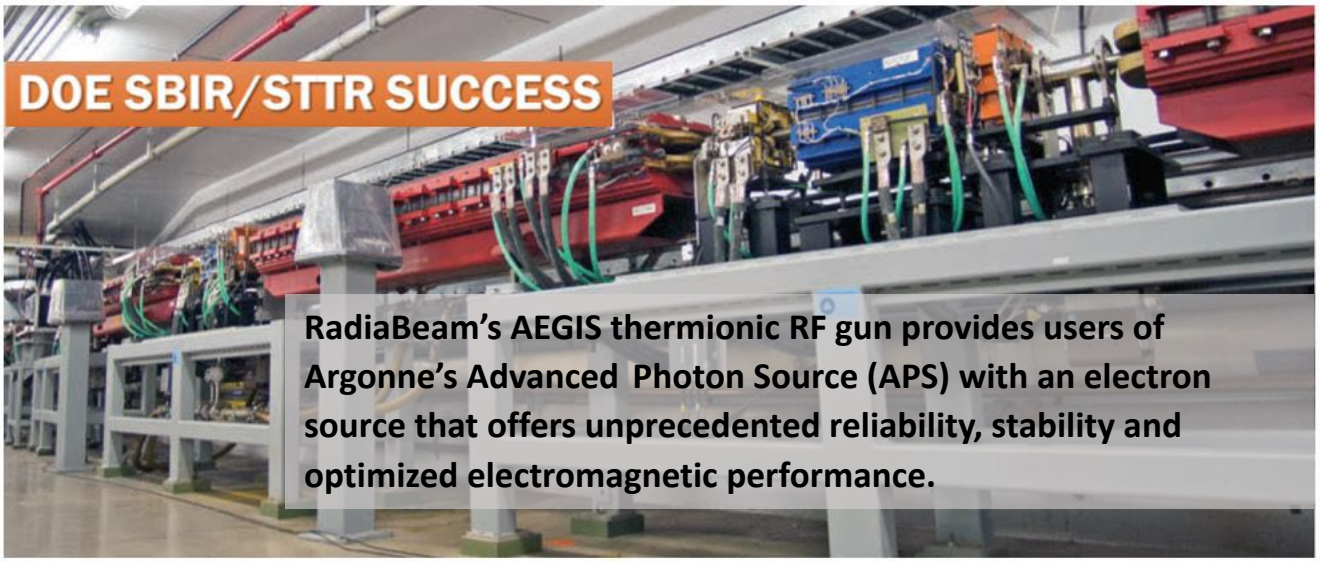
AMERICA'S SEED FUND SBIR·STTR

U.S. DEPARTMENT OF ENERGY | SBIR/STTR Programs Office



RADIABEAM SYSTEMS

The Advanced Photon Source (APS) operated by Argonne National Laboratory (Argonne) provides high brightness x-ray beams to over 5,000 researchers each year enabling scientific discoveries in materials science, biological and life sciences, earth science, chemistry, environmental science, physics, and polymers. The Office of Basic Energy Sciences (BES), within DOE's Office of Science, is responsible for current and future synchrotron radiation light sources. In 2017, BES issued a topic specifically focused on the development of robust microwave thermionic guns to enhance light source user facilities and enable future upgrades. Partnering with scientists at Argonne's APS facility, RadiaBeam responded with a proposal to develop an RF gun to solve urgent reliability, control, and performance issues with the existing RF guns. Issues that threatened to suspend APS operations.

FACTS

PHASE III SUCCESS
Delivering the first Aegis thermionic RF gun in 2019, Argonne purchased two additional units in 2021. RadiaBeam is currently working with industry partners to explore two high potential commercial applications.

IMPACT
RadiaBeam's Aegis RF gun delivers unprecedented reliability, stability, and performance to APS users.

DOE PROGRAM
Office of Basic Energy Sciences (BES)

https://radiabeam.com/

Named after the mythical shield carried by Athena and Zeus, the Aegis thermionic RF gun (Aegis) is a direct result of RadiaBeam's Fast Track DOE SBIR award (DE-SC0015191). Designed to meet stringent APS requirements, the Aegis provides not only improvements in RF design, thermal engineering, cathode mounting, and manufacturing processes but also exceeded expectations with quality metrics showing a factor of two improvement over previous thermionic RF guns.[1] Further, it can support operation to 5 MeV with 5 MW of input power even though it was designed for 3 MeV operation.

The Aegis was designed to be a market-ready, stand-alone product from inception. RadiaBeam simplified the design eliminating over 50 components in the process reducing cost and complexity. Further design modifications eliminated the issues with misalignment in the incumbent gun designs ensuring that the Aegis can be reliably centered for long-term operation. The prototype was delivered to the APS in 2019 where it was qualified at the Injector Test Stand (ITS) facility before being installed as one of the two injectors feeding the APS where it was used to provide the beam for APS storage ring operation for 9 months without interruption. As further testament to APS satisfaction, RadiaBeam received a Phase III contract from Argonne for two additional Aegis guns in 2021.

Given the design of the Aegis and interest garnered from industry, RadiaBeam is working to incorporate it into turnkey systems for industrial applications: a high average power table-top THz source being developed in collaboration with UCLA; and an industrial system for non-destructive testing (NDT) of power plant components under development with an established NDT player.

Founded in 2004, RadiaBeam is a spin-off of an accelerator research group at UCLA and has grown to become a major player in advanced applications of particle accelerator technology. Backed by nearly 20 years of expertise in microwave and accelerator design and manufacturing, RadiaBeam offers advanced solutions for a variety of industries including cancer radiation therapy, medical sterilization, non-destructive testing, and cargo inspection, as well as "big science" research facilities.

Today, RadiaBeam has multiple commercial products in production, including OEM medical linacs and high power linacs for food irradiation and medical device sterilization. In 2021, the company expanded into non-destructive testing (NDT) services, using its in-house variable energy linac to perform digital radiography and computed tomography of aerospace components. RadiaBeam manufactures its products in its 35,000 square feet facility in Santa Monica, which includes a state-of-the-art machine shop and extensive testing capabilities.

During 2021, RadiaBeam had multiple manufacturing achievements:

- Designing and manufacturing of two industrial linacs for a food irradiation customer.
- Manufacturing of multiple medical linac systems for radiation therapy.
- Designing and manufacturing high power, high gradient linacs for a defense contractor.
- Using a proprietary RadiaBeam design to manufacture a state-of-the-art RF photoinjector system for a German accelerator laboratory.
- Designing and manufacturing novel hybrid photoinjector for a DARPA funded initiative.

[1] S.V. Kutsaev et al., "Thermionic microwave gun for terahertz and synchrotron light sources", Rev. Sci. Instrum. 91, 044701, 2020. Featured paper.

- Supporting its medical spinoff with delivery of a prototype robotic radiation therapy system at UCLA Center for Health Sciences.

Many of RadiaBeam's commercial innovations resulted from SBIR awards, fulfilling DOE's mission to increase U.S. competitiveness and address our "energy, environmental and nuclear challenges through transformative science and technology solutions." In fact, RadiaBeam was recognized as the 2021 DOE SBIR/STTR Small Business of the Year award for their successes in commercializing innovations in particle accelerator technology deriving from DOE SBIR/STTR funding.

According to Salime Boucher, CEO of RadiaBeam, the company's business success has been a direct result of their participation in the DOE SBIR/STTR programs; "our SBIR awards provide the time and resources to pursue science that would otherwise not be possible – any new accelerator technology comes from government funding. This outcome is an excellent example of how the DOE SBIR/STTR program should work ideally," he explains. "The government invests in high risk R&D to keep America more competitive. The company receiving the funds then commercializes the innovation selling both to research facilities like Argonne and industrial markets providing ROI for the original funding."

When asked about advice he wanted to share with other SBIR/STTR awardees, Boucher offers these three tips: (1) his biggest lesson learned was learning the difference between technology push and market pull - customer discovery needs to be done early as soon as you have the idea not once you have a prototype; (2) working in the accelerator community it is important to collaborate with the national labs - APS was engaged with RadiaBeam throughout the project providing real-time, high-quality feedback on the design, tested and qualified the prototype purchasing additional units upon qualification; and (3) constantly be looking for commercial opportunities and then use your SBIR/STTR dollars to bring those commercial products to fruition.

Prepared By Carol Rabke, Tech to Market Advisor, DOE Office of SBIR/STTR Programs, August 2022.