

Photonic Band Gap Accelerating Structures Progress Report

3Q FY16

In the third quarter of FY16 the PI (Evgenya Simakov) continued simulations of PBG resonators with CST Microwave Studio and CST Particle Studio to design an 11.7 GHz PBG resonator with elliptical rods. A particular attention was paid to the suppression of the dipole higher order mode (HOM) and comparison to the previous designs with the round and elliptical rods. Figure 1 is the Fourier diagram that illustrates the decay of the HOM power in the newly designed PBG cell and compares it to the decay of the HOM power in a resonator with all round rods and the resonator with elliptical rods previously designed and tested at MIT. It can be seen from the diagram that although the dipole mode is excited in the PBG cell with elliptical rods with higher amplitude than in the cell with all round rods, it decays faster in the cell with elliptical rods. As compared to the previous MIT design, the dipole mode is excited with smaller amplitude and decays much faster in the newly designed cell.

LANL's R&D100 Award submission for development of Photonic Band Gap structures for accelerators was chosen as an R&D100 Award Finalist. Figure 2 shows the cover of the R&D100 submission.

The PI worked with the MIT graduate student (Sergey Arsenyev) to complete 2 papers that summarize the results of the 2.1 GHz SRF PBG cavity's design and testing. Both papers are now published:

1. Sergey A. Arsenyev, Richard J. Temkin, W. Brian Haynes, Dmitry Yu. Shchegolkov, Evgenya I. Simakov, Tsuyoshi Tajima, Chase H. Boulware, Terrence L. Grimm, and Adam R. Rogacki, *Cryogenic Testing of the 2.1 GHz Five-Cell Superconducting RF Cavity with a Photonic Band Gap Coupler Cell*, Appl. Phys. Lett. **108**, 222603 (2016).
2. Sergey A. Arsenyev, Richard J. Temkin, Dmitry Yu. Shchegolkov, Evgenya I. Simakov, Chase H. Boulware, Terrence L. Grimm, and Adam R. Rogacki, *Higher Order Mode Damping in a Five-Cell Superconducting RF Cavity with a PBG Coupler Cell*, Physical Review Special Topics – Accelerators and Beams **19**, 081301 (2016).

The PI attended the International Workshop on Breakdown Science and High Gradient Accelerator Technology (HG2016) and reported the new PBG structure's design and plans for further testing.

1. Evgenya I. Simakov, Sergey A. Arsenyev, Cynthia E. Buechler, Randall Edwards, William Romero, Dmitry Shchegolkov, Manoel Code, Gwanghui Ha, John G. Power, Eric E. Wisniewski, and Chunguang Jing, *X-band Photonic Band Gap cavities with elliptical rods and improved wakefield suppression*, International Workshop on Breakdown Science and High Gradient Accelerator Technology (HG2016), Argonne National Laboratory, Argonne, IL, June 2-8, 2016.

The MIT graduate student defended his thesis in June of 2016. The PI attended his thesis defense. The student graduated and accepted the postdoctoral fellowship at CERN to start in September 2016.

The new postdoc (Janardan Upadhyay) joined the group at LANL in June of 2016. He started to work on his safety training and learning about the new project.

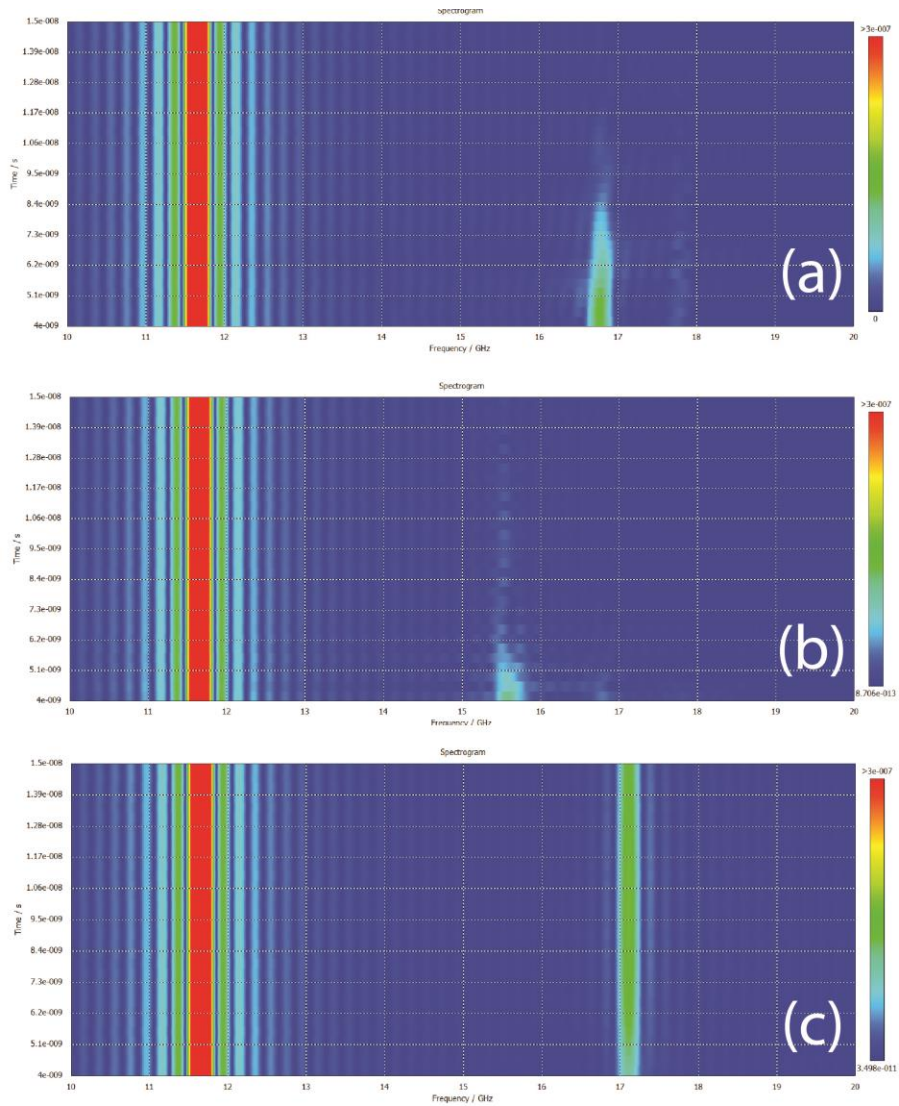


Figure 1: The Fourier spectrum of the decay of the stored HOMs power in the resonators with elliptical rods – new design (a); round rods (b); and elliptical rods – old MIT design (c).

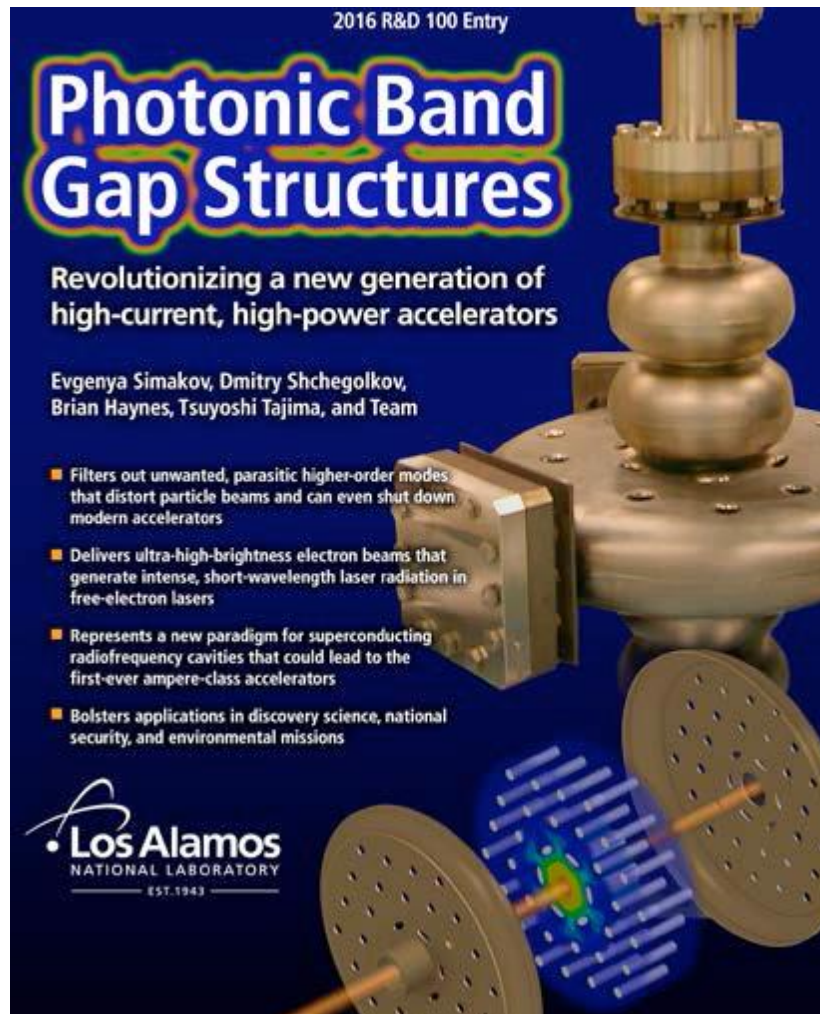


Figure 2: The cover of the R&D100 Award submission for the Photonic Band Gap Accelerator research.