

Demonstration of a Degenerate Band Edge in Periodically-Loaded Circular Waveguides

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Abstract—We demonstrate the existence of a special degeneracy condition, called degenerate band edge (DBE), between two Bloch modes in periodically-loaded circular all-metallic waveguides at microwave frequencies. The DBE condition has been associated with a dramatic reduction in group velocity and with some unique resonance properties, but it has not been shown in hollow waveguide structures yet. Hence, we show here its existence in two periodic waveguide examples. The unit cell of the first structure is composed of a circular waveguide loaded with two inner cylinders with elliptical irises with misaligned angles. The second structure is composed by loading the waveguide with elliptical rings. The demonstration of DBE in those waveguide is explained through a simple multi-transmission line approach where the conditions to obtain DBE are clarified, and suggests that the DBE can occur in several other analogous periodic waveguides. These structures can be potentially used to investigate unconventional gain schemes in traveling wave tubes or other kinds of distributed amplifiers, oscillators and novel pulse compressors.

Index Terms—Electromagnetic bandgap, periodic structures.