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Spontaneous Radiation of a Molecule Inside a Resonator

resonator. The aim of this article is to derive a general formula for the radiation probability of a molecule in a resonator. It is assumed that the energy spectrum of a molecule inside the resonator consists of two non-overlapping continuous bands having an identical width ΔE and average levels E_1 and E_2. The ensemble of the continuous quantum numbers determining a state will be denoted by α; the energy in the state α is equal to E_α. The problem consists of determining the probability W_o of a spontaneous transition (per unit time) of the molecule from a state α_2 corresponding to the second energy band into a state α_1 in the first energy band. If $w^{cn}_{\alpha_1\alpha_2}$ is the probability of a spontaneous transition from the state α_2 into the interval $(\alpha_1, \alpha_1 + d\alpha_1)$.

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the desired probability is expressed by:

$$W_{cn} = \int_{\Delta E} f(E_{\alpha_2}) w^{cn}_{\alpha_2\alpha_1} \, d\alpha_1 d\alpha_2 \qquad (2)$$

where $f(e_{\alpha_2})$ is the probability that the molecule is in the state $(\alpha_2, \alpha_2 + d\alpha_2)$. It is shown that the probability $w^{cn}_{\alpha_2\alpha_1}$ is given by Eq (9). By substituting Eq (9) into Eq (2), it is possible to obtain an expression for W_{cn}. This can only be evaluated if the functions $f(E_{\alpha_2})$ and $\left|p_{\alpha_1\alpha_2}\right|^2$ are known. As regards the latter it is assumed that it is equal to $\left|p_{12}\right|^2$. The probability can then be written as Eq (10), where $\Delta\omega_n = \Delta E/h$. Two special cases can now be considered.

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Spontaneous Radiation of a Molecule Inside a Resonator

When $\Delta\omega_{сп} \ll \Delta\omega \sim \omega_o/Q$, the probability is expressed by:

$$W_{сп} = \frac{4\pi^2}{\hbar} |p_{12}|^2 g_1 \frac{\omega_o^2}{QV} \frac{1}{(\omega_{21} - \omega_o)^2 + (\omega_o/Q)^2} \qquad (10a).$$

On the other hand, when $\Delta\omega_{сп} \gg \Delta\omega \sim \omega_o/Q$, the probability is given by:

$$W_{сп} = A \frac{\hbar\omega_o}{V\Delta\omega} \frac{\Delta\omega}{\Delta\omega_{сп}} \qquad (15).$$

The authors express their gratitude to N.G. Basov and A.M. Prokhorov for discussion of the problems considered in the paper.

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

AUTHOR: Orayevskiy, A.N. SOV/109-4-4-19/24

TITLE: On the Theory of a Molecular Oscillator (K teorii molekulyarnogo generatora)

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 4, pp 718 - 723 (USSR)

ABSTRACT: The system considered has two isolated energy levels W_a and W_b. The steady-state of the system is described by functions Ψ_a and Ψ_b. When the system is acted upon by an electromagnetic field, its behaviour can be described by (Ref 7):

$$\Psi(t) = a(t)\Psi_a + b(t)\Psi_b \qquad (1)$$

The dependence of the quantities a(t) and b(t) on time is described by Eqs (2), where F represents the radiation field, while μ_{ab} is the matrix element of the dipole moment, which is defined by Eq (3). The macroscopic description of the system can be achieved by determining

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On the Theory of a Molecular Oscillator

its polarisation, $p(t)$, which is defined by Eq (4). On the basis of Eqs (2), the polarisation should satisfy Eqs (5), where r and ω_{ab} are defined by Eqs (6). The average polarisation can be described by Eq (8). Consequently, the average polarisation should satisfy Eqs (9). If now the medium having an average polarisation $P(t)$ is situated in a metallic resonator, the system can be described by:

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On the Theory of a Molecular Oscillator

$$\frac{d^2\mathcal{E}}{dt^2} + \frac{\omega_o}{Q_o}\frac{d\mathcal{E}}{dt} + \omega_o^2\mathcal{E} = -4\pi N\frac{d^2P}{dt^2},$$

$$\frac{d^2P}{dt^2} + \frac{\omega_g}{Q_1}\frac{dP}{dt} + \omega_g^2 P = \frac{\mu_{ab}}{\pi}\mathcal{E}(R + R_o), \qquad (I)$$

$$\frac{dR}{dt} + \frac{1}{2}\frac{\omega_g}{Q_1}R = -2\frac{\mu_{ab}}{\pi}\mathcal{E}\left(\frac{dP}{dt} + \frac{1}{\tau}P\right)$$

where Q_o is the equivalent quality factor of the resonator. Eqs (I) show that a molecular oscillator is

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a system with 2.5 degrees of freedom. The third of these equations shows that the non-linearity of the oscillator is of the inertia type. The quantity R can approximately be expressed in the form of Eq (13). In this case, Eqs (I) are similar to those of a typical oscillator with an inertia-type non-linearity; the system is then described by Eqs (II). By adopting the notation defined by Eqs (15), the system can be described by Eqs (Ia) or (IIa). The latter equations can be employed to investigate the problem of synchronisation. This is described by Eq (16). The solution of Eqs (16) is in the form of Eqs (19), where the parameters R, P and Q are defined by Eqs (20). The author expresses his gratitude to N.G. Basov for a number of valuable remarks.

There are 12 references, 9 of which are Soviet and 3 English. 1 of the Soviet references is translated from English.

 Physics Institute imeni P.N. Lebedev of the Academy

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

VOLKOV, D.V.; ORAYEVSKIY, V.M. [Oraievs'kyi, V.M.]

Role of the form factor in $\pi^0 \to l + e^+ + e^-$ decay. Ukr.fiz. zhur. 4 no.6:804-806 N-D '59. (MIRA 14:10)

1. Fiziko-tekhnicheskiy institut AN USSR.
(Mesons--Decay)

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

AUTHORS: Basov, N.G. and Orayevskiy, A.N. SOV/109-4-7-13/25

TITLE: Absolute Stability of a Maser Oscillator Employing a Beam of Ammonia Molecules

PERIODICAL: Radiotekhnika i elektronika, 1959, Vol 4, Nr 7, pp 1185 - 1195 (USSR)

ABSTRACT: Maser oscillators have been described and analysed in a number of papers (Refs 1-9). In particular, an oscillator of this type can be constructed by employing two beams converging on each other; the system employs the inversion transition line of ammonia, $J = 3$, $K = 2$. In this oscillator, it should be possible to obtain absolute frequency stability of 10^{-10} or even 10^{-11}. In the following, it is shown that the same stability in a maser oscillator can be obtained by employing two coupled resonators; this was first realized by J. Bonanomi et al. (Refs 8,9). This method is more advantageous than the previous one since it does not require any special adjustment of the frequency during the operation of the oscillator. The frequency of the

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oscillations in a maser oscillator is given by:

$$\frac{\varepsilon' - 1}{\varepsilon''} = Q \frac{\omega}{\omega_o} \frac{\omega'^2_o - \omega^2}{\omega^2_o} \approx 2Q \frac{\omega'_o - \omega}{\omega_o} \qquad (1)$$

where ε' and ε'' are the real and the imaginary parts of the complex permittivity of the molecular beam, respectively; Q is the quality factor of the resonator, ω_o is the natural frequency of the resonator and $\omega'^2_o = \omega^2_o(1 + Q^{-2})$. Eq (1) can also be written as Eq (2), where $\langle\tau\rangle$ is the average transit time of the molecules in the resonator, while γ is given by the formula following Eq (2). Further, Eq (1) can be written as Eq (3), where Δ, Δ_1 and Q_L are defined by the last equations on p 1187. The functions $\varphi(\gamma)$ and $F(\theta)$ are defined by the equations on p 1188. The components

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Absolute Stability of a Maser Oscillator Employing a Beam of Ammonia Molecules

of the permittivity are expressed by Eqs (4). Eq (1) can therefore be written as Eq (6) where Δ is given by Eq (7). The oscillation frequency is therefore given by Eq (8), where ω_{mn} is the frequency of the molecular transition. The formulae can be used to evaluate the frequency deviation Δ as a function of the voltage α of the grouping system and the saturation parameter a. The results are plotted in Figure 1. It is seen that for the voltage change from 5 to 35 kV, the oscillation frequency changes by about 70 c.p.s. When the oscillator consists of 2 coupled resonators, its frequency deviation, with respect to the frequency of the molecular transition, is expressed by Eq (20). This can be rewritten and is then in the form of Eq (24), where Ω_1, Ω_o and Ω_{-1} are the roots of Eq (23). If the two resonators are tuned so that the three roots coincide with ω_{mn} with an error of a few percent of $1/Q$, it is possible to

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Absolute Stability of a Maser Oscillator Employing a Beam of Ammonia Molecules

secure an absolute stability of the oscillator of the order of 10^{-11}. The design details of a two-resonator oscillator are indicated in Figure 3. There are 3 figures, 2 tables and 19 references, of which 8 are English, 2 German and 9 Soviet.

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR (Physics Institute imeni P.N. Lebedev of the Ac.Sc., USSR)

SUBMITTED: February 18, 1958

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

BASOV, N.G.; OHAYEVSKIY, A.N.

Use of slow molecules in molecular generators. Zhur.eksp.i teor.fiz. 37 no.4:1068-1071 O '59. (MIRA 13:5)
(Oscillators, Electric)

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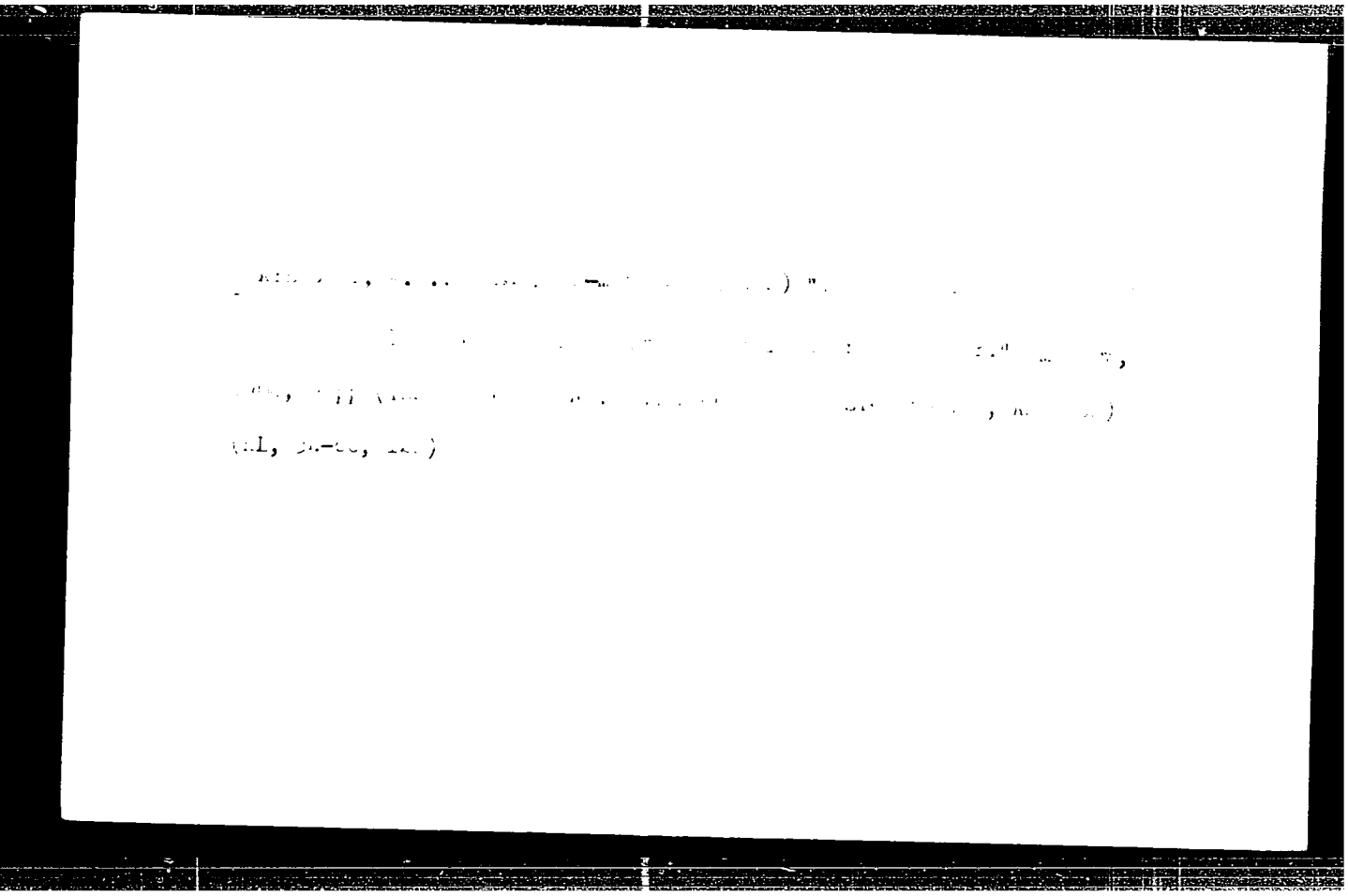

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9,2582 (1055, 1163)

22266
S/109/61/006/005/013/027
D201/D303

AUTHORS: Basov, N.G., Nikitin, V.V., and Orayevskiy, A.N.

TITLE: Investigation into the dependence of the frequency of molecular generators on various parameters. Part I (Theory, line J = 3, K = 2)

PERIODICAL: Radiotekhnika i elektronika, v. 6, n. 5, 1961, 796-805

TEXT: The work presented in this article was undertaken in order to explore the possibility of utilizing a molecular generator as an absolute frequency standard having an accuracy of about 10^{-10}. In order to determine the type of construction required and its operation, a detailed account of how its frequency depends on the various parameters has been undertaken. Several attempts to evaluate the influence of various factors in the oscillation frequency have been made by N.G. Basov, and A.M. Prokhorov (Ref. 1: Uspekhi fiz.

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Investigation into the ...

nauk 1955, 1, 7, 485) and by K. Shimoda, T.C. Wang and C.H. Townes (Ref. 2: Phys. Rev. 1956, 5, 102, 5, 1308), the dependence of the frequency of the molecular generator on the resonant frequency of the resonator being explained in Ref. 2 (Op.cit.). It was shown that the irregularities of beam emission along the resonator introduce frequency drift: The influence of the non-resolved components of the hyperfine structure was shown by K. Shimoda (Ref. 3: J. Phys. Soc. Japan 1957, 12, 1006; 1958, 13, 939); the dependence of the frequency drift of the molecular generator based on the hyperfine structure on the voltage of the sorter and on the beam intensity has been explained by N.G. Basov and A.N. Orayevskiy (Ref. 4: Radiotekhnika i elektronika, 1959, 4, 7, 1185). The results discussed cannot be taken, however, as final since none of the authors take into account the real velocity spread of molecules. First the influence of various parameters, including the velocity spread of molecules has been analyzed. Starting with

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$$\frac{\bar{\varkappa}'}{\bar{\varkappa}''} = 2Q \frac{\omega_0 - \omega}{\omega} , \qquad (1)$$

given in Ref. 1 (Op.cit.) for the oscillations frequency of a molecular generator where

$$\bar{\varkappa} = \bar{\varkappa}' + i\bar{\varkappa}''$$

is the average complex polarization of the molecular beam, ω - is the required frequency, ω_0 - the self resonant frequency of the resonator having the quality factor Q, it is shown that this equation provided $\bar{\varkappa}$ is properly evaluated, must take into account all factors affecting the frequency and its stability. These, state the authors, are listed in Ref. 4 (Op.cit.). After several mathematical transformations and assumptions, the Eq. (1) for two levels is derived as

$$\omega = \omega_1 \left[1 + \frac{\omega_0 - \omega_1}{\omega_1} \frac{Q}{Q_1} G + \Delta \right] \qquad (6)$$

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where

$$G = \frac{\sum_m |d_m|^2 \gamma_m^{-1} J_m^c}{\sum_m |d_m|^2 \gamma_m^{-2} J_m^s}; \quad \Delta = \frac{\sum_m \eta_m |d_m|^2 \gamma_m^{-1} J_m^s}{\sum_m |d_m|^2 \gamma_m^{-1} J_m^s}. \tag{7}$$

and ω_1 is such that $\omega_m = \omega_1 + \nu_m$; ω_m - frequency of the molecular transition; d_m - matrix element of the dipole moment $d_m = d_o \lambda_m$ where d_o - the dipole moment, λ_m determines d_m on quanta numbers characterizing the given transition;

$$\gamma_m = \gamma \frac{\lambda_m^2}{\bar{\theta}^2}; \quad \gamma = \frac{d\mathcal{E}}{\hbar} \bar{\theta};$$

$\mathcal{E}$ - the field amplitude in the resonator; $\bar{\theta}$ - the average transient time of molecules through the resonator. J_m^s and J_m^c are given by

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$$J_m^a = \int_0^\infty F(\theta)\left(1 - \frac{\sin \gamma_m \theta}{\gamma_m \theta}\right) d\theta,$$
$$J_m^c = \int_0^\infty F(\theta) \frac{1 - \cos \gamma_m \theta}{\gamma_m \theta} d\theta \qquad (5)$$

where $F(\theta)$ - time distribution of molecules in resonator. Functions G and Δ have been evaluated using an electronic computer and are represented graphically for the spectral line of ammonia $N^{14}H_3$ J = 3, K = 3. The rest of the theoretical results are based on N.G. Basov, G.M. Strakhovskiy, and I.V. Cheremiskin (Ref. 5: Radiotekhnika i elektronika 1961, 6, 6) and given as graphs. Fig. 3 shows the dependence of frequency on the pressure p in the molecular beam source with factor 3 compensated for line J = 3, K = 3, $N^{14}H_3$. The pressure p is given in relative units. Fig. 4 shows the dependence

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Investigation into the ...

of frequency on the voltage at the sorter. Effect No. 3 is compensated for the line J = 3 , K = 3 $N^{14}H_3$. Fig. 5 is the same as Fig. 4 but apparently for J = 3, K = 2 $N^{14}H_3$ [Abstractor's note: This would seem to be an error. The graph shows the detuning Δf as function of pressure p in the source]. The experimental verification of the theoretical results was carried out on a molecular generator using the line of the inversion transition of ammonia $N^{14}H_3$ J = 3, K = 2 which has no quadruples of the hyperfine structure. Three exactly similar generators were used each having two molecular beams running in opposition. The schematic diagram of the generator is shown in Fig. 7. In it a - sources of molecular beams; 1 - quadruple condensors, c - resonator; d - diaphragms cooled by liquid nitrogen. The resonator was made of invar, excited in E_{010} mode, the length of the resonator was 11.2 cm which corresponded to the transit width of the line of 1 Kc/s, q - 9000, timed within a few megacycles. Sorting of molecules according to their energy le-

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Investigation into the ...

vels was achieved using quadruple condensers having a length of 15 cm. A diaphragm was used to increase the beam intensity. The aperture of the diaphragm was 0.6 cm. The diaphragm was cooled by liquid nitrogen the molecule beam was obtained by a grid having square holes 0.05 · 0.05 mm^2, spaced 0.05 mm from each other. The signal from two molecular generators was applied to a balanced mixer of a superheterodyne receiver, the local oscillator of which was stabilized by a cavity resonator. The IF was 60 Mc/s, the pass band of the IF amplifier 2 Mc/s. At the output, the difference frequency of the two generators determined from a Lissagian figure was compared with the frequency of an audio generator which in turn, by using a crystal controlled generator could have the frequency adjusted and measured with an accuracy of 0.1 to 1 c/s. The pressure within the source was measured by a pressure tube ЛТ-2 (LT-2). The overall tuning accuracy of the molecular generator achieved by adjustments of its various parameters was around 3c/s. The experimental results are given in the form of graphs. It is

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Investigation into the ...

stated in conclusion that a molecular generator, having two similar and opposite beams working at a line without a hyperfine structure and having a symmetrical construction, can be used as an absolute standard of frequency time with an accuracy of 10^{-10}. There are 10 figures and 6 references: 3 Soviet-bloc and 3 non-Soviet-bloc. The references to the English-language publications read as follows:
K. Shimoda, T.C. Wang, C.H. Townes, Phys. Rev. 1956, 5, 102, 5, 1308
K. Shimoda, J. Phys. Soc. Japan 1957, 12, 1006; 1958, 13, 939;
J.P. Gordon, Phys. Rev. 1955, 994, 1253.

ASSOCIATION: Fizicheskiy institut im P.N. Lebedeva AN SSSR (Institute of Physics im. P.N. Lebedev, AS USSR)

SUBMITTED: June 17, 1960

Card 8/~~10~~

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27483

S/053/61/075/001/003/003
B125/B108

9.3592 also 1538,1057

AUTHORS: Basov, N. G., Krokhin, O. N., Grayevskiy, A. M., Strakhovskiy, G. M., Chikhachev, B. M.

TITLE: Investigation of relativistic effects with the aid of molecular and atomic frequency standards

PERIODICAL: Uspekhi fizicheskikh nauk, v. 75, no. 1, 1961, 3 - 39

TEXT: The present paper gives a survey of experiments verifying the general theory of relativity, some problems in special relativity theory, and cosmological hypotheses by means of molecular and atomic frequency standards. V. L. Ginzburg (UFN, 22, 11 (1956); sb. "Eynshteyn i sovremennaya fizika", M., Gostekhizdat, 1956, str. 93 - 139) made suggestions for the experimental verification of general relativity theory. By means of cesium frequency standards with two separate resonators, an absolute frequency stability of $\pm 1.5 \cdot 10^{-10}$ was attained. A further improvement of the stability of cesium standards requires the use of narrower spectral lines. With slow molecule beams, an absolute stability

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Investigation of relativistic effects...

of up to 10^{-12} was reached. A certain increase of stability may be attained using a beam of thallium atoms instead of cesium. Up to now, however, the authors have no information on such use of thallium. The electrical resonance method, i. e., the use of spectral lines of a molecular beam caused by transitions between rotational levels, guarantees the same stability as in cesium standards. The frequency standards relying on spectral lines of monatomic alkaline metals permit very sensitive indications. Quartz resonators, too, give a stability of 10^{-13} and, when immersed in liquid helium, even of 10^{-14}. The power of molecular generators has to be amplified by means of a low-noise amplifier (e. g., ЛБВ(LBV)) and an amplifying klystron. Self-tuning is necessary for high-precision frequency measurements. In measurements of the gravitational frequency shift by means of molecular generators on board of artificial satellites, the influence of the first order Doppler effect has to be eliminated. This can be done, for instance, by an exact measurement of long time intervals on the Earth and on the satellite with subsequent comparison by radiocommunication. Another method of this kind is based on the mixing of a signal emitted from the Earth (frequency f, with the signal

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of a molecular generator on the satellite (frequency 2f). Ionospheric and tropospheric fluctuations have to be taken into account. Measurements of the gravitational shift of frequency are being prepared (Sci. News Lett., 76, 35 (July 18, 1959)). The gravitational shift may be measured from two points of different altitude on the Earth's surface (mountain) without the use of satellites and, therefore, without consideration of the Doppler effect of first and second order. For H = 3.2 km and f = 1.[illegible] cps, $\Delta f = 3.4 \cdot 10^{-3}$ cps. At present, two first-order experiments are known for the verification of special relativity theory. In one of them (proposed by Møller and carried out by Townes), two inversely directed beams of excited ammonia molecules were sent toward each other through the horizontal resonators of two molecular generators mounted on a rotatable plate. The expected frequency deviations were not found in these experiments. The other first-order experiment with respect to (v/c) is based on the measurement of the phase difference of two nonsynchronized molecular generators placed on a rotatable base at a distance of a few meters. Some cosmological effects may be verified experimentally by means of highly stable atomic clocks. An idea of V. A. Fok (G. M. Strakhovskiy, Doklad na Lomonosovskikh chteniyakh v MGU, 1958) concerning singular reference

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Investigation of relativistic effects... B125, B108

systems is mentioned. The variations of the gravitational constant ($\delta g = g.10^{-10}$ within a year, according to Dirac, can be verified by comparing the motion of a high-precision atomic clock with the revolution period of an Earth satellite. The eccentricity of the Earth's orbit may also have an influence on the gravitational constant. The hypothetical time dependence $\delta a/a \sim [illegible]\, \delta g/g$ of the fine structure constant (L. D. Landau et al., DAN SSSR, 72, 437, 1950, 1177 [illegible]) can be verified experimentally by comparing the motion of two atomic clocks of different types. The character of gravitation may be determined by another series of experiments. There are 31 figures and 113 references: 47 Soviet and 66 non-Soviet. The three most recent references to English-language publications read as follows: Missiles and Rockets, No. 1, 1961, p. 34; B. Hoffmann, Phys. Rev. 121, 337 (1961); S. M. Bergmann, J. Appl. Phys. 31, 275 (1960).

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APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

S/109/62/007/005/012/021
D230/D308

9,1574

AUTHORS: Nikitin, V.V., and Orayevskiy, A.N.

TITLE: Investigating the frequency tuning of a molecular oscillator by modulating the radiation line by means of an external magnetic field

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 5, 1962, 859 - 865

TEXT: A theoretical and experimental investigation of the alternative tuning method by means of the external magnetic field is presented, applied to a maser using the line J = 3, K = 2 $N^{14}H_3$ and two equal and opposite molecular beams. The physical principle of magnetic tuning, relying on a split of the spectral line, is explained, and basic formulas are given for the frequency of oscillation for the simpler case of two identical energy levels and a single spectral line in the absence of a magnetic field. Corresponding expressions follow for the more general condition of two spectral line components, in terms of resonator natural frequency, Q-factors of

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cavity resonator and of the spectral line, saturation parameter, molecular dipole moment, electric field amplitude, mean passage time across the resonator, Zeeman spectroscopic splitting factor, nuclear magneton and the external magnetic field. The investigated inversion line has 6 intervals, leading to 6 components, and by calculating the Hamiltonian interaction forces the magnetic molecular reciprocity constants are obtained for upper and lower levels. A brief description of the experimental verification is given, illustrated by curves showing frequency constancy for the pressure method of tuning and three magnetic tuning experiments undertaken at constant low, medium and high pressures. There are 2 figures and 1 table.

SUBMITTED: June 21, 1961

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

S/109/62/007/006/024/024
B234/B308

AUTHOR: Grayevskiy, A. N.

TITLE: Possibility of a rigid regime in the molecular beam generator

PERIODICAL: Radiotekhnika i elektronika, v. 7, no. 6, 1962, 1006

TEXT: The author shows the possibility of a rigid regime in case of single-velocity beam or small dispersion of velocities about a certain mean value. There is no such possibility if the dispersion is considerable. There is 1 figure.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva, AN SSSR (Institute of Physics im. P. N. Lebedev, AS USSR)

SUBMITTED: November 25, 1961

Card 1/1

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

GRIGOR'YANTS, V.V.; ORAYEVSKIY, I.N.

Compensation method for measuring the efficiency of the use of a molecular beam. Radiotekh. i elektron. 7 no.12:2088-2089 D '62. (MIRA 15:11)
(Masers)

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

S/051/62/012/005/014/021
E032/E514

24 2400

AUTHOR: Grayevskiy, A.N.

TITLE: Absorption and dispersion in molecular crystals with the saturation effect taken into account

PERIODICAL: Optika i spektroskopiya, v.12, no.5, 1962, 632-634

TEXT: The use of stimulated emission of infrared and visible radiation is expected to facilitate the study of effects similar to the saturation effect in the microwave range. It is therefore of interest to calculate the dispersion of crystals for large intensities of incident radiation. The author considers the interaction of a monochromatic electromagnetic radiation $\vec{\mathcal{E}} = \vec{\mathcal{E}}_0 \cos(\underline{q}\cdot\underline{r} - \omega t)$ with a molecular crystal having narrow energy bands whose width is much smaller than the distance between them. The part of the Hamiltonian describing the interaction of the crystal with the field is assumed to be of the form $\hat{V} = \sum_{\underline{n}\alpha} \underline{\hat{P}}_{\underline{n}\alpha} \vec{\mathcal{E}}_0 \cos(\underline{q}\underline{r}_{\underline{n}\alpha} - \omega t)$, where $\underline{\hat{P}}_{\underline{n}\alpha}$ is the operator representing the dipole moment of the molecule α at the $\underline{n}$-th site. In evaluating the matrix elements of the operator

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

BASOV, N.G.; KROHIN, O.N. [Krokhin, O.N.]; ORAEVSKI, A.N. [Orayevskiy, A.N.]; STRAHOVSKI, G.M. [Strakhovskiy, G.M.]; CIHACIEV, B.M. [Chikhachev, B.M.]

Possibility of studying relativistic effects with the aid of the molecular and atomic standards of frequency. Analele [illegible]t 16 no.2:83-146 Ap-Je '62.

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

3?861
S/056/62/042/006/018/047
B104/B102

AUTHORS: Basov, N. G., Grayevskiy, A. N.

TITLE: Emission of molecules in a mixed energy state

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 42, no. 6, 1962, 1529-1535

TEXT: A double resonator molecule generator is investigated. It is shown that a molecular current polarized by a monochromatic emission excites a monochromatic oscillation in a resonator on which it is incident. The frequency of this oscillation coincides with the frequency of the polarized emission. A change in the eigenfrequency of the resonator affects only the amplitude and phase of the excited oscillation, not its frequency. The emission with frequencies different from that of the polarized field is incoherent. Therefore it is not necessary to take the effect of coherence into account while calculating the noise produced in quantum generators and amplifiers by spontaneous emission. If the polarized emission is not monochromatic the response of the resonator is also not monochromatic for small intensities. The spectrum of the response affects

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

the spectral characteristic of the resonator-beam system to a significant extent.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute imeni P. N. Lebedev of the Academy of Sciences USSR)

SUBMITTED: November 23, 1961

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AT3012115 S/2504/63/021/000/0003/0067

AUTHOR: Orayevskiy, A. N.

TITLE: Theoretical investigation of the frequency stability of a maser

SOURCE: AN SSSR. Fizicheskiy institut. Trudy*, v. 21, 1963, 3-67

TOPIC TAGS: maser, frequency stability, maser frequency standard, maser time standard, maser monochromaticity, maser error, maser frequency drift, ammonia maser, maser quadrupole structure

ABSTRACT: Several problems connected with the construction of a frequency (time) standard based on a maser are considered theoretically. Maser equations are derived not only for monochromatic but also for arbitrarily time-varying transient processes. The locking of a maser by an external signal is considered on the basis of the derived equations and the monochromaticity of maser oscillations is

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AT3012115

investigated. The effect of the waveguide system on the maser oscillations is taken into account. Effects influencing the maser oscillation frequency, evaluated as a function of different parameters, are analyzed. It is noted that the amplitude dependence of the maser frequency can cause a shift in the maser frequency when extraneous power, particularly from a neighboring generator, penetrates into the cavity. Different methods of tuning the maser frequency to that of the spectral line are discussed. The possibility of tuning the maser by modulating the line width with the aid of an external magnetic field is estimated. The possible use of two coupled cavities to tune the maser frequency to the spectral line is considered. It is shown that a maser with two opposing molecular beams, operating on the J = 3, K = 3 line of $N^{14}H_3$ can have stability (5--7) x 10^{-10}. To obtain higher stability (~10^{-10}) a line must be used without a quadrupole hyperfine structure (for example J = 3, K = 2). It is shown that to tune the maser frequency accurate to 10^{-10} it is necessary to compensate for the maser frequency shift

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AT3012115

due to the nonuniformity of radiation of the molecules along the resonator by using two identical opposing beams. The possibility of tuning the frequency of a maser to a spectral within 5×10^{-10} by the method of two coupled resonators is considered. The maser frequency error due to the waveguide system and to extraneous power sources is 10^{-8}--10^{-9} and good decoupling is necessary to eliminate this error. Prospects for further increase of the maser stability have been considered and it is shown that beams of "slow" molecules offer promise of stabilizing maser frequency within 10^{-11}. Experimental confirmation of many of the theoretical deductions is cited from literature sources. "The author is grateful to V. V. Nikitin, G. M. Strakhovskiy, and I. V. Chereminskiy for supplying the experimental material prior to publication and for discussion of the results, and also K. K. Svidzinskiy for a useful discussion. The author is particularly grateful to corresponding member AN SSSR N. G. Basov for continuous interest and great help with the work." Orig. art. has: 18 figures, 173 formulas, and 2 tables.

Card 3/4

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AT3012115

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 00 DATE ACQ: 29Jul63 ENCL: 00

SUB CODE: PH, GE NO REF SOV: 034 OTHER: 034

Card 4/4

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

S/141/63/006/001/001/018
E140/E435

AUTHOR: Orayevskiy, A.N.

TITLE: Molecular and atomic frequency standards

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy. Radiofizika, v.6, no.1, 1963, 5-23

TEXT: In this survey of the subject, covering work from 1948 to 1962, the author discusses the following topics: 1) obtaining narrow spectral lines in radiospectroscopy, 2) molecular and atomic oscillators, 3) caesium frequency standards. A possible application of these standards, previously unattainable experimentally, is in gravitational research (N.G.Basov et al. UFN, v.75, no.3, 1961). Also, the ultra-narrow lines obtained in magnetic atomic transitions should permit highly precise measurements of the atomic-nuclear magnetic constants. There are 8 figures.

SUBMITTED: September 3, 1962

Card 1/1

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

BELENOV, E. M.; ORAYEVSKIY, A. N.

A maser with two series cavity resonators. Radiotekh. i elektron. 8 no.1:158-161 Ja '63. (MIRA 16:1)

(Masers)

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 10504-63
EPR/EPF(c)/EPF(n)-2/EWT(d)/EWT(l)/EWT(m)/BDS--AFFTC/ASD/SSD--Ps-4/Pu-4/Pr-4--BW/
WW/WW
ACCESSION NR: AP3000074 S/0056/63/044/005/1742/1745

16
AUTHOR: Basov, N. G.; Oraevskiy, A. N. 74

TITLE: Obtaining negative temperatures by the method of heating and cooling of a system 21

SOURCE: Zhurnal eksper. i teoret. fiziki, v. 44, no. 5, 1963, 1742-1745

TOPIC TAGS: negative temperature state, laser theory, laser pumping method, thermal pumping

ABSTRACT: A method is proposed for establishing negative temperature states for certain pairs of energy levels by the rapid heating or cooling of a system having the appropriate energy level structure. In a three-level system, for instance, if the probability of transition from level 1 to level 3 is considerably greater than those from level 1 to level 2 and from level 3 to level 2, then with a sharp rise in temperature thermodynamic equilibrium will be established rapidly between levels 1 and 3 and slowly between levels 1 and 2 and levels 2 and 3. In such a case a negative temperature state will exist for a short time with respect to levels 3 and 2. The same state can occur during

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ACCESSION NR: AP3000074

2

cooling of the system, but with a different distribution of energy level transition probabilities. The optimum conditions are described by equations. A mixture of para- and ortho-hydrogen is proposed as a concrete example; molecules of the "symmetrical cone" type can be used as well. The abrupt temperature change required may be produced by rapid chemical reactions or by shock waves. Orig. art. has: 1 figure and 12 equations.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR, Moscow (Physics Institute, AN SSSR)

SUBMITTED: 19Oct62 DATE ACQ: 12Jun63 ENCL: 00

SUB CODE: PH NO REF SOV: 002 OTHER: 000

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 17842-63 EPR/EPF(c)/EWT(l)/EPF(n)-2/EWT(m)/BDS/EEC(b)-2 AFFTC/
ASD/ESD-3/RADC/IJP(C)/SSD Pa-4/Pr-4/Pu-4/Pi-4 GG/RM/WW/JW
ACCESSION NR: AP3005264 S/0056/63/045/002/0177/0179 86 85

AUTHOR: Orayevskiy, A. N.

TITLE: Generation of negative temperatures in chemical reactions

SOURCE: Zhur. eksper. i teoret. fiz., v. 45, no. 2, 1963, 177-179

TOPIC TAGS: negative temperature, population inversion, negative-temperature state, maser, maser action, chemical-reaction maser

ABSTRACT: It is shown that chemical reactions proceeding via the excited electronic state can lead to population inversion. Absorption or chemical reactions in which products formed cannot emit spectral lines can best be utilized to obtain an adequate rate of removal of unexcited particles necessary to achieve negative temperature under steady-state conditions. In particular, chain reactions of the Na—Cl type,

$$Na_2Cl = NaCl + Na,\ Na + Cl_2 = NaCl + Cl \qquad (1),$$

can be used for this purpose. Cs—Cl reactions which proceed according to (1)

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

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ACCESSION NR: AP3005264

may be even more convenient for obtaining negative temperature under steady-state conditions. The formation of metastables as a result of some chemical reactions, such as

$$CO_2 \rightarrow CO(^1\Sigma) + O, \quad N_2O \rightarrow N_2(^1\Sigma) + O, \qquad (2)$$

should be even more favorable for achieving population inversion. Orig. art. has: 8 formulas.

ASSOCIATION: Fizicheskiy institut imeni P. N. Lebedeva, Akademii nauk SSSR (Physics Institute, Academy of Sciences SSSR)

SUBMITTED: 20Dec62 DATE ACQ: 06Sep63 ENCL: 00

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Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

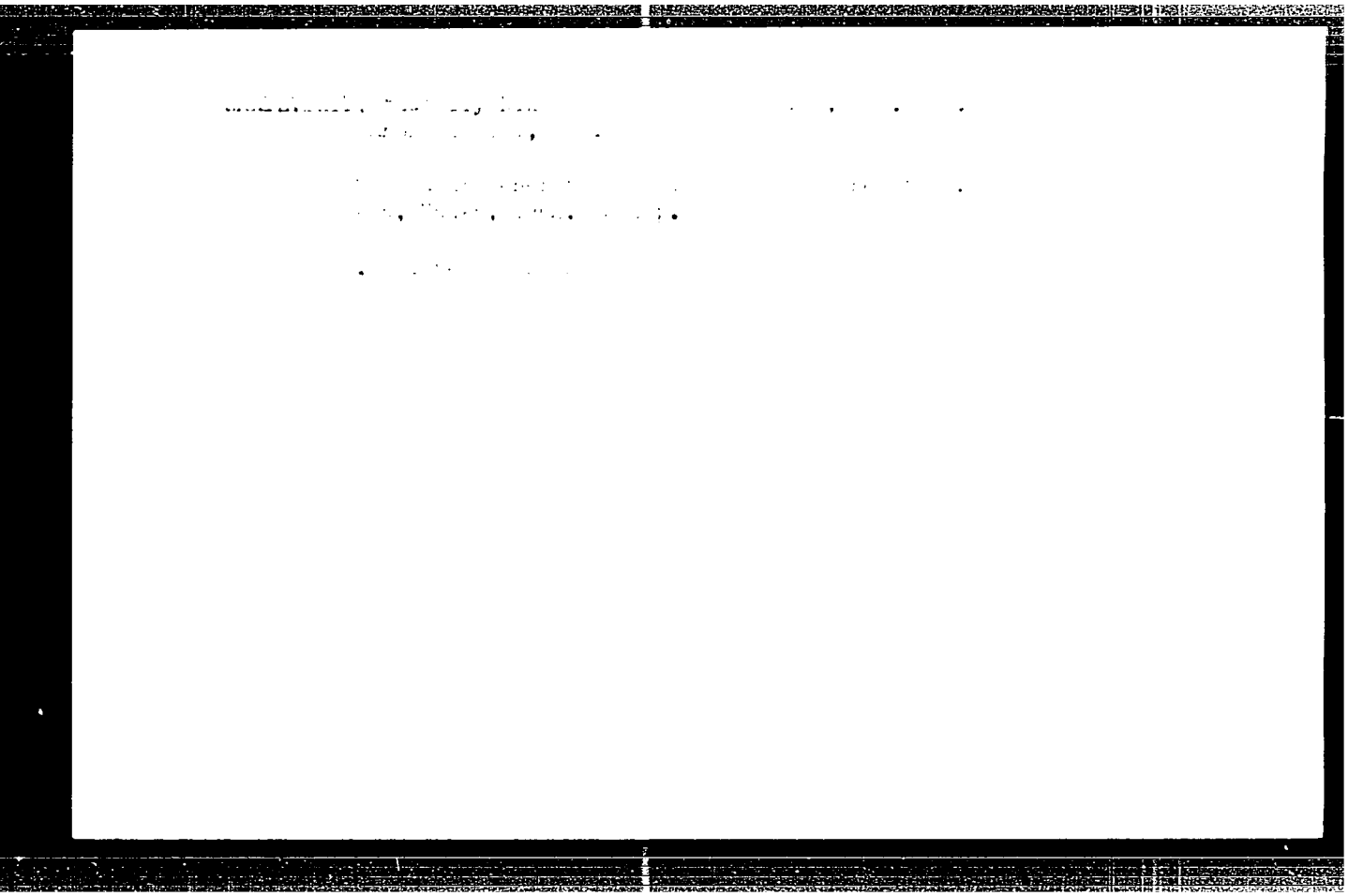
BASOV, N.G.; ORAYEVSKIY, A.N.; STRAKHOVSKIY; TATARENKOV, V.M.

Molecular generator with resonators connected in series. Zhur. eksp. i teor. fiz. 45 no.6:1768-1777 D '63. (MIRA 17:2)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238



APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 13975-65 EWT(l)/EWA(h) Peb AFETR/ASD(a)-5/BSD/AFWL/SSD/ASD(d)/RAEM(a)/
AIGC(b)/ESD(dp)/ESD(gs)/ESD(t)

ACCESSION NR: AP4044102 S/0141/64/007/003/0479/0490

AUTHOR: Belenov, E. M.; Orayevskiy, A. N.

B

TITLE: Investigation of molecular generator with two resonators in tandem

25

SOURCE: IVUZ. Radiofizika, v. 7, no. 3, 1964, 479-490

TOPIC TAGS: maser, maser theory, quantum generator, resonator, resonator Q factor, molecular electronics

ABSTRACT: This article contains a more thorough theoretical analysis than the first report by the authors (Radiotekhnika i elektronika, v. 8, 158, 1963). The equations for the maser oscillations are applied to masers with two separated resonators with opposing molecule beams and to a maser with closed circulation of the molecule beam. The frequency shift due to the traveling wave effect is evaluated. The analysis shows that a maser with two resonators in tandem

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ACCESSION NR: AP4044102

can support an oscillation mode in which the line width is determined essentially by the time of flight between the resonators. This reduces noticeably the effect of the traveling wave on the oscillation frequency. The stability of various maser modes is analyzed. It is shown that if the Q of the first resonator exceeds that of the second, then oscillations at the frequency of the first resonator are always stable in the second. In the opposite case the oscillation frequency is determined at first only by the parameters of the second resonator, but as the number of incoming molecules is increased, harmonic oscillations are produced in the first until synchronization is attained. Orig. art. has: 5 figures and 44 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 29Jul63 ENCL: 00

SUB CODE: EC NO REF SOV: 009 OTHER: 003

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AP4024732 S/0109/64/009/003/0524/0532

AUTHOR: Grasyuk, A. Z.; Orayevskiy, A. N.

TITLE: Transients in maser

SOURCE: Radiotekhnika i elektronika, v. 9, no. 3, 1964, 524-532

TOPIC TAGS: maser, maser transient , maser transient theory, maser transient experiment

ABSTRACT: A theoretical and experimental investigation of transients occurring in a maser is reported, from the moment of entry of the active-molecule beam into the resonator. Equations are developed which describe the transients; the form of these equations is similar to that of equations describing quasi-stationary conditions. It is found that the effect of the beam intensity on the quiescent time and the total transient time is stronger than the corresponding effect on the steady-state amplitude; this permits using the method of amplitude

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ACCESSION NR: AP4024732

transient characteristics for balancing beam intensities in two-beam masers. The phase and frequency in a maser are established in a different manner than is the amplitude, which should be borne in mind when dealing with the various methods of aligning a maser for its radiation line. The oscillating nature of the theoretical amplitude curves provides some reason to believe that an auto-modulation mode is possible in a maser under certain conditions. "The authors wish to thank A. V. Uspenskiy for his comments." Orig. art. has: 9 figures and 21 formulas.

ASSOCIATION: none

SUBMITTED: 28Jun62 DATE ACQ: 10Apr64 ENCL: 00

SUB CODE: PH NO REF SOV: 006 OTHER: 001

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 8717-65 EWG(j)/EWA(h)/FBD/EWT(l)/EEC(k)-2/EEC(t)/T/EEC(b)-2/EWP(k)/EWA(m)-2/EWA(h) Pn-4/Po-4/Pf-4/Pi-4/Peb/Pl-4 IJP(c)/ESD(gs)/AFWL/ASD(a)-5/AFTC(p)/SSD/RAEM(a)/RAEM(t)/AFETR/BSD/ESD(t)/ASD(d) WG

ACCESSION NR: AP4045491 S/0109/64/009/009/1680/1686

AUTHOR: Basov, N. G.; Grasyuk, A. Z.; Orayevskiy, A. N. 13

TITLE: Some special features of information transmission and reception by means of laser oscillators and amplifiers 26

SOURCE: Radiotekhnika i elektronika, v. 9, no. 9, 1964, 1680-1686

TOPIC TAGS: laser, multichannel communication line, laser beam, traveling wave laser, image amplifier 25

ABSTRACT: Some basic properties of multichannel communication lines using the time and space coherence of the radio emission of a laser oscillator concurrently are studied. The information is transmitted by irradiating an object of variable transparency with a laser beam. The authors demonstrated that the transmission capacity of such a system exceeds considerably the corresponding value yielded by the Shannon formula for one channel. The receiver signal-to-noise ratio required for the stable operation of communication lines using traveling-wave lasers is evaluated. The problem of the possibility of using regenerative lasers as image amplifiers is also studied.

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 8717-65

ACCESSION NR: AP4045491

The authors note that, for the purpose of simplifying the receiver of a multichannel communication line, it is possible to utilize space quantization of transparency functions with limited diffraction spectra. Orig. art. has: 7 figures and 8 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 25Apr 63 ATD PRESS: 3112 ENCL: 00

SUB CODE: EC NO REF SOV: 004 OTHER: 003

Card 2/2

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 19028-65 EWT(1)/EWA(h) Peb SSD/AFWL/RAEM(a)/AFETR/APGC(b)/ESD(gs)

ACCESSION NR: AP5000457 S/0109/64/009/012/2156/2165

AUTHOR: Agabekyan, A. S.; Grasyuk, A. Z.; Zubarev, I. G.; Svergun, V. I.; Orayevskiy, A. N.

TITLE: Stabilization of unstable conditions in a two-level quantum generator

SOURCE: Radiotekhnika i elektronika, v. 9, no. 12, 1964, 2156-2165

TOPIC TAGS: quantum generator, quantum generator stabilization

ABSTRACT: Two methods of stabilizing automodulation conditions in a two-level quantum generator are theoretically considered: (1) Locking-in of the unstable generator by a low-power constant-amplitude generator; (2) Stabilization by means of a resonator-Q negative feedback. The effect of a constant-amplitude external force on the stability of the amplitude of oscillations is mathematically investigated. To stabilize automodulation conditions, the magnitude of the external force should exceed a certain threshold which depends on the parameters

Card 1/2

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 19028-65

ACCESSION NR: AP5000457

of the generator being locked; hence, phase and amplitude locking-in must be distinguished. Four equations describing the stabilization by a resonator-Q negative feedback are set up and analyzed. Orig. art. has: 7 figures and 52 formulas.

ASSOCIATION: none

SUBMITTED: 31Jul63 ENCL: 00

SUB CODE: EC NO REF SOV: 005 OTHER: 001

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ORAYEVSKIY, A.N., kand. fiz.-matem. nauk

Semiconductor quantum generators. Priroda 53 no.9:15-19 '64.
(MIRA 17:10)

1. Fizicheskiy institut im. P.N. Lebedeva AN SSSR, Moskva.

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 52321-65 EEC(b)-2/EWG(r)/EEC(k)-2/EWA(h)/EWA(k)/EWP(k)/EWT(l)/EEC(t)/FBD/T/EWA(m)-2 Pf-4/Pi-4/Pl-4/Pm-4/Pn-4/Po-4/Peb IJP(c) WG

ACCESSION NR: AP5013667 UR/0386/65/001/001/0022/0026

60
59
B

AUTHOR: Mukhamedgaliyeva, A. F.; Crayevskiy, A. N.; Strakhovskiy, G. M.

TITLE: Maser with two series resonators and a "molecular ring" amplifier

25

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 1, no. 1, 1965, 22-26

TOPIC TAGS: maser, two beam maser, molecular ringing, maser line width

ABSTRACT: A maser was investigated with two cascaded cavities and with two colliding beams, one cavity acting as generator and the other as amplifier, with an aim of checking the possibility of obtaining in this system a narrower spectral emission line than in a single-cavity maser. A schematic diagram is shown in Fig. 1 of the Enclosure. The system dimensions were ℓ = 23 mm (length of each cavity) and L = 140 mm (distance between cavity ends). The beam of molecules, first polarized in one of the resonators, excites in the second resonator oscillations of the same frequency as in the first ("molecular ringing"). This "ringing" is amplified by the opposing intense beam of molecules. To attain approximate equality of the incoming and outgoing particles the intensity of the beam

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

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ACCESSION NR: AP5013667

amplifying the "molecular ringing" is made several times larger than the intensity of the beam producing the generation. The line narrowing in such a system can be estimated from the decrease of the slope of the plot of the change of generation frequency vs. resonator frequency deviation. The expected line narrowing should have been 10—12, but since the losses of beam intensity in the gap between cavities were not fully compensated for, a much smaller narrowing was obtained. The test results are shown in Fig. 2 of the Enclosure and indicate that as the cavity in which generation takes place is detuned the system frequency does not vary continuously over the entire detuning range. The jumps in frequency can be attributed to the fact that in this system there should be, besides a principal maximum at the molecular-transition frequency, two secondary maxima differing in frequency by approximately 1/T from the principal maximum. If the line has such a shape, then jumps of frequency and amplitudes should be observed in the generation mode. Orig. art. has: 2 figures. [02]

ASSOCIATION: Fizicheskiy institut Akademii nauk SSSR (Physics Institute, Academy of Sciences SSSR)

SUBMITTED: 12Feb64	ENCL: 02	SUB CODE: EC	
NO REF SOV: 002	OTHER: 003	ATD PRESS: 4009	

Card 2/4

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 52321-65

ACCESSION NR: AP5013667

ENCLOSURE: 01

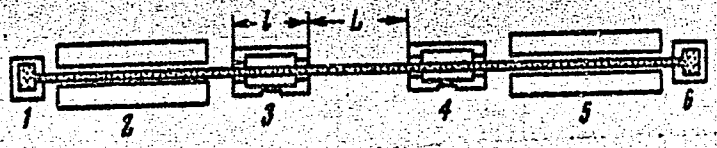

Fig. 1. Schematic diagram of two-cavity two-beam maser:

1, 6 - Molecular beam sources; 2,5 - sorting systems;
3, 4 - cavities.

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

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ACCESSION NR: AP5013667

ENCLOSURE: 02

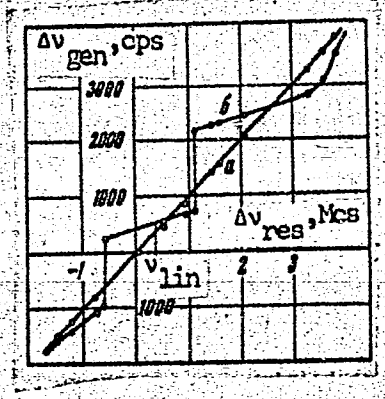

Fig. 2. Dependence of the generation frequency on the cavity frequency deviation: a - in a single-cavity maser, b- in a cavity with a "molecular ringing" amplifier.

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 00753-66 EWA(k)/FBD/ENT(l)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) IJP(c) WG

ACCESSION NR: AP5021731 UR/0386/65/002/002/0077/0079

AUTHOR: Veselago, V. G.; Orayevskiy, A. N.; Strakhovskiy, G. N.; Tatarenkov, V. M.

TITLE: A new method for tuning a maser

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 2, no. 2, 1965, 77-79

TOPIC TAGS: maser, resonator, microwave generator

ABSTRACT: The maser with two series connected resonators has previously been studied in detail by several authors. It has been shown that the amplitude and phase of the field in the second resonator are given by the expression:

$$E \sim \frac{N}{Z_{eff}} \langle P(\tau_1, \tau_2) \rangle e^{-i(\omega_2 - \omega_1)T}, \quad (1)$$

where P is an independent function of the intensity of the field in the first resonator and of the transit time through the first (τ_1) and second (τ_2) resonators; N is the number of molecules in a unit of volume; Z_{eff} is the effective impedance of

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ACCESSION NR: AP5021731

the resonator with respect to the molecules contained in it; ω_1 is the frequency of oscillations in the first resonator; and ω_{12} is the molecular transition frequency. The symbol <> indicates averaging with respect to the velocities of the molecules, T is the transit time of the molecules between resonators. It is evident from this approximation that when $\omega_{21} \neq \omega_1$, the phase difference between the oscillations in the first and second resonators depends on the distance l between them. When $\omega_{21} = \omega_1$, the phase difference is zero for any l. Thus the frequency of the maser ω_1 can be tuned exactly to the transition frequency ω_{21}. Actually, if the distance between the resonators is varied by the quantity Δl, the phase of the oscillations in the second resonator is changed by the quantity

$$\Delta\psi = (\omega_1 - \omega_{21})\frac{\Delta l}{\bar{v}}, \quad (2)$$

where $\bar{v}$ is the velocity of the molecular beam. If it is assumed that Δl is very nearly 10 cm, $\bar{v} = 5 \cdot 10^4$ cm/sec, and $\omega_1 - \omega_{21} = 10^{-10}\omega_{21}$, then $\Delta\psi = 2 \cdot 10^{-4}$, which corresponds to a change in the phase angle by approximately 0.01°. For practical purposes, the accuracy in phase measurements limits determination of emission frequency to an accuracy of 10^{-10}. It is also possible to use modulation of the distance between the resonators according to the law $\Delta l = \Delta l_0 \cos\Omega t$. This causes phase

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ACCESSION NR: AP5021731

modulation of the field in the second resonator due to periodic variation in the transit time $T = l(t)/\bar{v}$. The amplitude of the phase modulation is found from expression (2). Periodic modulation of the distance between the resonators may be used to record small changes in the phase difference between the oscillations in the first and second resonators since the method of synchronous detection can be used in this case. The advantage of this system for tuning is that it eliminates the effect of the traveling wave on the tuned frequency. If the spectral line used for emission consists of a single component, frequency ω_1 will coincide with the transition frequency ω_{21}. Orig. art. has: 2 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR
(Physics Institute, Academy of Sciences, SSSR)

SUBMITTED: 27May65 ENCL: 00 SUB CODE: EC

NO REF SOV: 004 OTHER: 001

Card 3/3

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L 49432-65 EWA(k)/FBD/EWG(r)/EWT(l)/EEC(k)-2/EEC(t)/T/EEC(b)-2/EWP(k)/EWA(m)-2/
EWA(h) Pf-4/Pi-4/Pl-4/Pm-4/Pn-4/Po-4/Peb SCTB/IJP(c) WJ

ACCESSION NR: AP5010680 UR/0141/65/008/001/0081/0090

62
61
B

AUTHOR: Orayevskiy, A. N.; Shcheglov, V. A.

TITLE: Natural modes of dielectric-filled quantum optical resonators

SOURCE: IVUZ. Radiofizika, v. 8, no. 1, 1965, 81-90

TOPIC TAGS: solid laser, natural mode, laser cavity, laser loss

25

ABSTRACT: The authors investigate the natural modes of a plane dielectric layer located between infinite ideally level absolutely conducting planes, and of a round dielectric cylinder located between two infinite planes, with the aim of using the results to determine the electrodynamic properties of open resonators filled with a dielectric. The quantities calculated are the transverse wave numbers, the natural frequencies, the values of Q of the different modes, and the number of modes in a specified spectral interval. The losses in the material and in the resonator walls are also calculated. "The authors thank N. G. Basov for continuous interest and L. A. Vaynshteyn for useful advice." Orig. art. has: 3 figures and 36 formulas. [02]

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACCESSION NR: AP5010680

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 02Mar64 ENCL: 00 SUB CODE: EC

NO REF SOV: 005 OTHER: 005 ATD PRESS: 4003

Card 2/2

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 00979-66 EWA(k)/FBD ENT(1)/EEC(k)-2/T/EEC(b)-2/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c)
ACCESSION NR: AP5014515 UR/0141/65/008/002/0409/0411 WG

AUTHOR: Voropayev, N.D.; Orayevskiy, A.N.

TITLE: Modes in a laser in the presence of an absorbing impurity

SOURCE: IVUZ. Radiofizika, v. 8, no. 2, 1965, 409-411

TOPIC TAGS: laser action, laser mode, laser, laser medium, stimulated emission, population inversion

ABSTRACT: The system of equations describing the fields in the cavity and the active medium of a laser, obtained by one of the authors earlier (Orayevskiy, Trudy fizicheskogo instituta im. P. N. Lebedeva v. 21, 3, 1963), is supplemented to take into account the presence of an absorbing impurity in the medium. Estimates show that the modified system of equations is nearly linear and can be solved by the small-parameter method. The condition under which lasing action can occur, namely that the power emitted by the active particles exceed the absorbed power, is derived. A numerical example is given. The results can be extended to the case when the line width and the reciprocal of the particle lifetime at the level are not equal. The principle can be used to develop shutter systems for tandem-connected lasers. Orig. art. has: 10 formulas.

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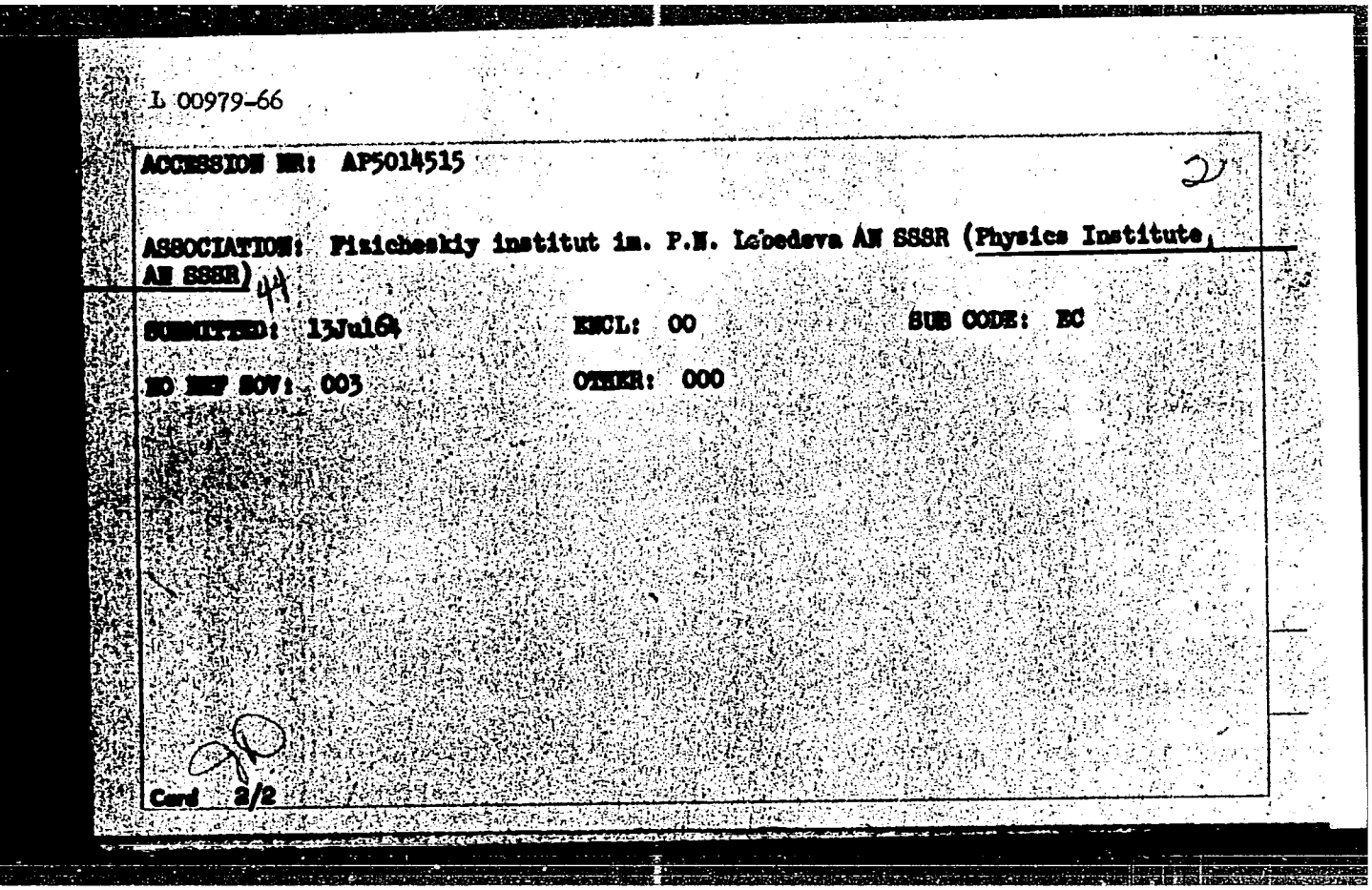

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ACCESSION NR: AP5014515

ASSOCIATION: Fizicheskiy institut im. P.N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 13Jul64 ENCL: 00 SUB CODE: EC

NO REF SOV: 003 OTHER: 000

Card 2/2

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 63121-65 EWT(1)

ACCESSION NR: AP5020376 UR/0141/65/008/003/0631/0633
621.378.1

29
28
B

AUTHOR: Agabekyan, A. S.; Grasyuk, A. Z.; Orayevskiy, A. N.

TITLE: Spontaneous emission of particles in a resonator with several coupled modes of oscillation

SOURCE: IVUZ. Radiofizika, v. 8, no. 3, 1965, 631-633

TOPIC TAGS: emission spectrum, resonator, oscillation

ABSTRACT: If there are several modes of oscillation in a resonator in a band of frequencies occupied by emission lines, the modes are usually assumed to be independent (orthogonal). However, in practice there is always some coupling between them, determined by the geometric parameters of the resonator, properties of the substance, etc. Clearly, this coupling should influence the physical processes in the resonator, causing spontaneous and induced excitation of particles in it. The probability of spontaneous emission is calculated by a method analogous to one used in a previous work coauthored by Orayevskiy, assuming that the energy spectrum of the particles contained in the resonator consists of 2 non-overlapping continuous bands of

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ACCESSION NR: AP5020376

width ΔE with average levels E_1 and E_2. Two limiting cases are considered in detail, and in both cases the coupling between modes reduces the probability of spontaneous emission. Orig. art. has: 9 formulas.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR (Physics Institute, AN SSSR)

SUBMITTED: 13Jul64 ENCL: 00 SUB CODE: NP

NO REF SOV: 003 OTHER: 001

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 56179-65

ACCESSION NR: AP5015816 UR/0109/65/010/006/1140/1142
621.372.413

AUTHOR: Orayevskiy, A. N.; Shcheglov, V. A. 7 8

TITLE: Natural oscillations in dielectric resonators

SOURCE: Radiotekhnika i elektronika, v. 10, no. 6, 1965, 1140-1142

TOPIC TAGS: dielectric resonator

ABSTRACT: A theoretical investigation is reported of the number of natural modes in a specified spectral interval and the minimum relative optical density at which the crystal loses its resonator properties. The modes due to the total internal reflection are considered. The field of natural modes is represented after A. Okaya and L. F. Barash (Proc. IRE, 1962, v. 50, no. 10, 2081). It is found, for fixed geometrical parameters of the system, that the number of natural oscillators in a given frequency interval decreases with the relative optical density of the crystal. Orig. art. has: 1 figure and 8 formulas. [03]

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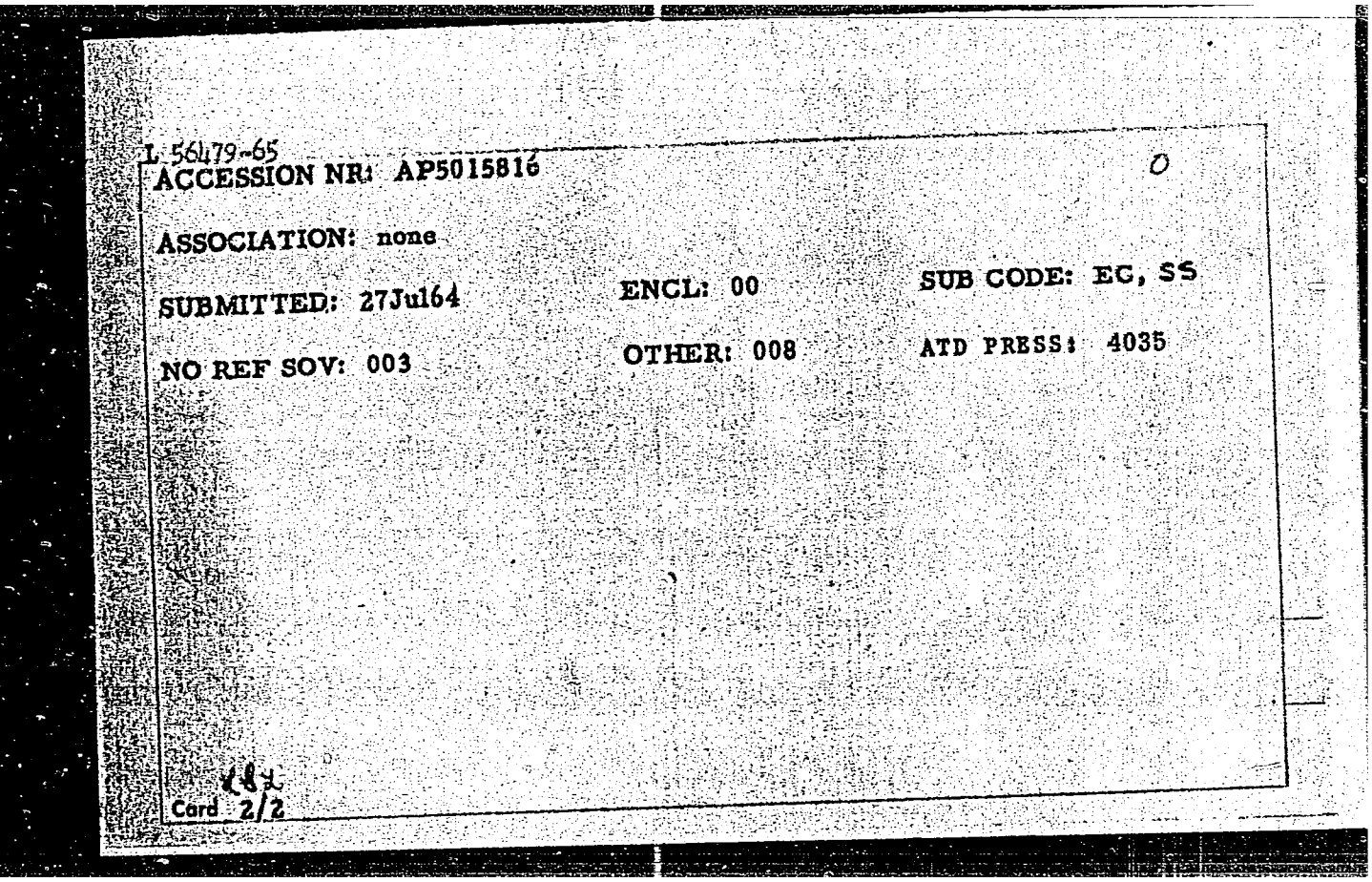

L 56479-65
ACCESSION NR: AP5015816 O

ASSOCIATION: none

SUBMITTED: 27Jul64 ENCL: 00 SUB CODE: EC, SS

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L 52322-65 EWG(r)/EEC(k)-2/EEC(b)-2/EWA(h)/EWP(k)/EWA(k)/EWT(l)/EEC(t)/FBD/T/
EWA(m)-2 Pf-4/Pi-4/Pl-4/Pm-4/Pn-4/Po-4/Peb IJP(c) WG

ACCESSION NR: AP5012604 UR/0051/65/018/005/0785/0791

AUTHOR: Morozov, V. N.; Orayevskiy, A. N.; Strakhovskiy, G. M.; Tatarenkov, V. M.

TITLE: Hyperfine structure of the inversion spectrum of $N^{15}H_3$ (line J = 3, K = 3)

SOURCE: Optika i spektroskopiya, v. 18, no. 5, 1965, 785-791

52
B

TOPIC TAGS: ammonia maser, hyperfine structure, inversion spectrum

ABSTRACT: In view of its importance in the construction of highly stable masers, the authors investigated theoretically and experimentally the hyperfine structure of the inversion spectrum of the ammonia molecule $N^{15}H_3$ (J = 3, K = 3) in the electronic ground state and vibrational states. The Hamiltonian of the molecule is determined in the Born-Oppenheimer approximation and its eigenvalues are calculated, from which the wave functions and the frequencies and relative intensities of the transitions are determined. The fine structure was also determined experimentally using as a spectroscope an underexcited maser with $N^{15}H_3$ beam. A block diagram of the set-up and a brief description of the experiment are given. The satellites observed on the photograph of the spectrum agreed within the limits of errors with the calculated transition frequencies. Orig. art. has: 3 figures, 11 formulas, and 2 tables.

[02]

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 52322-65

ACCESSION NR: AP5012604

ASSOCIATION: none

SUBMITTED: 16Apr64 ENCL: 00 SUB CODE: OP, EC

NO REF SOV: 002 OTHER: 005 ATD PRESS: 4009

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APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

BE'ENOV, E.M.; ORAYEVSKIY, A.N.

Kinetic processes in a gas laser. Opt. i spektr. 18 no.5 [illegible]
My '65. (MIRA 18:10)

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 1072-66 EWA(k)/FBD/EWT(l)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WG

ACCESSION NR: AP5016184 UR/0051/65/018/006/1086/1088
533.97

AUTHOR: Voropayev, N. D.; Orayevskiy, A. N.

TITLE: Effect of saturation on generation of higher harmonics

SOURCE: Optika i spektroskopiya, v. 18, no. 6, 1965, 1086-1088

TOPIC TAGS: laser, nonlinear effect, laser optics, harmonic analysis, harmonic generation

ABSTRACT: The authors consider the effect of saturation on the generation of higher harmonics in pulsed lasers, based on the model of a two-level system, assuming that the frequency of the external radiation is close to the interlevel transition frequency of the system. The equations of polarization for this model are given and solved for the field

$$\delta = \delta_0 \cos \omega_0 t + \delta_3 \cos (3\omega_0 t + \alpha).$$

This solution is used for qualitative evaluation of the polarization amplitude at the tripled frequency as a function of the amplitude of the external field. In view of the linearity of the Maxwell equations, the field amplitude for the third

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ACCESSION NR: AP5016104

harmonic will have this same relationship to the amplitude of the external field. The transformation ratio from the first to the third harmonic $\kappa = \frac{\delta_3}{\delta_1}$ which gives the efficiency of the crystal, will be proportional to δ_1 in small fields, and independent of the external field in large fields due to saturation. The efficiency of frequency transformation becomes constant in large fields when there is an absolute increase in the intensity of the third harmonic with an increase in the amplitude of the stimulating radiation. Orig. art. has: 7 formulas.

ASSOCIATION: none

SUBMITTED: 31Dec64 ENCL: 00 SUB CODE: EC, OP

NO REF SOV: 003 OTHER: 002

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 23389-66 EEC(k)-2/EWA(h)/EWP(k)/EWT(l)/FBD/T IJP(c) WG

ACC NR: AT6009313 SOURCE CODE: UR/2504/65/031/000/0096/0112

AUTHORS: Orayevskiy, A. N.; Uspenskiy, A. V.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Power pulsation regime of laser radiation

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 31, 1965. Kvantovaya radiofizika (Quantum radio physics), 96-112

TOPIC TAGS: laser theory, laser pulsation, relaxation process, laser radiation spectrum, laser r and d

ABSTRACT: The authors point out that at present there are many hypotheses concerning the theory of laser pulsation, although none give a satisfactory explanation of all the experimental facts. They review briefly presently known facts concerning the random pulsations and quasicontinuous pulsation mode, as well as the various theoretical hypotheses advanced on pulsation theory. They then analyze the character of the nonstationary processes in a two-level system within

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the framework of a single oscillation mode, and the conditions under which they arise. They use a model of a substance with two relaxation times. The equations of the two-level laser are derived rigorously and also in the form of approximate velocity equations, and the applicability of the latter as well as ways of increasing their accuracy are discussed. Modes that can be reconciled with a system of equations in which nondiagonal elements of the density matrix are included are analyzed. The transient in a two-level generator, as deduced from the analyzed equations, are briefly described. The authors solved the system of equations they derived with the aid of a computer for the case two oscillation modes and obtained damped pulsation regimes. They arrive at the following conclusions: 1) the sum of the amplitudes of the two modes execute regular damped oscillations, and the amplitude of each of them executes irregular oscillations; 2) the amplitudes in two different modes pulsate in phase opposition. Some disparity between their results and the results of others is pointed out. Orig. art. has: 3 figures and 42 formulas.

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ORAYEVSKIY, A.N.

Population inversion brought about by thermal dissociation of molecules in a shock wave. Zhur. eksp. i teor. fiz. 48 no.4:1150-1154 Ap '65. (MIRA 18:5)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 21005-66 EEC(k)-2/EWA(h)/EWT(l)/FBD/T/EWP(k) IJP(c) WG

ACCESSION NR: AP5024711 UR/0056/65/049/003/0895/0904

AUTHOR: Basov, N. G.; Morozov, V. N.; Oraevskiy, A. N. 15

TITLE: Nonlinear mode interaction in a laser 25 B

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 3, 1965, 895-904

TOPIC TAGS: laser, stimulated emission, nonlinear optics, oscillation mode

ABSTRACT: A theoretical analysis is conducted of the operation of a two-mode solid state laser. It is shown that the mode interaction can be described by a set of rate equations and that the steady-state regime is stable. The solution of the system of equations depends on the frequency difference of the modes. The two possible cases, nearly biharmonic and nearly harmonic oscillations, are analyzed. In the case of close modes the steady-state regime may be unstable, resulting in the appearance of undamped spiking. The laser operating regime is shown to depend on the shape and position of the mirrors and the quality of the crystal. Orig. art. has: 17 formulas and 1 figure. [CS]

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences, SSSR)

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L 21005-66

ACCESSION NR: AP5024711

SUBMITTED: 03Apr65 ENCL: 00 SUB CODE: EC,SS

NO REF SOV: 010 OTHER: 012 ATD PRESS: 4111

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APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 3196-66 EWA(k)/FBD/EWT(l)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WG
ACCESSION NR: AP5015414 UR/0020/65/162/004/0781/0784

AUTHOR: Basov, N. G. (Corresponding member AN SSSR); Morozov, V. N.; Orayevskiy, A. N.

TITLE: Dynamics of a two-mode laser

SOURCE: AN SSSR. Doklady, v. 162, no. 4, 1965, 781-784

TOPIC TAGS: laser, stimulated emission, mode, laser theory, laser cavity

ABSTRACT: A theoretical analysis is made of the operation of a two-mode laser. Simple substitution is used to obtain an equation containing the polarization and the electric field from a set of equations for a one-mode laser. The equation obtained can be expanded in terms of the eigenfunction of the field. Two special cases are considered: 1) eigenfrequencies much greater than the width of each of the resonance lines and oscillations occurring at both frequencies (nearly biharmonic oscillations) and 2) resonance curves overlapping considerably (nearly harmonic oscillations). In the case of nearly biharmonic oscillations, application of van der Pol equations to the system of equations obtained by the authors results in a set of rate equations which, under certain simplifying assumptions, are identical to those obtained by W. E. Lamb (Physical Review, v. 134, no. 6A, 1964, p. 1429).

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ACCESSION NR: AP5015414

In the case of nearly harmonic oscillations, application of van der Pol equations leads to a set of equations for slow oscillations. An analysis of the resulting equations shows that the intensity of emission consists of regular undamped oscillations and explains some of the experimentally observed operating regimes. However, the actual regime is much more complex and requires analysis of the interaction of a larger number of modes. Orig. art. has: 5 formulas and 1 figure.

[CS]

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva Akademii nauk SSSR (Physics Institute, Academy of Sciences, SSSR)

SUBMITTED: 04Jan65 ENCL: 00 SUB CODE: EC

NO REF SOV: 003 OTHER: 006 ATD PRESS: 4041

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 17985-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(h) IJP(c) WG
ACC NR: AP6006804 SOURCE CODE: UR/0386/66/003/001/0054/0058

50
48
B

AUTHOR: Belenov, E. M.; Markin, Ye. P.; Morozov, V. N.; Orayevskiy, A. N.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Interaction between traveling waves in a ring laser 25,44

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 1, 1966, 54-58

TOPIC TAGS: gas laser, ring laser, helium neon laser, laser R and D, traveling wave interaction

ABSTRACT: An investigation of beat frequencies in traveling waves generated in a ring laser on a rotating platform may be used for highly accurate analysis of the spectral, statistical, and other characteristics of laser emission. However, frequency splitting Δ of the traveling waves takes place only at rates of rotation v greater than some critical velocity v_{cr} (or the corresponding quantity $\Delta_{cr}=2kV_{cr}/\pi$, where v is the linear velocity of a resonator mirror, k is the wave vector). Coupling between traveling waves causes mutual synchronization at frequencies below the critical value which results in single-frequency conditions. The authors studied

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

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ACC NR: AP6006804

the quantity Δ_{cr} as a function of the parameters of a ring laser. A helium-neon laser was used in this experiment (λ=3.39 μ). A spectral analyzer was used for measuring the beat frequency Δ. The capture band Δ_{cr} was studied as a function of the coefficient of transmission for the output mirror. A reduction in transmission causes a sharp change in the capture band. Experiments were conducted on attenuation of the beam reflected from the external mirror by using a filter. Attenuation of this signal reduces the capture band. Various optical systems were used for passing the direct and reverse beams to the photoelectric mixer with a simultaneous reduction in the energy reflected into the resonator from the external mirrors. Figures are given showing two modifications of systems for reducing the capture band to 300 cps. The Q of the resonator was reduced for a further reduction of the band. This was done by replacing one of the opaque mirrors in the resonator with a semi-transparent mirror. The result was a reduction in the capture band from 300 to 50 cps at the same output power. The magnitude of the capture band is determined by the reverse reflection of energy from various elements in the resonator, scattering by nonhomogeneous media, and the nonlinear dependence of polarization on the field. "The authors are grateful to N. G. Basov for valuable consultation and interest in the work and to V. V. Gromov for assistance in carrying out the experiment." Orig. art. has: 2 figures, 2 formulas. [14]

SUB CODE: 20/ SUBM DATE: 23Nov65/ ORIG REF: 002/ OTH REF: 003/ ATD PRESS: 4213

Card 2/2

APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R0012381

"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 32209-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k) IJP(c) WG

ACC NR: AP6020791 SOURCE CODE: UR/0386/66/003/012/0468/0471

AUTHOR: Basov, N. G.; Orayevskiy, A. N.; Strakhovskiy, G. M.; Uspenskiy, A. V.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Two-cavity laser as high-resolution spectroscope

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 12, 1966, 468-471

TOPIC TAGS: laser application, laser radiation spectrum, molecular spectroscopy, receiver resolution, hyperfine structure

ABSTRACT: The authors show that in a laser it is possible to resolve spectral components within the limits of a homogeneously broadened line, so that a spectroscope based on the use of such a laser can have a resolution limit determined by the width connected with the monochromaticity and stability of the radiation source. The spectroscope consists of a previously-described laser with two cavities in tandem (Pis'ma ZhETF v. 2, 77, 1965). Modulation of the distance between the two cavities normally modulates the signal in the second cavity, but if the signal frequency coincides exactly with the peak of the spectral line, then the

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distance modulation does not cause phase modulation. Since the position of the line peak changes with the magnitude of the signal in the first cavity, it is possible, by measuring the generation frequency at which the phase of the second cavity does not depend on the modulation of the distance between cavities, to obtain at different signal values as many independent equations as there are hyperfine structure components in the line. Simultaneous solution of these equations determines the positions of the hyperfine components. A sample calculation is given for a line with two components, and it is shown that for cavities 10 cm long spaced 10 cm apart, a mean beam velocity 6 x 10 cm/sec, a modulation frequency 10 cps, and a detection time of 1 sec it is possible to resolve spectral components separated by several cps. Orig. art. has: 2 formulas.

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L 10412-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k)/EWA(m)-2/EWA(h) SCTB/IJP(c) WG
ACC NR: AM5013207 BOOK EXPLOITATION UR

Orayevskiy, Anatoliy Nikolayevich 44

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Masers (Molekulyarnyye generatory), Moscow, Izd-vo "Nauka," 1964, 294 p. illus., diagm., Errata slip inserted. 3,000 copies printed. (Head of title: Akademiya nauk SSSR. Fizicheskiy institut im. Lebedeva) 44

TOPIC TAGS: maser theory, maser arrangement, quantum electrodynamics, electromagnetic interaction, electromagnetic wave oscillation, one beam through two cavity maser, atomic hydrogen maser

PURPOSE AND COVERAGE: In this monograph the physical principles of molecular generation and of the amplification of electromagnetic waves, constructional features, theory and characteristics of masers are presented. Special attention is paid to the stability of the oscillation frequencies of masers, which is associated with the basic aspects of their use. The book is designed for engineers, scientific workers, aspirants, and advanced students specializing in the field of quantum radiophysics. The author acknowledges the contributions by Basov, N.G. (Corresponding Member, Academy of Sciences SSSR); Orayevskiy, I.N.; Mikitin, A.I.

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L 10412-66

ACC NR: AM5013207

SUBMITTED: 24Nov64 SUB CODE: EC, EM NO REF SOV: 116

OTHER: 080

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 27661-66 EEC(k)-2/EWA(h)/EWP(k)/EWT(1)/FBD/T IJP(c) WG

ACC NR: AP6008288 SOURCE CODE: UR/0109/66/011/003/0514/0518

44
B

AUTHOR: Morozov, V. N.; Grayevskiy, A. N.

ORG: Institute of Physics, AN SSSR (Fizicheskiy institut, AN SSSR)

TITLE: Effect of irregularity of radiation of molecules on maser frequency

25

SOURCE: Radiotekhnika i elektronika, v. 11, no. 3, 1966, 514-518

TOPIC TAGS: maser, maser theory

ABSTRACT: In explaining why maser frequency changes on introduction of a second molecular beam, K. Shimoda, et al., believe that the traveling wave is connected with the energy flow into the output waveguide (Phys. Rev., 1956, v. 102, 1308; J. Phys. Soc. Japan, 1961, v. 16, no. 9, 1728). The present article disputes this point and offers a different explanation for the "traveling-wave effect". It points out that even when the output waveguide is absent, the maser frequency deviates due to irregularity (or nonuniformity) of molecule flight in the resonator, with or without saturation. The field nonuniformity in a two-beam system is lower roughly by two orders of magnitude than in the one-beam system. "The authors wish to thank N. G. Basov for the problem statement and discussions." Orig. art. has: 1 figure and 15 formulas.

SUB CODE: 20 / SUBM DATE: 09Dec64 / ORIG REF: 002 / OTH REF: 002

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 29555-66 EEC(k)-2/EWP(k)/EWT(1)/FBD/T IJP(c) WG
ACC NR: AP6018052 SOURCE CODE: UR/0020/66/168/003/0550/0553

AUTHOR: Basov, N. G. (Corresponding member AN SSSR); Morozov, V. N.; Orayevskiy, A. N

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Contribution to the theory of undamped pulsations of laser intensity

SOURCE: AN SSSR. Doklady, v. 168, no. 3, 1966, 550-553

TOPIC TAGS: laser emission, solid state laser, laser pulsation, phase diagram, light pulse

ABSTRACT: The differential equation for the intensity of laser emission, which in the case of solid-state lasers reduces to an equation whose stable limiting cycle corresponds to undamped oscillations of the laser emission intensity, is solved analytically. It is shown that the solutions obtained approximate quite closely the phase trajectories of the system in a case of large depth of modulation. The solution consists of two parts. The first corresponds to a slow motion when the active particles accumulate and the amplitude increases relatively slowly. The second represents an increase in amplitude followed by a release of the stored energy by radiation during a short pulse. The analytic relations obtained are used to calculate the parameters of a scheme proposed by the authors (Paper at Scientific Congress in Leipzig, March 1965) to obtain short light pulses (Fig. 1). The periodic solution of the equations

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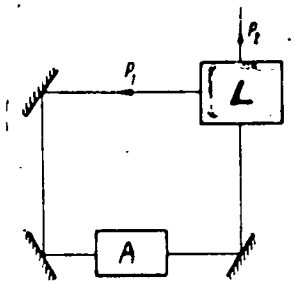

Fig. 1. Diagram of equipment for generation of short light flashes

L - Laser; A - amplifier.

is obtained and a numerical example is presented. It is shown that radiation pulses of 5.6×10^{-11} at half-power points with depth of modulation almost 100% are feasible in such a scheme. Orig. art. has: 1 figure and 19 formulas. [02]

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 2[illegible] EEC(k)-2/EWA(h)/EWP(k)/EWT(l)/FBD/T IJP(c) WG

ACC NR: AT6009314 SOURCE CODE: UR/2504/65/031/000/0113/0138

55

AUTHORS: Basov, N. G.; Belenov, E. M.; Markin, Ye. P.; Nikitin, V. V.; Orayevskiy, A. N. 49 B+1

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Investigation of a gas-mixture laser 25,24

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 31, 1965. Kvantovaya radiofizika (Quantum radio physics), 113-138

TOPIC TAGS: gas laser, laser r and d, laser beam, laser modulation

ABSTRACT: The purpose of this combined theoretical and experimental investigation was to assess the possibility of increasing the power of different gas lasers by choosing optimal operating conditions (pressure of mixture, partial pressures of the individual components, pump power, mirror transmission coefficient, diameter and length of discharges). The divergence of the beam and the spectrum of the generated radiation as functions of the outward power of the genera- 2,

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ACC NR: AT6009314

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tor are also investigated. Using a neon helium mixture and a special laser design, the authors obtained a power of 100 MW at 1.15 μ with an optimal tube radius of 8 mm and length 3 meters. The angular modulation characteristics were measured as a function of the output power. Reduction of the beam divergence by filtering out certain modes is discussed. Rotating-laser apparatus constructed for the measurement of the laser emission spectrum (a modification of the Sagnac experiment) is described. The results show that the output power of the laser can be increased by adding a buffer gas to intensify the decay of the metastable neon, by increasing the temperature of the working gas, by using pulsed excitation to populate the upper working level, by increasing the resonator length and the length of the discharge tube, and by decreasing the transverse dimensions of the discharge tube. The authors thank Yu. P. Trokhin, V. N. Lukanin, B. I. Prokopov, B. I. Belov, F. S. Titov, and A. F. Suchkov for a discussion of the results and help with the calculations. Orig. art. has: 16 figures and 13 formulas.

SUB CODE: 20/ ORIG REF: 022/ OTH REF: 020/ SUBM DATE: none

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

L 41759-66 FBD/EWT(1)/EEC(k)-2/T/EWP(k) IJP(c) WG
ACC NR: AP6011915 SOURCE CODE: UR/0141/66/009/002/0302/0307

AUTHOR: Mukhamedgaliyeva, A. F.; Orayevskiy, A. N.; Strakhovskiy, G. M.

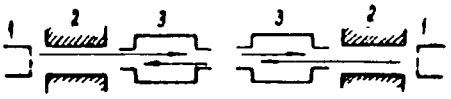
ORG: Institute of Physics, AN SSSR (Fizicheskiy institut AN SSSR)

TITLE: Investigation of a maser with "molecular-ringing" amplifier

SOURCE: IVUZ. Radiofizika, v. 9, no. 2, 1966, 302-307

TOPIC TAGS: maser, molecular generator, molecular ringing, LINE NARROWING

ABSTRACT: An experimental investigation is reported of a maser (see figure) with two series resonators and two opposing beams; one resonator functioned as a generator, the other, as an amplifier. In the figure: 1 - sources of molecular beams, 2 - sorting systems, 3 - resonators. Oscillations in the above maser were calculated for far-from-saturation operating conditions; the generation frequency was assumed to be close to the molecular-transition frequency. In the experimental model, the resonator length was 2.3 cm, distance between the resonators, 16 cm. Experimental curves of:



Card 1/2 UDC: 621.378.33

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

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ACC NR: AP6011915

generation frequency and amplitude vs. tuning of the generating resonator (at pressures 0.3, 1, 1.5 torr in the amplifying-beam source); generation frequency vs. tuning of the amplifying resonator (at the same pressures) are shown. The experimental characteristics have two frequency and amplitude jumps which are explained by two additional side maxima frequency-spaced from the principal maximum by $1.2\,T^{-1}$; the generation between the jumps takes place on different peaks of the Ramsey curve. It is found that the line width in the above system is 1/5 to 1/4 that of a single-resonator maser. Orig. art. has: 4 figures and 3 formulas.

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L 42128-66 EWT(l)/EEC(k)-2/T/EWP(k) IJP(c) WG

ACC NR: AP6026934 (A,N) SOURCE CODE: UR/0141/66/009/004/0710/0714

AUTHOR: Morozov, V. N.; Orayevskiy, A. N.

ORG: Institute of Physics im. P. N. Lebedev, AN SSSR (Fizicheskiy institut AN SSSR)

TITLE: Synchronization of spiking in lasers

SOURCE: IVUZ. Radiofizika, v. 9, no. 4, 1966, 710-714

TOPIC TAGS: laser R and D, laser theory, solid state laser

ABSTRACT: A. J. De'Maria et al. discovered experimentally (J. Appl. Phys., v. 34, 1963, 453) that regular pulsation of the radiation power with a frequency of an external force is obtainable in a laser by means of a periodic modulation of losses in its resonator. The present article offers a theoretical analysis of this phenomenon. The fundamental equations of a Q-switched laser are replaced by this approximate nonlinear conservative equation: $\ddot{x}+x(1+x)-\frac{\dot{x}^2}{1+x}=0$; the motion integral of this equation is: $\dot{x}^2=(1+x)\,|C+2\ln(1+x)-2x|$, this integral defines the phase trajectories of the equation and permits solving

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the equation by quadratures. This equation takes into account interactions between modes and contains stable maximum cycles. The maximum cycles are due to small nonlinear losses which depend on the amplitude of oscillations and which arise as a result of modes interaction. In the case of a ruby, the nonlinear losses that amount to about 0.0001 radiation loss through the mirrors may result in a stable maximum cycle. This cycle may be interpreted as a result of a mutual synchronization between phase-shifted modes. Several maximum cycles can arise in a multimode model, depending on the relations between the modes. Depending on phase relations, various time-intensity relations are possible. With random phase relations, the output will be irregular. "The authors wish to thank N. G. Basov for a useful discussion and V. I. Bespalov for his critical comments." Orig. art. has: 1 figure and 25 formulas.
[03]

SUB CODE: 09 / SUBM DATE: 29Nov65 / ORIG REF: 005 / OTH REF: 004/ ATD PRESS: 5062

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"APPROVED FOR RELEASE: Tuesday, August 01, 2000 CIA-RDP86-00513R001238

ACC NR: AP6032018 SOURCE CODE: UR/0386/66/004/006/0208/0210

AUTHOR: Kogan, L. M.; Libov, L. D.; Nasledov, D. N.; Nikitina, T. F; Orayevskiy, I. N.; Strakhovskiy, G. M.; Sungurova, O. A.; Tsarenkov, B. V.

ORG: Physics Institute im. P. N. Lebedev, Academy of Sciences, SSSR (Fizicheskiy institut Akademii nauk SSSR)

TITLE: Continuous coherent radiation of epitaxial diodes of GaAs at 77K

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 6, 1966, 208-210

TOPIC TAGS: gallium arsenide, epitaxial growing, pn junction, semiconductor laser, emission spectrum, recombination emission

ABSTRACT: The authors report continuous generation from a GaAs semiconductor laser with epitaxial pn junction operating with the medium at 77K. The junction was produced by liquid epitaxy by the method of H. Nelson (RCA Rev. v. 24, 603, 1963). The epitaxial layer was doped with tellurium to a density ~5 x 10^{18} cm^{-3}. A Fabry-Perot type resonator was produced by cleavage along the (110) plane. Emission values of the spectra of the same diode, obtained at different values of the exciting current, in pulsed or continuous operation, show that the maximum of the recombination spectrum shifts toward shoreter wavelengths with increasing current; this shift is due to the "dispersal" of the Fermi quasilevels with increasing pump energy, and also to the shift to the long-wave section of the spectrum in the continuous mode, relative to

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the spectrum in the pulsed mode, connected with the constant heating of the active region in the continuous case. This difference between the spectra in the two modes is larger for small currents and decreases on approaching the threshold current. The latter effect is connected with the presence of deep electronic levels with very low state density. Coherent radiation in the continuous mode occurs at a current of 250 ma (612 a/cm^2). The narrow spectral line appearing in this case corresponds most probably to the non-axial "annular" type of resonator oscillations. At 410 ma (1020 a/cm^2), a new system of coherent lines appears, which can be interpreted as corresponding to axial modes of the cavity. The total emission power of the diode for which the spectra are presented is 5 mW at the appearance of the first coherent line and 70 mW at a current 1.5 a. Orig. art. has: 1 figure. [02]

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