A NOVEL RECTANGULAR-RING SLOW-WAVE STRUCTURE FOR INTERACTION WITH A SHEET ELECTRON BEAM*

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Conventional round electron beams have a practical current limit beyond which space-charge forces will de-bunch the beam and prevent further rf power amplification. Alternatively, rectangular cross-section sheet electron beams can circumvent this limitation by distributing the current over a larger area by stretching the width of the beam. This topology can enable a >5× increase in current over round beam systems while maintaining relatively low operating voltages. Another advantage of the sheet beam is that the coupling impedance has a relatively small dependence on beam thickness.

We describe a novel slow-wave structure formed by a periodic array of rectangular rings interconnected by parallel diagonal conductors forming two zigzag-lines ("rectangular-ring slow-wave structure"). The zigzags form the inductive part of the slow-wave structure while the rectangular rings are largely capacitive and, with proper design, can slow the phase velocity (ω/β) of the wave to be synchronous with the longitudinally streaming electron beam. The period of the structure can be much less than the condition for backward-wave oscillation to occur. Compared with a rectangular helix,[1-3] this new structure should be less prone to backward-wave oscillation. We will present measurements and simulations of the cold characteristics of a test structure and analyses of mode competition and bandwidth optimization for a Ka-band rectangular-ring structure.

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