



# Virginia Tech Transportation Institute



# VTTI Mission

Conduct transportation research  
with the goal of:

Saving Lives

Saving Time

Saving Money

# Background

VTTI was established in August 1988 by agreement between US DOT and the University Transportation Centers Program

- Largest university-level research center at Virginia Tech
  - Approximately 300 faculty, staff and students working on over 150 projects
  - \$80 Million Awarded
  - \$25 Million in Annual Expenditures
  - Largest supporter of both undergraduate and graduate students

# Unique Facilities

## Instrumented Vehicles



## The Virginia Smart Road



# The Virginia Smart Road

- Advanced Control Room
- Weather capabilities



- Variable Lighting Systems
  - Pavement Testing

# Flat-Trac LTR Tire Force and Moment Measurement System



# Opportunity

- **Recent advances in nanotechnology and materials science have made it feasible to develop tires with:**
  - Decreased rolling resistance (i.e., 10-15% better fuel economy)
  - Improved handling and traction
- **General Motors and Goodyear are working together with VT faculty to develop this “Super Tire” that will:**
  - Revolutionize the tire and vehicle industries
  - Provide a tremendous, near-term, “green” initiative for the US
  - Allow light vehicle manufacturers to rapidly meet the new USDOT CAFÉ (fuel efficiency) standards

# Opportunity (continued)

- **Development and refinement of the super tire, and other advanced tire designs requires a quality of data that can only be generated at the NTRC**
- **All GM suppliers, world-wide, would be required to utilize the NTRC for 20 years**
- **Development of a state-of-the-art tire testing and research facility of this caliber would create numerous other funding opportunities:**
  - **Other vehicle manufacturers**
  - **Tire manufacturers**
  - **USDOE, USDOT, EPA and other government sponsors**
  - **NASCAR/motorsports**

# Facility and Equipment Requirements

- **A building to support the required machinery:**
  - Consists of utilizing the JOUSTER building at VIR with a facility upgrade
  - To be financed by VIR
  - 20 year lease with option to pay early or purchase
- **Revolutionary Tire Testing Machine: Approximately \$11.2M**
- **State-of-the-art Rolling Resistance Machine: Approximately \$1.2M**
  - To be purchased at a later date
  - Possibly funded by Federal EDA
  - Possibly \$500k from the Future of the Piedmont Foundation

# VTTI Centers & Groups

## *Centers*

- Automotive Safety Research
- Infrastructure Based Safety Systems
- Injury Biomechanics
- Product Development
- Smart Infrastructure and Sensing Technology
- Sustainable Mobility
- Sustainable Transportation Infrastructure
- Technology Development
- Truck & Bus Safety
- National Surface Transportation Safety Center for Excellence
- National Tire Research Center
- Virginia Green Highway Initiative

## *Groups*

- Advanced Product Testing and Evaluation
- Advanced Systems & Applications
- Behavioral Analysis & Applications
- Connected Vehicle Systems
- Cooperative Safety Systems
- Data Analysis Support
- Electrical & Systems Integration
- Light Vehicle Safety
- Mechanical Systems
- Motorcycle Safety Research
- Safety & Human Factors Engineering
- Transportation Policy
  
- Administration
- Financial

# VTTI Research



- Leading expert in Naturalistic research studies for teens, adults, older drivers
  - Light & Heavy Vehicles
- Controlled studies on The Virginia Smart Road
- Motorcycles

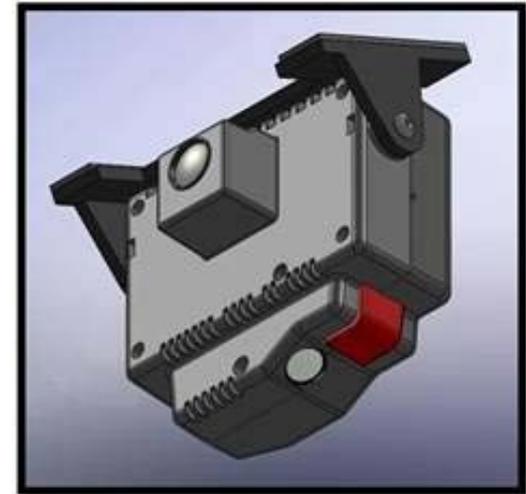
# Specific Areas of Research

- Driver distraction and crash causation
- Teen drivers
- Adult drivers
- Older drivers
- Billboard safety/distraction
- Truck driver fatigue
- Night visibility enhancement
- Wet visibility
- Lighting including airport lighting
- School bus safety
- Intersection crash avoidance
- Traffic modeling
- Pavement analysis and design
- ITS technology evaluation
- Intermodalism
- Proprietary research for major automotive companies
- Tire Research
- Product Development
- Transportation policy



# Specific Areas of Research (cont'd)

- Development of technologies for transportation research including:
  - software
  - hardware
  - data acquisition systems
  - Vehicle to Vehicle and Vehicle to Infrastructure systems



# VTTI Public Sector Sponsors

(partial listing)

- Federal Motor Carrier Safety Admin. (USDOT)
- Research and Special Projects Admin. (USDOT)
- Virginia Department of Transportation
- Virginia Transportation Research Council
- Virginia's Center for Innovative Technology
- USDOT
- Virginia Rail Policy Institute
- Federal Highway Administration
- National Highway Traffic Safety Admin. (USDOT)
- National Academies of Sciences
- National Institutes for Health
- Federal Railroad Administration
- Army Research Office (ARO)
- CICSO Systems

# VTTI Private Sector Sponsors

(partial listing)

- General Motors Corporation
- Ford Motor Company
- Battelle
- Nissan
- Toyota
- Volvo Heavy Truck
- Westat
- Philips Lighting
- The Travelers Companies
- AAA Mid-Atlantic
- Batelle
- SAIC (Science Applications International Corp.)
- Michelin
- Cambridge Systematics
- NAVTEQ
- FOARE (Foundation for Outdoor Advertising Research & Education)

# VTTI Impact



- Make highways safer for all drivers by providing education to all drivers to the dangers of distracted driving
- Provide real statistics regarding distracted driving for lawmakers to base informed decisions when introducing legislation to make driving safer for everyone.
- Conduct real-world research garnering real-world data to bring awareness to life-altering transportation issues to ultimately save time, save money and most importantly, save lives!

# Virginia Bioinformatics Institute



Our Mission is to solve society's most important problems in the life sciences, biomedicine, and biosecurity through transdisciplinary research and education

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# VBI At A Glance



**72**  
Students  
Employed

**35**  
Graduate  
Research  
Assistants

**106**  
Faculty and  
Researchers

**238**  
total employees

**130,000** ft<sup>2</sup>  
of working space  
on Virginia Tech's  
campus

**Cultivating scientific  
advancement**

# Tackling critical problems



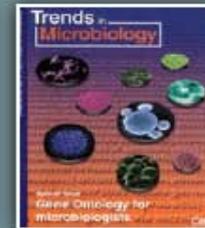
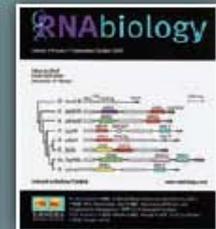
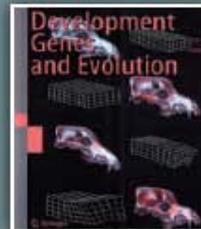
**\$120M**  
current total active  
funding awards

**\$150M**  
total amount of  
awards since 2000

more than  
papers  
published  
in scientific journals  
in 2010

**90**

**9** journal covers featuring  
research from VBI  
faculty



VBI AT A  
GLANCE

# Making transformative discoveries

29

Sponsored  
Research  
Agreements

28

Invention  
Disclosures

28

Provisional  
Patent Filings

17

Patent  
Filings

15 Small Business Innovation  
Research Awards

over 700 customers who have used  
VBI's Core Laboratory Facility



**5,000** students and parents  
VBI's Education and Outreach group  
interact with each year

**450** students attending  
each session of Kids'  
Tech University

**80**  
students  
participants  
in VBI's 2010  
summer  
programs

# Introducing children to science

**VBI AT A  
GLANCE**

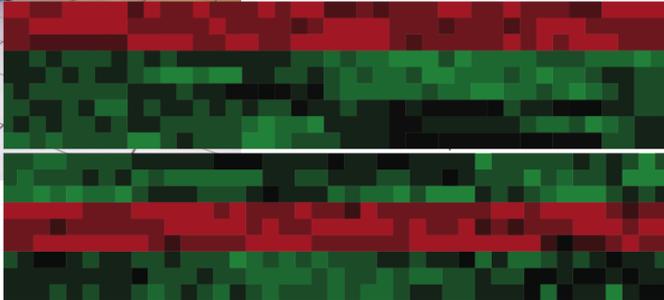
# Transdisciplinary Research



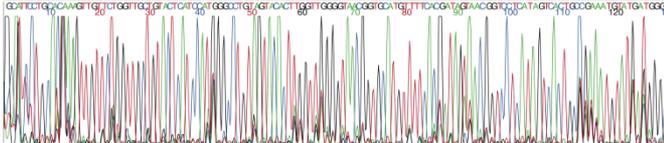
Experimental



Computational



bioinformatics



# Drivers for bioinformatics at VBI in the life sciences

- Rapid, low cost genomic sequencing enable the analysis of multiple species
- New computational tools are speeding the organization and analysis of genomics sequences
- High performance computing infrastructures for handling huge volumes of data
- Federal and private funding to support genomics research
- Engagement with the world scientific community

*VBI is uniquely positioned to translate genomics information into actionable life science products and policies.*

# CyberInfrastructure Division



The CyberInfrastructure Division develops, deploys and integrates large-scale cyberinfrastructure systems in support of health sciences activities, primarily in support of our nations biodefense activities.

Continuous and substantial support has enabled the CID to create and maintain systems in wide use by researchers.

- Funding from the National Institutes of Health NIAID is being used to integrate vital information on pathogens, advanced resources and tools to scientists, and enhance the analysis of genomic, proteomic and other various data arising from infectious disease research.
- The development of the Pathogen Portal for the Bioinformatics Resource Center (BRC) program serves to coordinate the activities of other NIH funded BRCs. PATRIC 2.0 portal is responsible for gathering information for all bacterial species on the NIAID pathogens list.
- Infectious Disease and Biodefense researcher are the major users of these resources.

# Biosystems Research Division



The Biosystems Research Division applies a systems approach to research issues involving host-pathogen-environment interactions and inflammation.

The Biosystems Research Division scientists use diverse expertise and techniques to advance their science.

- Scientific expertise in the Biosystems division focuses on genomics and proteomics technologies, human physiology, plant sciences, mathematical modeling, molecular and cellular biology, bacteriology and biochemistry.
- Bridging plant and human health research, the Biosystems division promotes transdisciplinary research through studying process that are universal to species as diverse as plants and humans.
- Using computational and experimental biological approaches, the Biosystems division to advance our understanding of how pathogens associated with humans and plants cause disease.

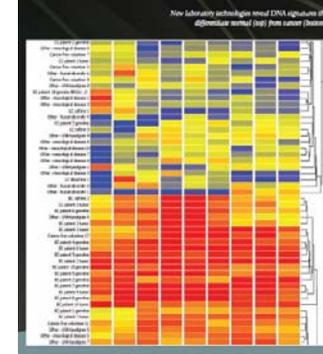
# Network Dynamics and Simulation Science Laboratory (NDSSL) Division



NDSSL's scientists are advancing 'policy informatics', a discipline they created, by modeling large-scale co-evolving networks. These networks represent real world biological, social, technical, organizational, infrastructure and information systems.

The interplay among research and application for more than a decade has yielded:

- Interaction-based modeling, co-evolving socio-technical and information networks.
- HPC-oriented service-based coordinating architectures.
- Synthetic Information environments representing diverse, semi-structured data.
- Data and network analytics for integrating, storing and analyzing synthetic data.
- Decision support tools for understanding and reasoning about the aforementioned systems.



# Medical Informatics and Systems Division

The Medical Informatics and Systems Division conducts translational research at the interface of medicine, informatics, genetics/genomics and molecular biology.

Division scientists use computational and wet lab techniques to make platform discoveries related to human health.

- The MIS division specializes and focuses on human disease through the analysis, integration and exploitation of very large “-omics”-oriented data sets.
- This division works to improve patient care and caregiver effectiveness by creating Health Information Technology (Health IT) solutions, including the development of clinician support systems based on text analytics and data mining of EMRs.
- Development of new diagnostic and prognostic markers, drug targets and other intervention strategies through deep analysis of genomic DNA sequence for patients with cancer and various neurological disorders.

# VBI's cores provide essential services to Virginia Tech researchers



- -omics core with sequencing, deep sequencing, Affy/other microarrays, mass specs, data analysis and interpretation
- Computational core with web, tool and database building; application building and hosting; High Performance Computing for the Life and Medical Sciences
- Data analysis core, from experimental design through manuscript ready figures and text
- In addition, VBI's administrative computing are building and propagating new tools and databases of value to the Virginia Tech organization

VBI's outreach program inspires students to want to become scientists by engaging them from a very young age through college and into graduate school.



Outreach activities  
on and off site  
reaches 5,000 students a  
year

Education and  
Outreach



# VBI's Major Strategic Goals – Improving the quality of life, health and security

- Significantly expand work in Medical Informatics; Health IT; Human genetics and disease to exploit our bioinformatics capabilities in this data rich research environment.
- Enrich our High Performance Computing capabilities so that we can take on larger bioinformatics problems
- Expand bi-directional partnerships with industry so that needs and IP can be readily exchanged
- Formalize and build IP, Commercialization and Entrepreneurship to translate our scientific findings into products for life, health and security
- Expand ‘core services’ so that more researchers world-wide can benefit from the latest state-of-the-art in computing, genetics/genomics and data analysis
- Engage philanthropists who want to be part of the ‘bioinformatics revolution’ by enabling VBI to expand to meet the changing ‘discovery needs’ of science and society

# Summary

- VBI's is a premier bioinformatics research facility that uses transdisciplinary approaches to integrate information technologies, with biology, medicine, and public health policy
- VBI researchers come from diverse scientific disciplines including mathematics, computer science, biology, plant physiology, biochemistry, systems biology, statistics, economics, synthetic biology, and medicine
- VBI trains our next generation of scientists through our graduate and out-reach programs
- VBI is translating research into real-world applications by increasing intellectual property, commercialization, and entrepreneurial activities

## *Overview of* ICTAS

Roop L. Mahajan

Tucker Chair Professor  
Director, ICTAS  
mahajanr@vt.edu

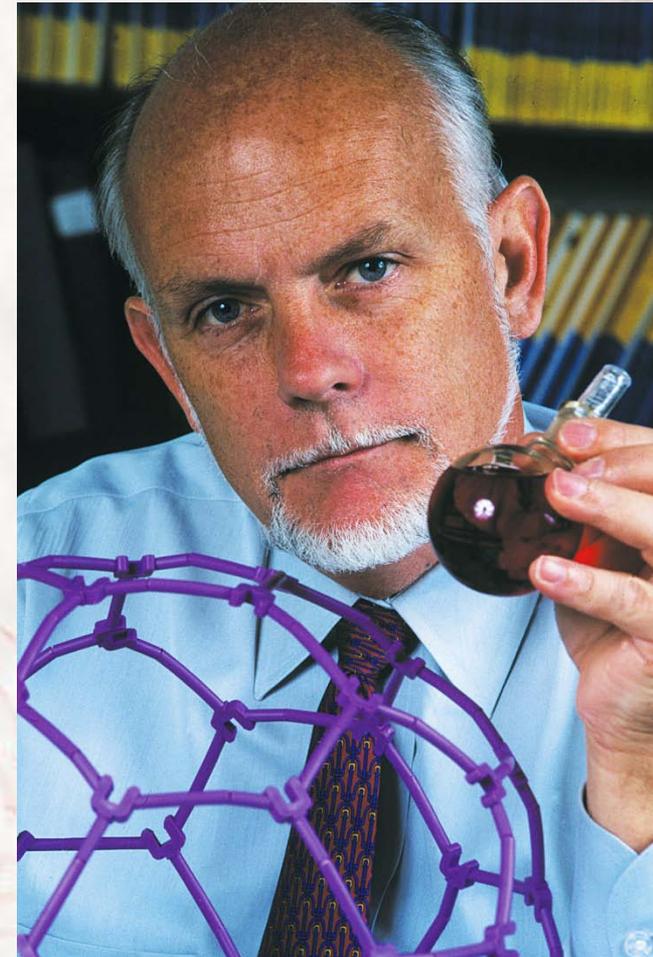
June 8, 2011.

### Top Ten problems of Humanity for next 50 years

1. Energy
2. Water
3. Food
4. Environment
5. Poverty
6. Terrorism & War
7. Disease
8. Education
9. Democracy
10. Population

**Richard E. Smalley**, noted scientist and Nobel prize winner

Source: Energy and Nanotechnology Conference,  
Rice University,  
May 3, 2003



- Complex
- A high level of uncertainty
- Challenging
- Multiple perspectives

Translation:

*Need interdisciplinary approach*

*Need innovation*



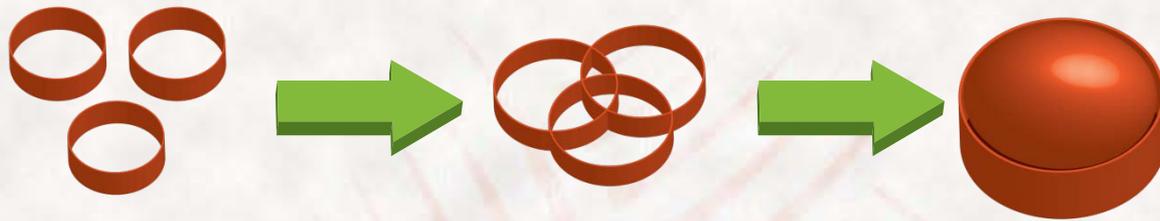
Buds of creativity bloom at intersections.

*Institute for Critical Technology & Applied Science was created at VT to fulfill this need.*

- As a Promoter of Interdisciplinary Research (IDR)
- An Agent of Innovation
- To enhance educational experience of students in IDR
- To promote economic development and enhance quality of life in the COV, USA and the world

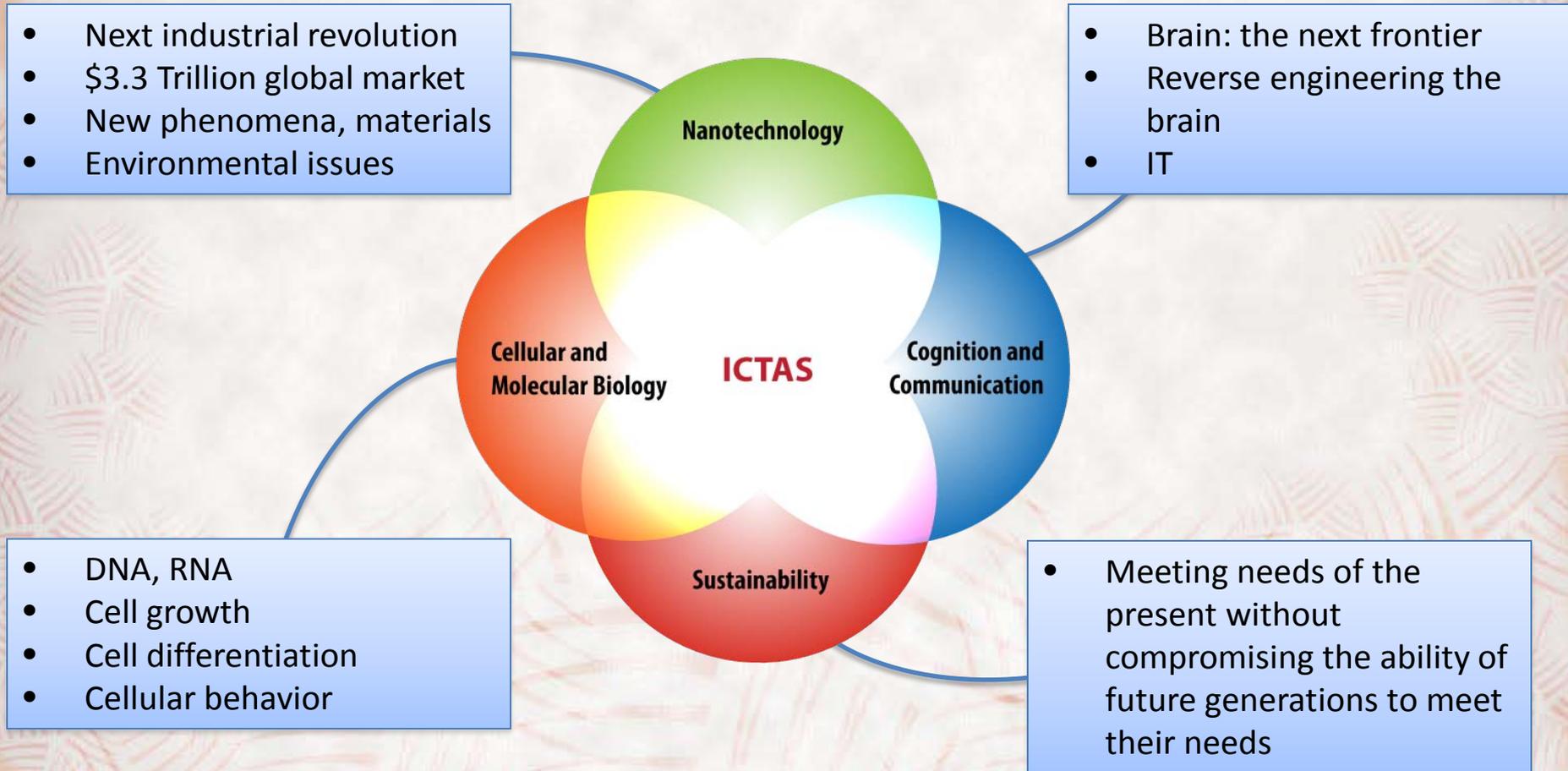


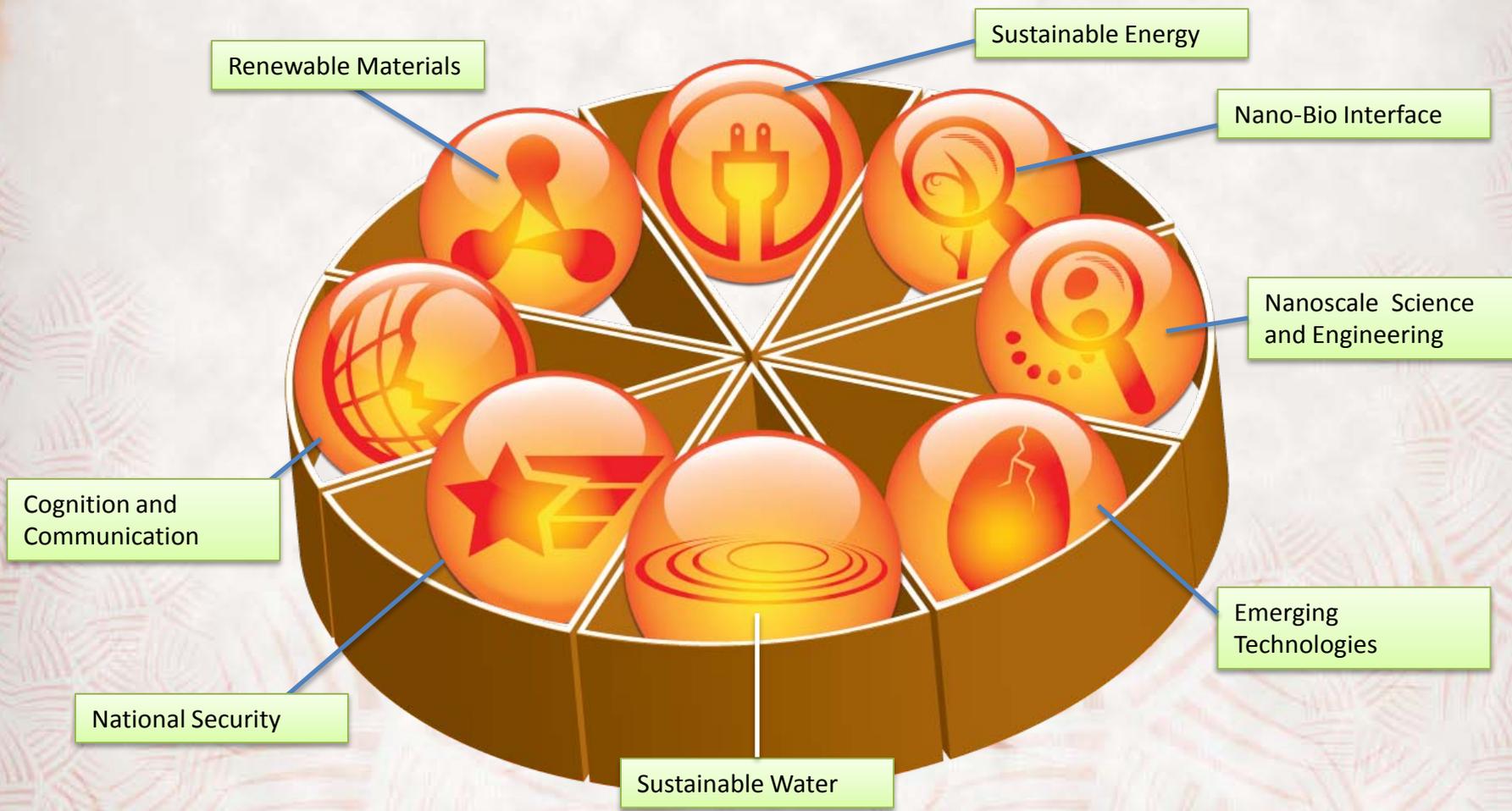
ICTAS Interdisciplinary Research  
at the intersection of Engineering and the Sciences



**Buds of creativity bloom at intersections.**



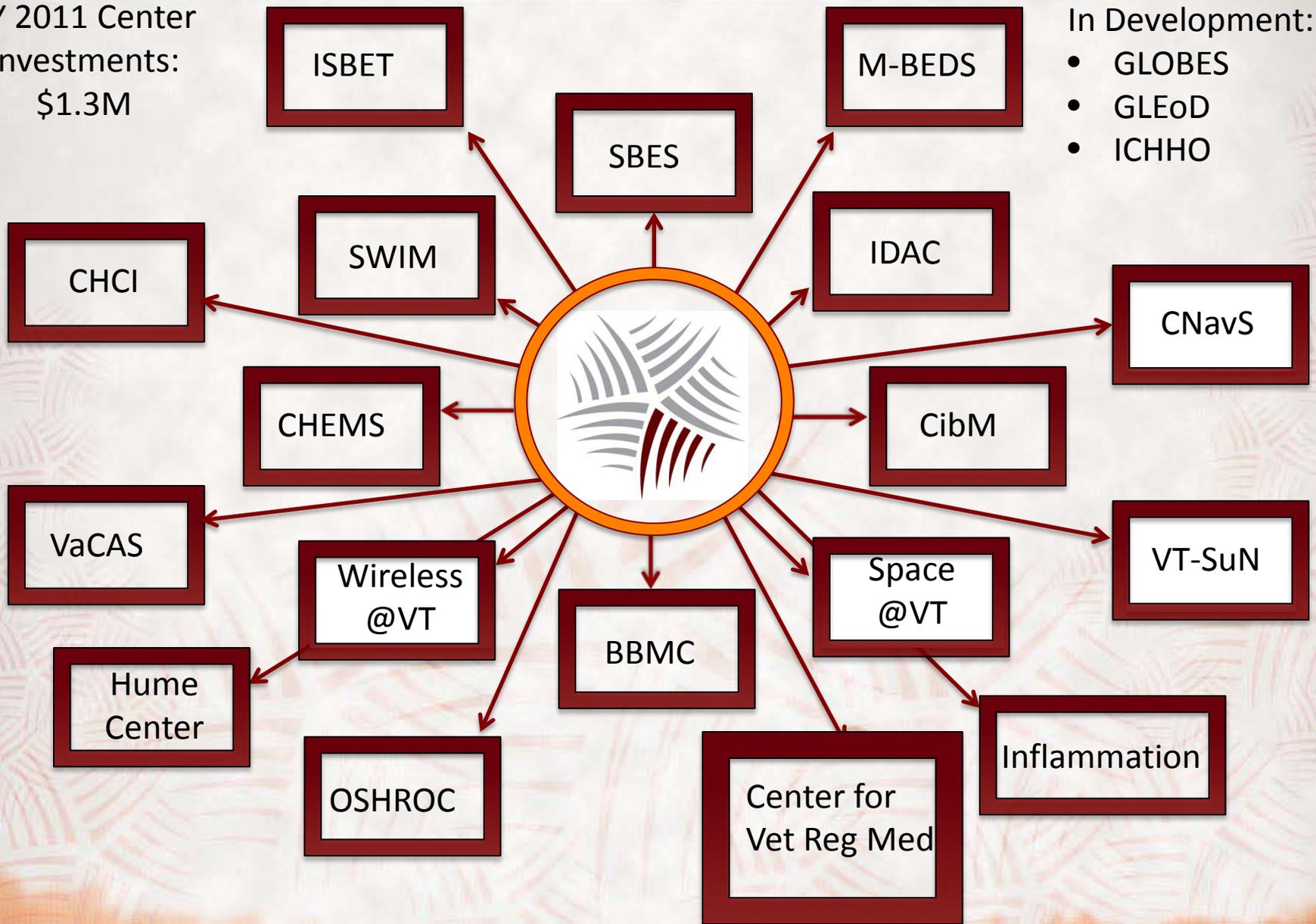




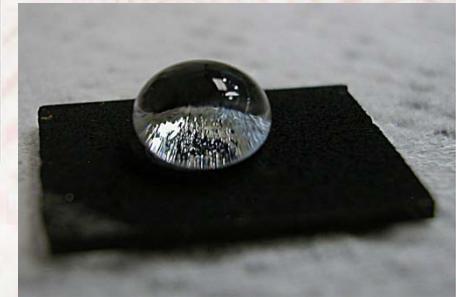
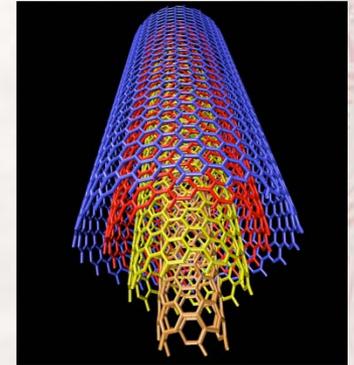
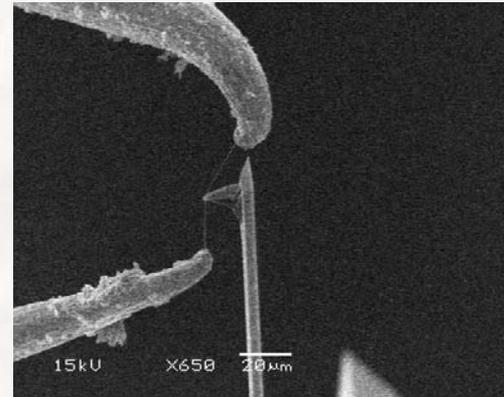
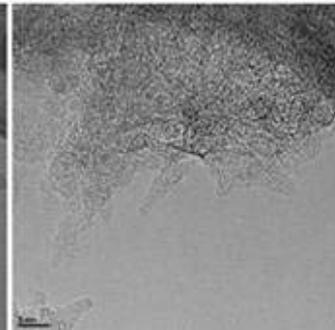
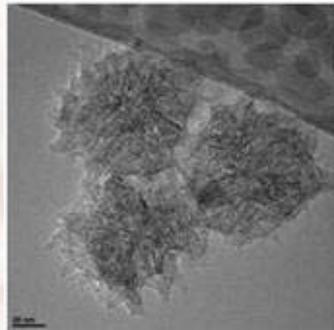
FY 2011 Center Investments:  
\$1.3M

In Development:

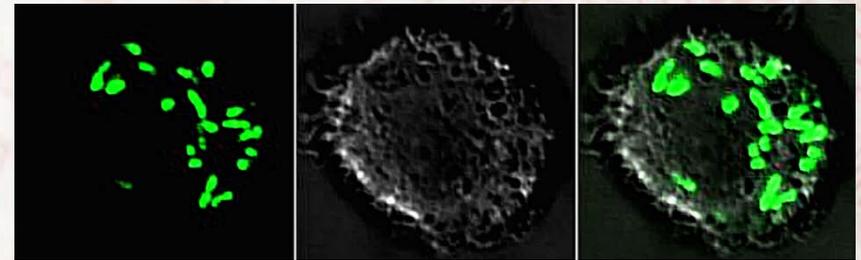
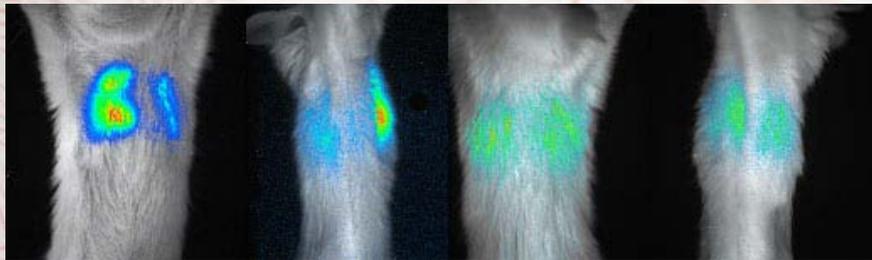
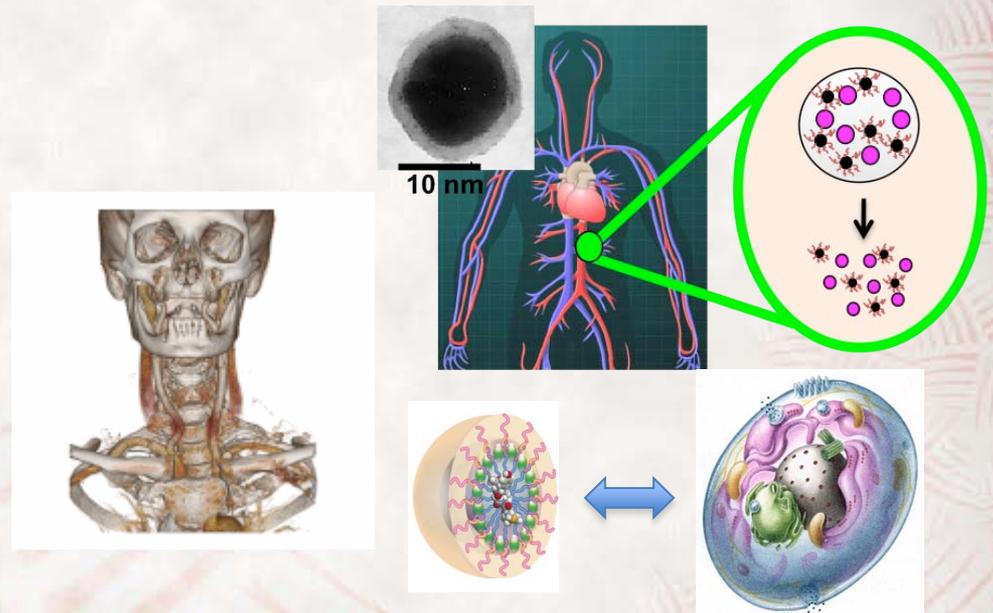
- GLOBES
- GLEoD
- ICHHO



- Environmental Nanoscience and Technology
- Nanomaterials including carbonaceous materials
- Nanosensors
- Nanodevices



- Targeted Delivery of Nano-medicine
- Cellular Engineering Microsystems
- Non-invasive Sensing and Diagnosis
- Inflammation
- Bio-Imaging





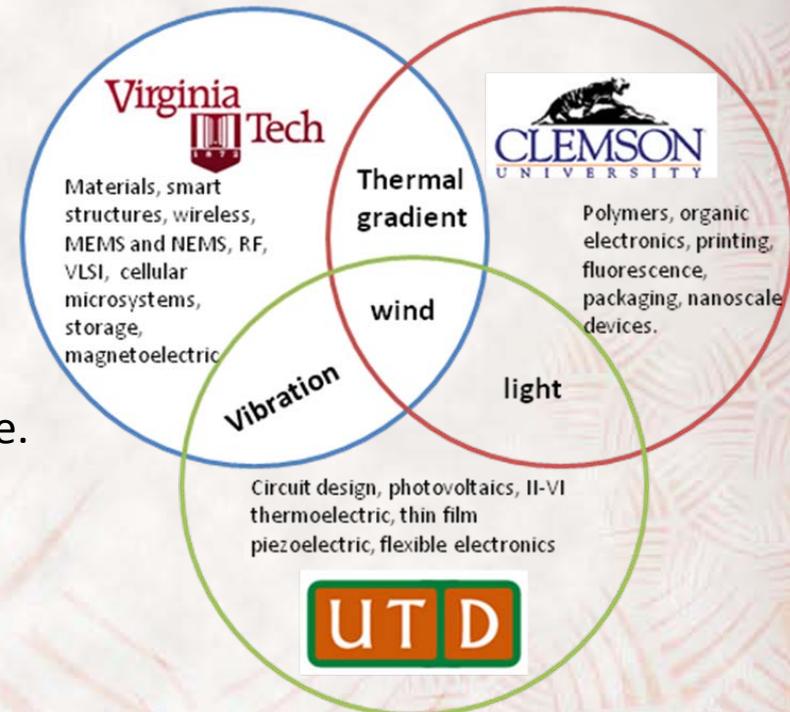
### Current Strength:

- 28 faculty members in 3 different universities covering all aspects of energy generation and storage.
- Excellent infrastructure for energy related research.

### Status:

- Currently operating as **ICTAS- I/UCRC**.
- Received NSF planning grant, Feb 2009
- Finished first planning meeting in Jan 2009  
-attended by 105 participants.
- Membership:  
Current - Texas Micropower, ICTAS  
Pending – SAIC, Mitras, Mide

**Lead Faculty:** Profs. Dan Inman and Shashank Priya



**ICTAS Center for Energy Harvesting  
Material Systems (CEHMS)**



**CEHMS**  
Center for Energy Harvesting Materials  
and Systems

**ICTAS Research is also about the next  
Black Swan**

**A Black Swan** is an event that has three characteristics;

- it is an outlier
- it carries an extreme impact
- it has retrospective predictability.

"The Black Swan", by Nassim Nicholas Taleb



- Our world is dominated by Black Swans.
  - the internet
  - the computer
  - the laser

## “The Black Swan and Disruptive Technology”:

*An informal discussion of the future*

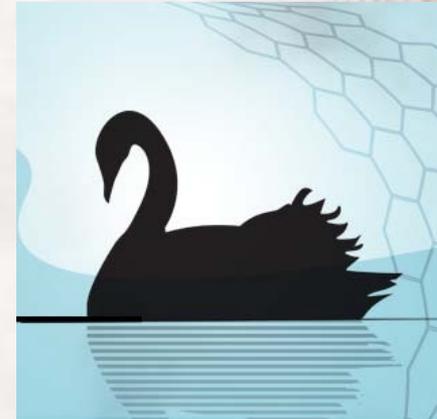
**Where ?** Café X located in the main ICTAS building.

### Objective

- Create an environment for engineers, scientists, and humanists to come together to move *beyond the predictable and incremental advances* in the current technologies to the ***disruptive technologies*** of the future.

### Features:

- No tyranny of power point
- Focus on one general area with invitees from outside the field





ICTAS HQ



ICTAS CRC



ICTAS LSC



ICTAS NCR

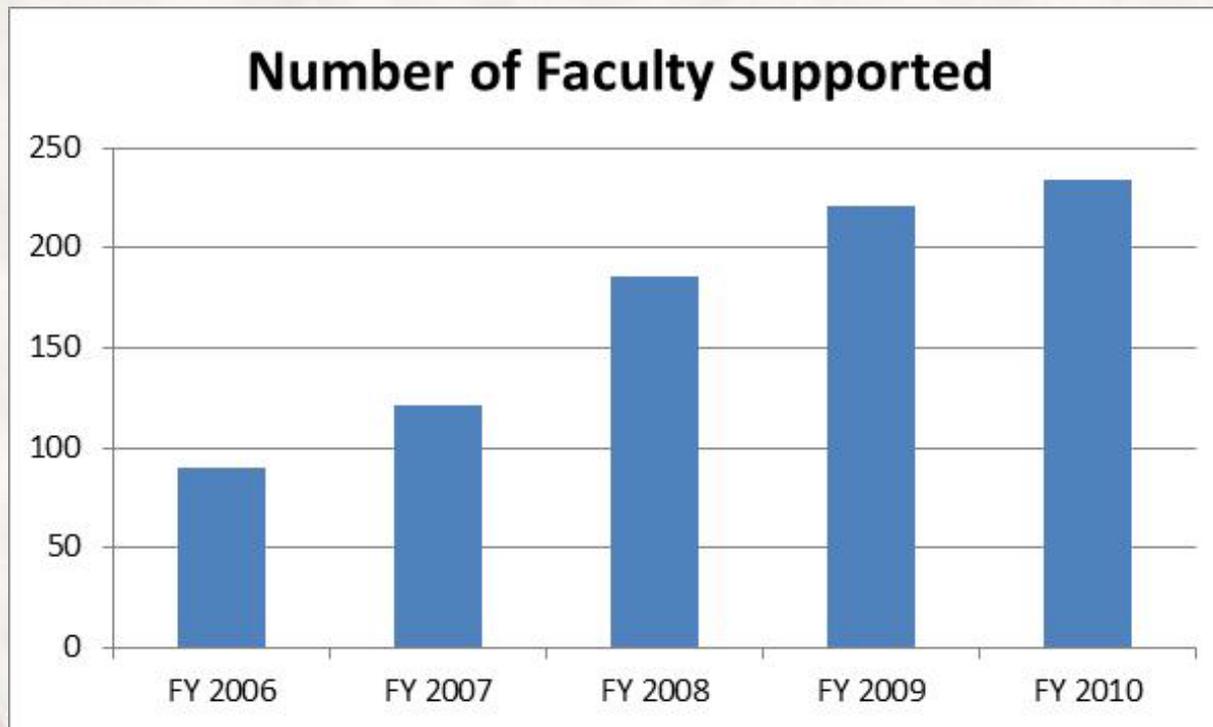


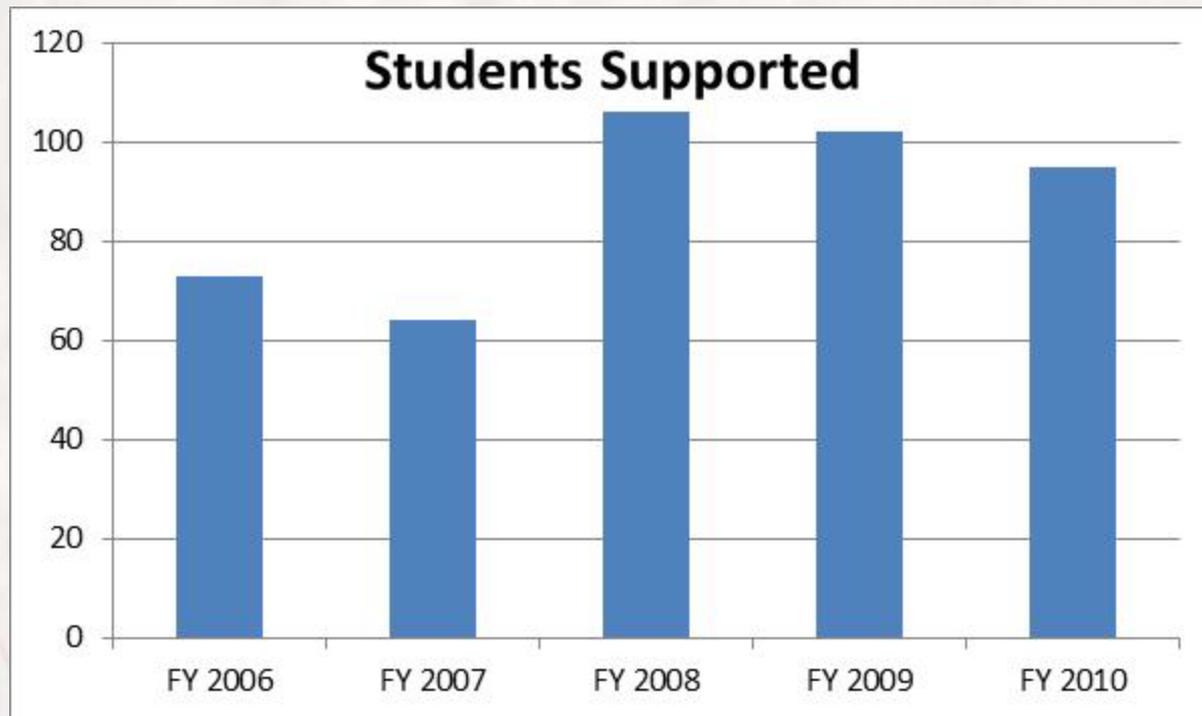


*Photo by Ivan Morozov*

- **ICTAS Doctoral Scholar Program**
  - current roster : 35 doctoral scholars
- **Focus on supporting Ph.D. students through seed projects**
- **Support of IGERT programs**
- **Graduate recruiting**
- **Research opportunities for undergraduates**







## □ Industry

NSF- I/UCRCs

- e-Design (Janis Terpanny),
  - Lunch presentation at the e-Design IAB
    - *Potential for two more I/UCRC Sites:*
    - *Fuel Cells (South Carolina), Water (Drexel)*
- CEHMS (Shashank Priya)
- Wood-Based Composite Center ( Chip Frazier)

## ➤ Kimberley Clark

- Nanofibers from multilayer melt blowing  
Prof. Eugene Joseph; 2 year contract expected

## ➤ AEP

- \$1 million gift in honor of Joe Vipperman, ECE.
- Recognition Lunch, May 3<sup>rd</sup>;



**BIG THANKS to the COE DEVELOPMENT TEAM !**

## □ **Community Partnerships**

- Eco Park, Giles County (Sam Houston)
  - Building available free of rent for 6- months
  - Land available in Eco Park for commercial facility
    - coal/bio-mass gasification + turbine test rig
    - Professor Jason Lai's Inverter
- Proposal Submitted to Senator Warner's office with GW University, Presidents' offices
  - Renewable Energy & Smart Grid
  - \$2 million
  - Did not survive



## ❑ **Bench to Bed/Bazaar**

- Aggressive approach to IP Protection
- Work with Knowledge Works, venture capitalists
- Some issues on sharing of licensing revenues



## □ National Labs

- NIST – SMART PIPE Proposal, \$10M, submitted 04/06/11; program did not survive federal budget cuts
- ORNL
  - *James B. Roberto, Associate Lab Director for Graduate Education & University Partnerships*
  - *Wes Hines, Interim Vice Chancellor for Research and Engagement, University of Tennessee, Knoxville*
- *NREL, NETL, LLNL (Satish Kulkarni)*

## □ Global

- VT, India
  - Visit to MARG, January 2011
  - ICTAS Innovation Center planned



- ICTAS Strategic plan 2012-18
  - By business segment
    - Eight thrust areas, NCFL , NCR
  - Emphasis on dominant position in scholarship/recognition
  - Research expenditures 2x in 6 years
  - Getting NCR off the ground to a successful start, collaboration with local industry, universities, integration with Blacksburg research
    - 3x in 6 years
  - Continued emphasis on large research proposals
  - Strategic partnership with National Labs—NREL, NIST, NETL, LLNL
  - Global opportunities
    - VT, India; getting ICTAS Innovation center off the ground
    - Global Laboratories on Bio-Inspired Science & Technology, Energy on Demand
  - **Commercialization an important contributor to growth**
  - Benchmarking & Branding of ICTAS
  - Promote and develop inter-institute collaboration
  - Develop plans for ICTAS-III

## *Overview of* ICTAS

# Thank You!!

Roop L. Mahajan

Tucker Chair Professor  
Director, ICTAS  
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June 8, 2011.