**Future Photon Initiative combines science and technology research to create powerful synergy**

By Jane E. Sutter

*Are we alone in the universe? How does the human brain develop? Can we extend the lives of breast cancer survivors? Can we “see in the dark” and through obstructions to ensure national security? Partners in the Future Photon Initiative hope to develop new photonic devices to pursue the answers.*

**Solving pressing problems**

Photonics is the field of technology that uses photons to process information or energy. Around the RIT campus, significant photonics research already takes place. The Center for Detectors develops next-generation detectors in a facility that rivals that of major space agencies. The NanoPower Research Laboratory designs and fabricates advanced photovoltaic devices. The Nanophotonics Group is leading the design, fabrication and characterization of integrated photonic chips. And that’s but three examples.

The Future Photon Initiative (FPI) will leverage RIT’s unique assets to develop advanced photonics, which represents the cutting edge of the field of photonics, with the ultimate goal of becoming one of the most effective applied photon research and development centers in the world.

Don Figer, director of the Center for Detectors, will lead the Initiative. “We’ve always had the idea to bring together the researchers to address the bigger problems” the world faces related to U.S. competitiveness and national security, he said. Initially, FPI will develop devices for: advanced manufacturing, communications and information technology, defense and national security, energy, and health and medicine.

Some of those big questions, Figer cites: “Are we alone in the universe? What is dark energy and dark matter?” and others listed at the beginning of this article. “The odd thing about these questions is they don’t seem to be related but they all overlap in the technology that’s needed to address them,” according to Figer.

FPI will apply and commercialize the efforts of existing RIT groups who develop technology for the generation, transmission, manipulation, absorption, and detection of photons.

**Leveraging success**

Being awarded $1 million in funding from RIT will provide the resources needed to take the individual research groups and transform them into an internationally recognized Initiative, Figer said.

Key to that is analyzing the areas of expertise that RIT currently has on its research faculty and identifying gaps that exist. Also important is analyzing a list of potential customers (ranging from NASA to Department of Defense) in order to target opportunities for funding and possible expansion, Figer said.

An assistant director will be hired to be the liaison between researchers and the industry, federal agencies, New York state, and non-profit organizations. “We think we could significantly increase funding for research,” Figer said. The most important long-term goal is to obtain funding to create a national photon device center. The total external funding goal for the Future Photon Initiative is $100 million within five years.

This RIT research initiative will be able to capitalize on opportunities, including funding, related to the American Initiative for Manufacturing of Photonics (AIM Photonics), a public-private partnership announced in 2015 in which RIT is a Tier 1 academic partner. Rochester is getting $610 million in federal, state and private funding to create a national photonics center.

**Impressive support**

“One of the measures of our emergence as international leaders is the strength of the letters of support in our proposal” to RIT for funding the Future Photon Initiative, Figer said. Organizations and businesses such as NASA, the U.S. Army and Air Force, Raytheon, Nikon, Intel and Harris enthusiastically endorsed the proposal, and in some cases, cited the opportunity to work with or continue to work with RIT.

“A number of our research groups are(?) already working with NASA,” including in the field of infrared detectors, Figer noted. “But NASA has many interests…We can become an entity that could be a think tank for NASA.” The NASA letter of support specifically mentions the potential collaboration on areas such as high speed lasers and optoelectronics.

**Specific R&D**

The Future Photon Initiative will focus on four specific areas for research and development.

* **Integrated Photonics**

Stefan Preble, director of the RIT Nanophotonics Group, is in charge of the integrated photonics work. Integrated photonics will likely be key to computing in coming decades. Through the FPI, Preble believes revolutionary advances in photon science and technology can be made.

“The goal is to be able to process every photon. Light is made up of photons and it’s very important you don’t lose any of those. You want to get all the information you can from these photons.” That’s difficult to do at this point, Preble said.

A key theme will be the exploitation of the quantum properties of photons and matter to eliminate tradeoffs in speed, efficiency and noise. “By moving to quantum-limited regime … in the laser, the wave guide, the detector, essentially you’re able to have much higher performance than is possible in classical technology,” Preble said. “As a result that shift helps us to answer those big questions.”

* **Scaled Electronics**

Bruce Smith, director of RIT’s microsystems engineering doctoral program, leads this area, which focuses on microelectronics, “making devices smaller and smaller beyond the wavelength of light itself. We’re talking about building features in electronic devices that are a tenth of the wavelength of visible light or a tenth of the wavelength of the light you use to image them. That requires huge challenges…going beyond the traditional predictive scaling laws,” Smith said.

Having the Initiative to partner with big businesses and huge consortiums is key. “More than ever now what these new grand challenges require is thinking about these things coming from different directions, and the collaborators collaborating with folks that are involved in different technologies is extremely important as we move to new technology, especially on the micro and nanometer scale,” Smith said. “We’re working to collaborate with as many partners as we can because these challenges aren’t anything that can be resolved with one discipline or one group.”

* **Photovoltaics**

Seth Hubbard, director of RIT’s NanoPower Research Laboratories, has overall responsibility for the energy area of the FPI. The United States and other countries have identified sustaining the energy supply as a high priority, according to Hubbard. His research focuses on photovoltaics, specifically “getting more photovoltaics into electronics for electricity and doing that in a very cost effective manner.”

Solutions will require “scientific breakthroughs and truly revolutionary developments,” according to the proposal. Hubbard, Preble and Figer already have been collaborating for a number of years, and plans call for a multi-disciplinary and multi-talented team of scientists and engineers with the goal of developing breakthroughs to advance the state-of-the-art in device efficiency and lower the cost of conversion of light to electrical energy.

While Hubbard has already developed collaborative relationships with a number of businesses over the years as a result of joint government funding, he believes the Future Photon Initiative will give the name recognition to be able to expand that.

* **Detectors**

Two of the most exciting application areas for detectors are astrophysics and biophotonics, according to Figer, who oversees this area in his role as head of the Center for Detectors. The Center, which is one of the most well-funded astronomical detector programs in the world, currently is leading development programs for both single photon counting detectors and also large format infrared detectors. The Future Photon Initiative will leverage these developments for future astrophysics missions.

In the field of biophotonics, fast low-noise detectors are crucial for the development of next-generation biophotonic instruments. Ultimately, these instruments can help answer big questions such as how to extend the lives of breast cancer survivors and how to study brain hematomas in infants, Figer said. There is interest in hiring a principal investigator faculty member for this area.

**Commercializing research**

Taking the outcomes of research and turning them into viable patents and products is a key goal of the Initiative. Richard DeMartino, director of the Simone Center for Student Innovation and Entrepreneurship, believes the commercialization of research coming out of RIT can be magnified to a much greater extent. “I think we just scratched the surface of what we can do” when it comes to taking photonic technology and building a business around it. As a former board member of the Rochester Regional Photonics Cluster and the author of several journal articles on commercializing photonic or optical technologies, DeMartino is well aware of the opportunities.

While several companies, most notably Pictometry, have been spun out from imaging science and photonic research at RIT, DeMartino noted that often in academia this process of exploring commercialization opportunities isn’t built in systemically. That won’t be the case for the Initiative.

Researchers will take advantage of the fact that RIT is an Innovation Corps (I-Corps) site designated by the National Science Foundation. I-Corps is a public-private partnership program that teaches grantees to identify valuable product opportunities that can emerge from academic research, and it offers entrepreneurship training to participants.

“This is a process that is specifically developed for science and technology where they work with scientists and coaches to help them understand the commercial value and push forward commercial opportunities,” DeMartino said.

Teams that have developed a photonic-related output will participate in the I-Corps program. Through seminars and meetings with coaches, Future Photon Initiative researchers and students will “explore if there are real customers for what they have and see if there’s a business that can be developed from that,” DeMartino said.

**Growing RIT’s reputation**

To ensure the Initiative has an effective communications strategy, the Vignelli Center for Design Studies will collaborate with it.

“We have expertise that can help this initiative in terms of establishing a coordinated, integrated, visual communications program,” said R. Roger Remington, Vignelli Distinguished Professor of Design.

Remington will work with Figer and the Initiative colleagues. “The first phase we’ll be involved with will be a phase of analysis and fact finding, and that will lead us to the place of trying to develop some specific strategies for the Initiative’s terms of communicating to its audiences and having a new face to use for internal and external publics. And then once we have a consensus on a direction with this, we will begin to work with them in terms of specific applications such as websites and promotional literature.”

As an example of a similar collaboration, Remington cites the Design Center’s work with the RIT Global Collaboration Grid -- video conferencing technology that creates a virtually connected global community.

**Powerful synergy**

A team of 16 researchers and professors currently make up the Future Photon Initiative, and the excitement is palpable.

“Each of us as an individual principal investigator has been trying to grow our reputation for the last 10 years,” Hubbard said. “You get hired to the faculty and you start growing your reputation nationally and internationally in a very specific field. Now that we can bring all of us together, I feel that the whole is better than the sum of the parts. So we can have a very strong Initiative that’s recognized in many different fields not just photovoltaics but from things such as solar energy through detectors, silicon photonics, bio-device industries, it’s a huge swath. We can get increased name recognition with this Initiative.”