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# The Interaction of Symmetric and Asymmetric Modes with Free Electrons in a Traveling-Wave Amplifier

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## ABSTRACT

A 3D model has been developed for the investigation of the coupling of the lowest symmetric and asymmetric modes in a high-power ($> 50$ MW), high-efficiency traveling-wave amplifier. It was shown that due to the interaction, the radius of the beam increases linearly with the power associated with the asymmetric mode at the input end. For a specific set of parameters simulations indicate that 0.5 MW of $HEM_{11L}$ power at the input end is sufficient to deflect to the wall a beam of 300A/0.85MV guided by a 0.5-1.5T magnetic field. As the existence of an asymmetric mode is therefore impairing the performance of the amplifier, a way to suppress the asymmetric mode is described.