

# High Precision Integrated Beam-Position and Emittance Monitor

CRADA No.: SLAC-275

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*SLAC National Accelerator Laboratory, Stanford University, Stanford, CA 94309*

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**Research Partnerships & Technology Commercialization**

*Please provide as much info as you wish on this MS Word form and email completed form to  
rptc@slac.stanford.edu*

**CRADA Final Report****Date** 11/16/2018**PM** Dr. Christopher Nantista**CRADA No.** SLAC-275

1. Parties:  
(Identify Parties to the CRADA)  
FAR-TECH, Inc. and SLAC
2. Title of the Project:  
High Precision Integrated Beam-Position and Emittance Monitor
3. Summary of the specific research and project accomplishments:  
(Were the goals of the CRADA achieved? Include relevant information but do not include proprietary or protected CRADA information.):  
The purpose of this project was to design and build a set of resonant cavity beam diagnostics including a monopole cavity, two dipole cavities, and a quadrupole mode cavity. An array of such diagnostics placed in an accelerator FODO lattice can be used to reconstruct beam emittance and envelope information on a pulse-by-pulse basis. In this project a more efficient quadrupole cavity shape was discovered which could provide the required sensitivity with just two cells vs. nine cells as originally envisioned. This new design was studied and optimized with RF simulation programs, followed by mechanical specifications and drawings, and fabrication of the diagnostics. The device was tested with a relativistic electron beam at Brookhaven National Laboratory ATF accelerator.
4. Deliverables:

Deliverable Achieved	Party (SLAC, Participant, Both)	Delivered to Other Party?
RF redesign and mechanical drawings	both	yes
Fabricate device	participant	—
Network analyzer & wire tests	both	yes
Beam test & analysis	participant	—

5. Identify publications or presentations at conferences directly related to the CRADA.

- Jin-Soo Kim, Roger Miller and Christopher Nantista “Design of a Standing-Wave Multicell Radio Frequency Cavity Beam Monitor for Simultaneous Position and Emittance Measurement,” Rev. Sci. Instrum. 76, 073302 (2005); SLAC-REPRINT-2005-138.
- J.S. Kim *et al.*, “Resonant-Cavity Approach to Noninvasive, Pulse-to-Pulse Emittance Measurement,” Rev. Sci. Instrum. 76, 125109 (2005); SLAC-PUB-11570.
- N. Barov *et al.*, “High-Efficiency Resonant Cavity Quadrupole Moment Monitor,” contributed to the 2006 Advanced Accelerator Concepts Workshop, Lake Geneva, WI, July 10–15, 2006; SLAC-PUB-12453.

6. List of Subject Inventions and software developed under the CRADA:  
(Please provide identifying numbers or other information.)  
US patent 7,276,708  
No software.

7. A final abstract suitable for public release:  
(Very brief description of the project and accomplishments without inclusion of any proprietary information or protected CRADA information.)  
High energy particle accelerators require a sophisticated array of beam diagnostics to maximize beam quality and facilitate beam tune-up. This project involved the development of a set of non-intercepting resonant cavity based diagnostics that can be used to analyze the beam shape and infer beam quality. These diagnostics were built and successfully tested with a high energy electron beam at Brookhaven National Laboratory.

8. Benefits to DOE, SLAC, Participant and/or the U.S. economy.  
Advancing beam diagnostics technology for particle accelerators and supporting U.S. R&D capabilities in this field, both at national laboratories and in industry.

9. Financial Contributions to the CRADA:

DOE Funding to SLAC	\$50k
Participant Funding to SLAC	\$150k
Participant In-Kind Contribution Value	\$
Total of all Contributions	\$ 200k