

## **HPC Annual Report 2007-2008**

Mar 19, 2009

### **A new era for HPC at UF**

January 1, 2008 marked the beginning of a new era for high performance computing at UF. For three years, 2005 through 2007, a growing number of researchers at UF have come to use an increasingly powerful and productive high performance computing cluster, storage system, and research network. This growth shows that HPC service at UF is needed and does work. In December 2008, Phase III of the HPC Cluster expansion will become a reality. Then the HPC activity will involve partners from all parts of UF: College of Liberal Arts and Sciences (CLAS), College of Engineering (COE), Institute for Food and Agricultural Sciences (IFAS), and the Health Science Center (HSC) through the Interdisciplinary Center for Biotechnology Research (ICBR).

We have already collected over \$40K to start Phase IIIb. In short HPC at UF is alive and well right now.

### **Challenges ahead**

The HPC Center clearly offers a valuable service to the University. Faculty members are willing to work with the HPC Center to be more productive in their HPC activities than they would be on their own. As can be seen from the budget overview later in this report, significant funds have been brought in by individual faculty members from grant and startup funds year after year. However, the amounts fluctuate, as is to be expected. The long term sustainability and relevance of the HPC Center depends, in part, on having more faculty members become investors, even with modest amounts, and on faculty members being effective in competing for large equipment grants.

In the last year, from discussions with many faculty members, their research associates, and with administrators, two major issues confronting the HPC community at UF and elsewhere stand out clearly.

### **Funding model**

During Phase II the HPC Committee formulated a Sustainability Plan and Contract. The full documents can be found on the HPC web site. The funding model takes the funds contributed by all partners [faculty members, department chairs, directors, deans (DDD), Chief Information Officer (CIO), Senior Vice-President for Research (SVPR)] that are used for personnel, infrastructure and equipment and divides the sum total by the total number of CPUs in the HPC clusters to arrive at an investment cost per CPU of \$1,720.

With resources of several large investors and many small investors pooled, the HPC center has been able to deliver extraordinary return on investment for all partners involved. As long as there are large investments from the DDD, the CIO, and the SVPR in equipment (in addition to investments in personnel and infrastructure) the number of CPUs is large enough to ensure that all investors, large or small, get the use of a much

larger, on average, number of CPUs than the number computed from their investment amount.

However, the model has not been sustained. As can be seen over the short history of HPC Center funding, the share of funds from the DDD, the CIO, and the SVPR going towards equipment acquisition has declined, even though their total contribution is significant and has increased. In the long run, it must be attractive for faculty members to make small investments and get a reasonable share of the cluster. The cost of \$1,720 per CPU is too high compared to the upfront cost of modern-technology multi-core computers and small desk-side clusters to make small investments attractive. The challenge is that such small-scale investments typically do not fund personnel nor facilities, so they compare bare costs to supported costs.

During summer 2008, discussions were started between the HPC Committee and Marc Hoit, then Interim CIO, to draft a revision of the funding model. The new model proposes that faculty members, with their fluctuating research funds, would be responsible for acquisition of equipment, whereas the DDD, the CIO, and the SVPR would fund ongoing personnel cost and one-time infrastructure costs. The faculty would need to generate between \$500K and \$1M per year to keep growing and refreshing the shared cluster and storage system every 3 to 5 years. The estimated investment rate then becomes a much more competitive number, around \$700 per NCU (normalized computing unit, which is one core with everything on it) instead of \$1,720. The implied matching by the University in the form of staff and facilities is 1:1 or about \$700. This uses the numbers for Phase III.

This discussion needs to be completed and a new document written and posted so that the HPC Center is authorized to solicit and negotiate new investments.

As a comparison, consider the Amazon Cloud computing model. The cost calculation is based on a computing unit called EC2 which is a 1.0 GHz Opteron processor. And you can use these in two forms (small is 1 EC2 and large is 4 EC2) at a cost of \$10 per 100 hours of use of 1 EC2. One UF HPC Center Phase III NCU is equivalent to 2.5 EC2, and \$700/NCU buys priority access for the lifetime of the cluster, typically three years, with generous access to unused cores. The amount of computing enabled by investment in one NCU at \$700/NCU would cost \$2,190/year in the Amazon Cloud. In addition, Amazon charges \$100 per TB-month for storage.

### **Scalable infrastructure**

The ability to operate modern HPC equipment requires sophisticated infrastructure. As an example, consider that the HPC Center is currently (Nov 2008) working with three groups on campus on proposals that each will bring significant computing equipment to campus: One proposed equipment requires 90 ton (300 kW) of cooling, the second needs 45 ton (150kW), the third one estimates a need for 45 ton (150 kW). The machine room prepared for HPC expansion Phase III has the space to place more racks, but does not have sufficient power and cooling for any of these projects, certainly not for all of them.

These three projects do not include any of the activities that will be initiated when the Center for Computational Biology starts its activities.

An initial estimate to add 90 ton (300 kW) of cooling to Larsen 121 projects the cost to be \$1.5M. To accommodate all three projects at 180 ton (600 kW) is not possible in Larsen. To allow our faculty members, who are nationally competitive in these proposals in all respects, to write credible proposals, UF needs to invest in an efficient building with machine room space (e.g. 10,000 sq.ft. of machine room space with 1,000 ton cooling and 3.5 MW of power) so that the equipment of several of these projects can be accommodated for 3 to 5 year life times can be accommodated without the need to find space and expensive renovations for each individual project. This quality machine room space can and should be shared with other organizations in UF that need tier II or Tier III machine room space, such as CNS and ERP.

As an example of the kind of structure UF should plan, consider that NCSA at the University of Illinois at Urbana Champaign, got a \$200M grant from NSF to build a petaflop computer system with IBM. As part of the proposal, the University of Illinois and the State of Illinois committed to build a 22,000 sq.ft. machine room building with 6,000 ton cooling and 24 MW of power. The building costs \$72M and the governor of Illinois has committed to put in \$60M.

### **Accomplishments and activities**

**Phase III** The new cluster has been purchased at the cost of \$664K. The HPC Committee selected the configuration from Penguin, which:

- 1) provides 896 cores with Intel E5462 processors at 2.8 GHz and 1600 MHz Front Side Bus (FSB) and DDR2-800 ECC RAM;
- 2) provides 168 cores with 8 GBytes/core ECC RAM in 21 nodes with 64 GB RAM;
- 3) provides 728 cores with 4 GBytes/core ECC RAM in 91 nodes with 32 GB RAM;
- 4) provides 250 GB (SATA II) storage per node (local disk);
- 5) provides one zero-mem IB port per node;
- 6) provides GigE connectivity between all nodes (for management);
- 7) includes InfiniBand switch equipment with sufficient IB switch ports to connect all nodes in a no-more-than 50% blocking fabric;
- 8) includes at least two 10GbE ports in at least one IB switch with the ability to add additional 10GbE ports (for IB to IP gateway capability);
- 9) includes all cables for ethernet and infiniband connectivity.

It will be installed and tested and will become available for users around the New Year 2009.

**Larsen 121 machine room** To operate the Phase III expansion of the HPC Cluster a new machine room has been prepared in Larsen Hall. With \$124K of funding the initial preparations were made and completed in 2007. That work did not include the actual power conditioners, chillers, and cable guides. With another \$340K that equipment was purchased and is being installed with an estimated completion date end of November 2008. This will give the Larsen 121 machine room a cooling capacity of 45 tons and conditioned power of 100 kW. Cabling to add two additional 100 kW power conditioners has been installed. The Phase III cluster will use about 27 tons of that cooling capacity right away. Another 5 tons may be used soon to alleviate some of the overheating in the NPB 2250 and NPB 1114 machine rooms housing the Phase IIa and Phase IIb clusters and storage systems.

**InVigo for BLAST** The Interdisciplinary Center for BioTechnology Research (ICBR) and the Advanced Computing and Information Systems (ACIS) Laboratory have worked together to create a powerful and user friendly web interface to run the National Center for Biotechnology Information (NCBI) Basic Local Alignment Search Tool (BLAST) gene sequence matching searches on the HPC clusters. The interface uses the InVigo software originally created and maintained by ACIS. This will serve the growing computational biology community starting 2009 as Phase III comes online.

**IFAS development server** The HPC Center staff has configured a server for IFAS with the same software as runs on the HPC cluster to allow IFAS users to develop and debug and test their software before submitting jobs to the HPC clusters. IFAS is a big investor in Phase III.

**NVIDIA Tesla S1070 processors** The HPC Center has invested in two of the new Tesla S1070 from NVIDIA that support high performance 64-bit floating point arithmetic. Each

of these units has four Graphics Processor Units (GPUs), which have 240 cores and a combined peak performance of 4 Teraflops. Each unit is connected by two PCIe interface cards to nodes of the HPC cluster and will be available to the community. The development environment CUDA is used to program GPUs. GPUs are increasingly used to give certain applications a significant performance boost compared to standard CPUs. Astronomy professor Eric Ford does research on using GPUs to speed up calculations in planet modeling. Precise information on how to use and access the GPUs will be made available on the HPC website.

**Scheduler** Improved scheduling for parallel jobs has been achieved with the Moab scheduler after some intense research with Cluster Resources, the company that supports Moab.

**Uptime** There was a scheduled downtime in January 2008 and a weekend in November 2008, when the chilled water supply to NPB 2250 and NPB 1114 was shut down for work elsewhere on campus. A few times this summer, we had to shut down some racks of the HPC Cluster because the machine room got too hot when two auxiliary air conditioning units failed. The HPC Cluster had one major unexpected shutdown caused by hardware failure that resulted in a corruption of the Lustre file system. Some heroic efforts by the HPC staff resulted in complete recovery of the data. Otherwise the cluster has been up and running at over 95% capacity 24 hours per day, 7 days per week.

**Campus Research Network** Added connectivity to ICBR in Genetics Institute; to Weil Hall Coastal; changed connectivity to Larsen Hall so that now Ben 312 and Lar 320 are fed from Lar 121. A document was written with representatives from all over campus to formalize the operation and use of the Campus Research Network (CRN).

**Administrative reorganization** The CIO position moved from reporting to the Provost to reporting to the Senior Vice-President for Administrative Affairs Kyle Cavanaugh. Marc Hoit departed and Chuck Frazier is now Interim CIO for one year. The HPC Center has been given a PeopleSoft Department ID and reports to the CIO with the HPC Committee acting to define the strategic direction and long term decisions. All HPC center staff and the OPS students have been moved into this Department ID to improve efficiency in managing payroll and other administrative matters. The position of Taylor is funded by OIT and DSR, that of Prescott is funded by CLAS, and that of Akers by COE with a sharing agreement between the departments.

**Public relations** A poster was created in the Fall of 2007 and distributed to many departments to increase awareness about the HPC Center. We published several articles about HPC Center events and accomplishments in campus publications such as "IT Connections" and "/Update". The poster can also be downloaded from the HPC web site.

**Campus Research Network (CRN) storage server** Using the storage part of the 2004 NSF MRI award that funded the creation of the Campus Research Network, the HPC Center bought and installed a second storage server for the campus grid with a usable capacity of 80 TB. The first storage server is the HPC cluster storage server with 32 TB

of usable capacity. Thus clusters will be able to mount the HPC cluster file system across the 20 Gbps Research Network.

**RAID Inc Collaboration** The CRN storage was built with RAID Inc hardware and a press release was issued about the exceptional performance obtained by the work of the HPC Center staff:

**RAID INC. AND UNIVERSITY OF FLORIDA TEAM UP TO DRIVE HPC TO NEW LEVELS**

*Release Date: May 13, 2008*

*Methuen, MA-RAID Inc., a customer-centric storage solutions provider specializing in custom manufacturing of leading edge storage solutions, today announced that the University of Florida's High-Performance Computing Center has chosen RAID Inc. for a large implementation of over 100TB of performance-intensive 4Gb Fibre to SATA-2 storage. The storage solution, which was designed in a clustered architecture, is networked in such a way to allow shared access not only between multiple research facilities across campus, but by scientific groups at various educational and government research facilities that span the state of Florida and the entire country.*

*The University's HPC Center is linked to five satellite facilities on campus via its 20 Gb/s Ethernet Campus Research Network (CRN). Their distributed storage solution consists of six RAID Inc. Falcon III (24-bay, 4Gb FC to SATA-2) subsystems. This storage is made available to users as a cluster file system (Lustre) hosted by three servers. Two of the servers are configured with three dual-port Fibre Channel (4 Gb/s) HBAs, an InfiniBand (4X SDR) HCA, and a 10 Gb/s Ethernet adapter. The Fibre Channel HCAs provide access to the storage while the InfiniBand and Ethernet adapters distribute the file system to the HPC cluster (locally) and to the satellite facilities over the CRN. The resulting architecture has sustained throughput of up to 2 GB/s (read and write) from both local and remote clients.*

*"This novel approach to sharing scientific data will facilitate analysis and increase the likelihood of important discoveries. It raises the bar for storage innovation in the HPC arena," stated Bob Picardi, Chief Operating Officer at RAID, Incorporated. "We are thrilled that RAID's Falcon III, 24-bay product was integral to the success of this exciting storage solution."*

*Research groups at other universities within the state will also be able to take advantage of this RAID Inc. storage solution. The University is one of ten academic institutions across the state to be a member of the Florida LambdaRail, Florida's research and education network. The FLR is complementary to the National LambdaRail initiative, a national high-speed research network for research universities and technology companies. The FLR provides opportunities for faculty, researchers, and students within the state of Florida to collaborate with colleagues around the world on leading edge research projects. The FLR also supports the State of Florida's economic development and high-tech aspirations.*

*"The High-Performance Computing Center at the University of Florida seeks best of breed providers that can push the technology envelope in support of our research projects, " said Charlie Taylor, associate director of the University of Florida's HPC Center. "RAID Inc. was the ideal partner for our challenging storage needs, and their Falcon III product was a key component in the success of this project."*

*Thus far, the storage has been distributed between the University of Florida in Gainesville and Florida International University (FIU) located in Miami. This type of work between research groups at geographically distant universities is a major step towards a large collaborative effort that has been in the planning phase for several years now and is beginning to finally take shape. Among other projects, researchers at University of Florida and FIU are working towards finding evidence of a hypothetical particle that has been theorized by physicists, but as of yet never observed. Researchers at these universities will also be working remotely with a new particle accelerator currently under construction at CERN in Geneva, Switzerland. As their work begins to move forward, it is likely that more research labs across the state and the country will also have the ability to access the same storage pool.*

**CRN storage mounted across CRN and FLR** The file system is actually mounted and used from FIU. A quote from Prof. Jorge Rodriguez (Oct 27, 2008):

*“Bottom line is that the Lustre stuff seems to work quite well with performance approaching line speed. In all the tests I've done I've never observed a problem with the mounts nor with the read/writes operations. Everything performs quite smoothly.”*

Dr. Jorge Luis Rodriguez  
Florida International University  
Department of Physics  
Miami, FL 33199  
Phone: (305) 348 0259  
Fax: (305) 348 6700  
<http://www.fiu.edu/~jrodrig>

**CRN storage gives quick access to new research data** The storage server was also used during the summer to provide researchers at UF first access to 60 TB of the LHC. A quote from Yuriy Pakhotin (Sep. 8, 2008):

*“Entire CMS group is highly appreciated this opportunity to have data locally at UF. SUSY, Higgs and Zprime analyses used that data.”*

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University of Florida                      Web: <http://www.phys.ufl.edu/~pakhotin/>  
Gainesville, FL 32611-8440, US

**Small-Tree contract** Charlie Taylor and Craig Prescott have successfully completed a multi-year contract with a software company, called Small-Tree. The contract has paid for several graduate students to work in the HPC Center and ends in December 2008. The company focuses on software for Macs and the HPC part of the contract is to develop an open source version of the software for the Linux system.

**Research support** The HPC Center enables quick and nimble response from UF faculty to funding opportunities. Quote from Prof. Eric Ford, Astronomy, regarding a NASA contract (Aug 5, 2008):

*“Perhaps the most remarkable aspect of this project was that it demanded an unusually fast turn around time. Typically, there is a year lead time between submitting a NASA proposal and receiving the first funding. In this case, NASA Headquarters requested rather a detailed study on a strict timeline. As one of the "A teams", our results were the input to the "B team" that performed additional calculations to generate input for several "C teams" that had to produce results in time for a report to NASA Headquarters. To meet these deadlines, our A team need to perform hundreds of long-term simulations of planetary systems within just three months. The first preliminary set of results were due in less than a month! The HPC's ability to provide a burst of computing power enabled us to accept this project and contribute to an important and detailed evaluation of the capabilities of NASA's Space Interferometry Mission - PlanetQuest mission.”*

**Campus grid** The QTP clusters were upgraded this summer with new operating system. These clusters now share user ID with the HPC Center cluster and mount the Lustre parallel files system and use the Moab scheduler. This is the second cluster on campus to become interoperable with the HPC Center, the first one being the Tier2 cluster of the CMS/LHC collaboration.

**Software development** With student John Parhizgari, HPC engineers developed a tool to monitor the state of an InfiniBand fabric. The tool was filed as UF invention 13006 entitled “InfiniBand Fabric Web Monitor”. It will be distributed under an open source license.



### Budget overview

The HPC Center operates on a very small annual budget for operations, but it manages a significant amount of assets and funds. A brief overview is presented in the table below.

<b>Description</b>	<b>2003-2004</b>	<b>2004-2005</b>	<b>2005-2006</b>	<b>2006-2007</b>	<b>2007-2008</b>
Faculty	\$200,000	\$1,092,000	\$0	\$620,000	\$480,000
Dept/Inst	\$0	\$213,000	\$25,000	\$67,000	\$389,000
College	\$100,000	\$463,000	\$130,000	\$182,000	\$215,000
OIT	\$370,000	\$301,000	\$110,000	\$336,000	\$575,000
<b>TOTAL IN</b>	<b>\$670,000</b>	<b>\$2,069,000</b>	<b>\$265,000</b>	<b>\$1,205,000</b>	<b>\$1,660,000</b>
Staff	\$0	\$171,000	\$244,000	\$263,000	\$279,000
Facilities	\$70,000	\$0	\$0	\$158,000	\$340,000
Equipment	\$600,000	\$1,667,000	\$0	\$760,000	\$872,000
Operation	\$0	\$10,000	\$10,000	\$61,000	\$45,000
<b>TOTAL OUT</b>	<b>\$670,000</b>	<b>\$1,848,000</b>	<b>\$254,000</b>	<b>\$1,242,000</b>	<b>\$1,532,000</b>

## **List of investors**

Some investors are investing as head of a college or department, some as individual faculty, some are playing both roles.

Archer D. L., Associate Dean, IFAS

Asthagiri A., Professor, Chemical Engineering

Avery P., Professor, Physics

Balachandar S., Chair, Mechanical and Aerospace Engineering

Beck H. W., Professor, Agricultural and Biological Engineering

Cheng H.-P., Professor, Physics QTP

Curtis J., Chair, Chemical Engineering

D'Anieri P., Dean, College of Liberal Arts and Sciences

Emond J.P., Professor, Agricultural and Biological Engineering

Gao B., Professor, Agricultural and Biological Engineering

Graham W., Professor, Agricultural and Biological Engineering

Fortes J., Professor, Electrical and Computer Engineering

Haman D.Z., Chair, Agricultural and Biological Engineering

Haselbacher A., Professor, Mechanical and Aerospace Engineering

Hoit M., CIO, Office of Information Technology

Jones J., Professor, Agricultural and Biological Engineering

Khargonekar P., Dean, College of Engineering

Kiker G. A., Professor, Agricultural and Biological Engineering

Law M., Chair, Electrical and Computer Engineering

Martinez C., Professor, Agricultural and Biological Engineering

Merz K., Professor, Chemistry QTP

Munoz-Carpena R., Professor, Agricultural and Biological Engineering

Philpott S., Professor, Materials Science and Engineering

Shea J., Professor, Electrical and Computer Engineering

Sinnott S., Professor, Materials Science and Engineering

Soltis P., Professor, Florida Museum of Natural History

## **Staff**

The HPC Center reports to the office of the CIO, similar to CNS and AT, and has three permanent staff members:

1. Charles Taylor, IT senior, and associate director of the HPC Center,
2. Craig Prescott, IT senior,
3. Jon Akers, IT engineer

The part time position of program director is currently held by Dr. Erik Deumens, scientist in the Department of Chemistry and in the Department of Physics. In addition, the center has had several students working part-time.

## Usage statistics

The HPC Center website provides a wide range of information, including live data about system utilization: <http://www.hpc.ufl.edu/index.php?body=util>. These are organized into three groups:

1. Cluster status shows the activity on the running system.
2. Queue status shows the jobs in the system, either running, or waiting for available resources.
3. Past status shows accounting statistics of jobs that are still running or have completed. There are several displays worth pointing out.
  1. "CPU Usage Summary" <http://www.hpc.ufl.edu/index.php?body=pbs/nodestate> shows in a single view each of the 1600 CPUs with a color code indicating whether the CPU is idle or busy on a serial job, or a parallel job with 2-8, 9-32, 33-128, or 129 or more processors.
  2. "CPU Job Utilization" <http://www.hpc.ufl.edu/index.php?body=pbs/cpustat> summarizes the same information with a bar chart and a pie chart.
  3. "General Queue Status", "Torque Queue Status" and "Moab Queue Status" show a full list of all jobs waiting and running with details such as number of CPUs requested and time accumulated in the queue or time accumulated executing.
  4. "Cluster Usage Statistics (last 7 days)" show the percentage of the cluster time used labeled by research group as a pie chart and as a table. You can also request this information for a different number of days than 7.
  5. "Usage by College" and "Usage by Department" show the percentage labeled by College and Department for the last 30 days. You can request any number of days at the bottom of the screen. The plots for 365 days before Aug 14, 2007 are included below.

### Usage summary for July 1, 2007 through June 30, 2008

College	Department	Investigator	Investor	Hours
CLAS				
	Physics			
		John Yelton	No	190515
		Arthur Hebard	No	52169
		Christopher Stanton	No	433
		Ho Bun Chan	No	1303
		Peter Hirschfeld	No	272911
		Andrey Korytov	No	98172
		Darin Acosta	No	63
		Khandker Muttalib	No	9083
		Kevin Ingersent	No	168944
		Hai-Ping Cheng	Yes	1002840
		Paul Avery	Yes	1221309
		Steven Detweiler	No	343
		Brent Nelson	No	2151
		Robert Buchler	No	63
		Total		3020299

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### Statistics

Arthur Berg	No	0
Rongling Wu	No	20154
Song Wu	No	0
Vikneswaran Gopal	No	185
Ronald Randles	No	1909
Total		22248

### Zoology

Ben Bolker	No	17036
Edward Braun	No	90043
Martin Cohn	No	0
Jamie Gillooly	No	170
David Evans	No	0
Charles Baer	No	3
Michael Barfield	No	0
Rebecca Kimball	No	15577
Michael Miyamoto	No	11944
Total		134773

### Chemistry

William Dolbier	No	1429
Mike Scott	No	3044
Kirk Schanze	No	0
David Powell	No	0
Nick Polfer	No	0
Weihong Tan	No	0
Alexander Angerhofer	No	0
John Eyler	No	0
Charles Martin	No	0
Nicole Horenstein	No	0
Total		4473

### Astronomy

Michael Barker	No	9303
Eric Ford	Yes	510268
Anthony Gonzalez	No	0
Rafael Guzman	No	0
Total		519571

### Anthropology

Connie Mulligan	No	14075
Total		14075

### FLMNH

Matt Gitzendanner	No	0
David Reed	No	51555
Juan Andres Lopez	No	85
Total		51640

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Botony	Doug Soltis	No	0
	Total		0
Wildlife	Saif Nomani	No	0
	Total		0
QTP	Nigel Richards	Yes	86949
	Kenneth Merz	Yes	141690
	David Micha	Yes	775
	Erik Deumens	Yes	11714
	Jeffrey Krause	Yes	375875
	Adrian Roitberg	Yes	251650
	John Sabin	Yes	346714
	So Hirata	Yes	7018
	Rodney Bartlett	Yes	12346
	Total	Yes	1234731

## COE

Coastal	Tian-Jian Hsu	No	1741
	Alexandru Sheremet	No	97
	Peter Sheng	No	46013
	Andrew Kennedy	No	4322
	Arnoldo Valle-Levinson	No	74030
	Total		126203
BME	Huabei Jiang	No	57396
	Total		57396
ISE	Timothy Middelkoop	No	0
	Total		0
CISE	Arunava Banerjee	No	130822
	Anand Rangarajan	No	0
	Sanjay Ranka	No	0
	Total		130822
HCS	Alan George	No	0
	Total		0
EES	John Sansalone	No	0

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	Total		0
NRE			
	Samim Anghaie	No	0
	Total		0
ECE			
	Tao Li	Yes	170305
	Jing Guo	Yes	18803
	John Shea	Yes	90759
	Dapeng Wu	Yes	0
	Jose Fortes	Yes	1
	Total		279868
MAE			
	Youping Chen	Yes	136196
	Raphael Haftka	Yes	0
	Liming Xiong	Yes	16778
	Subrata Roy	Yes	1223
	Nagaraj Arakere	Yes	39
	S. Balachandar	Yes	500623
	John Schueller	Yes	0
	Bhavani Sankar	Yes	0
	Peter Ifju	Yes	0
	Lou Cattafesta	Yes	0
	Total		654859
MSE			
	John Mecholsky	Yes	4
	Shirley Meng	Yes	26067
	Simon Phillpot	Yes	961776
	Susan Sinnott	Yes	1154653
	Brij Moudgil	Yes	2976
	Rolf E. Hummel	Yes	0
	Total		2145476
CHME			
	Jennifer Curtis	Yes	87980
	Aravind Ashagiri	Yes	110185
	Tony Ladd	Yes	73
	Richard Dickinson	Yes	0
	Dmitry Kopelevich	Yes	199374
	Anuj Chauhan	Yes	0
	Tim Anderson	Yes	1495
	Total		399107
BME			
	Huabei Jiang	Yes	122351
	Tifiny Dyer	Yes	3046
	Total		125397

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ACIS	Fortes	Yes	62598	
	Total		62598	
<b>IFAS</b>				
IFAS	Rafael Munoz-Carpena	Yes	943	
	Jasmeet Judge	Yes	40181	
	Donald McCarty	Yes	1048	
	Wendy Graham	Yes	0	
	Phil Harmon	Yes	0	
	Christopher Martinez	Yes	0	
	James Jones	Yes	0	
	Greg Kiker	Yes	0	
	Daniel Hahn	Yes	0	
	James Austin	Yes	0	
	Kamin Miller	Yes	0	
	Total		42172	
	<b>HSC</b>			
	ICBR	Li Liu	Yes	1020
Total			1020	
ICHP	Chris Barnes	Yes	0	
	June Nogle	Yes	0	
	Narayan Raum	Yes	0	
	Total		0	
MBI	Mavis Agbandje-McKenna	No	10624	
	Christiana Leonard	No	0	
	Keith White	No	0	
	Art Edison	No	12782	
	David Ostrov	No	1320	
	Total		24726	
PHHP	Zhou Yang	No	177	
	Total		177	
MGM	Lauren McIntyre	No	16344	
	Lei Zhou	No	151	
	Total		16495	
Entomology				



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	Marc Branham	No	0
	Total		0
USFWS			
	Mark Koneff	No	0
	Total		0
CBA			
	Chunrong Ai	No	0
	Total		0
Biochem			
	Michael Kladde	No	0
	Total		0
EHPR			
	Samuel Wu	No	0
	Total		0