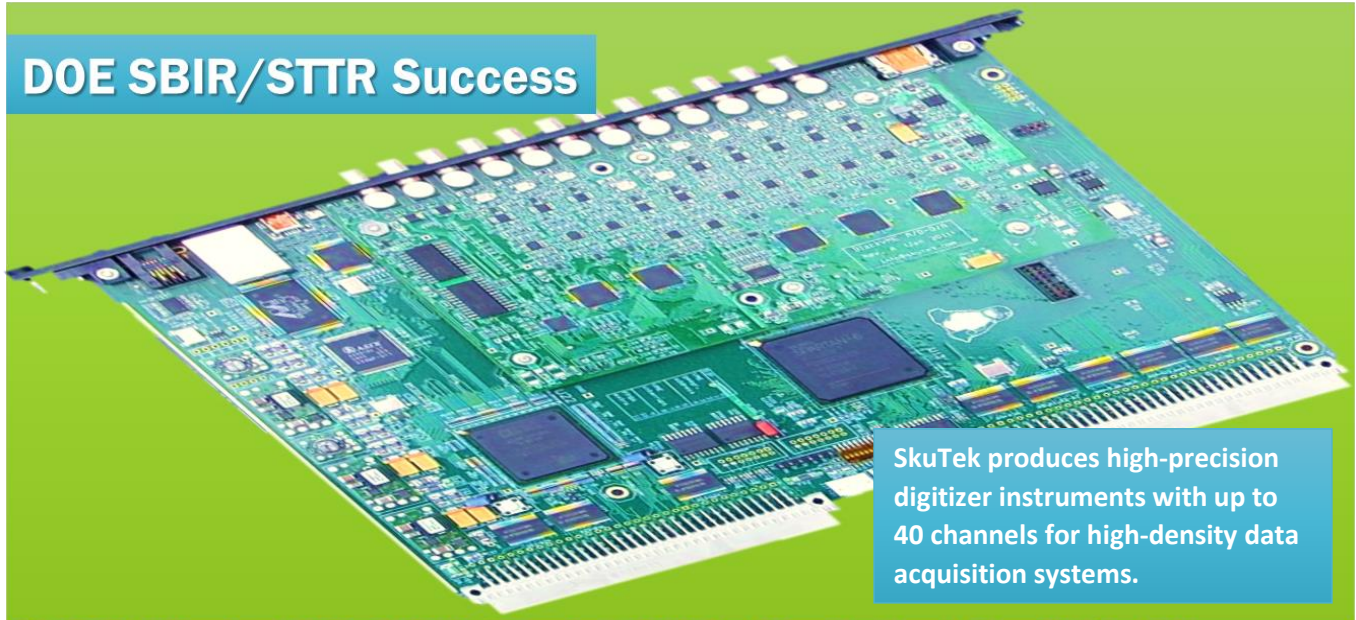


## DOE SBIR/STTR Success



SkuTek produces high-precision digitizer instruments with up to 40 channels for high-density data acquisition systems.

# SKUTEK INSTRUMENTATION

**S**kuTek had an exciting and unusual beginning as a company, which perhaps is not surprising in the world of experimental physics startups. It was founded in 2000 by Wojtek Skulski and his wife Joanna while Dr. Skulski was working at the University of Rochester on the PHOBOS experiment, carried out at the Relativistic Heavy Ion Collider (RHIC) located at Brookhaven National Laboratory (BNL). PHOBOS, an experiment devised to search for the formation of Quark-Gluon Plasma (QGP) recreating the scenario that occurred at about a micro-second after the Big Bang, was in need of a critical upgrade to improve the time-of-flight resolution, which is a critical parameter in discriminating elementary particles of different mass.

## FACTS

### PHASE III SUCCESS

While SkuTek is still completing a Phase IIB DOE SBIR award, its high channel density digitizers have already yielded \$ 78 k in non-SBIR funding, \$ 71 k in sale revenues and \$ 674 k in a pending purchase order.

### IMPACT

SkuTek's LZ multichannel digitizers address a need for cost-effective, high-density data acquisition for the newest generation of experiments in both nuclear and high energy physics.

### DOE PROGRAM

Nuclear Physics (NP).

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The signals from the T0 counters, which provide the time-start definition for the particle showers in the collider, were offset due to the signal travelling through long cables. Dr. Skulski developed an electronic board where time alignment would be performed electronically by computer control, thus solving the problem<sup>1</sup>. He subsequently formed SkuTek so that BNL could buy from the newly founded company all the Time Equalizer boards needed for the PHOBOS operation over the years.

The Time Equalizer board solved an urgent problem and saved the PHOBOS physicists significant effort, which would have been lost by shutting down the beam had the time-zero signal alignments been performed manually every few weeks.

After PHOBOS, SkuTek moved on to digital signal processing technology and started developing multichannel digitizers, which address a need for cost-effective, high-density data acquisition (DAQ) in nuclear physics, high energy physics, and nuclear astrophysics experiments. SkuTek instruments process signals produced by gamma-ray and particle detectors by converting the analog voltage to digital samples and extracting pulse's characteristics such as height, area, and shape, with high energy and time resolution. An early prototype with 8 channels was developed with help from a Phase I award from the Department of Energy (DOE) in 2003. However, it was only by 2014 that SkuTek was able to leverage significant SBIR funds for further development of its digitizers. The funds were awarded by the DOE Nuclear Physics (NP) Program through a Phase II and then a sequential Phase IIB, which will conclude in 2019.

SkuTek's interest in digitizer designs is tied to exciting scientific achievements during Dr. Skulski's work on the Large Underground Xenon experiment (LUX)<sup>2</sup>. LUX is a two-phase (liquid/gas) xenon time projection chamber designed to detect nuclear recoils resulting from interactions between dark matter particles and ordinary matter. SkuTek electronics for online real time triggering was one of the key contributions to the LUX operation, establishing the most stringent limit on Dark Matter interaction cross section at the time of the experiment, in 2015. The LUX trigger was also a very inexpensive system when compared to typical equipment cost in the field of high energy physics. In addition, it is important to note that although the LUX trigger did not have much of a monetary return on investment, it had a major scientific impact in the quest to unravel the biggest mystery in modern physics, which certainly qualifies as a success for the SBIR program and the DOE.

Later on, the same electronics used for the LUX trigger was applied to develop similar digitizers, which were purchased by the University of Rochester and deployed for educational purposes in the University's Advanced Nuclear Science Education Laboratory (ANSEL)<sup>3</sup>.

Finally, SkuTek received \$ 78 k in non-SBIR development contracts over two years for further development of the highest tier digitizer with 32 and 40 channels. The 32-channel devices are being employed in another large fundamental physics project on the detection of Dark Matter, the LUX-Zeplin (LZ) project, which passed the DOE review and approval stage in 2017 and stems from the collaboration between 250 scientists in 37 institutions in the U.S., U.K., Portugal, Russia, and Korea. These high channel density digitizers, which target the newest generation of experiments in both nuclear and high energy physics brought SkuTek sales revenues of \$ 71 k and a pending purchase order of \$ 674 k. The latter are

significant returns when considered that SkuTek has not yet completed its Phase IIB award on this technology.

Dr. Skulski acknowledges that the SBIR program was crucial to SkuTek's progress in several ways. The SBIR funds allowed SkuTek's team to grow from 2 people to the present size of 4 full-time employees, two interns, two part time employees, and a regular consultant. "It would be much harder to hire and retain talent without SBIR funding", Dr. Skulski explains. In addition, as an SBIR recipient, SkuTek gained significant credibility among peers. In Dr. Skulski's own words "We are treated as a serious partner when people hear the word SBIR. It is hard to quantify the effect, but it is real." Finally, Dr. Skulski recognizes another beneficial aspect of an SBIR grant, which is seldom acknowledged: The opportunity to attend meetings organized for the awardees by the funding programs, in the case of SkuTek, the NP Exchange Meetings held annually for Phase II awardees. As Dr. Skulski states, "the meetings have an important function as they allow the different companies to meet each other and exchange knowledge. I was able to make important connections and I learned a lot."

*Written By Claudia Cantoni, Commercialization Program Manager, DOE SBIR/STTR, January 2018.*

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<sup>1</sup> <https://www.bnl.gov/phobos/Detectors/T0Counters/T0Upgrade/T0Upgrade060602WEB/sld001.htm>

<sup>2</sup> <https://arxiv.org/abs/1511.03541>

<sup>3</sup> <https://www.pas.rochester.edu/undergraduate/courses-phy.html>