§7. Measurement of Radiation Patterns from the Square Corrugated Waveguide

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We have developed a generator of elliptic gaussian beam which consists of square corrugated (SC) waveguide connected to the parallel corrugated plates [1]. The SC-waveguide has two parallel smooth walls, the other two walls being corrugated. To confirm the performance of SC-waveguide, the radiation patterns from the SC-waveguide are measured.

The HE_{11} mode with the frequency of $\omega/2\pi = 84.05$ GHz excited in 88.9 mm circular corrugated waveguide is injected into the circular polarizer. The output waveguide of the polarizer is connected to the SC-waveguide (82.1 $\times$ 82.1 mm^2) with 1m in length. The field pattern in front of the SC-waveguide mouth is measured by means of the WR-12 waveguide antenna. When an electric field in WR-12 waveguide is in parallel to y-direction, $P_{eyhx} = -\eta_{eff}\Re(E_y \times H_x^*)\Delta S$ is picked up. Here, η_{eff} is antenna gain factor and ΔS the effective area of antenna. When WR-12 waveguide is rotated by 90 degrees around the axis, $P_{exhy} = \eta_{eff}\Re(E_x \times H_y^*)\Delta S$ is detected. Fig. 1(a) shows the results from measurement of P_{eyhx} at the waveguide mouth when the input $\vec{E}$ from the polarizer is adjusted so as to satisfy $E_x = 0$. The contour of output signal is almost axisymmetric near the center and shows the calculated P_{eyhx} pattern of HE_{11} shown in Fig. 2(a). The measured value of P_{exhy} shows cross-polarized field is less than - 20 db.

In order to excite the cross-polarized mode, an angle of polarization is increased by 90 degrees. In Fig. 1(b) the measured field pattern of P_{exhy} at the waveguide mouth is shown. For the purpose of comparison of experimental results with the theoretical ones, we calculate theoretically the content of higher modes in the case of Fig. 1(b) by eigen mode expansion. The purity of the mode number with (n =0, m =1), (n =2, m =1) and (n =4, m =1) are 80.4%, 18.4% and 0.4%, respectively. When each mode propagates along the SC-waveguide, field pattern changes due to the different propagation constant β. By using these values and each propagation constant, we can calculate field pattern of P_{exhy} as shown in Fig. 2(b). For reference, the calculated pattern corresponding to Fig. 1(a) is also shown in Fig. 2(a).

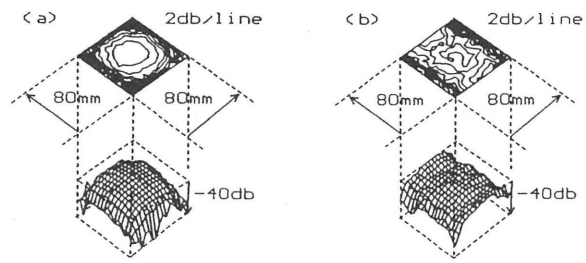

Fig.1:(a) Experimental P_{eyhx} profile in front of square corrugated waveguide with 1m in length.
(b) Experimental P_{exhy} profile in front of the square corrugated waveguide with 1m in length when the cross-polarized mode is excited.

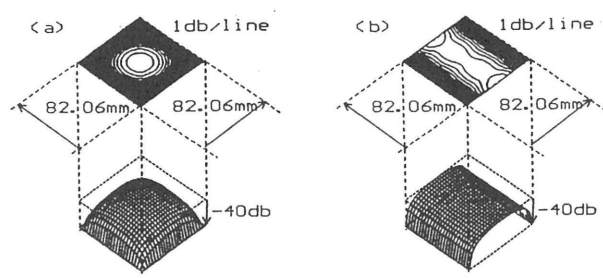

Fig.2:(a) Calculated P_{eyhx} profile at the output of the square corrugated waveguide with 1m in length.
(b) Calculated P_{exhy} profile at the output of the square corrugated waveguide with 1m in length when the cross-polarized mode is excited.

References

1)K. Ohkubo, S. Kubo, M. Sato, H. Idei, Y. Takita and T. Kuroda: To be published in *J. Fusion Engineering and Design*