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MODES AND LOSSES IN OPEN RIMMED RESONATORS

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An open resonator which seems to be promising both in laser and microwave applications is the planar Fabry-Perot resonator with rimmed mirrors. Such a resonator has, for a suitable choice of the parameters, smaller losses but not reduced mode volume in comparison with the planar Fabry-Perot. Another important feature is the possibility of easy control of the field at the edges of the mirrors, useful, for example, for output coupling purposes.

The present communication is concerned with the theoretical treatment of the problem of modes and losses of this resonator for different rim shapes, along with some experimental checks carried out on microwave models of such resonators.

Figs.1-a,b,c show the cross sections of the rimmed resonator for the considered cases of step, sloped and curved rims, respectivaly.

The theoretical treatment consisted in the solution of the appropriate integral equation in a number of particular cases. The equation was solved for the two fundamental modes (first even and odd modes) by a numerical iterative procedure, while in some cases losses and field patterns were obtained also for immediately higher order modes with a more sophysticated procedure.

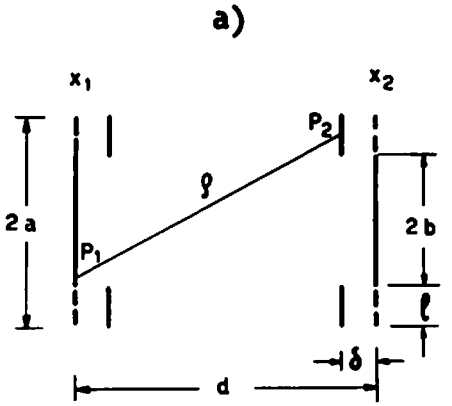
The rim of the step type showed to be particularly interesting also in view of practical applications; it gives rise to an oscillating periodical trend of the losses as a function of the rim thickness with periodicity $\lambda/2$. Such a periodicity which is felt also in the mode field patterns can be accounted for, by considering the successive positions of the rim surface with respect to the nodal and antinodal planes inside the resonator.

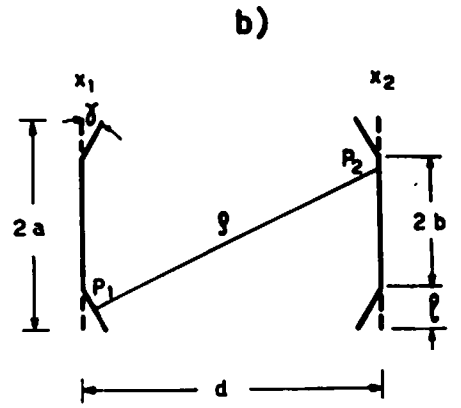
The sloped and curved rim resonators exhibit an oscillating but not periodical trend of the losses versus slope angle or curvature radius respectively with maxima and minima which repeat with decreasing amplitudes. Such losses can reach a minimum lower of about one order of magnitude than that of the step rim case.

For some values of the Fresnel number ($N=a^2/\lambda d$) and of the ratio ℓ/a the loss curves of different modes may present some crossing and/or some inversions. This behaviour is observed for all the three considered rim shapes.

Experimental tests

were carried out on X-band models of Fabry-Perot resonators with square plane rimmed mirrors for the three rim shapes. A very good agreement was found between theoretical and experimental results.





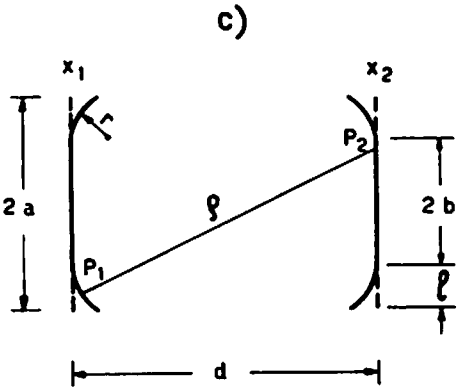


Fig.1 - a) Normal cross section of the infinite strip step rim resonator, b) normal cross section of the infinite strip sloped rim resonator and c) normal cross section of the infinite strip curved rim resonator.