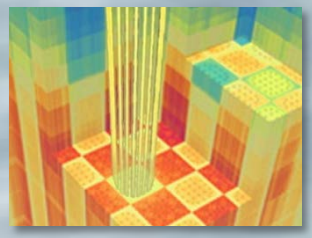
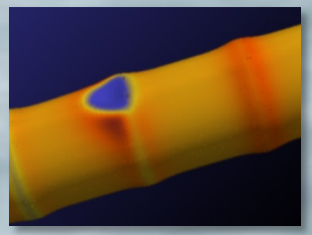
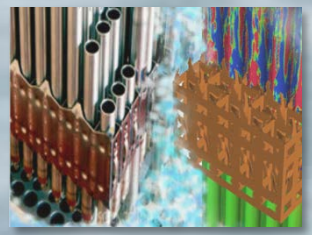
CASL Education Program and Summer Institute

Dr. J. Michael Doster
Professor of Nuclear Engineering
North Carolina State University
Director, CASL Education Program


CASL Education Program
A new generation of LWR Designers, Scientists, and Nuclear Power Professionals

Program Charter:

- Integrate CASL technology into undergraduate and graduate curricula
- Develop a plan to educate industry users
- Encourage diversity of participation in CASL activities
- Advise Chair on educational development activities
- Review and recommend education curricula and programs

Program Activities:

- Recruiting at ANS Student Conference
- Undergraduate Research Scholars Program
- Summer Internships
- Summer Workshops for Students, 2011-2015
- Course Modules/VERA-EDU
- CASL Institute/Certificate Program
- CASL Summer Research Experience for Undergraduate (REU)

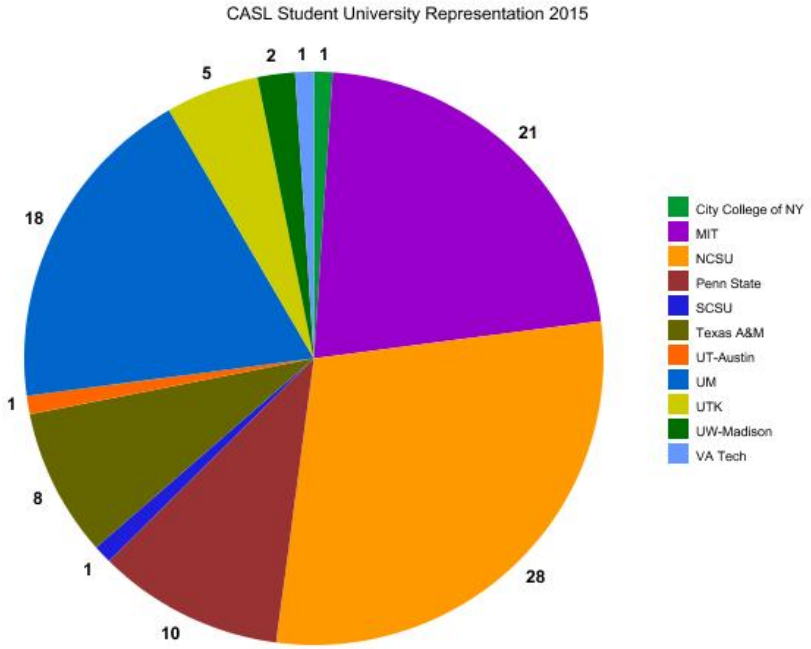
CASL Education Program
A new generation of LWR Designers, Scientists, and Nuclear Power Professionals

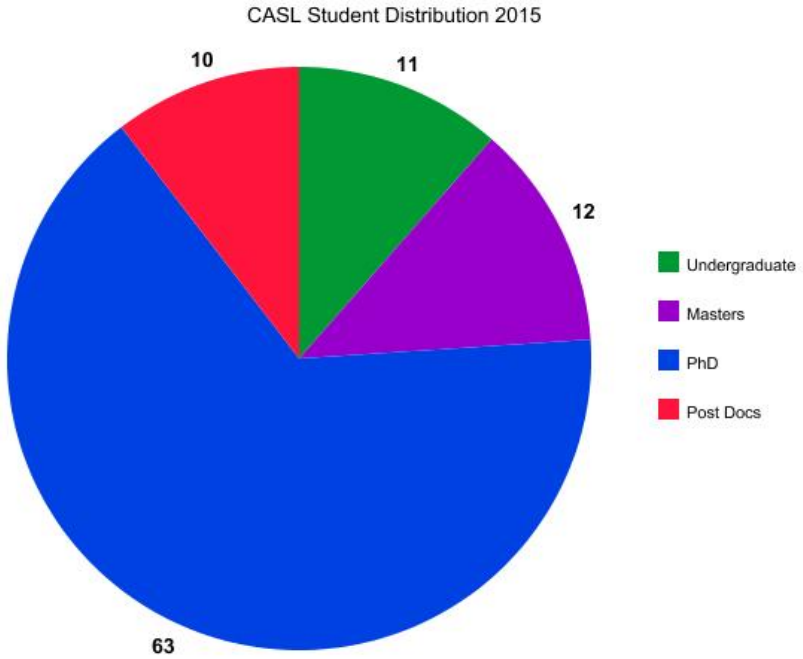
Program Members:

J. Michael Doster, Director, Professor, North Carolina State University

- **Sherry Bailey,** Program Associate**,** North Carolina State University
- **Douglas Burns**, CASL Deputy Director, INL
- **Bill Martin**, Professor, University of Michigan
- **John Turner**, Chief Computational Scientist, Oak Ridge National Laboratory
- **Koroush Shirvan,** Research Scientist**,** MIT
- **Leigh Winfrey**, Associate Professor, University of Florida

CASL Education Program
A new generation of LWR Designers, Scientists, and Nuclear Power Professionals





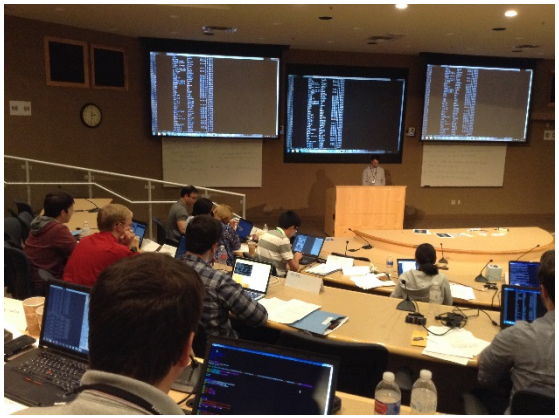
CASL Student ANS Involvement, 2015

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- CASL (The Consortium for Advanced Simulation of Light Water Reactors) - A DOE Energy Innovation Hub for Modeling & Simulation of Nuclear Reactors Education Program participated for the fifth time in the ANS Student Conference.
- The conference was hosted by Texas A & M and held in College Station, Texas.
- The ANS 2015 Student Conference included 450 attendees with 125 podium presentations and 36 posters on new and innovative solutions for the nuclear science and engineering community.

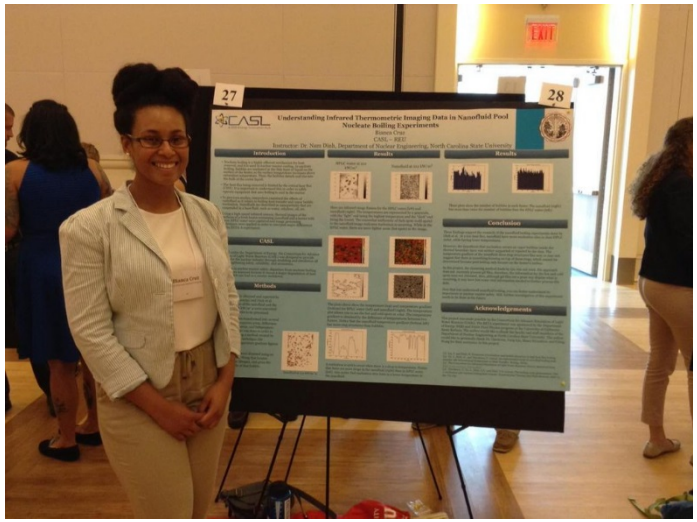
CASL Undergraduate Research Scholars, 2015-2016
Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- CASL Education Program implemented an Undergraduate Research Scholars program at North Carolina State University to aid in the recruitment of top students.
- Selected undergraduates are given the opportunity to do research with a CASL faculty member.
- Each undergraduate receives support to perform CASL related research.
- Since its implementation 27 students have participated. Out of the 19 that have completed their undergraduate degree, 12 are attending graduate school.
- Other partner universities are being encouraged to develop similar programs.



CASL Summer Research Experience for Undergraduates 2015
Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- To support its diversity mission, the CASL Education Program supported its first Research Experience for Undergraduates (REU) in Summer 2015.
- Bianca Cruz from South Carolina State University performed research under Dr. Nam Dinh at North Carolina State University (NCSU).
- The student was granted a stipend plus housing and a food allowance while staying at NCSU.
- Ms. Cruz's research focused on nucleate boiling heat transfer by analyzing data obtained in the BETA-A experiment. In addition to attending the CASL Summer Student Workshop at ORNL, Ms. Cruz participated in a Poster Session at NCSU to highlight the results of her research.



CASL Education Summer Student Workshop, 2015
Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

Workshop Purpose:

- Orient and integrate graduate students into the CASL project providing a hands-on experience in the VERA Software platform in an intense two day setting
- Feature student presentations of CASL work

Workshop Activities:

- Presentations by CASL leadership and key researchers on VERA
- Featured speakers from ORNL, tours of SNS, Graphite Reactor, & TITAN
- Student Presentations, Awards and Feedback Sessions

Workshop Highlights:

Organized by Education Program: J. Michael Doster, Sherry Bailey, John Turner, Rose Montgomery, and Linda Weltman

- 27 graduate students representing 9 universities
- 11 Students participated in a student poster session highlighting their own CASL research. Three winners were selected for their outstanding work.
- VERA Demonstration included working with the software platforms
- Exposure to environment of national lab with strong participation by ORNL Staff

CASL Education Modules, 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- Lesson plans and example problems based on VERA software products
- Transferable to all CASL Partner Universities
- Currently focused on three physics areas
  - **Fuel Performance (MIT)-BISON**
  - **Thermal Hydraulics (UTK)-CTF**
  - **Neutronics (UM)-MPACT**
- Ultimately to be run under education configuration VERA-EDU

CASL Education VERA-EDU Implementation, 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- To facilitate distribution of course modules (present and future), a standard educational configuration of VERA is under development.
- This configuration, informally denoted as VERA-EDU, provides a uniform framework for distribution of materials developed under the Education Program to our University partners. Initial configuration
  - **MPACT**
  - **CTF**
  - **BISON**
  - **DAKOTA**
- Stand alone or coupled execution with integrated sensitivity/uncertainty analysis
- Continue working within export control boundaries

CASL Education VERA-EDU Implementation, 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- The Certificate for Nuclear Systems Design has evolved from a user certificate plan to be administered at each university into a two week CASL Institute/School to certify both students and industry in CASL Technologies.
- Based on the course modules implemented under VERA-EDU
- In depth treatment of the methods and models employed by the CASL software tools
- Will result in a CASL Certificate in Advanced Modeling and Simulation to be administered by ORAU
- Open to both University graduate students, faculty and industry participants
- Qualifies for continuing education credits from NSPE

CASL Education Summer Institute 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- The CASL Institute will introduce participants to CASL and the Virtual Environment for Reactor Applications (VERA) framework.
- Participants will receive instruction in radiation transport, thermal hydraulics, fuel performance, multi-physics coupling and sensitivity and uncertainty analysis.
- Lectures and hands on examples and projects will focus on the VERA component codes MPACT, COBRA-TF, BISON and DAKOTA. In addition, the workshop will utilize high performance computing resources.
- After successful completion of the Institute and meeting certification requirements (team project), participants will earn the CASL-VERA Certificate.

CASL Education Summer Institute 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

Time	9	10	11	12	1	2	3	4
Monday	Arrive!							Welcome
Tuesday	VERA	VERA I/O	VERA Practicum	Lunch	MPACT I		MPACT Practicum	
Wednesday	MPACT II	MPACT II Practicum		Lunch	MPACT III		MPACT III Practicum	
Thursday	COBRA-TF Theory			Lunch	COBRA-TF Practicum			Feedback
Friday	Multi-Physics Coupling		MPACT TH Practicum	Lunch and Poster Session	Coupled COBRA-MPACT Practicum			Feedback
Saturday	HPC Status and Future		Validation Activities & Data Needs	Lunch	Group Assignment			
Sunday	Free Day - Explore Knoxville!							
Monday	BISON I		MOOSE/Meshing	Lunch	BISON Practicum			Feedback
Tuesday	BISON Model Development Practicum			Lunch	Project Work			
Wednesday	CASL Challenge Problems			Lunch	Project Work			
Thursday	Sensitivity and UQ		S&UQ Application/ Practicum	Lunch	Project Work			
Friday	Project Work			Lunch	Feedback, Project Submittal and Wrap Up		Go Home!	

CASL Education Goals, 2016 and Beyond

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- Continue to use Summer Student Workshop, CASL Institute and Internship Programs to serve as a vehicle to introduce students to CASL research activities.
- Consider CASL Webinar series as a component of the course module development.
- Expand Undergraduate Research Scholars at NCSU and promote the establishment of similar programs at our partner Universities
  - Special session at the 2014 winter ANS meeting to highlight work done by undergraduate CASL researchers sponsored by the Education and Training Division
- Develop an Industry Education Transfer Plan. Transfer VERA operating skills as well as enable background knowledge to industry partners.
- Expand VERA course modules and demonstrate course module implementation under VERA-EDU
- Develop the curriculum for the CASL Institute to be implemented in summer 2016
- Continue Research Experience for Undergraduates (REU) at NCSU for students from South Carolina State University (SCSU) to facilitate achieving diversity goals

CASL Education Phase 2 Plan, 2016

Creating a new generation of LWR Designers, Scientists, and Nuclear Power Professionals

- Continue the CASL Summer Student Workshop and Internship Programs
- Mature VERA-EDU as a uniform framework for distribution of educational materials to partner Universities
- Deploy course modules currently under development to our partner and other Universities and develop metrics for evaluating their performance in the class room
- Develop new course modules as additional physics capabilities are added to the VERA-EDU configuration
- Implement the CASL Technology School
- Expand REU opportunities with SCSU to improve participation of under represented groups in CASL programs

www.casl.gov

CASL-U-2016-1090-000