RADIO PHYSICS

I. MOLECULAR BEAMS*

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A. AMMONIA MASER WITH SEPARATED CAVITIES

Some improvements have been made in the ammonia maser with separated microwave cavities discussed in Quarterly Progress Report No. 72 (pages 8-11). The separation of the microwave cavities has been increased from 36 cm to 105 cm. This results in a molecular resonance linewidth of 350 cps.

Previously, a crinkle-foil[1] molecular beam source was used. The holes in this source were approximately 0.002 in. in diameter and 0.125 in. in length, and the total source diameter was 0.25 in. A new source consisting of a "glass capillary array" was obtained from Permeonics Corporation, Southbridge, Mass. This source contains holes 0.00012 in. in diameter and 0.01 in. in length, and the total source diameter is also 0.25 in. This new source resulted in approximately twice the beam intensity (molecules/steradian second) with only one-half as much total flux through the source. Also, the resonance linewidth for 105-cm cavity separation was reduced from 400 cps with the crinkle-foil source to 350 cps with the new source. The molecular resonance observed with the new source and 105-cm cavity separation is shown in Fig. I-1.

Figure I-2 shows a plot of intensity of the resonance signal as a function of focusser voltage. This voltage determines the focal length of the "quadrupole lens" focusser.

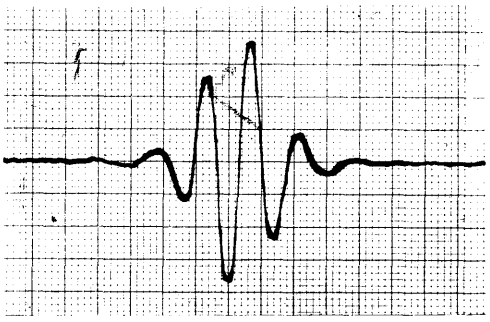

Fig. I-1. First derivative of molecular resonance with 105-cm cavity separation. (Molecular resonance linewidth is 350 cps.)

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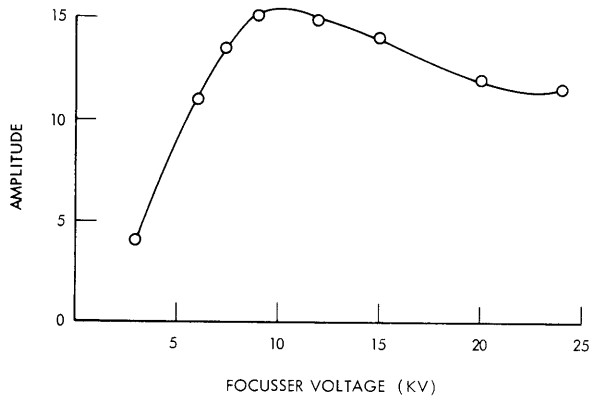

Fig. I-2. Molecular resonance amplitude as a function of focusser voltage.

The maximum in this function indicates the condition for the most probable velocity molecules to be focussed into the second cavity. The center frequency of the molecular resonance was also measured for focusser voltages from 6 kv to 24 kv. This large range of focusser voltages produced a variation in the center of the resonance signal by less than 1 part in 10^9.

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References

1. J. G. King and J. R. Zacharias, Technology in molecular beams, Advances in Electronics and Electron Physics, Vol. 8 (Academic Press, Inc., New York, 1956), pp. 19-20.