

VII. ATOMIC BEAMS*

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| Prof. J. R. Zacharias | V. J. Bates | R. D. Haun, Jr. |
| Prof. J. G. King † | H. H. Brown, Jr. | R. E. Lyon |
| Prof. G. W. Stroke † | A. W. Crooke | C. L. Searle |
| B. B. Aubrey | B. DiBartolo | R. Weiss |
| | D. S. Edmonds, Jr. | |

RESEARCH OBJECTIVES

The distributions of electric charge and magnetism in an atomic nucleus are usually described in terms of multipole moments limited in number by the magnitude of the nuclear angular momentum. In this laboratory, atomic beam techniques are used to determine such electric and magnetic moments. In addition, information about the radial distribution of nuclear magnetism can be obtained in cases in which more than one isotope is available. These techniques lend themselves to such precision that they were used in this laboratory for the development of the most accurate atomic clock. In turn, these clocks are being used to make studies on the nature of time itself. Precision apparatus is under construction to observe not only the dependence of atomic time on gravitational potential but also on the epochal dependence of nuclear gravitational and atomic time. Similar studies are being made on the velocity of light.

J. R. Zacharias, J. G. King

A. FREQUENCY STABILIZATION OF K-BAND KLYSTRONS

In the Quarterly Progress Report of April 15, 1956, page 37, a stabilization system for an S-band klystron was discussed. These techniques have now been extended to K-band. In the S-band system, the 75th harmonic obtained from a crystal diode multiplier was used as the locking signal. Since the K-band harmonics of this diode were too small to be used directly, the output of the S-band phase-locked klystron was multiplied by 8, using a 1N26 crystal, to obtain the K-band locking signal. The K-band phase loop is identical in form to the S-band loop.

The phase-locked K-band klystron is to be used in an ammonia Maser experiment, serving both as a stable source to excite the ammonia in the K-band cavity, and as a stable local oscillator for a high-sensitivity receiver which detects the ammonia spectrum line. From the block diagram of Fig. VII-1, it can be seen that when the klystron signal is mixed with the cavity output signal, the difference frequency is 200 kc, precisely the frequency of the 200-kc reference. For this reason, a very narrow-band (40-cps), high-gain (150-db) intermediate frequency can be used. Preliminary tests,

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† Also of the Department of Physics, Graduate School, Boston University.

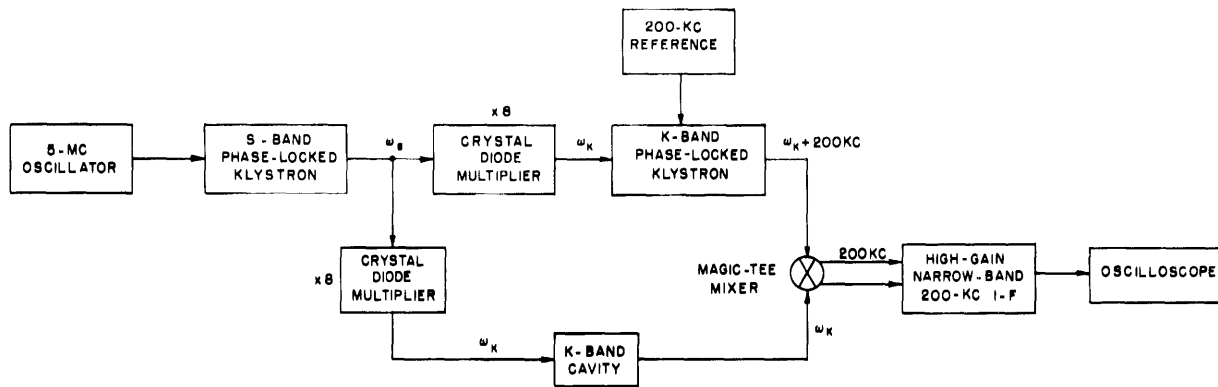


Fig. VII-1. Block diagram of K-band system.

in which a variable attenuator was used in place of the cavity, indicate that K-band signals of 10^{-14} watt can be easily detected.

R. E. Lyon