ANALYSIS OF INTERACTION STRUCTURE FOR KA-BAND GYRO-TWT

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In GYRO-TWT, the RF wave propagates in the smooth wall cylindrical waveguide structure with a speed greater than the speed of light. Such type of interactions structure used in gyro-TWTs are not capable of providing fairly wide device bandwidth due to rapid change in group velocity with frequency, at or near the cut off frequency of waveguide, which causes a narrow band coalescence between beam mode line and waveguide mode dispersion hyperbola. Wider bandwidths are achievable from this device using special type of loaded waveguides. The analysis has shown that the shape of the dispersion characteristics depends on the disc thickness, though not as much as it does on the disc-hole radius and the structure periodicity. The prediction of the effect of the structure or disc parameters on the control of the structure dispersion characteristics and their shape by the analysis ignoring the finite disc thickness more or less continues to hold good when the analysis is improvised by including the finite disc thickness. However, the improved analysis has further added to the prediction that, out of the parameters, namely, the structure periodicity, the disc-hole radius and the disc thickness, while the structure periodicity continues to be the most effective, the disc thickness proves to be the least effective, in controlling the dispersion shape, more precisely, in widening the frequency range of the straight-line portion of the dispersion characteristics. A decrease in the value of the structure periodicity has led to the widening of this frequency range. As for the disc-hole radius, it has to be optimised for maximising the frequency range of the straight-line portion of the dispersion characteristics.

The properly loaded dielectric shell was periodically intercepted by narrow metal rings to reduce the danger of dielectric charging. Such a special structure provided multidimensional freedom to adjust the attenuation imposed on the propagating modes and brought the interaction structure a high mod-selective-propagation ability. However for the complex waveguide structure, the circuit design and interaction analysis of the ECM instability in a dielectric loaded structure adopted a simplified model that reduces the circuit into an empty waveguide and only took the propagation attenuation into consideration. The technique of using dielectric to further explore the broad bandwidth operating ability of the Gyro-TWT is called dispersion shaping.