Photonic Band Gap Accelerating Structures Progress Report

2Q FY16

In the first 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. The preliminary design was identified that has reduced surface magnetic fields and improved wakefields suppression. Figure 1 shows the geometry of the cell. Table 1 summarizes dimensions and accelerator characteristics of the designed structure.

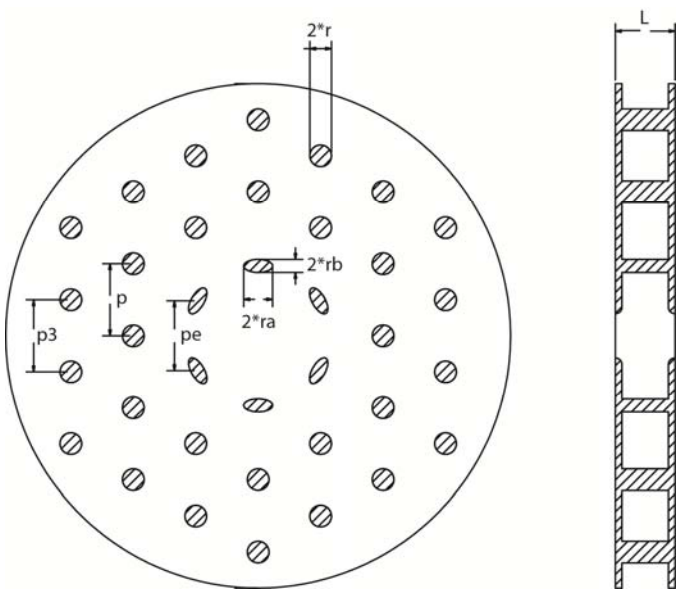

Figure 1: The geometry of a PBG resonator with elliptical rods.

They decay of the HOM power in the newly designed PBG resonator with elliptical rods is shown in Figure 2 and compared to the decay of the HOM power in a resonator with round rods. The resonator with elliptical rods demonstrates better decay of the HOM power.

The PI work with LANL's Feynman Center for Innovations to prepare and submit the patent on the 11.7 GHz PBG resonator with elliptical rods and improved wakefield suppression. The provisional patent was filed. The PI worked with LANL's Communication Services to prepare an R&D100 Award submission for development of Photonic Band Gap structures for accelerators.

The PI worked with the MIT graduate student to complete 2 papers that summarize the results of 2.1 GHz SRF PBG cavity's design and tested. One paper was submitted to Physical Review Special Topics – Accelerators and Beams. The second paper was submitted to Applied Physics Letters.

Table 1: Dimensions and accelerator characteristics of the 11.7 GHz resonator with elliptical rods.

Frequency	11.700 GHz
Phase shift per cell	$2\pi/3$
Cell's length, L	8.55 mm
Period of the round rods, p	10.33 mm
Radius of the round rods, r	1.55 mm = 0.15*p
Period of the e-rods, pe	10.22 mm=0.99*p
Period of the 3rd row of rods, p3	10.85 mm = 1.05*p
Major radius of e-rods, ra	2.58 mm = 0.25*p
Minor radius of e-rods, rb	0.93 mm = 0.09*p
Ohmic Q	5600
Shunt impedance, r_s	83.66 MΩ/m
r_s/Q	14.94 kΩ/m
B_{peak}/E_{acc}	5.3 mTesla/(MV/m)
Q_{diff} (HOM)	130.86

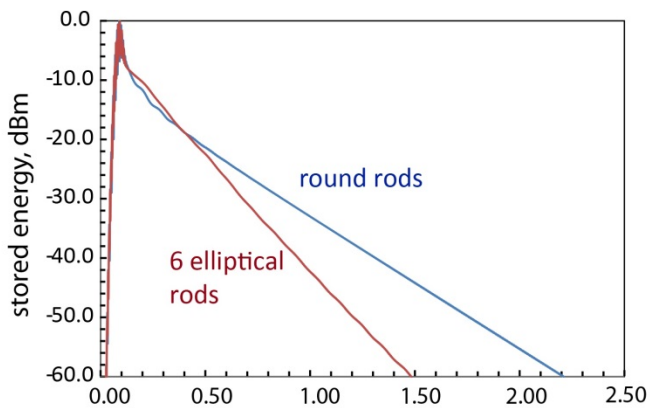

Figure 2: The decay of the stored HOMs power in the resonators with elliptical rods and with round rods.

The PI interviewed a potential postdoc (Janardan Upadhyay) and offered him a job at Los Alamos National Laboratory. Dr. Upadhyay has accepted the job offer and will join the project on May 31st, 2016. The PI is working with the group office on arrangements for the incoming postdoc.

The PI published a paper in Physical Review Letters that summarizes the results of wakefield testing of the PBG accelerator at AWA user facility:

- Evgenya I. Simakov, Sergey A. Arsenyev, Cynthia E. Buechler, Randall L. Edwards, William P. Romero, Manoel Conde, Gwanhui Ha, John G. Power, Eric E. Wisniewski, Chunguang Jing, *Observation of Wakefield Suppression in a Photonic Band Gap Accelerator Structure,* Phys. Rev. Lett. **116**, 064801 (2016).