Photonic Band Gap Accelerating Structures Progress Report

4Q FY16

In the fourth quarter of FY16 the PI (Evgenya Simakov) trained the new postdoc (Janardan Upadhyay) to conduct simulations of PBG resonators with CST Microwave Studio. The postdoc designed a PBG structure to conduct high gradient testing of the PBG structure with elliptical rods and improved wakefield suppression at SLAC National Accelerator Laboratory. Figure 1 shows the field profiles in the newly designed structure with couplers. Table 1 compares the characteristics of the newly designed structure to MIT PBG structures previously tested at SLAC. The postdoc is currently working on mechanical drawings of the structure for fabrication. An accelerating test with a high gradient PBG structure is also considered at the NLCTA facility at SLAC and is being discussed between the PI and SLAC's personnel.

The postdoc also visited the Argonne Wakefield Accelerator (AWA) to jumpstart the acceleration and more precise wakefield testing of the traveling-wave PBG structures at the AWA. The postdoc learned about the AWA facility and met the people who work there. He observed some beam tests at AWA. The more precise wakefield and acceleration tests at AWA required a new spectrometer and a new thinner beryllium window. Both components were ordered and have about 12 weeks delivery time.

The PI attended the Advanced Accelerator Concepts (AAC 2016) workshop and reported on the progress of this project. The PI proposed to host the AAC 2018 workshop at LANL with the Tech-X company being a co-host. The proposal was approved by the AAC core committee. The PI will now serve as a Chair for the AAC 2018.

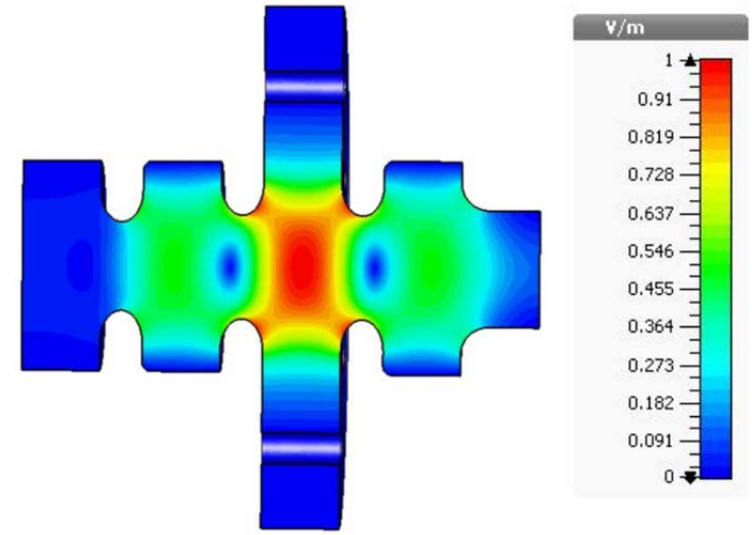
The PI attended the workshop on Challenges of High Photon Energy High-Repetition Rate XFELs Workshop and discussed applications of the superconducting PBG structures for the proposed MaRIE XFEL facility.

The PI attended the LINAC 2016 conference and reported on the final SRF results of the Early Career project and the progress of this X-band project.

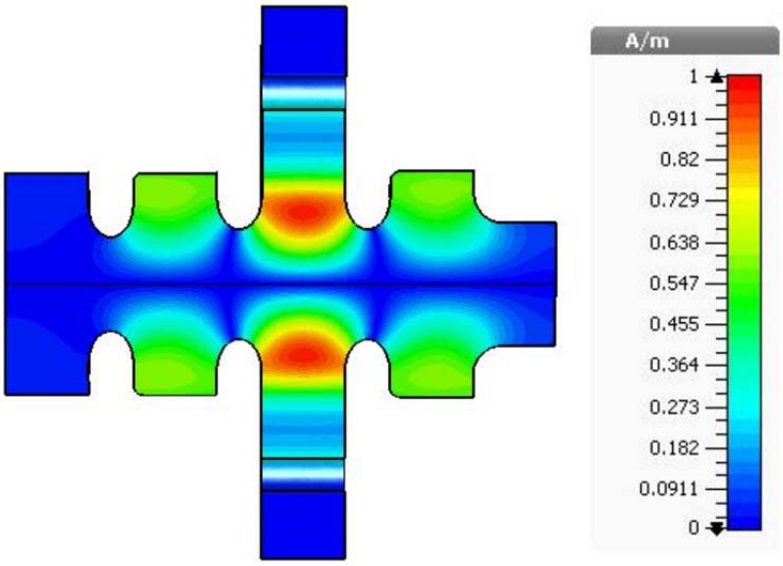
1. S. Arsenyev, R. Temkin, E. Simakov, T. Tajima, D. Shchegolkov, W.B. Haynes, C. Boulware, A. Rogacki, and T. Grimm, *Latest cryogenic testing of the 2.1 GHz 5-cell SRF cavity with a PBG coupler cell*, 28th Linear Accelerator Conference (LINAC 16), East Lansing, MI, September 25-30, 2016.
2. Evgenya I. Simakov, *X-band photonic band gap accelerating structures with improved wakefield suppression*, 28th Linear Accelerator Conference (LINAC 16), East Lansing, MI, September 25-30, 2016.
3. Evgenya I. Simakov, Sergey A. Arsenyev, Cynthia E. Buechler, Randall Edwards, W. Brian Haynes, William Romero, Dmitry Shchegolkov, and Tsuyoshi Tajima, *Superconducting Photonic Band Gap structures and their possible application to the MaRIE XFEL*, Challenges of High Photon Energy High-Repetition Rate XFELs, A MaRIE Workshop, Santa Fe, NM, August 9-10, 2016.

4. Evgenya I. Simakov, Manoel Conde, Gwanghui Ha, John G. Power, Eric E. Wisniewski, and Chunguang Jing, *X-band photonic band gap accelerating structures with elliptical rods and improved wakefield suppression*, Advanced Accelerator Concepts 2016 Workshop (AAC 2016), National Harbor, MD, July 31- August 5, 2016.

The PI was elected a Fellow of the American Physical Society.



(a)



(b)

Figure 1: The electric (a) and magnetic (b) field profiles in the PBG structure for the high gradient testing at SLAC. Simulations conducted by Janardan Upadhyay.

Table 1: The accelerating parameters of the PBG structure designed for the high gradient testing at SLAC (PBG E (LANL)) compared to the previously tested PBG structures (PBG E(MIT) and PBG R) and the disk loaded waveguide structure (DLWG).

Structure	PBG E (MIT)	PBG E (LANL)	PBG R	DLWG
Power	5.2 MW	5.5 MW	5.7 MW	3.9 MW
Gradient	100 MV/m	100 MV/m	100 MV/m	100 MV/m
Q_0 (calculated)	7733	7301	7109	8870
r_{sh}	42 MΩ/m	39 MΩ/m	36 MΩ/m	51 MΩ/m
Peak surface E field	215 MV/m	215 MV/m	215 MV/m	211 MV/m
Peak surface H field	700 kA/m	663 kA/m	899 kA/m	418 kA/m