Numerical Analysis of Slow-Wave Instabilities in X-band Sinusoidally Corrugated Waveguide with Coaxial Slow-Wave Structure

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Backward wave oscillator (BWO) is high power microwave sources and can be driven by an axially injected electron beam without initial perpendicular velocity. In such slow-wave devices, a slow-wave structure (SWS) is used to reduce the phase velocity of electromagnetic wave close to the beam velocity. Typical SWS is a hollow circular waveguides having periodically corrugated wall. Electron beams are injected into the SWS and interact with the slow-wave. For such configurations, theoretical studies of slow-wave interaction have been performed extensively as can be seen in Refs.[1,2]. Another type of SWS is a coaxial SWS [3,4]. It has been pointed out that the coaxial types have potentially attractive features such as a wide frequency tenability based on transverse electromagnetic mode, increasing operation frequency and improving the conversion efficiency.

In this work, a numerical code is developed to analyze dispersion characteristics and slow-wave instabilities in coaxial SWSs. In the SWSs, a center cylindrical conductor is surrounded by an outer cylindrical conductor. Sinusoidal corrugation is given to either conductor or both conductors. The latter case is schematically shown in Fig. 1. We analyze the dispersion properties of the coaxial SWSs. The relative phase between the sinusoidal corrugations on inner and outer conductors has effects on the dispersion characteristics. Instabilities due to the beam interactions with the slow-waves are examined by considering three-dimensional perturbations of beam. Slow cyclotron instability in addition to Cherenkov one occurs since transverse as well as longitudinal perturbations are included.

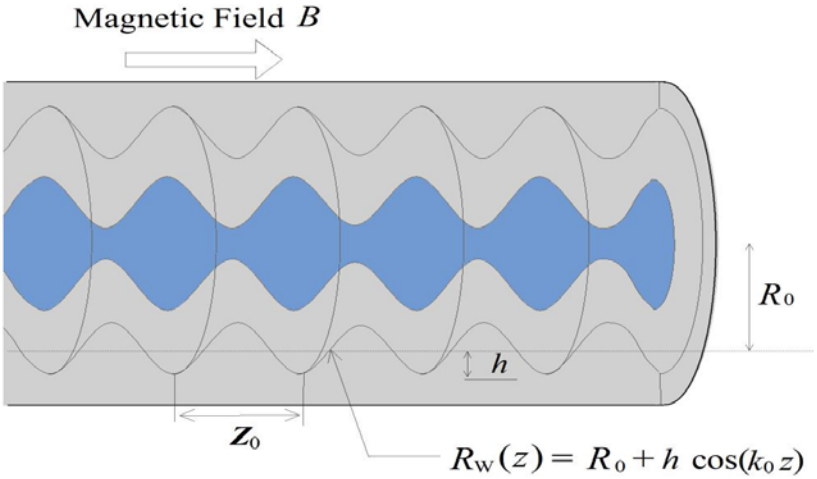

Fig.1.The coaxial SWS model.

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