	48	51	+6%
Total User Fees	\$17.6M	\$18.7M	+6%

NNCI Year 3 User Statistics (10/2017-03/2018)

	NNCI Network	NNCI Sites Mean (Min – Max)
Unique Facility Users	9,149	572 (113 – 1,273)
Unique External Users	2,140 23.4%	134 (32 – 406) 24.3% (10.6% - 43%)
Industry Users	1,250	78 (19 – 179)
External Academic Users	890	56 (6 – 286)
Average Monthly Users	4,915	307 (60 – 780)
New Users Trained	2,454	153 (39 – 341)
Facility Hours	468,744	29,296 (2.5k – 87k)
External Facilities Hours	101,774 21.7%	6,361 (534 – 24k) 22.5% (4.1% - 42.8%)
Hours/User	51	47 (22 – 92)
Total User Fees	\$18.71M	\$1.17M (180k – 3.43M)

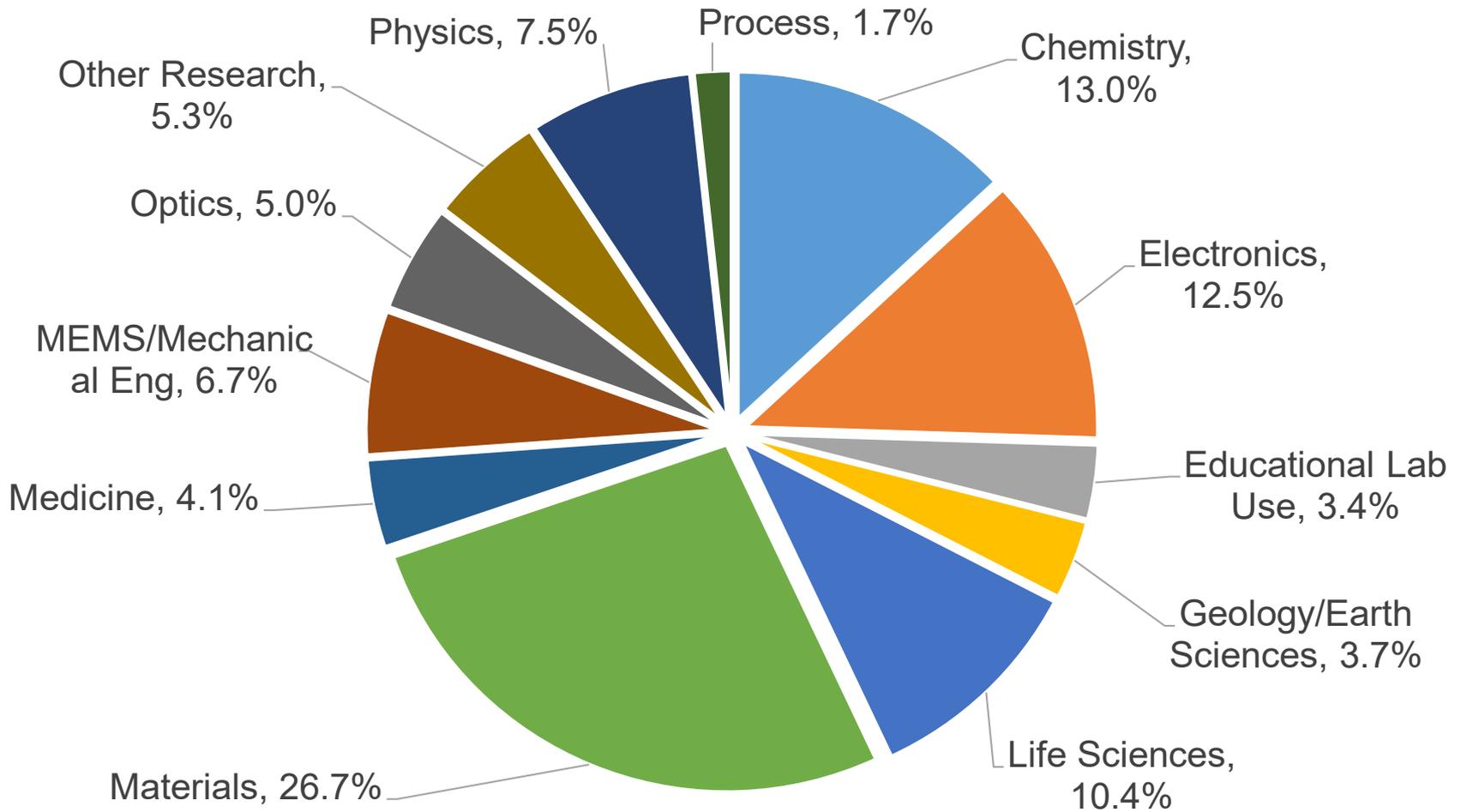
NNCI User Data – Users by Affiliation



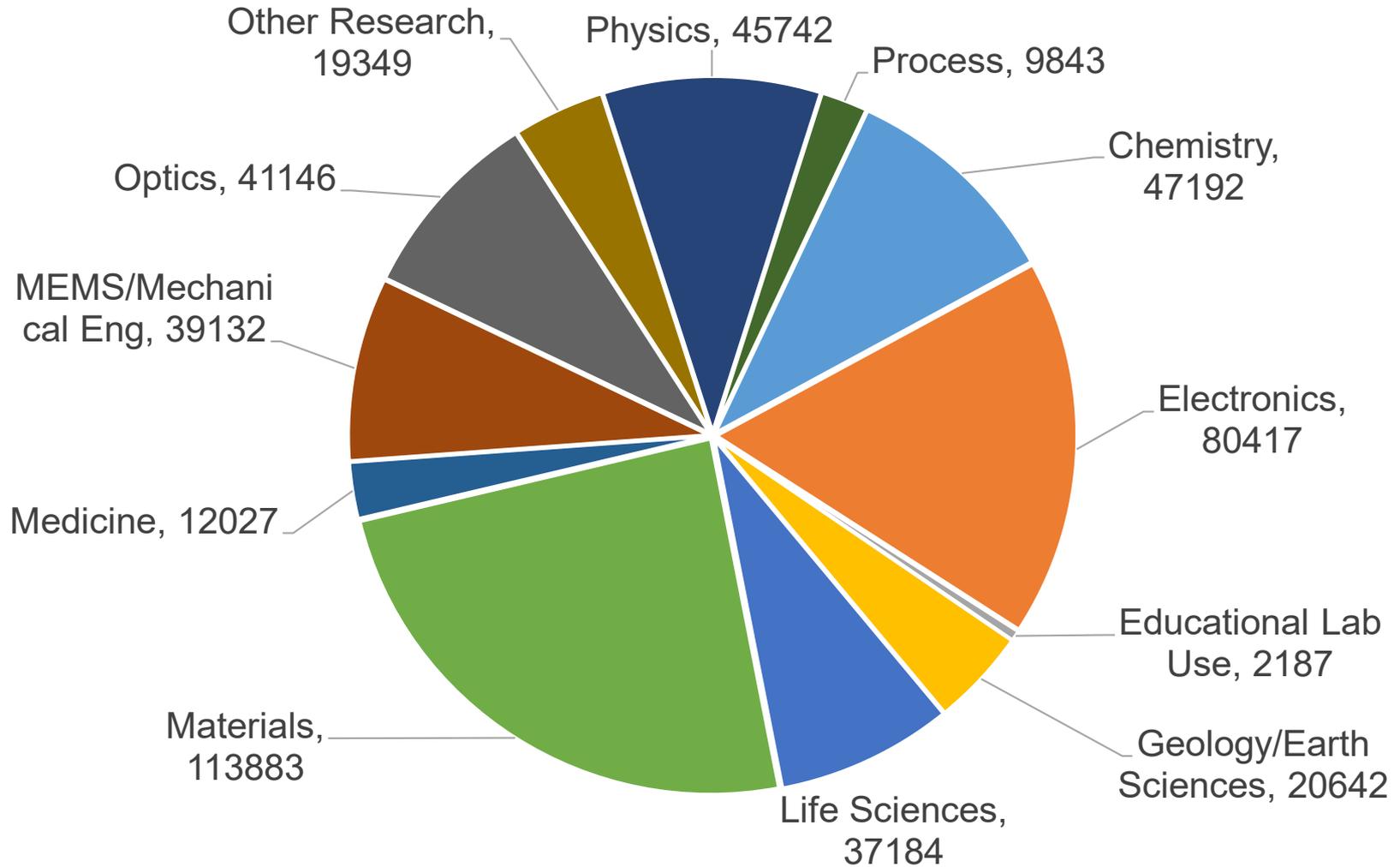
NNCI External Academic Institutions



NNCI User Data – Users by Discipline



NNCI User Data – Hours by Discipline



Scholarly Impact

Publication Type (CY 2016)	
Internal User (Site) Papers	2400
External User Papers	466
Internal User Conference Presentations	1088
External User Conference Presentations	120
Books/Book Chapters	38
Patents/Applications/Invention Disclosures	340
Total	4452

Remember: Encourage/enforce acknowledgement of NNCI award in publications by NNCI users for work enabled by NNCI resources!

Overall Coordinating Office Objectives

1. Facilitate and promote the NNCI network, rather than trying to direct it
2. Use creative means to incentivize the sites for participation in network activities
3. **Assist in making the network more than the sum of its parts**



NNCI Website – Phase 3 (CY 2018)

- Improved contact forms and added Spanish language version
- Improvements/additions to individual NNCI site pages
- **Added pages for NNCI Technical Working Groups (news, forums)**
- Improved navigation for SEI and Education/Outreach pages
- Improved Nanooze page
- **Added Testimonials page**
- **Added Commercialization Resources page**
- **Added Technical Resources, including Remote Work Contractors and Seed Grant Opportunities**
- Added global website search capability
- Improved tool search formatting and layout
- Backend improvements and changes

Analytics: Already surpassed 13,000 visitors in 2018 through Sept. 5 (more than all of 2017)

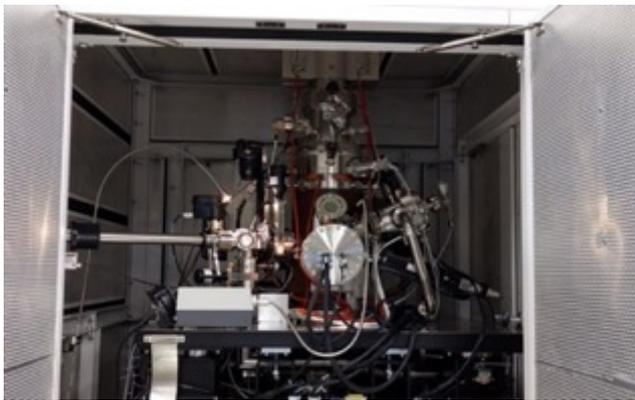
Sub-Committees

- **Diversity**
Mike Hochella (NanoEarth) - Lead
- **Metrics**
Stephen Campbell (MINIC) - Lead
- **National and International Relations**
Vinayak Dravid (SHyNE) - Lead
- **New Equipment and Research**
Kevin Walsh (KY MMNIN) - Lead
- **Entrepreneurship**
Mark Allen (MANTH) - Lead
- **Building the User Base**
Nan Jokerst (RTNN) – Lead

“Subcommittees of the Executive Committee will be formed to tackle high-level issues related to the NNCI network as a whole”

New Equipment & Research (Lead: Kevin Walsh)

- Established comprehensive list of new equipment (and funding models/sources) within NNCI facilities:
 - 300 pieces of equipment valued at \approx \$67M (incl. two Cryo TEM valued at $>$ \$5M at RTNN and NNI)
 - 11 tools at $>$ \$1M; 16 tools at \$500k-\$1M; 86 tools at \$100k-\$500k
- Established wish list for workhorse replacement tools
- Promote unique capabilities on webpage



Global and Regional Interactions (Lead: V. Dravid)

- **Staff exchange program** – establish a program to allow staff to travel between sites and share expertise, conduct workshops and network between NNCI sites
- **Joint workshops with national labs** – for sites with regional national labs, we propose establishing joint user meetings and workshops to build connections with these facilities
- **Rotating workshop series** – establish partnerships with international nano organizations to establish a series of bi-lateral workshops that would rotate between sites
- **Members:** Karl Bohringer (NNI), Vinayak Dravid (SHyNE, Chair), Bob Westervelt (CNS), Chris Ober (CNF), Bruce Alphenaar (KY-MMNIN)

Building the User Base (Lead: Nan Jokerst)

- **Key factors impacting user growth:** Awareness, Cost & Distance
- **Awareness:** SBIR/STTR database mining for contacts; Small business incubator contacts; Websites (*including Spanish language access*); Coursera Nanotechnology course; Workshops; Display booths at conferences; RET and REU programs; Seminars, webinars, live stream Q&A on Nanotech
- **Cost:** Encourage sites to offer free use funds to non-traditional users
- **Distance:** Remote use of equipment; Live stream equipment use with staff; Mail samples – Remote Work; Portable SEM; Nano Bus
- Committee focused on three areas with recommendations to CO:
 1. **Engaging the startup/small business community** through SBIR/STTR databases and through local incubators;
 2. Enabling **remote use of facilities**;
 3. Longer term building the user base investments through **K-12 user engagement**.
- Members: Nan Jokerst (RTNN, Chair), Bill Wilson (CNS), Todd Hastings (KY-MMNIN), Shyam Aravamudhan (SENIC)

Working Groups

Network Support WG – Technical WG – Research Area WG

- **Equipment, Maintenance and Training**
Meredith Metzler (MANTH) - Lead
- **Vendor Relations**
Mike Khbeis (NNI) - Lead
- **EBeam Lithography**
Devin Brown (SENIC) - Lead
- **Etch Processing**
Vince Genova (CNF) - Lead
- **REU**
Lynn Rathbun (CNF) - Lead
- **K-12 and Community**
Jim Marti (MINIC) – Lead
- **Assessment & Evaluation**
Nancy Healy (SENIC) - Lead
- Planned: EHS, Geo & Env. Sciences,
Life Sciences, Add. Manufacturing, ...

“One of the greatest strengths of the NNCI network is without doubt the combined staff expertise of the individual sites. To leverage this expertise at the network level, we propose the formation of various *working groups* composed of staff members from the NNCI sites.”

Working Groups

Working Group Topic	Working Group Lead
<i>Network Support</i>	
Equipment Maintenance & Training	Meredith Metzler (Univ. Pennsylvania)
Vendor Relations	Mike Khbeis (Univ. Washington)
Environmental Health & Safety	Nasir Basit (Northwestern) and Greg Cibuzar (Minn.)
<i>Technical Topics</i>	
XPS/UPS	Carrie Donley (UNC), Walter Henderson (Georgia Tech)
E-Beam Lithography	Devin Brown (Georgia Tech)
Etch Processing	Vince Genova (Cornell)
Atomic Layer Deposition	Michelle Rincon (Stanford), Xiaoqing Xu (Stanford), and Mac Hathaway (Harvard)
Photolithography	Pat Watson (Univ. Pennsylvania)
Additive Manufacturing	TBD
<i>Education and Outreach</i>	
K-12 and Community	Jim Marti (Univ. Minnesota)
Research Experience for Undergraduates	Lynn Rathbun (Cornell)
Workforce Dev. and Community Colleges	Ray Tsui (Arizona State)
Assessment and Evaluation	Nancy Healy (Georgia Tech)
Online Technical Learning	Angela An-Chi Hwang (Stanford)
<i>Societal and Ethical Implications</i>	
SEI Coordinators	Jamey Wetmore (ASU)

REU Convocation 2018 @ RTNN

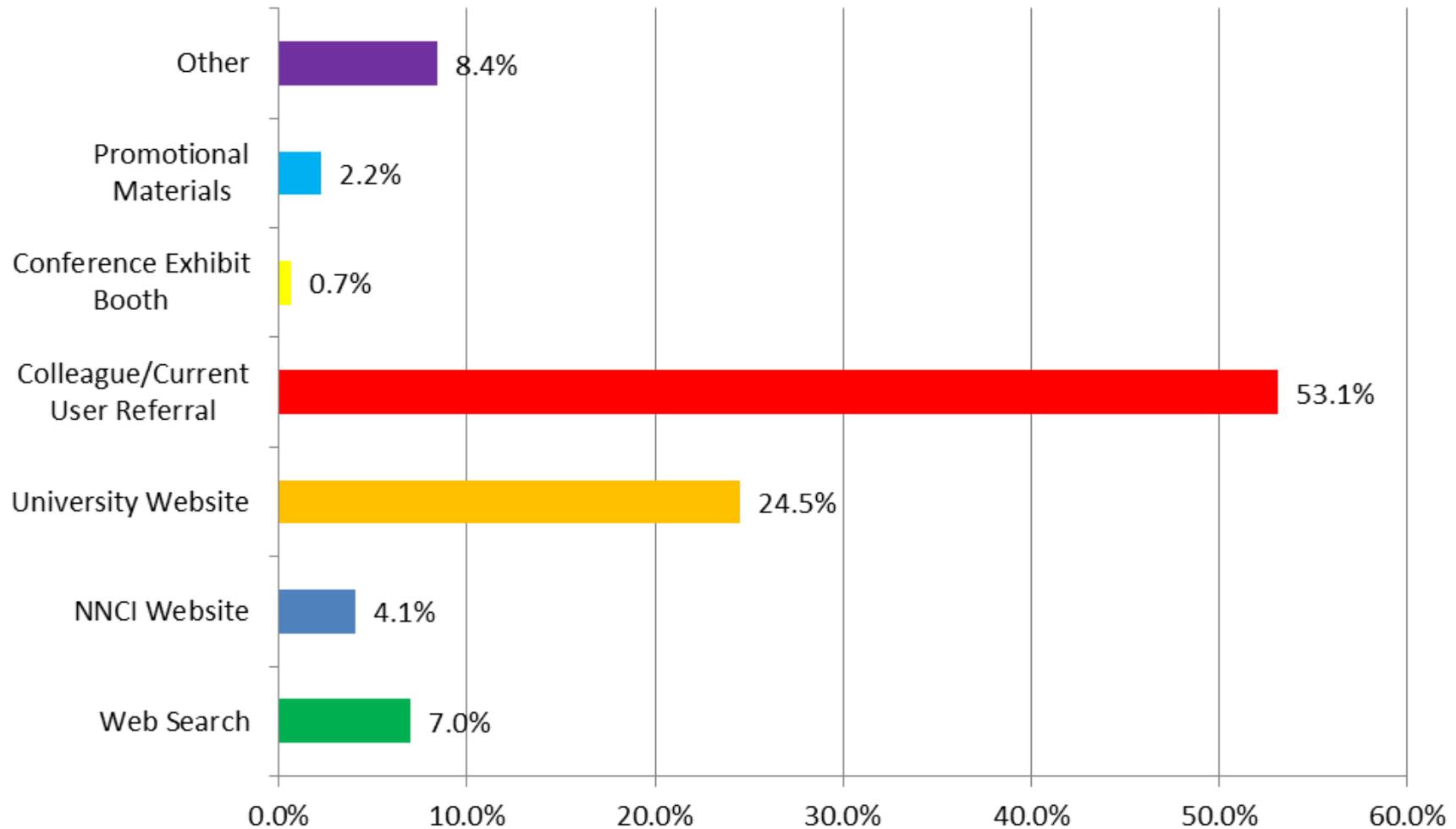


**45 REU students from 10 NNCI sites
6 iREU students
1 Visiting graduate student from Japan**

NNCI User Survey (2017)

- **Were you able to complete your project in a timely manner?** Yes: 93.6% (N=721)
- **Would you recommend this site to a colleague?** Yes: 97.3% (N=1015)
- **Provide an overall rating for the site facilities** Network Average: 4.36/5, with 85.7% responding 4 or 5 (N=1017)
- **Provide a rating of your overall experience of the NNCI site** Network Average: 4.43/5, with 88.4% responding 4 or 5 (N=748)
- Modified 2018 survey is underway with 494 responses by Sept. 4, 2018: similar results; slightly higher ratings

How did the user find the NNCI site? (N=742)



NNCI Video - <https://www.youtube.com/watch?v=72ZXh-ESt3U>

What is the NNCI?

National Nanotechnology Coordinated Infrastructure
Published on Apr 4, 2018

An introduction to the NSF-funded National Nanotechnology Coordinated Infrastructure, a network of user research facilities.

SHOW MORE



Kiki Sanford

Network Activities

- Participation in National Nanotechnology Day Activities (10-9, 2016 and 2017)
- Attending NSF Nano Grantees Conference (Dec. 2016 and 2017)
- Attending NNCI Annual Conference (January 2017 and October 2017)
- Sending students to REU Convocation (August 2017 and 2018)
- **Chairing and membership of Subcommittees**
- **Leading and membership of Working Groups**
- Participation in NNCI site visits with the Coordinating Office
- **Providing content for the NNCI website**
- **Participation in NNCI Workshops**
- **Discussions between site staff on equipment repair and maintenance issues**
- **User referrals to other sites, via NNCI email list or responses to NNCI website contact form**

Multi-Site Activities

- CNF & SENIC participated in USA Science and Engineering Festival
- Joint RET Proposal: “Research Experiences for Teachers across the National Nanotechnology Coordinated Infrastructure” (Arizona State University (lead), Georgia Institute of Technology, U. of Minnesota, U. of Louisville, U. of Nebraska-Lincoln)
- Japanese NNCI/NIMS Graduate Exchange Program (coordinated by CNF)
- Joint marketing efforts (NNCI exhibit booth at Hilton Head Sensors, Actuators and Microsystems Conference, TechConnect, SERMACS)
- MANTH hosted the Mid-Atlantic Cleanroom Managers’ Meeting (50 attendees)
- Dave Mogk (MONT), Michael Hochella (NanoEarth), and Nancy Healy (SENIC) organized the “*Nanoscience in the Earth and Environmental Sciences – Research and Teaching Opportunities*” workshop for the 2017 Goldschmidt Conference
- NanoEarth and Stanford participated together in the NanoEHS Webinar Series: “The National Nanotechnology Coordinated Infrastructure (NNCI) Nodes and Environmental Research: Examples from the Field” moderated by Larry Goldberg at the NSF.
- RTNN, NNF and SENIC joined the Nanotechnology Applications and Career Knowledge Networks’s Remote Access Instrumentation in Nanotechnology (RAIN) coordinated by Pennsylvania State University. NCI-SW provided a demonstration of its remote capabilities with RAIN at the first annual NNCI Conference as a recruitment tool for NNCI sites.
- Multi-site Project Example: Dense, high aspect ratio through-silicon-via (TSV) array capability [SDNI (UCSD): TiN coating, SNSF (Stanford): XRR analysis, NNI (OSU): Ru coating, SENIC (GaTech): TiN/Pt coating]
- Participation in SEI Programs: a. ASU Winter School on Responsible Innovation and Emerging Technologies; b. Science Outside the Lab (SotL)

Site-to-Site Interactions

- **Joint user project support**
- **Equipment/parts backup/exchange**
- **Staff technical interactions**
- Advisory board and site review activities
- Technical seminars
- Facility management software
-

Site Activity on Behalf of NNCI

- NNCI Promotion: CNF has promoted NNCI with vendor booths at the MRS, AVS, and EIPBN conferences.
- Nanooze: CNF publishes Nanooze, and, in addition to direct distribution to classrooms, distributes it to all NNCI sites for use in their outreach activities
- Disney NSF Science Portal: CNF is restructuring the Nanooze Disney exhibit into the Disney NSF Science Portal to promote NSF research, NNCI, and nanotechnology in general
- CNF and Georgia Tech (Coordinating Office) have conducted longitudinal tracking of NNUN/NNIN/NNCI REU students since 1997
- RTNN initiated and is responding to the Habla espanol? contact form on the NNCI website
- SHyNE organized the 2016 NSF NSE Grantees Conference (Arlington, VA).
- Hosting of NNCI conference by Georgia Tech (Jan. 2017), University of Pennsylvania (Oct. 2017) and University of Washington (Sept. 2018)
- Hosting of REU Convocation by Georgia Tech (Aug. 2017) and NC State (Aug. 2018)

2018 NNCI Outstanding Staff Members

Education and Outreach

- Matt Hull, NanoEarth
- Ben Myers, SHyNE



Technical Staff

- Chris Alpha, CNF
- Tonya Pruitt, NanoEarth



User Support

- Carrie Sinclair, NCI-SW
- Phillip Strader, RTNN



Use NNCI Conference to Discuss Challenges & Opportunities!

At the NNCI Site Level

- How can I maintain a state-of-the-art (evergreen) infrastructure?
- How can I attract (and retain) the required staff expertise?
- How can we best serve our customers?

At the NNCI Network Level

- How can we be more than the sum of our parts?
- How can we help (external) users? Especially from non-traditional areas?
- How can we help each other?
- How can we help/collaborate with other nanotechnology facilities/centers?
- How can we help nanotechnology start-ups?
- How can we educate the general public?
- How can we become the world-leading nanotechnology infrastructure network?

Next NNCI Conferences

- 2018: University of Washington
 - Date: September 12-14, 2018
- 2019: Cornell University
- 2020: Northwestern University (SHyNE)

Thank You!



<http://www.nnci.net>