A quasi-optical input for a whispering-gallery-mode gyro-twystron

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Beginning with 2005, the International Science and Technology Center (ISTC) funded a research program (grant No. 3169) for development of Ka-band gyro-klystrons operating at combinations of high order modes. A number of versions differing in RF inputs and in sequences of operating modes have been tested at microsecond pulses [1, 2]. In particular [2], a 35.4 GHz gyro-klystron with the output rotating mode TE73 delivered 15 MW pulses with 33% efficiency and 30 dB gain.

One of further modifications of the existing configuration is planned to operate at sequences of rotating modes with high azimuthal indexes $m >> 1$ and the radial index equal to 1. Operation at such whispering gallery modes would allow to expand the RF amplification band and approximate the gyro-klystron to a gyro-twystron.

In such an amplifier, the electron-beam-modulation section is expedient to be fed with a wave arriving from a waveguide being coaxial relative to the tube axis [3] (Fig. 1). The drive RF signal would be injected to the structure from a horn (Fig. 2). In this case the azimuthal index m_h of the excited coaxial waveguide mode would be excessively high; and to convert this mode into the counter-rotating operating mode with azimuthal index m, the inner wall of the coaxial waveguide would be corrugated with azimuthal index $\overline{m} = |m| + |m_h|$

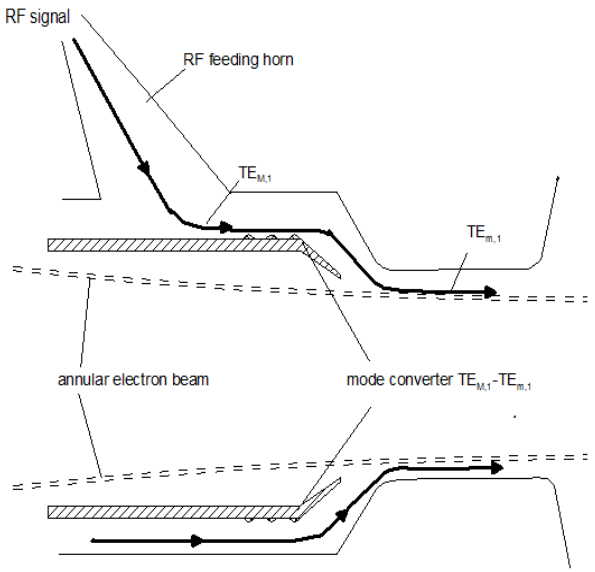

Fig. 1. A scheme of quasi-optical RF input into the electron beam modulating section

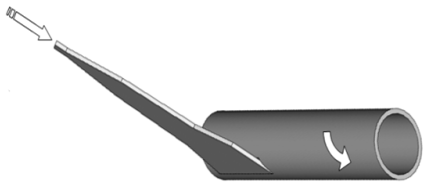

Fig. 2. A scheme of matching of a horn to a coaxial wavegude

The above approach was used to preliminary design a 35.4 GHz gyro-twystron to operate at a sequence of TE modes with the common azimuthal index equal to 7. The junction between the feeding coaxial waveguide and the electron beam modulating section (Fig. 3) was optimized to suppress parasitic resonances and minimize parasitic RF losses. A $TE_{15,1}$ mode would be launched from a Fig. 2 horn to the coaxial waveguide and then converted to the $TE_{7,1}$ mode by means of the inner wall corrugation with azimuthal index $\overline{m} = 22$

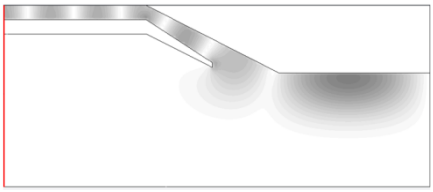

Fig. 3. The coupling of the feeding coaxial waveguide and the electron beam modulating section at the $TE_{7,1}$ mode (numerical simulation)

By analogy with present-day free-running gyro-monotrons, future gyro-twystrons might operate at modes with azimuthal indexes up to 20–30.

Acknowledgements

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