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Novel electromagnetic structures for high-power dispersion engineering JOHN LUGINSLAND, Air Force Office of Scientific Research — High power sources of coherent electromagnetic radiation have been an active area of research for decades, and have driven advances in directed energy, radar, and communications applications. At the highest levels of peak power, however, much of this research has been focused on oscillators driven by intense electron beams. One reason for this is the large amount of free energy associated with the space-charge of these intense beams provides ample means to drive an amplifier into self-oscillation. Recent advances in metamaterials, transformation optics, and photonic band gap structures have the potential to dramatically increase our capability to engineering the electromagnetic properties of the circuit, provide greater control of the beam-wave interaction, and offer new avenues to reach high power amplification. A notable challenge with this concept, however, is the capability of these structures to handle an intense RF and DC environment while retaining their physical integrity and electromagnetic properties. These challenges include electrical breakdown of the structures, AC and DC beam-loading, and melting due to losses in the configurations. Fundamental study of the physics of high-power sources based on metamaterials is needed to realize the potential of these advanced electromagnetic geometries.

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