PHOTON2 NEWS

A PROJECT OF THE NEW ENGLAND BOARD OF HIGHER EDUCATION (NEBHE)

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PHOTON2 Holds Showcase Workshop

PHOTON2's capstone activity was hosting a Showcase workshop. An industry-education collaboration with the International Society of Optical Engineering (SPIE) provided a perfect meeting venue from August 13 - 17, 2006 in San Diego, Calif.

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PHOTON2 Participants at Showcase workshop in San Diego, Calif.

Problem-Based Learning is Focus of New NSF Grant to NEBHE

How can our education system improve students' comprehension, critical thinking, problem-solving and communication skills—each vital in today's work environment? The Advanced Technological Education (ATE) program of the National Science Foundation (NSF) recently funded NEBHE to develop eight industry-driven problem-based learning (PBL) challenges in the field of photonics technology for secondary and postsecondary institutions.

PBL is an instructional method that challenges students to "learn to learn" by collaboratively solving "real-world" problems faced by technicians and engineers in the workplace. Unlike traditional case studies where students are passive observers, the PHOTON PBL challenges will engage students in the problem-solving process.

Co-PIs Nick Massa and Judy Donnelly (far L & R) recording the first challenge on site with IPG Photonics technicians Eran Redick and Josh Chafee (center L & R).

PBL teaches students the *process* of solving open-ended problems that have a number of possible solutions. In small groups, students will work collaboratively to:

- Define and frame the problem
- Identify resources needed to solve the problem
- Apply those resources to develop possible solutions to the problem
- Reflect on the problem-solving process in an effort to arrive at an optimal solution

While PBL has been used extensively in medical education since the early 1970s and widely adopted in fields including business, law and education, it is emerging as an alternative to the traditional lecture-based approach in engineering and technology education. The PHOTON PBL project is particularly important since the educational resources needed to help engineering and technology faculty adopt PBL in their courses are few and far between. This is especially true in the photonics field, where the limited instructional resources are a constant challenge.

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Interdisciplinary Technical High School Course Hits the Mark

PHOTON2 New England Alliance member Donna Goyette has captured the attention of her students and colleagues with her work at H. H. Ellis Technical High School (Ellis) in Danielson, Conn. Drawing from her rich research background, she integrated components of Ellis' 11 technical shops into her one-semester "Introduction to Optics" classroom curriculum. She met with PHOTON2 News staff to discuss her professional development, success and plans for the future.

L to R. Karen Schmidt, H. H. Ellis Regional Technical School; PHOTON2 Co-PI Nick Massa, Central Connecticut State University; Donna Goyette, H. H. Ellis Regional Technical School.

Goyette was the right person for the job. After two years teaching with another instructor who utilized the PHOTON2 lab kit, her colleague retired. With the school's support of continuing an optics curriculum and utilizing the kit's flexibility, Goyette moved it from the technical shops to her classroom and immediately saw her students' enthusiasm. Soon after, she collaborated with then guidance counselor Karin Schmidt, whose student connections made her the "go-to" optics person outside the classroom. This partnership was essential, Goyette said: "Photonics is a rapidly emerging field; if no one tells students about it, they will go on the same old pathway."

The reason that state-level approval for the "Introduction to Optics" course came quickly is three-pronged. All Connecticut technical high schools fall under a single state-level umbrella, rather than belonging to multiple school districts. The local boards of education report directly to the state, helping to expedite the decision making process. The Connecticut Department of Education (DOE) values technology within technical high schools and, even more, the career awareness enhanced by the curriculum's connection to the technical shops' real-world applications. The DOE also remembered Goyette. She had been "Teacher of the Year" only a few years prior to seeking approval for the optics curriculum, which added validity to her course proposal.

But science had found Goyette well before she began at Ellis. As an undergraduate student she majored in chemistry and clinical microbiology, which she pursued in graduate school. After graduation she began working at the Centers for Disease Control in Atlanta and continued researching in Norwich, Conn., where she was a clinical microbiologist at the William W. Backus Hospital in the laboratory/pathology department. Although Goyette was initially teaching biology rather than physics, she changed disciplines based on what Ellis needed at the time. "I fell in love with it," she confessed. Although her prior research had involved optics, she had not viewed it in those terms. Once she began teaching, the optics material was second nature.

Goyette's career change from research to teaching was based on reasons more personal than professional. A mother of two young boys, she found that research was taking too much of her time from her family. She was accepted into Alternate Route to Teaching Certification (ARC), a Connecticut Department of Higher Education program that targets mid-career professionals. She speaks highly of ARC. For ten months, Goyette joined her peers on weekends and then obtained her teaching certificate. She now teaches honors and college prep levels physics, biology and optics electives to 11th and 12th graders at Ellis.

Today student engagement and course success have a number of contributing factors. "Introduction to Optics" course components include hands-on activities based on the discovery model. Goyette gauges the students' interests by what they are attracted to in the technical shops. From LASIK surgery to hair pigments, research-oriented Goyette sends students into every shop looking for practical applications.

Other teachers are enthusiastic that she builds bridges and their students return to shops excited and with more foundational knowledge. By developing an interdisciplinary curriculum, Goyette has helped enrich the shops—an opportunity, she says, that rarely exists in a comprehensive high school.

But what about students who aren't in her course? Goyette recalls feeling daunted as she started to develop the optics curriculum. She is in the process of changing the course name so it is more understandable to those unfamiliar with photonics and to convey the excitement in her classroom. Additionally, and arguably her biggest selling point, she replaced math with hands-on activities. "Teaching physics is hard enough using math," said Goyette, who had found a number of "mathphobic" students. The course still includes algebra and students use it to manipulate formulas without being fixated on math and apply math principals to optics by, for example, examining the line spacing on a compact disc.

With a successful model for an interdisciplinary curriculum approved by the state, Goyette is thinking about how her course could be disseminated to other technical high schools in Conn. using the PHOTON2 materials: "They would need a support system, including professional development [starting at the state level]." Having never envisioned teaching physics, Goyette felt somewhat intimidated by more advanced courses in the discipline. The PHOTON2 introductory workshop she took helped assuage her doubts. Using the PHOTON2

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PBL Grant, continued from page 1

To address the lack of PBL resources in photonics technology education, the PHOTON PBL project has partnered with U.S. photonics companies and university research centers to create eight problem-based learning challenges representing a broad spectrum of optics and photonics applications (see photo of IPG Photonics visit on p. 1). Each multimedia-based PBL challenge will be designed for the typical student to complete in one to four weeks.

Detailed multimedia company solutions will be provided to students at varying points in the problem-solving process depending on skill level to "scaffold" and enhance critical thinking and problem solving skills.

The PBL challenges will include photonics applications such as:

- Environmental sensing
- Machine vision
- Optical science/systems
- Lighting & illumination
- Precision measurements
- Imaging
- Laser materials processing
- Renewable energy
- Medical diagnostics
- Laser beam diagnostics

Project PHOTON PBL has a three-year grant period and builds upon NEBHE's previous projects FOTEP (DUE #9553762), PHOTON (DUE #0053284) and PHOTON2 (DUE #0302528). The challenges will be directly linked to the highly successful curriculum and laboratory materials developed for classroom and web-based instruction in previous projects. So far, these materials have been introduced in more than 80 secondary and postsecondary institutions across the nation. Industry partners will benefit from their participation. By collaborating to develop the PBL challenges, their unique products and services will be analyzed in classrooms throughout the U.S. Additionally, these companies will be able to provide guidance for the scientific and technical content of photonics curriculum, especially how students learn to solve problems and apply their academic and technical skills. By better preparing students, photonics companies will have access to a more diverse pool of U.S.-educated talent from which to draw employees.

A summer 2007 professional development workshop will introduce instructors to the PBL concept, as well as how to introduce PBL challenges to their students. Research will be conducted to determine the effectiveness of PBL compared to traditional instructional methods.

During academic year 2007-2008 and 2008-2009, project participants will field-test the PHOTON PBL challenges. Field-tested challenges will be disseminated by the Optical Society of America, SPIE, New England Fiberoptics Council and other industry associations, through NSF/ATE projects and Centers, conference presentations, a newsletter, the PHOTON PBL website http://www.nebhe.org/photonpbl and other dissemination strategies.

Project Co-PI Nick Massa will be giving a presentation about PHOTON PBL at the Bi-Annual Education and Training in Optics and Photonics (ETOP) meeting, held in conjunction with the Photonics North conference in Ottawa, Canada in June 2007. For more information about Photonics North, go to http://www.spie.org. ■

PHOTON2 Dissemination: A Year in Review

Throughout 2006, PHOTON2 principal investigators traveled across the U.S. educating photonics instructors and students using a number of activities and curriculum materials developed by the PHOTON2 professional development team.

At the American Association of Physics Teachers meeting from March 31 to April 1 at Boston University, PI Fenna Hanes exhibited at a poster session and Co-PI Judy Donnelly presented light and vision "magic demos" to 25 secondary and higher education instructors and college physics students. Most of the demonstrations, such as seeing glass disappear or a "solid" wall vanish, require only inexpensive materials.

Later in April 2006 at the National Science Teachers Association meeting in Anaheim, Calif., Donnelly presented to physics high school and college instructors some of the readily available web-based applets, assembled by herself and Co-PI Nick Massa and used in the PHOTON2 professional development curriculum. Recognizing that participants in a web-based optics laboratory course need instructional support beyond a traditional textbook and written problem assignments, Donnelly explained the context for the applets' uses—ranging from basic physics concepts to pre-lab simulations of experiments that utilize the PHOTON2 lab kit. Donnelly also used the PHOTON2 hands-on lab experiments to illustrate the connection between applet simulation and real-world experience. Many attendees regarded the presentation as the "most useful" of the day and indicated that the PHOTON2 materials would improve their curriculum. One teacher said, "I can't believe I didn't know this existed. We could be doing so much more with our students."

In early May, Hanes and Donnelly exhibited PHOTON2 and Three Rivers Community College (TRCC) posters at the New England Fiberoptics Council (NEFC) annual FiberFest trade exhibition in Marlborough, Mass. The show featured more than 100 vendors serving the fiber optics community and was attended by a variety of regional industry professionals.

In May 2006, 150 fifth graders participating in "System Explorers"—a project of EastCONN—met at the University of Connecticut and Helen Baldwin Middle School in Canterbury. Nancy Magnani of EastCONN invited Donnelly to prepare optics activities for the meet-

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Showcase, continued from page 1

PHOTON2
Showcase Workshop
August 14 - 17, 2006
at the
SPIE Annual Meeting
San Diego, California

SPIE convened more than 5,500 engineers and designers, corporate managers, application and product developers, project managers and technical managers to learn about the latest trends and commercial developments in optical engineering, remote sensing, materials and devices, signal and image processing, illumination engineering, nanotechnology and X-ray optical technologies.

Twenty PHOTON2 instructors and counselors from across the country came together to share with each other and the SPIE annual meeting attendees how they have implemented what they learned during Project PHOTON2 and the "Introduction to Photonics" distance-learning course. They also had the opportunity to visit more than 230 exhibitors in the convention exhibit hall. The PHOTON2 educators and companies working in the optics/photonics industry established valuable connections over the three-day period.

L to R. SPIE President Paul McManamon, PHOTON2 Principal Investigator Fenna Hanes, SPIE Executive Director Eugene Arthurs.

The Showcase workshop commenced with a reception and dinner on Monday, August 14. In addition to the PHOTON2 educators, guests included SPIE Board President Paul McManamon, SPIE President Eugene Arthurs and members of his staff, members of the PHOTON2 National Visiting Board and National Visiting Committee.

The dinner guest speaker was Kristen M. Kulinowski, Executive Director for Public Policy at the Center for Biological and Environmental Nanotechnology and faculty member at Rice University. Her state-of-the-art talk was titled "*Nanotechnology: Managing Potential Risks in a Climate of Uncertainty.*"

Guest Speaker Kristen Kulinowski, Rice University.

SPIE Student Service Coordinator Dirk Fabian presenting to PHOTON2 participants.

PHOTON2 participants in breakout session.

Participants met in breakout sessions to discuss implementation issues and share solutions and challenges.

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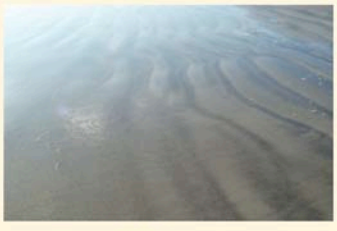
PHOTON2 Showcase Photo Contest

Participants were challenged to submit photographs illustrating any optical phenomenon they observed while in San Diego for the Showcase workshop. Photos were judged by industry mentors who participate in the PHOTON2 email listserv.

First place prize; Donna Goyette, H. H. Ellis Technical High School.



Edd Spidell, Cranston Area Career and Technical Center (left photo) and Chien-Wei Han, Pima Community College (right photo) tied for second place.

For more information about the contest and to view other submissions, go to http://www.lasertechonline.org/photocontest/photocontest.html.

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Each PHOTON2 Showcase participant presented a poster session to describe his/her work. Co-PI Nick Massa interviewed the participants; to view the interviews visit www.nebhe.org/photon2, go to the Showcase Workshop link and click on the name of the school and PHOTON2 participant. Alliance interviews were given by the following educators, each representing a different PHOTON2 Alliance:

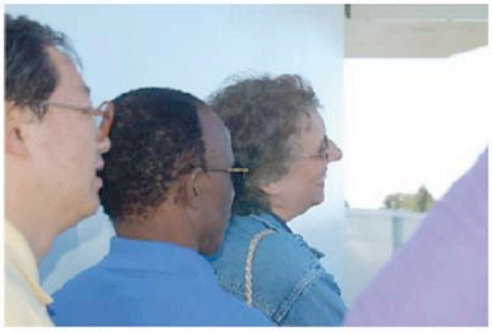
Cranston Area Career and Technical Center, Cranston, RI	Edd Spidell
H. H. Ellis Regional Technical High School, Danielson, CT	Donna Goyette
Kingswood Regional High School, Wolfeboro, NH	Ken Franson
Manchester Community College, Manchester, CT	Negussie Tirfessa
Nashville State Community College, Nashville, TN	Innocent Usoh
New Hampshire Community Technical College at Pease	David Miller
Pima Community College, Tucson, AZ	Chien-Wei Han
Southwest Regional Career Development Center, Bennington, VT	Adrian Sebborn
Sunnyside School District, Tucson, AZ	Yolanda Fernandez-Carr

L to R. PHOTON2 Co-PI Judy Donnelly and Project Evaluator Karen Wosczyna-Birch with Adrian Sebborn, Southwest Regional Career Development Center.

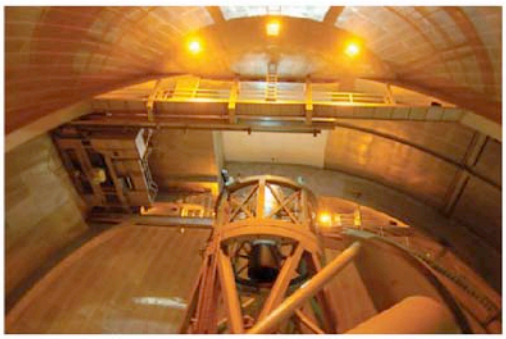
Edd Spidell, Cranston Area Career and Technical Center and Dave Miller, New Hampshire Community Technical College at Pease (in blue shirts) talking with conference attendees.

L to R. Tom Merrell, Kingswood High School/Region 9; Negussie Tirfessa, Manchester Community College; Alfredo Carbonel, Kauai High School; Innocent Usoh, Nashville State Community College.

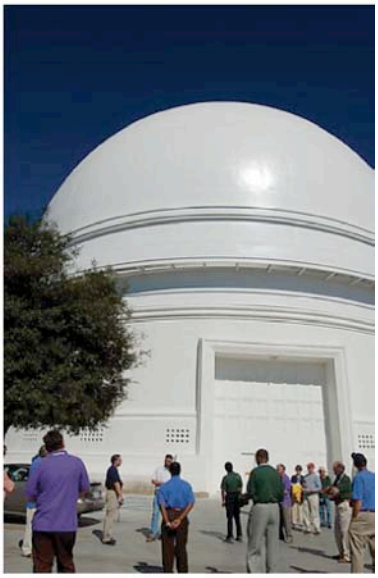
A highlight of the workshop was a field trip to the Palomar Observatory, located in north San Diego County, California. A world-class center of astronomical research, the observatory is owned and operated by the California Institute of Technology (Caltech) and is home to five telescopes used nightly for a wide variety of astronomical research programs. The research is conducted by Caltech's faculty, post-doctoral fellows and students and researchers at Caltech's collaborating institutions.



L to R. Chien-Wei Han, Innocent Usoh and Judy Donnelly on the observatory cat walk, 60 feet off the ground.



View of the top of the dome from inside.



PHOTON2 participants gathered outside the Palomar Observatory dome after a winding two-hour drive up Palomar Mountain.

For more information about PHOTON2 activities and the Showcase workshop, visit www.nebhe.org/photon2. ■

New England Fiberoptics Council Awards Scholarships

In May 2006, the New England Fiberoptic Council (NEFC) awarded merit-based scholarships to seven New England community college students. Each award included a $1000 scholarship for 2006-2007 college enrollment expenses, free attendance at NEFC dinner meetings and free admission to NEFC workshops at the annual FiberFest Trade Show in May 2007.

L to R. Dave Miller, with winners Bryce Carlson and Alex Morrissey.

Since the mid-1990s, NEFC—a regional professional organization committed to promoting the photonics and fiber optics industry—has annually awarded $1000 merit-based scholarships to New England community college students entering their second year in a degree program that includes at least one course in fiber optics technology. Since the scholarship's inception eight years ago, the organization has provided $44,000 in educational funds to regional students.

"A goal of NEFC scholarships is to support the education of talented technicians for New England companies in the fiber optic industry," said Margie Katz, 2006 chairman of the NEFC Board. "With help from the New England Board of Higher Education, we were able to double the number of participating community/technical colleges from two to four institutions this year."

A faculty member from each college nominated the following:

Christopher Moulton of New Hampshire Technical Institute is enrolled in the Broadband Networking & Communications Technology program. He is planning a career as a fiber optics technician.

From the New Hampshire Community Technical College at Pease, Stephen "Alex" Morrissey majors in Information Systems Technology. He hopes to continue working with emerging information technologies and become an instructor in the field.

Norman Lloyd Jr. is in the Laser Electro-Optics Technology (LEOT) program at Springfield Technical Community College (STCC). He has participated in an internship at IPG Photonics in Oxford, Mass. and plans to finish school with a BS in engineering and an MBA.

Emiliana Rivas is also enrolled in STCC's LEOT program, where she found her "calling." She plans to complete her bachelor's degree at Western New England College and work in the laser technology field.

At Three Rivers Community College (TRCC), John Wadsworth III double majors in both the Electrical and Photonics Engineering Technology programs. He has served as the SPIE student chapter president and plans to enter the optics industry.

Also studying in the Photonics Engineering Technology program at TRCC and double majoring in Electrical and Photonics Engineering Technology, Yevhen Rutovytskyy has "a promising future before him," according to faculty member and PHOTON2 Co-PI Judy Donnelly. After Yevhen completes his associate degree in optics, he plans to continue on to a bachelor's degree and eventually a Ph.D. in applied mathematics, as well as a career in image processing research.

In October 2006, NEBHE invited Morrissey and Rutovytskyy to participate in the 13th NSF/ATE Principal Investigator Conference "*Collaborations and Partnerships: U.S. Technicians Driving the Global Workforce.*" Morrissey and Rutovytskyy were among 45 students/alumni of ATE programs who were recognized for their achievement in ATE programs. The conference was held at the Omni Shoreham Hotel in Washington, D.C. More than 800 teachers, faculty members, industry representatives and education administrators participated.

For more information about NEFC and the 2007-2008 scholarship program visit http://www.nefc.com. ■

Darren Galus: A Map for Success

Career Spotlight

PHOTON2 News spoke with Darren Galus of the Harris Corporation about his background, experiences in the fiber optics field and views on career paths in the industry.

What was your introduction to photonics, and how did you get to where you are today?

My first true introduction to the photonics industry was at Springfield Technical Community College (STCC). I decided to attend STCC after reading an article in a local paper about the laser program there. I feel that my contacts within the industry, education I received at STCC, hands-on experience gained at the NSF/ATE-funded National Center for Telecommunications Technologies (NCTT) and my strong work ethic have advanced my career to the level it is today.

What were some of the critical turning points that made you into the successful Engineering Specialist in electro-optics that you are today?

Working as an intern at NCTT for then Professor Nick Massa was a huge defining point in my career. His vast network of contacts helped me find my first two jobs after college, which were at Sandia National Laboratories and Qtera Corporation, a subsidiary of Nortel Networks.

What are you currently doing at Harris Corporation?

I work on various classified government programs as well as a Free Space Optics program at the Kennedy Space Center in Florida.

What academic background do you think high school students need to be successful in a photonics technology associate degree program and the workforce?

First, I think they need a strong base in algebra and an introduction to calculus. Second, they should have had a course in physics.

Where do you see the job opportunities for high school and community college students in this field?

I see little-to-no technician-level opportunities for students with only a high school degree. However, gaining a science/technology background that includes optics/photonics in high school is a very helpful building block. It will give students a solid educational foundation and open the door to a career in demand. With good contacts and a strong work ethic, a student from a community college can achieve a very fulfilling and successful career.

What do you see as the current economic climate in the field of photonics?

The field is constantly growing with new applications arising every day. The forecast is for a rapidly growing market, especially in the defense sector.

Darren Galus doing setup for a Free Space Communications link test at Shuttle Landing Facility at Kennedy Space Center.

What are your plans for continuing your education?

I am currently working towards my bachelor's degree in Optical Engineering at the University of Central Florida, where I have been teaching graduate students about work in Free Space Laser Communications.

Do you have any other thoughts?

With today's growing workforce, it is vital to have the hands-on experience acquired at a two-year college like STCC. This, coupled with a four-year degree from a university, will contribute to a long and successful career in the photonics industry.

Darren Galus' mentor Professor Nick Massa is a Co-Principle Investigator for Project PHOTON2 and PHOTON PBL. Massa is now associate dean for the School of Technology at Central Connecticut State University. ■

Tech. High School, continued from page 2

lab kit and working with her peers helped propel her success. "It wouldn't have been possible without PHOTON2 support. Knowing someone was backing me up...that in itself has been invaluable."

Goyette is excited about providing that support to other schools. She recognizes that her research background could be valuable for teachers who do not share it. Whether explaining ways to team up with guidance counselors or how cross curriculum can be developed for any subject, Goyette has found her niche in the PHOTON2 Alliance and H. H. Ellis Technical High School.

The next challenge for Goyette is how to bring industry into the classroom. Currently there is no advisory committee for that. Because academics receive a different kind of support than the technical shops, she and the Ellis administration will need to shift gears to partner with industry. It will be one among many of Goyette's steps in the right direction.

Donna Goyette can be reached at Donna.Goyette@ct.gov. ■

Dissemination, continued from page 3

ings. Using the PHOTON2 curriculum, students constructed spectroscopes, investigated the Magic Box and examined refraction and lenses using low-power lasers and Jell-O®. Magnani's team of teachers joined Donnelly in presenting to the students. In September, Donnelly and Magnani held a professional development workshop for 24 Connecticut teachers based on the same activities. Donnelly and Magnani will present a paper at the June 2007 Education and Training in Optics and Photonics (ETOP) meeting, held in conjunction with the Photonics North conference in Ottawa, Canada in June 2007.

On October 12, more than 100 teachers attended Donnelly's exhibit at Science Educators' Day: Optics in the Spot Light (E'Day), part of the Optical Society of America's Frontiers in Optics 2006 conference in Rochester, NY. Donnelly gave away 20 "Introduction to Photonics" sample CDs and received requests from more than 25 other teachers.

Days later, Donnelly held a PHOTON2 Explorations Workshop for teachers and counselors whose students were attending the Coast Guard Academy's Girls and Technology Expo, sponsored by the Connecticut Women's Educational and Legal Fund. Each attendee received the PHOTON2 sampler CD and most said they would try some or all of the activities with their classes.

PHOTON2 broadened its outreach this spring by recruiting a new cohort of high school and college instructors, who are now participating in the PHOTON2 one-semester distance-learning course "Introduction to Photonics." The course, offered through the TRCC Continuing Education Division and delivered by the Connecticut Distance Learning Consortium, is co-taught by Donnelly and PHOTON2 participant Donna Goyette. The course quickly filled up with 22 educators from Alabama, Connecticut, Hawai'i, Illinois, Iowa, Massachusetts, Michigan, North Carolina, New York, Ohio and Romania. Hanes will give a presentation describing collaboration with Romania at the 2007 ETOP meeting.

The PHOTON2 professional development team has worked with middle school, high school and college instructors nationwide since 1995. ■

PHOTON2 NEWS

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