Analysis of a traveling wave tube tuned by a cavity

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We present a theoretical analysis of a system composed of two periodic structures separated by a uniform waveguide section, taking into consideration the impedance mismatch at both ends of the system. First we examine the effect of the reflections on the output gain for a single stage system, i.e., when the uniform waveguide is not present. It is shown that if the product of the gain and the reflection coefficients is of order of unity, the output gain might be significantly smaller than the one-pass gain as calculated by ignoring reflections. Introducing the uniform waveguide section, additional reflections occur from the two new planes of impedance mismatch. However, a proper location of these planes generates a wave, in the first slow wave structure, that practically may cancel the wave reflected toward the input end. The principle is similar to quarter wavelength tuning in transmission line or optical systems. The main difference is the fact that the electrons may have a significant influence on the waves, affecting the tuning condition.