The advent of High-Power EM sources based upon intense relativistic electron beams in the 1970s has created an intense area of research, with a wide range of applications. These sources transform the kinetic energy of an electron beam into radiation through the interaction of the electrons with the geometrical structure the beam passes through. Currently there is growing interest in the possible application of metamaterials for High-Power EM sources.

Metamaterials are artificial macroscopic composites with a periodic cellular structure, which over a certain frequency range can be described as an effective media with a negative index of refraction. In this presentation we discuss the novel interaction that can arise between particles and waves in the presence of metamaterials, and how this interaction could lead to novel High Power EM sources [1,2]. We examine both experimentally and numerically the limits of metamaterials at High Power, examining the effects of heating and defects to the material performance. We consider the type of defects that would result from high power operation, where damage to the unit-cell results in an effective electrical “open” or “short”.
