# Phiar Adding New High-Speed Waves To Electronics

University of Colorado

## Phiar Corp.'s quantum tunneling technology is centered around the idea of electrons as "waves" rather than "particles."

Garret Moddel considers an unfinished tuna salad in California one of the best lunches of his life.

"It was at a presentation to the investors of Menlo Ventures on our technology," says Moddel, the co-founder, chairman and CTO of Phiar Corp. in Boulder, Colo.

"I told them we might have a whole new platform technology. In a way, just as vacuum tubes gave way to semiconductors about 50 years ago, now perhaps we have the potential for semiconductors to give way to something that is newer, faster, more easily integrated and cheaper.

"I remember I ordered tuna salad. I couldn't eat it because I was talking. After I was done with the presentation, Mark Siegel, one of the managing directors, says, 'We'll get back to you' and told me I could go into the next conference room to finish lunch. I sat down to eat my tuna salad and about halfway through it, Mark came into the room and says, 'We're going to fund you.' So I never did finish the tuna salad."

That led to $9.3 million in venture funding for Phiar, which officially opened on July 2, 2001. Today, the company employs 16 people. The company has a partnership with Motorola, which could become a major purchaser of the technology. It recently moved to a 10,000-square-foot facility that includes a clean room, testing and development labs, as well as office space.

Phiar's Technology: Less Costly, Much Faster

Phiar is developing components for what the company describes as "true monolithic integration of high-frequency electronic and electromagnetic-wave functions onto silicon chips and other substrates."

> *Phiar's metal-insulator technology replaces costly hybrid semiconductors and extends the functions to higher frequencies.*

The company is implementing this concept as practical components — diodes, detectors, transistors, varactors, modulators — to provide a full suite of low cost, ultra-fast, integrated components for building high-frequency electronic and terahertz (THz) wave circuits and systems.

Quantum tunneling is the basis of Phiar's technology. At the heart of the phenomenon is the quantum mechanical notion that electrons are "waves" rather than "particles."

Phiar remains focused on research and development. At the time of publication, the company did not have commercialized products for sale. Diodes and detectors will be the first Phiar products to market, followed by transistors and other devices, culminating in transceivers. The company expects to have its diodes and detectors in production in 2007. The company targets 2008 for production-ready transistors for transceivers.

**Growth Opportunities**

Potential applications for the technology seem almost unlimited. "The term 'platform technology' has been abused," says Adam Rentschler, director of business development. "But Phiar's is truly a platform technology. Metal-insulator electronics will impact everything from aircraft landing assistance and improved airport security screening to wireless consumer electronics and adaptive cruise control for cars.

"The radar and imaging applications for our technology are very exciting. An example is aircraft landing assistance imaging that sees through clouds, fog or smoke. There are applications for security screening. The idea here is you can shoot safe, non-tissue damaging waves at people. The screening will reveal things missed by metal detectors like ceramic knives or plastic explosives.

"On the automotive radar front, we are not doing anything that can't be done today with other solutions, but we can reduce the costs of these systems by about a factor of 10. If auto makers can get their costs down from about $1,000 to let's say $100, all of a sudden you're going to see these systems — today found only in luxury vehicles — popping up on KIAs and Hyundais."

Wireless data transfer is another potential application. "The promise is putting five DVDs of data on an iPod in two seconds," Rentschler says. "When the supporting technology in hard drives and flash memory catches up with us, this will be a reality. We'll also be able to stream 50 channels of uncompressed high def TV simultaneously." The technology has potential applications in medical imaging and other fields.

**The Birth of a Start-up**

Moddel, who is on the faculty at the University of Colorado at Boulder (CU), has been interested in startup companies since the early years of his career, when he was part of a solar cell startup in California.

"When I first graduated from grad school, I went to a little Silicon Valley startup company," Moddel says. "We wanted to make solar cells and paint the world with solar technology and reduce the power of the oil companies. It was very idealistic. It was fascinating, and we developed a lot of technology, but we really had no markets. I learned a lot about what to do and what not to do with startups. I probably got the bug then."

Moddel remained interested in solar cells and in the potential of metal-insulators while at CU. He and a grad student, Blake Eliasson, who now is director of engineering for Phiar, worked long and hard on the technology.

The team ran into a challenge: single-insulator diodes were not efficient enough. Eliasson had a novel solution: Two insulators (rather than one), can be engineered to form a quantum well in the middle of the device, greatly enhancing performance.

Attorney Steve Shear, Moddel and Eliasson decided to start a company to explore the breakthrough. That led Moddel to that memorable "non-lunch" at Menlo Ventures.

After many months of negotiations with the CU, Moddel simultaneously inked deals with Menlo Ventures and CU's Technology Transfer Office.

Moddel served as Phiar's CEO for four years. During his tenure, Phiar grew from three to 10 employees and raised the $9.3 million in venture capital.

In May 2005, Moddel stepped aside as CEO and Goodman was hired. To date, Goodman has successfully negotiated the Joint Development Agreement and Intellectual Property Agreement with Motorola, moved the company to the 10,000-square-foot fabrication and testing facility and continues to strengthen the team with top talent.

Partnerships between startups and universities have become keys for technology development. "Tech transfer has come a long way at the university," Moddel says. "They have been very helpful. Now if you want to do breakthrough technology, it's at universities and startups. It's a different culture and the economy has changed."

Tom Smerdon of the Office of Technology Transfer at CU, says Phiar was one of several startups that began with ties to the university. "It's been making fine progress on development," Smerdon says.

Partnerships like Phiar's with Motorola are another key. "That sort of makes us real," Moddel says.

"We view the metal-insulator technology from Phiar, combined with Motorola's technology and expertise, as being an innovative approach to potentially providing the device speeds that will be required in future generations of wireless, radar and imaging solutions provided by Motorola," says Vida Ilderem, vice president and director of the center of excellence for embedded systems and physical sciences research, Motorola Labs, in a press release when the partnership between Phiar and Motorola was first announced.

And, of course, the venture capital from Menlo Ventures was another key —
even if Moddel never did finish that tuna salad.

This story was originally published in 2007.