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where

$$\varepsilon_1(\omega)=1-\frac{\omega_e^2}{\omega^2-\omega_{He}^2},\quad \varepsilon_2(\omega)=1-\frac{\omega_e^2}{\omega^2},$$

$$g=\frac{\omega_e^2\omega_{He}}{\omega(\omega^2-\omega_{He}^2)},\quad \omega_e^2=\frac{4\pi ne^2}{m_e},\quad \omega_{He}=\frac{eH}{m_e c}.$$

In an appendix, it is exactly shown that

$$\left.\begin{aligned} E_z=0,\ \frac{E_\perp}{E_0}&=\frac{1}{\varepsilon_1(\omega)}\sqrt{\frac{\varepsilon_1(\omega)}{\varepsilon_2(\omega)}} && \text{при } \frac{\varepsilon_1}{\varepsilon_2}>0,\\ E_z=E_\perp&=0 && \text{при } \frac{\varepsilon_1}{\varepsilon_2}<0.\end{aligned}\right\} \qquad (3)$$

holds at $\vec{r}\perp oz$ and $\vec{d}\parallel oz$, while

$$E_z=0,\quad \frac{E_\perp}{E_0}=\frac{\varepsilon_2(\omega)}{\varepsilon_1^2(\omega)}. \qquad (4)$$

is valid for $\vec{r}\parallel oz$ and $\vec{d}\perp oz$. In these relations, E_0 indicates the amplitude of the electric field of the dipole in a vacuum; E_z and $E_\perp$ are the amplitudes of the h-f field in the plasma. In the case of weak magnetic fields ($\omega_{He}\ll\omega$), (3) agrees with (4), and $E_\perp/E_0$ as a function of

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density becomes infinite at one point. At $\omega = \omega_e$ the electric field in the plasma as a function of density becomes infinite with the exception of $\vec{r} \parallel oz$, $\vec{d} \perp oz$ and $\omega_{He} > \omega$, where resonance is absent. The field strength $\vec{E}$ as a function of the field strength of the external magnetic field is of great interest with a fixed plasma density. These properties of an electric field in plasma have been studied with the aid of an arrangement shown in Fig. 3. At a pressure of $2 \cdot 10^{-2}$ mm Hg (air), a gas discharge was produced between two electrodes in a glass flask 4 mm in diameter and 18 mm long. Transmitting and receiving antennas were inserted from both sides (spacing: about 3 mm). The antennas were made of coaxial cables. In first approximation, the transmitting antenna constituted an emitter which could be considered a dipole oriented along the axis of the cable. The frequency applied was $\omega = 5.7 \cdot 10^{10}$ sec^{-1}, and the receiving signal was amplified and conveyed to an oscilloscope. The solenoid generated a magnetic field of 7000 oe in the discharge tube. The authors studied the resonance of an electric field at small plasma densities, which had been produced by a discharge current of about 1 ma.

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Fig. 8 shows the electrical diagram of the single h-f probe. A comparison between experimental and theoretical results indicates that, in accordance with theory, resonance will occur at $\varepsilon_2(\omega) = 0$ only if the dipole moment of the emitter has a definite orientation with respect to the magnetic field. The experimental density required is slightly different from the theoretical one. This is due to the varying input resistance of the antennas, which complicated the experiments considerably. The authors further examined the possibility of measuring the plasma density with the use of a single h-f probe. This method is based on the dependence of the resonance of the input resistance of the dipole on the plasma density. It could be shown that this method is applicable to both isotropic and anisotropic plasma. There are 9 figures and 6 references: 4 Soviet-bloc and 2 non-Soviet-bloc.

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AUTHOR: Rukhadze, A. A.

TITLE: Electromagnetic waves in a system of interpenetrating plasmas

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 10, 1961, 1236 - 1245

TEXT: Electromagnetic waves are considered in a system, consisting of an infinite plane-parallel charged-particle beam moving with an arbitrary relativistic velocity $\vec{u}$, and an isotropic stationary plasma. The stability of this system is investigated. Presupposition: The total current induced, referred to the coordinate system of the plasma, is the sum of all currents induced in the beam and in the stationary plasma:

$$j_i = j_i^{(1)} + j_i^{(2)} = \frac{\omega}{4\pi i}[\varepsilon_{ij}(\omega, \mathbf{k}) - \delta_{ij}]E_j, \qquad (2)$$

where

$$\varepsilon_{ij}(\omega, \mathbf{k}) = \varepsilon_{ij}^{(1)}(\omega, \mathbf{k}) + \varepsilon_{ij}^{(2)}(\omega, \mathbf{k}) - \delta_{ij}, \text{ and} \qquad (3)$$

$\varepsilon_{ij}^{(1)}(\omega, \mathbf{k})$, $\varepsilon_{ij}^{(2)}(\omega, \mathbf{k})$ и $\varepsilon_{ij}(\omega, \mathbf{k})$,

$$\varepsilon) = \left(\delta_{ij} - \frac{k_i k_j}{k^2}\right)\varepsilon^{(2)tr}(\omega, k) + \frac{k_i k_j}{k^2}\varepsilon^{(2)l}(\omega, k), \qquad (4)$$

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are the dielectric constants of the beam, of the stationary plasma, and of the total system, respectively. The dispersion equation $\left|k^2\delta_{ij} - k_i k_j - \frac{\omega^2}{c^2}\varepsilon_{ij}(\omega,\vec{k})\right| = 0$ can be reduced to

$$k^2 - \frac{\omega^2}{c^2}\left[\varepsilon^{(2)tr}(\omega, k) + \frac{\omega'^2}{\omega^2}\left(\varepsilon^{(1)tr}(\omega', k') - 1\right)\right] = 0, \qquad (10),$$

$$\left\{k^2 - \frac{\omega^2}{c^2}\left[\varepsilon^{(2)tr}(\omega, k) + \frac{\omega'^2}{\omega^2}\left(\varepsilon^{(1)tr}(\omega', k') - 1\right)\right]\right\}\left(\varepsilon^{(1)l}(\omega', k') + \right.$$
$$\left. + \varepsilon^{(2)l}(\omega, k) - 1\right) - \frac{k^2u^2 - (\mathbf{ku})^2}{c^2\left(1 - \frac{u^2}{c^2}\right)}\left[\varepsilon^{(1)l}(\omega', k') - 1 + \frac{\omega'^2}{c^2k'^2} \times\right.$$
$$\left. \times \left(\varepsilon^{(1)tr}(\omega', k') - \varepsilon^{(1)l}(\omega, k)\right)\right]\left[\varepsilon^{(2)l}(\omega, k) - 1 + \right.$$
$$\left. + \frac{\omega^2}{c^2k^2}\left(\varepsilon^{(2)tr}(\omega, k) - \varepsilon^{(2)l}(\omega, k)\right)\right] = 0. \qquad (11),$$

since $j_i^{(1)} = \frac{\omega'}{4\pi i}\left[\varepsilon_{ij}^{(1)'}(\omega', \vec{k}') - \delta_{ij}\right] E_j'$ and since Eq. (4). $j_i^{(1)}$ = current density induced in the beam referred to a coordinate system

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$$\omega' = \frac{\omega - \vec{u}\vec{k}}{\sqrt{1 - u^2/c^2}},$$

$$\mathbf{k}' = \mathbf{k} + \mathbf{u}\,\frac{\mathbf{uk}\left(1 - \sqrt{1 - \frac{u^2}{c^2}}\right) - \omega\frac{u^2}{c^2}}{u^2\sqrt{1 - \frac{u^2}{c^2}}} \qquad (A)$$

moving with the beam. Conclusions from (10): For large ω and ω' follows $\omega^2 = c^2k^2 + \omega_{1Le}^2 + \omega_{2Le}^2 = c^2k^2 + \frac{4\pi e^2}{m}(N_{1e} + N_{2e})$, i. e., the oscillations are undamped. Considering the heat motion of particles, and in case of the temperature of the electrons exceeding by far that of the ions,

$$\omega = \left\{\mathbf{ku} - i\sqrt{\frac{2}{\pi}}\,k\sqrt{\frac{\varkappa T_{1e}}{m}}\,\frac{k^2c^2}{\omega_{1Le}^2}\right\}\left(1 + \frac{N_{2e}}{N_{1e}}\sqrt{\frac{T_{2e}}{T_{1e}}}\right)^{-1}. \qquad (16)$$

holds (where ω_{1Le} is the Larmor frequency of electrons), i. e., the oscillations in the beam are weakly damped in case of high particle densities. Conclusions from (11): In contrast to (10), (11) may have solutions which correspond to oscillation amplitudes increasing with time. (A) If $u \ll c$,

$$\frac{\omega_{1Le}^2}{(\omega - \mathbf{uk})^2} + \frac{\omega_{2Le}^2}{\omega^2} - 1 = 0. \qquad (19)$$

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is obtained from (11) in the range of high frequencies ω and ω'. For $\omega \gg \vec{k}\vec{u}$, (19) has solutions that correspond to undamped oscillations. The system is, however, unstable in case of $\omega \ll \vec{k}\vec{u}$ and $\vec{k}\vec{u} < \omega_{Le}$. (B) Considering the heat motion of particles in the stationary plasma, the dispersion equation for $T_{2e} \gg T_{2i}$ will be

$$1 + \frac{\omega_{2Le}^2}{k^2 \frac{\varkappa T_{2e}}{m}} - \frac{\omega_{2Li}^2}{\omega^2} - \frac{\omega_{1Le}^2}{(\omega - \mathbf{ku})^2} = 0. \qquad (25);$$

this means that for $\omega \gg \vec{u}\vec{k}$ only weakly damped oscillations occur, whereas for $\omega \ll \vec{u}\vec{k}$ the oscillation amplitudes are increasing with time if $N_{1e}/N_{2e} > u^2 m/\varkappa T_{2e}$. (C) Considering the thermal motion of particles in the beam, the dispersion equation is

$$1 + \frac{\omega_{1Le}^2}{k^2 \frac{\varkappa T_{1e}}{m}} - \frac{\omega_{Li}^2}{(\omega - \mathbf{uk})^2} - \frac{\omega_{2Le}^2}{\omega^2} = 0. \qquad (30);$$

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for $\omega \gg \vec{k}\vec{u}$ only weakly damped oscillations occur, whereas solutions are obtained for $\omega \ll \vec{u}\vec{k}$ that correspond to oscillation amplitudes increasing with time. (D) Considering the thermal motion of particles both in the beam and in the stationary plasma, and if $T_{1e} \gg T_{1i}$, $T_{2e} \gg T_{2i}$, then

$$\omega = \pm\omega_{2Li}\left\{1 + \frac{\omega_{1Le}^2}{k^2\frac{\varkappa T_{1e}}{m}} + \frac{\omega_{2Le}^2}{k^2\frac{\varkappa T_{2e}}{m}} - \frac{\omega_{1Li}^2}{(\mathbf{ku})^2}\right\}^{-1/2}. \quad (36)$$

holds for $\omega \ll \vec{u}\vec{k}$, which corresponds to oscillations increasing with time provided that the particle densities in the beam are sufficiently high. Finally, the author considers the case of relativistic velocities $\vec{u}$ neglecting thermal motion; in case of $\omega \gg \vec{u}\vec{k}$ only such solutions are offered as correspond to non-increasing oscillation amplitudes.

$$\omega^2 = P_1 \pm \sqrt{P_1^2 - P_2}, \quad (39)$$

$$P_1 = \frac{1}{2}\frac{(k^2c^2 + \omega_{1Le}^2 + \omega_{2Le}^2)\left[(\mathbf{ku})^2 - \omega_{1Le}^2\left(1 - \frac{u^2}{c^2}\right)\right] + \omega_{2Le}^2(\mathbf{ku})^2}{(\mathbf{ku})^2 - \omega_{1Le}^2\left(1 - \frac{u^2}{c^2}\right)},$$

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$$P_2 = \frac{\omega_{2Le}^2 (\mathbf{ku})^2 \left[k^2c^2 + \omega_{1Le}^2 + \omega_{2Le}^2\right] + \omega_{1Le}^2 \omega_{2Le}^2 \left[k^2u^2 - (\mathbf{uk})^2\right]}{(\mathbf{ku})^2 - \omega_{1Le}^2 \left(1 - \frac{u^2}{c^2}\right)}.$$

holds for $\omega \ll \vec{k}\vec{u}$ which, in case of $N_{1e} \gg N_{2e}$ corresponds to oscillation amplitudes increasing with time. In case of $N_{1e} \ll N_{2e}$, the plasma oscillations will be unstable if $\omega_{2Le} > \vec{k}\vec{u}$. The author thanks V. P. Silin for advice and discussions. A. I. Akhiyezer and Ya. B. Faynberg (DAN SSSR, 69, 555, 1949; UFN, 44, 324, 1951) are mentioned. There are 13 references: 10 Soviet and 3 non-Soviet. The four references to English-language publications read as follows: D. Bohm, E. P. Gross, Phys. Rev. 75, 185, 1949; Problemy sovremennoy fiziki, 11, 7, 1952; P. L. Auer, Phys. Rev. Let., 1, 411, 1958; J. Lindhard, Det. Kong. Danske. Vid. Selsk. Dan. Mat. Fys. Medd., 28, No. 8, 1954.

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

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24.6720

AUTHORS: Lovetskiy, Ye. Ye., Rukhadze, A. A.

TITLE: Hydrodynamics of a nonisothermal plasma

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 41, no. 6, 1961, 1845-1849

TEXT: Single-fluid magnetohydrodynamics of a nonisothermal, collision-free plasma, created by Yu. L. Klimontovich and V. P. Silin (Ref. 1: ZhETF, 40, 1213, 1961), is extended to a plasma in which particle collisions occur. Taking collisions into consideration preponderantly affects the damping decrement of waves; the frequency remains unaltered. The consideration is confined to a dilute plasma where ion-ion collisions are more significant than electron-ion collisions. In this case, the equation of motion for the plasma is given by

$$\frac{\partial \mathbf{v}}{\partial t} + \left(\mathbf{v}\frac{\partial}{\partial \mathbf{r}}\right)\mathbf{v} = -\frac{v_s^2}{\rho}\frac{\partial \rho}{\partial \mathbf{r}} + \frac{1}{4\pi\rho}[\mathrm{rot}\,\mathbf{B}, \mathbf{B}] + \frac{1}{\rho_0}(\mathbf{F}_1^{\text{дис}} + \mathbf{F}_2^{\text{дис}}), \quad (8),$$

and is thus extended by F_2^{dis} compared with the equation stated by

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Klimontovich and Silin (F_1^{dis} is the dissipative force due to Cherenkov absorption and to absorption by magnetic bremsstrahlung; F_2^{dis} takes ion-ion collisions into consideration). The effect of collisions on the spectrum of magnetohydrodynamic and magnetoacoustic waves is studied. In first approximation, magnetohydrodynamic waves are undamped while a damping decrement is obtained for magnetoacoustic waves. The contributions to the damping decrement, resulting from collisions, do not depend on the magnitude of the wave vector. Hence, only Cherenkov absorption is responsible for the divergence of wave packets. Conditions indicating whether Cherenkov absorption exceeds, and when absorption by collisions are stated. Another derivation of the dispersion laws for the two wave types is given by solving the dispersion equation for electromagnetic waves. The range of validity of the theory is estimated. The authors thank V. P. Silin for a discussion. There are 3 Soviet references.

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

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Hydrodynamics of a nonisothermal ...

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24,2500(1109,1141,1147)

AUTHORS: Rukhadze, A. A., and Silin, V. P.

TITLE: Electrodynamics of media with spatial dispersion

PERIODICAL: Uspekhi fizicheskikh nauk, v. 74, no. 2, 1961, 223-267

TEXT: The present paper gives a systematic representation of the electrodynamics of media with spatial dispersion. The equations of the electromagnetic field in a medium are usually written down in the form

$$\operatorname{div} \mathbf{D} = 4\pi\varrho_0, \qquad \operatorname{rot} \mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{B}}{\partial t}, \qquad (1,3)$$

$$\operatorname{rot} \mathbf{H} = \frac{1}{c}\frac{\partial \mathbf{D}}{\partial t} + \frac{4\pi}{c}\mathbf{j}_0, \qquad \operatorname{div} \mathbf{B} = 0.$$

$$\mathbf{j} = \frac{\partial \mathbf{P}}{\partial t} + c \operatorname{rot} \mathbf{M}, \qquad (1,4)$$

$$\mathbf{H} = \mathbf{B} - 4\pi\mathbf{M}, \qquad (1,5)$$

$$\mathbf{D} = \mathbf{E} + 4\pi\mathbf{P}. \qquad (1,6)$$

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The vector $\vec{M}$ denotes the magnetization, and $\vec{P}$ is the polarization vector of the medium. With the quantity $D'(\vec{r},t) = \vec{E}(\vec{r},t) + 4\pi \int_{-\infty}^{t} dt' j(\vec{r},t')$ (1.7), the field equations can be represented in the form

$$\operatorname{div} D' = 4\pi\varrho_0, \qquad \operatorname{rot} E = -\frac{1}{c}\frac{\partial B}{\partial t},$$
$$\operatorname{rot} B = \frac{1}{c}\frac{\partial D}{\partial t} + \frac{4\pi}{c} j_0, \qquad \operatorname{div} B = 0. \qquad \text{(II)}$$

The authors restrict themselves to linear electrodynamics. Then, the material equations $D_i = \varepsilon_{ij}E_j$, $B_i = \mu_{ij}H_j$ are also linear, and can only be used for slowly varying fields. With high-frequency fields, material equations of the type $D_i(t) = \int_{-\infty}^{t} dt' e_{ij}(t-t')E_j(t')$ $B_i(t) = \int_{-\infty}^{t} dt' \mu_{ij}(t-t')H_j(t')$ (1.8)

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must be used, which consider the influence of the previous history on the electromagnetic properties of the medium. Spatially nonlocal relations consider spatial dispersion besides the dispersion in time; for a homogeneous, isotropic and nongyrotropic medium, they may be written down in the form

$$\mathbf{D}(\mathbf{r}, t) = \int_{-\infty}^{t} dt' \int d\mathbf{r}' \hat{\varepsilon}(t-t', \mathbf{r}-\mathbf{r}') \mathbf{E}(\mathbf{r}', t'),$$
$$\mathbf{B}(\mathbf{r}, t) = \int_{-\infty}^{t} dt' \int d\mathbf{r}' \hat{\mu}(t-t', \mathbf{r}-\mathbf{r}') \mathbf{H}(\mathbf{r}', t'). \qquad (1,9)$$

The material equation considering both kinds of dispersion and integrating Eq. (II) has the form $D_i(\vec{r},t) = \int_{-\infty}^{t} dt' \int d\vec{r}' \hat{\varepsilon}_{ij}(t-t', \vec{r}, \vec{r}') E_j(\vec{r}', t)$ (III) in linear electrodynamics. Summing up: The field equations II integrated by the material equations III (and the material equations for the surface) permit a unique determination of the electromagnetic field in any part of

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the space. The tensor of the complex dielectric constant has the form

$$\varepsilon_{ij}(\omega,\vec{k}) = \int_0^\infty dt e^{i\omega t}\int d\vec{r} e^{-i\vec{k}\vec{r}}\hat{\varepsilon}_{ij}(t,\vec{r}) = \int d\vec{r} e^{-i\vec{k}\vec{r}}\varepsilon_{ij}(\omega,\vec{r}) \quad (2,6)$$

for plane monochromatic waves. Such a tensor, however, only applies to unlimited and spatially homogeneous media for which the material equation

$$D_i'(\vec{r},t) = \int_{-\infty}^{t} dt'\int d\vec{r}'\hat{\varepsilon}_{ij}(t-t',\vec{r}-\vec{r}')E_j(\vec{r}',t) \quad (2.4)$$

holds.

$$\varepsilon_{ij}'(-\omega,\ -k) = \varepsilon_{ij}'(\omega,\ k),\ \varepsilon_{ij}''(-\omega,\ -k) = -\varepsilon_{ij}''(\omega,\ k),$$
$$\varepsilon_{ij}^*(\omega,\ k) = \varepsilon_{ij}(-\omega,\ -k). \quad (2,7)$$

holds for the real part $\varepsilon'_{ij}(\omega,\vec{k})$ and the imaginary part of the complex tensor $\varepsilon_{ij}(\omega,\vec{k})$. When fields are applied, which depend on the coordinates through the factor $e^{i\vec{k}\vec{r}}$, (2.4) takes the form

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Electrodynamics of media with ...

$D_i(t) = \int_{-\infty}^{t} dt' \varepsilon_{ij}(t-t', \vec{k}) E_j(\vec{t'})$ (2.8) with $\varepsilon_{ij}(t-t'\vec{k}) = \int d\vec{r} e^{-i\vec{k}\vec{r}} \hat{\varepsilon}_{ij}(t-t', \vec{r})$ (2.9). The tensor of the dielectric constant in an isotropic and non-gyrotropic medium has the form

$$\varepsilon_{ij}(\omega, k) = \left(\delta_{ij} - \frac{k_i k_j}{k^2}\right) \varepsilon^{tr}(\omega, k) + \frac{k_i k_j}{k^2} \varepsilon^{l}(\omega, k). \qquad (2,11)$$

Further,

$$\varepsilon^{tr'}(\omega, k) = \varepsilon^{tr'}(-\omega, k), \quad \varepsilon^{tr''}(\omega, k) = -\varepsilon^{tr''}(-\omega, k),$$
$$\varepsilon^{l'}(\omega, k) = \varepsilon^{l'}(-\omega, k), \quad \varepsilon^{l''}(\omega, k) = -\varepsilon^{l''}(-\omega, k). \qquad (2,12)$$

holds. For fields depending like $e^{i\vec{k}\vec{r} - i\omega t}$ on time and coordinates, $j_i = \sigma_{ij}(\omega, k) E_j$ (2.26), where the complex tensor of conductivity $\sigma_{ij}(\omega, \vec{k}) = \int_0^{\infty} dt e^{i\omega t} \int d\vec{r} e^{-i\vec{k}\vec{r}} \hat{\sigma}_{ij}(t, \vec{r})$ (2.27). Similarly to (2.11),

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holds for an isotropic and nongyrotropic medium. Dispersion of the tensor of the dielectric constant: For a Debye screening of the electrostatic field in an isotropic medium, it is sufficient that the static dielectric constant $\varepsilon^1(0,k)$ at $k = 0$ has a singularity of the type $1/k^2$, and is positive. In general, two different limits of the longitudinal dielectric constant $\varepsilon^1(\ ,k)$ may exist for $= 0$ and $k = 0$. For $/k \to 0$

$$\mu_k(0,0) = \lim_{k \to 0} \lim_{/k \to 0} \left\{1 - \frac{\omega^2}{c^2k^2}(\varepsilon^{tr} - \varepsilon^1)\right\}^{-1}$$ (3.14) holds, and a weak spatial dispersion exists for $k/ \ 0$. "Frequency dispersion" concerns the quantity $\mu(\ ,k)$ near the point $/k = 0$. Similar statements are made for anisotropic media. The energy

$$Q = \frac{i}{4\pi}(\ - \ )EE' + (\mu' - \mu)HH' \ = \frac{}{2\pi}\{ \ '' E^2 + \mu'' H^2\}$$ (4.14) is released due to the effect of an electromagnetic field in a medium. In a quasimonochromatic field, the formula

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Electrodynamics of media with ...

$$\left(\frac{dW}{dt}\right)_{\text{cp}} = \frac{1}{4\pi}\int d\mathbf{r}\,d\mathbf{r}'\left\{E_{0i}^*(\mathbf{r},t)\frac{\partial E_{0j}(\mathbf{r}',t)}{\partial t}\frac{\partial}{\partial\omega}[\omega\varepsilon_{ij}(\omega,\mathbf{r},\mathbf{r}')] + \right.$$
$$\left. + E_{0j}(\mathbf{r}',t)\frac{\partial E_{0i}^*(\mathbf{r},t)}{\partial t}\frac{\partial}{\partial\omega}[\omega\varepsilon_{ji}^*(\omega,\mathbf{r}',\mathbf{r})]\right\} + \frac{1}{4\pi}\int d\mathbf{r}\frac{\partial}{\partial t}(\mathbf{B}_0^*\mathbf{B}_0) + Q, \quad (4,16)$$

is obtained for the rate of the systematic change of the electromagnetic energy. Here, Q denotes the amount of heat released per unit time. U may be regarded as the mean energy of the electromagnetic field of the medium. For the electromagnetic waves in a medium, the authors obtain a system of linear algebraic equations

$$k_i\varepsilon_{ij}(\omega,\mathbf{k})E_j(\mathbf{k},\omega) = -\mathbf{k}\mathbf{D}^{(0)}(\mathbf{k},\omega), \quad (5,4')$$
$$(\omega^2\varepsilon_{ij}(\omega,\mathbf{k}) - c^2k^2\delta_{ij} + c^2k_ik_j)E_j(\mathbf{k},\omega) = -\omega^2D_i^{(0)}(\mathbf{k},\omega) +$$
$$+ i\omega D_i(\mathbf{k},t=0) + ic[\mathbf{k},\mathbf{B}(\mathbf{k},t=0)]. \quad (5,5')$$

for determining $\mathbf{E}(\mathbf{k},\omega)$. From these more general deliberations, the

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Electrodynamics of media with ...

authors also derive formulas for plane monochromatic waves in a medium, for the propagation of electromagnetic waves through media with weak spatial dispersion, for the energy losses of fast electrons in a medium, and for the fluctuations of an electromagnetic field. The theory of losses of fast, charged particles was developed by Tamm, Frank, and Fermi. A consideration of weak spatial dispersion in isotropic media near absorption bands leads to a qualitatively new phenomenon, namely, the appearance of new transverse waves. There are 3 figures and 44 references: 36 Soviet-bloc and 8 non-Soviet-bloc. The most important references to English-language publications read as follows: D. Pines, Revs. Mod. Phys. 28, 184 (1956), R. H. Ritchie, Phys. Rev. 106, 874 (1957).

Card 8/8

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A. A.

95

S/089/62/013/006/019/027
B102/B186

AUTHORS: G. T. and M. R.

TITLE: Nauchnaya konferentsiya Moskovskogo inzhenerno-fizicheskogo instituta (Scientific Conference of the Moscow Engineering Physics Institute) 1962

PERIODICAL: Atomnaya energiya, v. 13, no. 6, 1962, 603 - 606

TEXT: The annual conference took place in May 1962 with more than 400 delegates participating. A review is given of these lectures that are assumed to be of interest for the readers of Atomnaya energiya. They are following: A. I. Leypunskiy, future of fast reactors; A. A. Vasil'yev, design of accelerators for superhigh energies; I. Ya. Pomeranchuk, analyticity, unitarity, and asymptotic behavior of strong interactions at high energies; A. B. Migdal, phenomenological theory for the many-body problem; Yu. D. Fiveyskiy, deceleration of medium-energy antiprotons in matter; Yu. M. Kogan, Ya. A. Iosilevskiy, theory of the Mössbauer effect; M. I. Ryazanov, theory of ionization losses in nonhomogeneous medium; Yu. M. Ivanov, A. A. Rukhadze, h-f conductivity of subcritical plasma;

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B102/B186

Nauchnaya konferentsiya...

Ye. Ye. Lovetskiy, A. A. Rukhadze, electromagnetic waves in nonhomogeneous plasma; Yu. D. Kotov, I. L. Rozental', the origin of fast cosmic muons; Yu. M. Ivanov, muon depolarization in solids; V. G. Varlamov, Yu. M. Grashin, B. A. Dolgoshein, V. G. Kirillov-Ugryumov, V. S. Roganov, A. V. Samoylov, μ^- capture by various nuclei; V. S. Demidov, V. G. Kirillov-Ugryumov, A. K. Ponosov, V. P. Protasov, F. M. Sergeyev, scattering of π^- mesons at 5 - 15 Mev in a propane bubble chamber; S. Ya. Nikitin, M. S. Aynutdinov, Ya. M. Selektor, S. M. Zombkovskiy, A. F. Grashin, muon production in π^-p interactions; B. A. Dolgoshein, spark chambers; N. G. Volkov, V. K. Lyapidevskiy, I. M. Obodovskiy, study of operation of a convection chamber; K. G. Finogenov, production of square voltage pulses of high amplitudes; G. N. Aleksakov, problems of color vision; V. K. Lyapidevskiy, relation between number of receivers and number of independent colors; Ye. M. Kudryavtsev, N. N. Sobolev, N. I. Tizengauzen, L. N. Tunitskiy, F. S. Fayzulov, determination of the moment of electron transition of oscillator forces and the widths of the Schuhman-Runge bands of molecular oxygen; B. Ye. Gavrilov, A. V. Zharikov, V. I. Rayko, decomposition of the volume charge of intense ion beams; Ye. A. Kramer-Ageyev, V. S. Troshin, measurement of neutron spectra; G. G. Doroshenko, new methods of fast-neutron recording; V. I. Ivanov, dosimetry terminology; R. M. Voronkov,

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35362

S/057/62/032/003/009/019
B108/B104

26.2214

AUTHORS: Bogdankevich, L. S., and Rukhadze, A. A.

TITLE: Electromagnetic waves in a plasma in the range of ion cyclotron resonance

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 3, 1962, 322-328

TEXT: Electromagnetic waves in the range of ion cyclotron resonance, i. e., $\omega \sim m\Omega_i = m\frac{e_i H_o}{Mc}$ (M = 1, 2, ...), arising in a magnetoactive plasma are studied assuming the plasma particle collisions to be negligible. The refractive index n and the absorption coefficient $\varkappa$ are determined from the dispersion relation $n^2(\delta_{ij} - n_i n_j - \varepsilon_{ij}(\omega,\vec{k}) = 0$. In the case of weak spatial dispersion of the dielectric constant, the components of the anti-Hermitian part of ε_{ij} are exponentially small as compared with the Hermitian part. In the opposite case, i. e., near the frequencies $\omega = m\Omega_i$ where the spatial dispersion of ε_{ij} is considerable, the first

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anti-Hermitian component of ϵ_{ij} must be taken into account at $m > 1$. n and κ are calculated for $m = 1$ and $m = 2$. It is shown that near these frequencies the energy of the electromagnetic field absorbed by the plasma ions may be considerable. Plasma waves near the resonance frequencies may be excited in a sufficiently cold plasma. These waves, however, are very strongly absorbed as is shown for the case $m = 1$. V. P. Silin, V. L. Ginzburg, and M. S. Rabinovich are thanked for discussions. Reference is made to V. D. Shafranov (Sb. Fizika plazmy i problema upravlyayemykh termoyadernykh reaktsiy (Plasma physics and problems of controlled thermonuclear reactions), 4, 426, Izd. AN SSSR, 1958). There are 5 references: 2 Soviet and 3 non-Soviet. The two references to English-language publications read as follows: T. H. Stix. Phys. Rev., 106, 1146, 1957; Phys. of Fluids, 3, 19, 1960.

SUBMITTED: March 18, 1961

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9.9845

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B125/B108

AUTHORS: Rukhadze, A. A., and Silin, V. P.

TITLE: The shape of the lines of magnetic slowing-down absorption in a plasma

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 4, 1962, 423-434

TEXT: The shape of lines of magnetic slowing-down absorption in a non-relativistic electron plasma is calculated proceeding from the dispersion relation $|k^2\delta_{ij} - k_ik_j - (\omega^2/c^2)\varepsilon_{ij}(\omega,\vec{k})| = 0$ (1) for electromagnetic waves for the case $k\langle v\rangle/\omega = n\langle v\rangle/c \ll 1$. $\langle v\rangle$ is the mean thermal velocity of electrons, n is the refractive index. In the present cases with weak or prevailing influence of thermal motion, the dispersion relation

$$n^2 = \frac{(\varepsilon_1^2 - g^2 - \varepsilon_1\varepsilon_2)\sin^2\vartheta + 2\varepsilon_1\varepsilon_2 \pm \sqrt{(\varepsilon_1^2 - g^2 - \varepsilon_1\varepsilon_2)^2\sin^4\vartheta + 4g^2\varepsilon_2^2\cos^2\vartheta}}{2(\varepsilon_1\sin^2\vartheta + \varepsilon_2\cos^2\vartheta)}. \quad (3)$$

follows from equation (1) with the use of the tensor

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$$\varepsilon_{ij}(\omega, \mathbf{k}) = \varepsilon^{э}_{ij} + \varepsilon^{a}_{ij} = \begin{pmatrix} \varepsilon_1 & -ig & 0 \\ ig & \varepsilon_1 & 0 \\ 0 & 0 & \varepsilon_2 \end{pmatrix} \qquad (2)$$

of the dielectric constant for the ordinary and extraordinary waves, respectively. $\varepsilon^{э}_{ij}$ and ε^{a}_{ij} denote the Hermitian and anti-Hermitian parts of this tensor, respectively. (3) gives for the angles not very near to $\vartheta = \pi/2$ the expression

$$\begin{aligned} x = &-i\varepsilon_1^{a}\{[\sin^4\vartheta(\varepsilon_1-g)^2+2\sin^2\vartheta\cos^2\vartheta(\varepsilon_1-g)\varepsilon_2+\varepsilon_2^2\cos^2\vartheta(1+\cos^2\vartheta)]\times \\ &\times\sqrt{(\varepsilon_1^2-g^2-\varepsilon_1\varepsilon_2)^2\sin^4\vartheta+4\varepsilon_2^2g^2\cos^2\vartheta}\pm[\sin^4\vartheta(\varepsilon_1^2-g^2-\varepsilon_1\varepsilon_2)\times \\ &\times((\varepsilon_1-g)^2\sin^2\vartheta+\varepsilon_2(2\varepsilon_1-2g-\varepsilon_2)\cos^2\vartheta)+4g\varepsilon_2^2\cos^2\vartheta(\varepsilon_1\sin^2\vartheta+ \\ &+\varepsilon_2\cos^2\vartheta-g\sin^2\vartheta)]\}\left\{\left[4n(\varepsilon_1\sin^2\vartheta+\varepsilon_2\cos^2\vartheta)^2-\frac{\partial\varepsilon_1}{\partial n}(\sin^4\vartheta(\varepsilon_1-g)^2+\right.\right. \\ &\left.+2\sin^2\vartheta\cos^2\vartheta\varepsilon_2(\varepsilon_1-g)+\varepsilon_2^2\cos^2\vartheta(1+\cos^2\vartheta))\right]\times \\ &\times\sqrt{(\varepsilon_1^2-g^2-\varepsilon_1\varepsilon_2)^2\sin^4\vartheta+4\varepsilon_2^2g^2\cos^2\vartheta}\mp\frac{\partial\varepsilon_1}{\partial n}[4\varepsilon_2^2g\cos^2\vartheta\times \\ &\times(\varepsilon_1\sin^2\vartheta+\varepsilon_2\cos^2\vartheta-g\sin^2\vartheta)+\sin^4\vartheta(\varepsilon_1^2-g^2-\varepsilon_1\varepsilon_2)((\varepsilon_1-g)^2\sin^2\vartheta+\varepsilon_2(2\varepsilon_1-2g-\varepsilon_2)\cos^2\vartheta)]\Big\}^{-1}; \end{aligned} \qquad (4)$$

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for the absorption coefficients of the ordinary and extraordinary waves. At $\vartheta \approx \pi/2$, the refractive index and the absorption coefficient are

$$\left.\begin{aligned} n_1^2 &= \varepsilon_1 - \frac{g^2}{\varepsilon_1}, \quad \varkappa_1 = -i\varepsilon_1^2 \cdot \frac{\left(1-\frac{g}{\varepsilon_1}\right)^2}{2n - \frac{\partial \varepsilon_1}{\partial n}\left(1-\frac{g}{\varepsilon_1}\right)^2}, \\ n_2^2 &= \varepsilon_2, \quad \varkappa_2 = \frac{-i\varepsilon_2^2}{2n - \frac{\partial \varepsilon_2}{\partial n}}. \end{aligned}\right\} \qquad (5).$$

(4) and (5) only hold for the frequency range with $n^2 > 0$. With a weak influence of the thermal motion and angles not very near to $\pi/2$, the spatial dispersion in the Hermitian part of the tensor can be neglected.

$$n^2 = 1 - \frac{\omega_0^2}{\omega(\omega \mp \omega_B)}, \quad \varkappa = -\frac{2\pi^3 e^2 m_e c}{n^2\omega^2} F_1\left(\frac{m_e c^2 (\omega - \omega_B)^2}{2n^2\omega^3}\right)(1 \pm 1). \qquad (6)$$

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holds for waves propagating under the angle $\vartheta = 0$ with respect to the magnetic field. If the waves propagate under the angle $\vartheta \approx \pi/2$ with respect to the magnetic field, the spatial dispersion has to be taken into account even near the first resonance line. In a dense plasma, the ordinary wave cannot propagate under the angle $\vartheta \approx \pi/2$. Relativistic effects of the thermal motion of particles may cause a considerable absorption of waves near the first resonance line even at nonrelativistic temperatures. Near the second resonance line of absorption, the waves are likely to enter the plasma readily. With a prevailing influence of the thermal motion, the waves may be strongly absorbed in plasma. There are 18 references: 14 Soviet and 4 non-Soviet. The four references to English-language publications read as follows: J. B. Bernstein. Phys. Rev., 109, 10, 1958; J. E. Drummond. Phys. Rev., 112, 1460, 1958; W. E. Drummond, M. N. Rosenbluth. Phys. Fluids, 3, 45, 1960; D. B. Beard. Phys. Rev. let., 2, 81, 1959. Phys. Fluids, 3, 342, 1960.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev AS USSR Moscow)

SUBMITTED: April 5, 1961

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B104/B102

24.6740
24.2120

AUTHORS: Ramazashvili, R. R., and Rukhadze, A. A.

TITLE: Electromagnetic waves in a magnetoactive plasma in the range of large refractive indices

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 5, 1962, 644 - 647

TEXT: Dielectric constant and refractive index of ordinary, extra-ordinary, and plasma waves in plasma with a refractive index $|z^\alpha| \gg 1$ are studied. $z^\alpha = T_\alpha k_\perp^2 / m_\alpha \Omega_\alpha^2$. For $|\beta_m^\alpha| \ll 1$ the tensor $\varepsilon_{ij}(\omega, \vec{k})$ differs very little from δ_{ij}; the refractive index is about unity. $\beta_m^\alpha = (\omega - m\Omega_\alpha) / |k_z| \sqrt{T_\alpha / m_\alpha}$. In the case of $|\beta_m^\alpha| \gg 1$, $\varepsilon_{13} = \varepsilon_{23} = 0$,

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$$\varepsilon_{22}=1-\frac{1}{\sqrt{2\pi}}\frac{\omega_{La}^2\Omega_a}{\omega(\omega-m\Omega_a)}\left(\frac{m_a}{k_\perp^2 T_a}\right)^{1/2}\left\{1-i\sqrt{\frac{\pi}{2}}\beta_m^2 e^{-\frac{\beta_m^2}{2}}\right\},$$

(4)

$$\varepsilon_{33}=1-\frac{1}{\sqrt{2\pi}}\frac{\omega_{La}^2\Omega_a}{\omega(\omega-m\Omega_a)}\left(\frac{m_a}{k_\perp^2 T_a}\right)^{1/2}\left\{1-i\sqrt{\frac{\pi}{2}}\beta_m^2 e^{-\frac{\beta_m^2}{2}}\right\}.$$

The dispersion equation $n^2\delta_{oj} - n_i n_j - \varepsilon_{ij}(\omega, \vec{k}) = 0$ yields with the help of (4) the equations $n^2\sin^2\vartheta = \varepsilon_{33}$, $n^2 = \varepsilon_{22}$, $\varepsilon_{11} = 0$. The anti-Hermitean part of the tensor is neglected and these equations give in first approximation:

$$\begin{pmatrix} n_1 \\ n_2 \end{pmatrix}=\left(\frac{\omega_{La}^2\Omega_a c\sqrt{m_a}}{\sqrt{2\pi T_a}\,\omega^2(m\Omega_a-\omega)}\right)^{1/2}\begin{pmatrix}\frac{1}{\sin\vartheta}\\ \frac{1}{\sqrt[3]{\sin\vartheta}}\end{pmatrix},$$

(6)

$$n_3=\left(\frac{\omega_{La}^2\Omega_a^3 c^3 m_a^{3/2} m^2}{\sqrt{2\pi}\,T_a^{3/2}\omega^4(\omega-m\Omega_a)}\frac{1}{\sin^3\vartheta}\right)^{1/2}.$$

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Conclusion: For ordinary and extraordinary waves the plasma is transparent when $\omega < m\Omega_\alpha$; for plasma waves it is so when $\omega > m\Omega_\alpha$. Ω_α is the cyclotron frequency of the electrons and ions, $\Omega_\alpha = e_\alpha H/m_\alpha c$.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva, Moskva (Physics Institute imeni P. N. Lebedev, Moscow)

SUBMITTED: October 14, 1961 (initially) November 20, 1961 (after revision)
November 20, 1961 (after revision)

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B108/B102

24.6716

AUTHOR: Rukhadze, A. A.

TITLE: Interaction of a charged particle beam with a plasma

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 6, 1962, 669 - 673

TEXT: A general method of examining the interaction of an unbounded relativistic charged particle beam with a plasma is proposed. If the particle beam is considered as an anisotropic plasma with a directed group velocity of the particles one can use the dielectric permittivity tensor of a streaming plasma, instead of solving the linearized equations of motion for plasma and beam together with the Maxwell equations. Starting from the dispersion relation, the author examines the electromagnetic oscillations that occur in two colliding plasma beams with and without an external magnetic field. There are 2 figures.

ASSOCIATION: Fizicheskiy institut im. P. N. Lebedeva AN SSSR Moskva (Physics Institute imeni P. N. Lebedev AS USSR Moscow)

SUBMITTED: June 7, 1961

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

S/053/62/076/001/002/004
B117/B101

24.2120

AUTHORS: Rukhadze, A. A., and Silin, V. P.

TITLE: Linear electromagnetic phenomena in plasma

PERIODICAL: Uspekhi fizicheskikh nauk, v. 76, no. 1, 1962, 79 - 108

TEXT: This is a summary of the progress achieved in the field of linear electromagnetic processes in plasma which, according to the authors, will form the foundation of nonlinear electrodynamics of plasma. Electromagnetic properties of plasma as to the type of distribution function of particles with respect to their velocities are dealt with on very general assumptions, special attention being paid to the electromagnetic phenomena in nonequilibrium plasma. The problems dealt with comprise: Tensor of the dielectric constant of plasma; electromagnetic properties of isotropic plasma; anisotropic plasma without strong fields; electromagnetic waves in plasma placed in a strong magnetic field; interaction of a beam of charged particles with magnetically active plasma; particle collisions in plasma; fluctuations of the electromagnetic field in plasma. B. A. Trubnikov, V. S. Kudryavtsev, Yu. N. Dnestrovskiy, D. P. Kostomarov, Ya. B. Faynberg,

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Linear electromagnetic phenomena ....

L. D. Landau, S. G. Belyayev, and G. I. Budker are mentioned. There are 40 references: 34 Soviet and 6 non-Soviet. The four references to English-language publications read as follows: R. Balescu, Phys. Fluids 3, 52 (1960); J. Hubbard, Proc. Roy. Soc. A260, no. 1300, 114 (1961) and Proc. Roy. Soc. A261, no. 1306, 85 (1961); N. Rostoker, Phys. Fluids 3, 922 (1960).

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APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

IVANOV, Yu.B.; MUKHANOV, A.A.

High-frequency conductivity of a magnetoactive plasma. Izv. vys. ucheb. zav. radiofiz. 7 no.2:232-241 '64 (MIRA 18:1)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

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ACC NR: AP6002358 SOURCE CODE: UR/0207/65/000/006/0058/0064

AUTHOR: Rukhadze, A. A. (Moscow); Savodchenko, V. S. (Moscow); Triger, S. A. (Moscow)

ORG: none

54
03

TITLE: Method of geometrical optics for fourth-order differential equations relevant to low-frequency plasma oscillations

21,44,55

SOURCE: Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki, no. 6, 1965, 58-64

TOPIC TAGS: plasma oscillation, differential equation, geometric optics, approximation method

ABSTRACT: The authors investigate a general fourth-order equation arising for small oscillations of a nonhomogeneous plasma in an external magnetic field without consideration of dissipative processes in the first approximation of geometrical optics with real coefficients. Asymptotic solutions of this equation with an accuracy up to the first-order terms are obtained and quasiclassical rules of quantization are established for various specific cases. A new vibration spectrum characteristic only for an inhomogeneous plasma in a magnetic field is determined by the theory developed. In conclusion, authors thank V. P. Silin who aided in the development of the concepts on the joining of the quasiclassical solutions, as well as Yu. N. Dnestrovskiy and D. P. Kostomarov for a discussion of the work and critical comments. Orig. art. has: 3 figures and 21 formulas.

SUB CODE: 12, 20 / SUBM DATE: 03Mar65 / ORIG REF: 004 / OTH REF: 004

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ACC NR: AP6003755 SOURCE CODE: UR/0181/66/008/001/0024/0027

60
B

AUTHOR: Veselago, V.G.; Glushkov, M.V.; Rukhadze, A.A.

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

TITLE: The amplification of electromagnetic waves in solid-state plasmas

SOURCE: Fizika tverdogo tela, v. 8, no. 1, 1966, 24-27

TOPIC TAGS: electromagnetic wave phenomenon, plasma electromagnetic wave, plasma oscillation, solid state plasma

21,44,55

ABSTRACT: Recently, numerous researchers have investigated the possible electromagnetic wave amplification in solid-state plasmas in the presence of carrier drifts. Starting from the linearized system of Maxwell's equations, the equation of motion of two types of carriers, and the equation of continuity, the present authors develop a theory of and study the conditions for the amplification of UHF oscillations in solid-state plasmas in the presence of carrier drifts in external electric and magnetic fields. An analysis of the results shows that there are favorable conditions for the amplification of waves propagating along the magnetic field in a plasma with an unequal number of carriers. An estimate is given of the maximum frequency which can be amplified, of the amplification, and of the

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power dissipated in InSb and in Sb samples containing admixtures disequilibrating the number of carriers. The respective carrier concentrations are $\sim 10^{17}$ cm^{-3} and $\sim 10^{19}$ cm^{-3}, and the maximum frequencies which could be amplified are $\sim 10^{10}$ sec^{-1} and up to 10^{12} sec^{-1}. Orig. art. has: 13 formulas and 1 figure. [08]

SUB CODE: 20 / SUBM DATE: 19June65 / ORIG REF: 003 / OTH REF: 006
ATD PRESS: 4197

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APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

LOVETSKIY, Ye.Ye.; RUKHADZE, A.A.

Acceleration of electrons in a plasma in a strong electric field. Zhur. eksp. i teor. fiz. 48 no.2:514-525 F '65. (MIRA 18:11)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.

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ACC NR: AP6004872 SOURCE CODE: UR/0057/66/036/001/0007/0012

82
81
B

AUTHOR: Bakanov, S.P.; Rukhadze, A.A.

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

21,44,55

TITLE: On the oscillations of a plasma in constant external electric and magnetic fields

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 1, 1966, 7-12

TOPIC TAGS: plasma stability, electric field, semiconductor plasma, plasma oscillation, constant magnetic field, ionized plasma, electron plasma, electromagnetic wave oscillation, propagation velocity

ABSTRACT: The authors (ZhETF, 48, 1656, 1965) have previously discussed the excitation under the influence of a constant electric field of low frequency electromagnetic oscillations in a weakly ionized electron-ion plasma and in the electron-hole plasma of a semiconductor. In the present paper they consider the influence on these oscillations of a strong external magnetic field parallel to the electric field. [Abstracter's note: The results and notation of the previous paper are employed without redefinition of the symbols; it is accordingly difficult to follow the argument without reference to the earlier paper] It is shown that the magnetic field does not stabilize the noise oscillations that arise in arbitrarily weak electric fields. It

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ACC NR: AP6004872

is found that in a plasma having unequal numbers of carriers of the two signs there can arise drift waves with a propagation velocity close to the drift velocity. Conditions for the stability of these waves are derived and it is shown that these conditions depend on the longitudinal dimension of the plasma. This phenomenon can be employed to design a semiconductor microwave amplifier. The authors also discuss the influence of the magnetic field on the stability of the waves propagating transversely to the drift at a velocity considerably exceeding the drift velocity, the possible existence of which they demonstrated in the earlier paper. The authors thank V.M.Levin for discussing the results and for critical remarks. Orig. art. has: 17 formulas.

SUB CODE: 20/ SUBM DATE: 10May65/ ORIG REF: 006/ OTH REF: 000

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ACC NR: AP6031452 SOURCE CODE: UR/0056/66/051/002/0628/0638

47
B

AUTHOR: Bogdankevich, L. S.; Rukhadze, A. A.

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

TITLE: Drift-cyclotron oscillations of a collision plasma propagating across a magnetic field

SOURCE: Zh eksper i teor fiz. v. 51, no. 2, 1966, 628-638

TOPIC TAGS: cyclotron, external magnetic field, particle collision, particle spectrum, plasma wave, Larmor radius, plasma temperature

ABSTRACT: An attempt has been made to investigate the drift-cyclotron oscillations of a spatially inhomogeneous low-pressure plasma with collisions propagating on an external magnetic field. Particle collisions are taken into account by the Landau collision integral [L. D. Landau, ZhETF, 7, 206, 1936]. Short-wave oscillations with a wavelength smaller than the Larmor ion radius but larger than the Larmor electron radius are examined. The analysis of oscillation spectra are carried out in the geometric and optical approximation. Dispersion relations are obtained for

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L 05784-67

ACC NR: AP6031452

determining the local spectra and growth increment of drift-cyclotron oscillations of an inhomogeneous plasma. It is shown that in the growth of particle collision frequency, the drift-cyclotron oscillations of a collisionless plasma go over to drift-dissipative oscillations, which are only characteristic of a collision plasma. The stability of such oscillations depends on the nonuniformity of the plasma particle temperature. Orig. art. has: 28 formulas. [Based on authors' abstract]

SUB CODE: 20/ SUBM DATE: p6Mar66/ ORIG REF: 013/ OTH REF: 001/

Card 2/2

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACC NR: AT6033045 SOURCE CODE: UR/2504/66/032/000/0206/0217

AUTHOR: Lovetskiy, Ye. Ye.; Rukhadze, A. A.

ORG: none

TITLE: Acceleration of electrons in a plasma placed in a strong electric field

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 32, 1966. Fizika plazmy (Plasma physics), 206-217

TOPIC TAGS: electron acceleration, plasma magnetic field

ABSTRACT: The article starts with the development of equations for the adiabatic theory of the instability of a plasma in an electric field. However, if the plasma is in a sufficiently strong electric field, the results of the adiabatic theory, generally speaking, will not be valid. The remainder of the article is devoted to the extension of the results for the adiabatic case to the nonadiabatic case. "In conclusion we express our indebtedness to V. P. Silin, I. S. Danilkin, and A. M. Stefanovskiy for valuable remarks and stimulating discussion." Orig. art. has: 30 formulas.

SUB CODE: 20/ SUBM DATE: none/ ORIG REF: 014/ OTH REF: 002

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L 11419-67 EWT(1) IJP(c)

ACC NR: AP6031267 SOURCE CODE: UR/0057/66/036/009/1639/1648

AUTHOR: Bakanov,S.P.; Bogdankevich,L.S.; Rukhadze,A.A.

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

56
49

TITLE: On the excitation of electromagnetic oscillations in a plasma beam bounded by plane conducting walls

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 9, 1966, 1639-1648

TOPIC TAGS: plasma stability, plasma oscillation, plasma electromagnetic wave, plasma magnetic field, betatron, uhf amplifier, extreme high frequency

ABSTRACT: The authors discuss the stability of a plasma uniformly filling most of the space between two plane parallel conducting walls and carrying an electron current in the direction of an applied magnetic field that is parallel to the walls. The calculations were undertaken because of their practical interest in connection with negative absorption amplifiers and plasma betatrons. The walls were assumed to be plane and parallel to facilitate the calculations; it is presumed that the results are qualitatively valid for the technically interesting case of a plasma beam in a cylindrical enclosure with conducting walls. The calculations are based on a dielectric tensor derived by linearizing hydrodynamic equations for the electron motion, which include the self consistent field and the effects of collisions. The calculations are therefore valid for waves whose phase velocities are high compared with the electron thermal

UDC: 533.9

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ACC NR: AP6031267

velocities. Dispersion equations are derived for the limiting cases of weak and strong external magnetic field, and the logarithmic increments of the oscillations are calculated. It is found that in a rarefied plasma in a weak magnetic field there develops a periodic convective instability that is carried by the electron current, and that such a system can amplify. The instability persists in a weakly ionized dense plasma, in which collision effects are predominant, and a strong external longitudinal magnetic field reduces the logarithmic increment in a collision-free plasma but does not stabilize it. The frequency band that can be amplified increases in width with increasing wall conductivity, but the length of the tube required for a given gain also increases. It is concluded that the optimum wall conductivity for a negative absorption amplifier is 10^{13} or 10^{14} sec^{-1} and the optimum plasma density is such as to provide a collision frequency of 10^{12} or 10^{13} sec^{-1}. Under these conditions frequencies up to about 10^{12} Hz can be amplified. It is found that under the conditions of the plasma betatron experiments of A.M.Stefanovskiy (Yadernyy sintez, 5, 215, 1965), the instability discussed here develops during the course of several microseconds. This time is much longer than the observed acceleration times and is also longer than the time that would be required for acceleration of the electrons if the acceleration were not interrupted. It is therefore concluded that the instability associated with wall conductivity cannot explain the observed interruption of acceleration in the plasma betatron and will not in itself prevent the operation of such an accelerator. The authors thank V.P.Silin, who instigated the work. Orig. art. has: 31 formulas and 1 figure.

SUB CODE: 20 SUBM DATE: 28Jun65 ORIG. REF: 006 OTH REF: 001

Card 2/2 bab

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACC NR: AP7008878 SOURCE CODE: UR/0020/66/169/003/0558/0561

AUTHOR: Rukhadze, A. A.; Silin, V. P.
ORG: Physics Institute im. P. N. Levedev, Academy of Sciences USSR (Fizicheskiy institut AN SSSR)
TITLE: Effect of Coulomb collisions on the drift instability of plasmas
SOURCE: AN SSSR. Doklady, v. 169, no. 3, 1966, 558-561
TOPIC TAGS: Coulomb collision, plasma instability
SUB CODE: 20
ABSTRACT: The effect of charged particle collisions on the drift instability of plasmas was calculated earlier using the model collision integral (see, e. g., T. E. Stringer, Bull. Am. Phys. Soc., 10, 208, 1965; P. L. Batnagar et al., Phys. Rev., 94, 511, 1954). However, such a collision integral does not allow the study of effects connected with the temperature inhomogeneity of plasmas and often leads to incorrect results. The authors use the Landau collision integral (L. D. Landau, ZhEFT, 7, 206, 1936) and restrict their inquiry to low-pressure plasmas. The instability consists of the excitation of potential oscillations; the effective particle collision frequencies are small compared with Larmor frequencies. The analysis of oscillation spectra is carried out in a geometrical optics approximation. An analysis of expressions derived from the eikonal equation yields conditions under which the electron and ion collisions damp out or excite oscillations. Graphs show the stability boundaries of the plasma. This paper was presented by Academician I. Ye. Tamm on January 7, 1966. Orig. art. has: 2 figures and 21 formulas. [JPRS: 38,417]

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACC NR: AT6033046 SOURCE CODE: UR/2504/66/032/000/0218/0225

AUTHOR: Lovetskiy, Ye. Ye.; Rukhadze, A. A.

ORG: none

TITLE: Theory of the hydrodynamic instability of nonhomogeneous plasma flows

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 32, 1966. Fizika plazmy (Plasma physics), 218-225

TOPIC TAGS: plasma flow, plasma instability, hydrodynamic theory, Larmor frequency

ABSTRACT: The article starts with the derivation of an equation for small oscillations in the following form:

$$\Delta\Phi + \Sigma\left\{\frac{\omega_L^2\left(\frac{\partial^2}{\partial x^2} - k_y^2\right)\Phi}{\Omega^2(\omega - k_z u_0)^2} + \frac{\partial\Phi}{\partial x}\frac{\partial}{\partial x}\frac{\omega_L^2}{\Omega^2 - (\omega - k_z u_0)^2} + \right.$$

$$\left. + \frac{\omega_L^2 k_z^2 \Phi}{(\omega - k_z u_0)^2} - k_y \Phi \frac{\partial}{\partial x}\frac{\Omega\omega_L^2}{(\omega - k_z u_0)[\Omega^2 - (\omega - k_z u_0)^2]}\right\} = 0. \qquad (2.1)$$

where Φ is the potential of a field oscillating with a frequency ω; k_y and k_z are the projections of the wave vector along the y and z axes; Ω is the Larmor frequency; ω_L is the Langmuir frequency; u_0 is the directed velocity of flow of particles of

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one kind. The summation in Equation (2.1) extends over all the kinds of charged particles in the plasma. Based on the foregoing, the next section treats the instability of plasma flows in the presence of a strong magnetic field. The final section treats mathematically the problem of the instability of plasma flows in the absence of an external magnetic field. "In conclusion the authors thank V. P. Silin for discussion of the results of the present work, and A. M. Stefanovskiy who called our attention to the work described in Ref. (4)." Orig. art. has: 21 formulas.

SUB CODE: 20/ SUBM DATE: none/ ORIG REF: 006/ OTH REF: 003

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L 10655-66 EWT(1)/EIC/EPF(n)-2/EWG(m) IJP(c) AT

ACC NR: AP5028304 SOURCE CODE: UR/0057/65/035/011/1913/1924

44,55 44,55

AUTHOR: Baykov, I.S.; Rukhadze, A.A.

44,55

ORG: Physics Institute im. P.N.Lebedev, Moscow (Fizicheskiy institut)

60
B

TITLE: Excitation of oscillations in opposing streams of nonuniform plasma

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 11, 1965, 1913-1924

21,44,55

TOPIC TAGS: plasma beam, plasma stability, nonuniform plasma · plasma magnetic field, magnetic trap

ABSTRACT: The authors discuss the stability of two identical nonuniform streams of plasma moving in opposite directions parallel to a strong external magnetic field, the velocities, temperatures, and densities of the streams being assumed to vary in a direction perpendicular to the motion. The calculations for nonuniform streams were undertaken in an effort to account for the poor agreement with experiment of the analogous theory previously developed for uniform streams. The treatment is based on the kinetic equation without collision terms, from which dispersion equations are derived in the geometric optics approximation. It is shown that the nonuniformity of the streams strongly affects their stability only at frequencies below at least one of the relevant Larmor frequencies. Separate dispersion equations are derived and discussed for frequencies below the ion Larmor frequency and between the ion and electron Larmor frequencies. Owing to the nonuniformity there are in-

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ACC NR: AP5028304

stabilities at these frequencies which are not damped by the external magnetic field; expressions are derived for the corresponding logarithmic increments. Instabilities of this type should occur in the closed magnetic trap described recently by G.M.Batanov et al. (DAN SSSR, 160, No. 6,1965) at frequencies from 10^5 to 10^8 cycle/sec; it is suggested that the resulting oscillations may give rise to anomalous diffusion of the plasma transverse to the magnetic field and thus account for the short life of the plasma in this installation.

SUB CODE: 20 SUBM DATE: 02Mar 65/ ORIG.REF: 007 OTH REF: 002

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Card 2/2

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 13452-66 EWT(1)/ETC(F)/EPF(n)-2/EWG(m) IJP(c) AT

ACC NR: AP6002435 SOURCE CODE: UR/0057/65/035/012/2143/2149

AUTHOR: Mikhaylovskiy, A.B.; Rukhadze, A.A.

ORG: Physics Institute im. P.N.Lebedev, Moscow (Fizicheskiy institut)

60
B

21,44,55

TITLE: Instability of electronic waves in nonuniform plasma streams

SOURCE: Zhurnal tekhnicheskoy fiziki, v.35, no. 12, 1965, 2143-2149

TOPIC TAGS: plasma instability, plasma magnetic field, moving plasma, nonuniform plasma, plasma electron oscillation, charged particle

ABSTRACT: The authors calculate the effect of convective drift of charged particles on the high frequency slipping instability of a nonuniform plasma carrying a current in an external magnetic field, discussed by E.Harrison and E.Harrison & T.Stinger (Proc.Phys. Soc. B82, 689, 700, 1963) with neglect of drift. The equation for small potential oscillations in a cold nonuniform current-carrying plasma in which the current is parallel and the gradients are perpendicular to an external magnetic field is quoted from work of A.B.Mikhaylovskiy (ZhETF, 48, No. 1,1965; ZhTF,35, No.10,1965) and a dispersion equation is derived from it in the geometric optics approximation. The stability condition is derived and an approximate expression is obtained for the logarithmic increment of the oscillations. It was found that the plasma is unstable over a much wider range of velocity gradient than was concluded by Harrison and Stinger, who neglected drift. The solution is obtained and discussed in detail for

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the case in which the plasma density is constant for $|x| < a$ and zero for $|x| > a$, and the z-component of the velocity is a linear function of x (x, y, z are rectangular Cartesian coordinates with the z-axis parallel to the uniform magnetic field). This solution reduces to that of Harrison and Stinger (loc.cit.) in the limit of high magnetic field, when drift is negligible, and gives the previous results of the present paper in the limit of short wavelength, when the geometric optics approximation is valid. Experiments, possibly by A.M.Stefanovskiy (reference not given), on inductive acceleration of plasma in a toroidal chamber are discussed. Under the conditions of the experiment the plasma was subject to the long wavelength instability previously discussed by Mikhaylovskiy (loc. cit.), but this instability develops too slowly to account for the observed rapid saturation of the current in $\sim 10^{-8}$ sec. The short wavelength instability discussed in the present paper was also active in the experimental conditions, however, and develops sufficiently rapidly to account for the observed results. Orig. art. has: 20 formulas.

SUB CODE: 20 SUBM DATE: 16Apr65 ORIG. REF: 004 OTH REF: 005

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APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

BAKANOV, S.P.; RUKHADZE, A.A.

Excitation of electromagnetic waves in plasmas placed in an external electric field. Zhur. eksp. i teor. fiz. 48 no.6: 1656-1668 Je '65. (MIRA 18:7)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ROZINSKIY, S.Ya.; RUKHADZE, A.A.; RUKHLIN, V.G.

Theory of the instability of an anisotropic plasma with a beam. Izv.vys.ucheb.zav.; radiofiz. 8 no.1:50-56 '65. (MIRA 18:6)

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

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L 58403-65 EWT(d)/EWT(l)/EEC(k)-2/EPF(n)-2/EWG(m)/EEC-4/EPA(w)-2/EEC(t) Pn-4/Pz-6/Po-4/Pab-10/Pg-4/Pt-7/Pi-4/Pl-4 IJP(c) WW/AT/WS-4

ACCESSION NR: AP5016560 UR/0056/65/048/006/1656/1668

90
B

AUTHOR: Bakanov, S. P.; Rukhadze, A. A.

21

TITLE: Excitation of electromagnetic waves in plasma media in an external electric field

4

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 48, no. 6, 1965, 1656-1668

TOPIC TAGS: plasma, plasma oscillation, electromagnetic wave, electromagnetic field, plasma conductivity, anomalous Doppler effect

ABSTRACT: Excitation of low-frequency electromagnetic waves in a weakly ionized electron-hole plasma or in electron-hole plasma of a solid body in the presence of an external electric field is investigated. An expression for the dielectric permeability tensor of a plasma medium is obtained by solving the kinetic equation involving the collision integral introduced by Davydov (ZhETF, v. 7, 1937, p. 1069). The dispersion equation for small oscillations is analyzed in detail. It is shown that excitation of longitudinal oscillations in a plasma occurs only when electron drift velocities exceed the phase velocity of the wave parallel to the drift. In this case buildup of the oscillations is due to the change in the sign of the high-

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ACCESSION NR: AP5016560

frequency plasma conductivity under conditions of the anomalous Doppler effect. On the other hand, transverse electromagnetic waves are excited at arbitrarily small electron drift velocities, i.e., at arbitrarily small currents in the plasma. Under the conditions considered, only transverse oscillations can arise in the electron-hole plasma of a solid body. The oscillation increments and frequencies are found and conditions for oscillation buildup are given. Orig. art. has: 42 formulas. [CS]

ASSOCIATION: none

SUBMITTED: 06Jan65 ENCL: 00 SUB CODE: EM, ME

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Card 2/2

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.A.; SHPIGEL', I.S.

Elimination of channel instability of a plasma by an inhomogeneous electric field. Zhur. eksp. i teor. fiz. 48 no.1:151-157 Ja '65. (MIRA 18:4)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

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L 53012-65 EWT(1)/EPF(n)-2/EWG(m)/EPA(w)-2 Pz-6/Po-4/Pab-10/Pi-4 IJP(c)
WW/AT

ACCESSION NR: AP5010676 UR/0141/65/008/001/0050/0056

AUTHOR: Rosinskiy, S. Ye.; Rukhadze, A. A.; Rukhlin, V. G.

TITLE: Contribution to the theory of instability of an anisotropic plasma with a beam

SOURCE: IVUZ. Radiofizika, v. 8, no. 1, 1965, 50-56

TOPIC TAGS: anisotropic plasma, two stream instability, plasma instability, dielectric tensor

ABSTRACT: The authors analyze the low-frequency oscillations which can occur in a system comprising an anisotropic plasma and a beam, with account taken of the antihermitian part of the dielectric tensor. It was suggested in earlier papers by one of the authors (Rukhadze, Izv. vyssh. uch. zav. - Radiofizika v. 6, 401, 1963 and with V. G. Makhan'kov, Yadernyy sintez v. 2, 177, 1962) that electromagnetic waves can be produced in such a plasma by mechanisms other than the Cerenkov effect and the anomalous Doppler effect, buth the possibility of development of two-stream instability in such a system when the condition for the Cerenkov effect is not satisfied was not demonstrated in the earlier work, which was limited to hydrodynamic

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oscillations under conditions when the antihermitian part of the dielectric tensor can be neglected. The analysis is carried out both with and without an external magnetic field. It is shown that in the absence of an external magnetic field, a spatially unbounded anisotropic plasma with a beam is unstable for arbitrary directional velocities of the beam. The values of the critical beam velocities at which low-frequency instability in a bounded plasma sets in, are estimated. It is shown that a strong magnetic field stabilizes such an instability of an anisotropic plasma. "The authors thank V. P. Silin for valuable remarks." Orig. art. has: 15 formulas.

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

SUBMITTED: 21Nov63 ENCL: 00 SUB CODE: ME

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACCESSION NR: AP4041991 S/0057/64/034/007/1175/1182

AUTHOR: Bogdankevich, L.S.; Rukhadze, A.A.

TITLE: On the cyclotron oscillations of a nonuniform plasma

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.7, 1964, 1175-1182

TOPIC TAGS: plasma, nonuniform plasma, cyclotron resonance

ABSTRACT: The frequency spectra and damping constants of the normal oscillations of a nonuniform plasma are calculated in the neighborhood of the electron and ion Larmor frequencies and their second harmonics. It is assumed that the plasma is magnetized parallel to the z axis of a rectangular Cartesian coordinate system x,y,z and that its properties are functions of x, but the authors assert that their results can be easily transformed to apply to a racially nonuniform cylindrical plasma. It is also assumed that drift effects can be neglected, so that the dielectric tensor has the same form as for a uniform plasma. The authors assert that this assumption is justified in the case of the long wavelength cyclotron oscillations that they treat. The eikonal equation is then simply the dispersion equation in its usual form but with coefficients that are functions of π (in analogy with the Bohr-Sommerfeld

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ACCESSION NR: AP4041991

quantum conditions) the integral over the transparent portion of the plasma of the real part of the wave number obtained by solving the eikonal equation. The corresponding damping constant is the appropriately normalized integral of the imaginary part of the wave number. These integrals are written explicitly for frequencies near the second harmonic of both the electron and ion Larmor frequencies, and for frequencies near, but not too near, the Larmor frequencies themselves. The integrals (except for those pertaining to the second harmonic of the electron Larmor frequency, which are very cumbersome) are evaluated for a plasma of which the density, N(x), is given by

$$N(x)=N(0)\left[1-\left(\frac{x}{d}\right)^2\right],$$

and the results are discussed briefly. In each of the four cases there are two kinds of oscillation, corresponding to the ordinary and extraordinary waves, of which one is confined to the surface region and the other is not. Orig.art.has: 34 formulas.

ASSOCIATION: Fizicheskiy institut im.B.N.Lebedeva AN SSSR (Physical Institute,ANSSR)

SUBMITTED: 19Aug63 ENCL: 00

SUB CODE: ME NR REF SOV: 003 OTHER: 000

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L 19698-65 EWT(1)/EWG(k)/EPA(sp)-2/EPA(w)-2/EEC(t)/T/EEC(b)-2/EWA(m)-2 Pz-6/
Po-4/Pab-10/Pi-4 SSD/AEDC(b)/BSD/SSD(c)/SSD(b)/AFWL/ASD(a)-5/ASD(p)-3/AS(mp)-2/
AFETR/RAEM(a)/ESD(gs)/ESDT/IJP(c) AT
ACCESSION NR: AP4039723 S/0141/64/007/002/0232/0241

AUTHOR: Ivanov, Yu. B.; Rukhadze, A. A.

TITLE: High-frequency conductivity of a magnetoactive plasma

B

21

SOURCE: IVUZ. Radiofizika, v. 7, no. 2, 1964, 232-241

TOPIC TAGS: magnetoactive plasma, plasma conductivity, plasma oscillation, electron collision, particle collision, refractive index, absorption coefficient

ABSTRACT: An expression is derived for the high-frequency conductivity of a fully ionized magnetoactive plasma on the conditions when the field frequency and the particle gyrofrequency are considerable larger than the effective collision frequency. The research is aimed at investigating the increase in the high-frequency conductivity due to the particle collision, and the increase in the absorption of the short-wave oscillations which exist in the plasma under these conditions. Expressions are derived for the components of the conductivity tensor, the refractive indices, and the absorption coefficients of the short-wave oscillations in the plasma. The calculations are based on linearization of the transport equation and using the first two terms of the expansion of the solution in powers of the collision integral. It is noted that in this wavelength region the electron collisions make the

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same contribution to the plasma conductivity as the electron-ion collisions. "The authors are deeply grateful to V. P. Silin for a discussion of the work." Orig. art. has: 37 formulas.

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

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SUB CODE: ME, NP NR REF SOV: 004 OTHER: 000

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

BOGDANKEVICH, L.S.; RUKHADZE, A.A.

Cyclotron oscillations of an inhomogeneous plasma. Zhur. tekh. fiz. 34 no.7:1175-1182 Jl '64 (MIRA 17:8)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.A.; SILIN, V.P.

Method of geometrical optics in the electrodynamics of an inhomogeneous plasma. Usp. fiz. nauk 82 no.3:499-535 Mr '64. (MIRA 17:4)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

KULESHOV, V.F.; RUKHADZE, A.A.

Theory of the interaction between a beam of charged particles and an inhomogeneous plasma. Zhur.tekh. fiz. 34 no.4:577-589 Ap '64. (MIRA 17:4)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

LOVETSKIY, Ye.Ye.; RUKHADZE, A.A.

Low-frequency oscillations of a cold magnetoactive plasma in a gravitational field. Izv. vys. ucheb. zav.; radiofiz. 6 no.4: 715-720 '63. (MIRA 16:12)

1. Moskovskiy inzhenerno-fizicheskiy institut.

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.A.

Cyclotron oscillations of a low-pressure inhomogeneous plasma.
Izv. vys. ucheb. zav.; radiofiz. 6 no.5:928-931 '63. (MIRA 16:12)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACCESSION NR: AP4028942 S/0057/64/034/004/0577/0589

AUTHOR: Kuleshov, V. F.; Rukhadze, A. A.

TITLE: On the theory of interaction of a charged particle beam with an inhomogeneous plasma. I. Potential oscillations

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 34, no. 4, 1964, 577-589

TOPIC TAGS: plasma, plasma beam interaction, charged particle beam, inhomogeneous plasma, potential oscillation, oscillation instability, kinetic instability, dielectric permittivity tensor, geometric optics approximation

ABSTRACT: A theoretical investigation of the interaction of a charged particle beam with an inhomogeneous plasma is presented. It is limited to the case of a one-dimensional inhomogeneity; i.e., when all the characteristic dimensions of the plasma and beam depend on one single coordinate. An expression for a dielectric permittivity tensor and the eikonal equation for a plasma-beam system are derived using the geometric optics approximation. Potential oscillations of the

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ACCESSION NR: AP4028942

system are studied in two opposite cases: 1) interaction of a uniform beam of low density with an inhomogeneous plasma and 2) interaction of a nonuniform beam of low density with a homogeneous plasma. Some conclusions related to the instability of oscillations are drawn up for both cases. The author thanks V. P. Silin for a discussion of the work and critical remarks. Orig. art. has: 33 formulas.

ASSOCIATION: none

SUBMITTED: 08May63 DATE ACQ: 28Apr64 ENCL: 00

SUB CODE: PH NO REF SOV: 011 OTHER: 001

Card 2/2

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

ACCESSION NR: AP4024575 S/0053/64/082/003/0499/0535

AUTHOR: Rukhadze, A. A.; Silin, V. P.

TITLE: The geometrical optics method in the electrodynamics of inhomogeneous plasma

SOURCE: Uspekhi fizicheskikh nauk, v. 82, no. 3, 1964, 499-535

TOPIC TAGS: plasma, inhomogeneous plasma, isotropic plasma, confined plasma, inhomogeneous plasma electrodynamics, geometrical optics method, quasiclassical quantization rule, Bohr-Sommerfeld phase integral, plasma oscillation spectrum, plasma potential oscillations, plasma nonpotential oscillations, plasma instability, plasma drift instability

ABSTRACT: Whereas earlier studies of the electrodynamics of media with spatial dispersion were limited to homogeneous media with either infinite or distinctly defined boundaries, the introduction of geometrical-optics methods has made possible noticeable progress in the development of a theory of electromagnetic properties of weakly inhomogeneous plasmas. This review article details the principles of

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ACCESSION NR: AP4024575

the geometrical-optics method as applied to media with spatial dispersion and treats the concrete problem of oscillations in a weakly inhomogeneous plasma confined by a strong magnetic field. The spectral characteristics of natural oscillations of the plasma are derived in terms of the Bohr-Sommerfeld phase integrals (quasiclassical quantization rules) and are used to establish the conditions under which a weakly inhomogeneous plasma is unstable. The analysis is limited to the one-dimensional case. The section headings are: 1. Method of geometrical optics in the electrodynamics of media with spatial dispersion, and the permittivity tensor of a weakly inhomogeneous plasma confined by a strong magnetic field. 2. Quasiclassical quantization rules and the oscillation spectrum of an isotropic inhomogeneous plasma. 3. Oscillation spectrum of inhomogeneous magnetoactive plasma. 4. Spectrum of low-frequency potential drift oscillations of an inhomogeneous plasma. 5. Nonpotential drift oscillations of an inhomogeneous plasma. 6. Effect of non-parallel magnetic flux lines; stabilization of drift oscillations. Orig. art. has: 125 formulas and 1 table.

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.A. (Moskva)

Convective instability of a compressible fluid in magnetohydrodynamics. (MIRA 16:9)
PMTF no.3:139-142 My-Je '63.
(Optics, Geometrical) (Magnetohydrodynamics)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 12908-63 EWT(1)/EWG(k)/BDS/EEC(b)-2/ES(w)-2 AFFTC/ASD/ESD-3/AFWL/
SSD Pz-4/Pi-4/Po-4/Pab-4 AT/IJP(C)

ACCESSION NR: AP3001323 S/0057/63/033/006/0652/0659 82

AUTHOR: Lovetskiy, Ye. Ye.; Rukhadze, A. A. 78

TITLE: Oscillations of a cold non-uniform plasma in a gravitational field

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 33, no. 6, 1963, 652-659

TOPIC TAGS: plasma, stability, non-uniform plasma

ABSTRACT: The stability of a cold non-uniform plasma in crossed magnetic and gravitational fields is investigated, using the equations of two-component hydrodynamics to describe the plasma and treating the oscillations in the WKB approximation. The two-component hydrodynamic model is adopted because of its mathematical tractability. The drift transverse to the magnetic field produced in a plasma by pressure gradients and by external forces can be investigated on the basis of this model only by introducing external forces, since effects of pressure are neglected. Although gravity itself is negligible in conditions of practical interest, the introduction of the gravitational field makes it possible for the effects of drift to manifest themselves; moreover, the present results can be adapted to the case of other external forces (for example, centrifugal force). In addition to the previously known instability associated with longitudinal waves propagating transversely

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ACCESSION NR: AP3001323

to the magnetic field in the direction of the drift, the authors find an instability associated with transverse waves propagating along the magnetic field, polarized with the electric vector in the direction of the drift. This instability is analogous to the bunching instability of a uniform isotropic plasma (A.A. Rukhadze, Izv. VUZ-ov, Radiofizika, No. 2, 6, 1963) and does not involve the Cherenkov excitation mechanism. In the course of the calculations expressions are obtained for the dielectric tensor as a differential operator, for the dispersion relation, and for Poynting's vector. It is found that no heat is evolved in an infinite plasma. "The authors are deeply grateful to V.P. Silin and M.S. Rabinovich for discussions of the results, and to V.L. Ginzburg, on whose initiative the present investigation was completed." Orig. art. has: 26 formulas.

ASSOCIATION: Fizicheskiy institut AN SSSR, Moscow (Physics Institute, AN SSSR)

SUBMITTED: 09Apr62 DATE ACQ: 01Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 005 OTHER: 007

Card 2/2

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

BOGDANKEVICH, D.S.; RUKHADZE, A.A.; SILIN, V.P.

Fluctuation of an electromagnetic field in a nonequilibrium plasma. Izv.vys.ucheb.zav.; radiofiz. 5 no.6:1093-1103 '62. (MIRA 16:2)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.
(Plasma (Ionized gases)) (Electromagnetic waves)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RAMAZASHVILI, R.R.; RUKHADZE, A.A.; SILIN, V.P.

Rate of temperature equalization of charged particles in a plasma. Zhur. eksp. i teor. fiz. 43 no.4:1323-1330 O '62. (MIRA 15:11)

1. Fizicheskiy institut im. P.N. Lebedeva AN SSSR.
(Plasma (Ionized gases))

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 9926-63 EPA(b)/EWT(1)/EPF(n)-2/EWG(k)/BDS/T-2/ES(u)-2--AFFTC/ASD/ESD-3/AFWL/SSD--Pd-4/Pu-4/Pz-4/Pab-4/Po-4--AT/IJP(C)

ACCESSION NR: AP3002820 S/0207/63/000/003/0139/0142

87
86

AUTHOR: Rukhadze, A. A. (Moscow)

TITLE: On convective instability of a compressible fluid in magnetohydrodynamics

SOURCE: Zhurnal prikladnoy mekhaniki i tekhnicheskoy fiziki, no. 3, 1963, 139-142

TOPIC TAGS: convective instability, compressible fluid stability, magnetohydrodynamics

ABSTRACT: The problem of convective instability in a compressible, ideally conducting fluid situated in a gravitational field has been solved by an approximate method of geometrical optics, in which the equation of state of the fluid is not defined. A dispersion equation for determining the spectrum of magnetohydrodynamic oscillations for a weakly inhomogeneous fluid in a gravitational field was obtained and analyzed for two ultimate cases, i.e., with high and low oscillation frequencies. It was shown that for high-frequency oscillations a conductive inhomogeneous fluid in a gravitational field is always stable; it can be unstable only in the case of low-frequency oscillations.

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L 9926-63

ACCESSION NR: AP3002820

The oscillations of an unstable fluid have an aperiodic character. "In conclusion, I express my appreciation to V. P. Silin for discussing the work." Orig. art. has: 13 formulas

ASSOCIATION: none

SUBMITTED: 25Dec62 DATE ACQ: 16Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 007 OTHER: 001

Card 2/2

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 10132-63 EWT(1)/EEC(b)-2/ES(w)-2/BDS--AFFTC/ASD/ESD-3/AFWL/SSD--
Pab-4/Pi-4/Po-4--IJP(C)
ACCESSION NR: AP3000165 S/0141/63/006/002/0401/0403

AUTHOR: Rukhadze, A. A.

77
76

TITLE: One type of beam instability in plasma 21

SOURCE: Izvestiya vysshikh uchebnykh zavedeniy, radiofizika, v. 6, no. 2, 1963, 401-403

TOPIC TAGS: electron-ion plasma, beam instability in plasma

ABSTRACT: It is pointed out mathematically that a beam of charged particles 21 in an isotropic plasma can effect the transverse component of the electric field of a wave. Two cases are considered: (a) a neutral cold beam of charged particles traverses the neutral cold plasma and (b) all plasma electrons move with a superthermal speed in relation to the ions. The conclusion is that a beam of charged particles moving with a superthermal speed in an isotropic plasma generates transverse electromagnetic waves. "The author expresses his deep thankfulness to V. L. Ginzburg, M. S. Rabinovich, and V. P. Silin for their valuable advices and discussions." Orig. art. has: 7 equations.

Physics Institute, Ac SSSR

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 12910-63 EWT(1)/BDS/EEC(b)-2/ES(w)-2 AFFTC/ASD/ESD-3/AFWL/SSD
Pi-4/Pab-4/Po-4 AT/IJP(C)
ACCESSION NR: AP3001324 S/0057/63/033/006/0660/0666 76 74

AUTHOR: Lovetskiy, Ye. Ye.; Rukhadze, A. A.

TITLE: On the convective instability of non-uniform plasma in a gravitational field

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 33, no. 6, 1963, 660-666

TOPIC TAGS: plasma, non-uniform plasma, plasma stability

ABSTRACT: The authors previously investigated the stability of a non-uniform plasma in crossed magnetic and gravitational fields using the two-component hydrodynamic approximation and found two sorts of instability: the previously known instability to longitudinal waves propagating transversely to the magnetic field in the direction of the drift (drift instability), and an instability with respect to transverse waves propagating parallel to the magnetic field and polarized with the electric vector parallel to the drift (convective instability). (Ye.Ye. Lovetskiy and A.A. Rukhadze, ZhTF, 33, 652, 1963). It is known that the drift instability disappears if the thermal velocities of the plasma particles exceed the drift velocity (M. Rosenbluth, N. Krall and N. Rostoker, Report No. 170 of the Salzburg Conference on Plasma Physics, 1962). The present calculations were accordingly undertaken to investigate the effect of thermal motions on the convective instability remains even when thermal motions are taken into account, provided the plasma is sufficiently rarefied and the magnetic

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L 12910-63

ACCESSION NR: AP3001324

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field sufficiently strong. The calculations are based on the kinetic equation for the electron and ion distribution functions. The spatial non-uniformity is assumed to be small and the gradient term is omitted from the kinetic equation. An unperturbed solution to the kinetic equation is assumed which involves a finite temperature and the linearized kinetic equation for the perturbations is written. Plane waves are assumed for the perturbations, and the dielectric tensor and the dispersion equations are derived in the usual way. The waves propagating transversely to the magnetic field are found to be stable. This is a consequence of the omission of the gradient term in the kinetic equation. The stability conditions for waves propagating parallel to the field are discussed in some detail. Such waves, if the wavelength is sufficiently long, are found to be unstable even when the thermal velocities exceed the drift velocity. "The authors express their sincere gratitude to V.L. Ginzburg for discussions of the results." Orig. art. has: 28 formulas.

ASSOCIATION: Fizicheskiy institut imeni P. N. Lebedev AN SSSR, Moscow (Physics Institute, AN SSSR)

SUBMITTED: 03May62 DATE ACQ: 01Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 005 OTHER: 001

Card 2/2

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

KOVRIZHNYKH, L.M.; LOVETSKIY, Ye.Ye.; RUKHADZE, A.A.; SILIN, V.P.

Hydrodynamic oscillations of an inhomogenous low-pressure plasma in a magnetic field. Dokl. AN SSSR 149 no.5:1052-1055 Ap '63. (MIRA 16:5)

1. Fizicheskiy institut im. P.N.Lebedeva AN SSSR. Predstavleno akademikom M.A.Leontovichem.

(Plasma oscillations)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.A.

One form of instability of beams in plasma. Izv. vys. ucheb. zav.; radiofiz. 6 no.2:401-403 '63. (MIRA 16:6)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR.
(Plasma(Ionized gases))
(Electromagnetic waves)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

L 13634-63 EWT(1)/EWG(k)/BDS/EEC(b)-2/ES(t)-2/ES(w)-2 ASD/ESD-3/
AFWL/AFFTC/SSD Pi-4/Po-4/Pab-4/Pz-4 AT/IJP(C)

ACCESSION NR: AP3003126 S/0056/63/044/006/1953/1963

83
82

AUTHOR: Kovrizhny*kh, L. M.; Rukhadze, A. A.; Silin, V. P.

TITLE: Oscillations of a low pressure inhomogeneous plasma 21

SOURCE: Zhurnal eksper. i teor. fiziki, v. 44, no. 6, 1963, 1953-1963

TOPIC TAGS: plasma oscillations, low pressure, optical approximation, strong magnetic field containment

ABSTRACT: The methods of geometric optics are extended to electrodynamics with spatial dispersion, when the field equations are integral equations, and applied to the problem of stability of a magnetically confined plasma. The dispersion relations for longitudinal oscillations are derived. Analysis of the dispersion relations for the limiting cases of long and short wave perturbations yields the necessary and sufficient conditions for plasma instability. It is shown, in particular, that if the ratio of the electron to ion temperatures is independent of the coordinates, a weakly inhomogeneous low-pressure plasma confined by a magnetic field is almost always unstable against short-wave oscillations. It is pointed out that the instabilities of an inhomogeneous plasma confined by a strong field are kinetic, since they are associated with residue terms in the kernal of the solved integral equation. Orig. art. has: 38 formulas.

Card 1/2/ Association: Physics Inst., Academy of Sciences, SSSR

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"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

LOVETSKIY, Ye.Ye.; RUKHADZE, A.A.

Convective instability of an inhomogeneous plasma in a gravitational field. Zhur. tekh. fiz. 33 no.6:660-666 Je '63. (MIRA 16:6)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Plasma(Ionized gases))

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

KOVRIZHNYKH, L.M.; RUKHADZE, A.A.; SILIN, V.P.

Oscillations of an inhomogeneous low-pressure plasma. Zhur. eksp. i teor. fiz. 44 no.6:1953-1963 Je '63. (MIRA 16:6)

1. Fizicheskiy institut im. P.N. Lebedeva AN SSSR.
(Plasma oscillations)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

LOVETSKIY, Ye.Ye.; RUKHADZE, A.A.

Oscillations of a cold inhomogeneous plasma in a gravitational field. Zhur. tekh. fiz. 33 no.6:652-659 Je '63. (MIRA 16:6)

1. Fizicheskiy institut imeni P.N. Lebedeva AN SSSR, Moskva.
(Plasma oscillations)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.K.

RT-456 (Problem of the torsion of a circular cylinder reinforced with a longitudinal circular rod) Zadacha krucheniia krugovogo tsilindra, armirovannogo prodol'nym krugovym sterzhem.

SO: Izvestiia Akademii Nauk, VII Seriia. Otdelenie Matematicheskikh i Estestvennykh Nauk, (3): 373-386, 1933.

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A. K. L Gorgidze, A. Ya.

Ob odnom chislennom reshenii integral'nykh uravneniy ploskoy zadachi teorii uprugosti. Tbilisi, soobshch. Gr. fil, AN, 1 (1940), 255-258.

SO: Mathematics in the USSR, 1917-1947
edited by Kurosh, A. G.,
Markushevich, A. I.,
Rashevskiy, P. K.
Moscow-Leningrad, 1948

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A.K.

Deflection of a vigorously twisted rod by a shearing force.
Soob.AN Gruz.SSR 8 no.5:291-298 '47. (MLRA 9:7)

1.Akademiya nauk Gruzinskoy SSSR, Tbilisskiy matematicheskiy institut imeni A.M.Razmadze. Predstavleno akademikom N.I.Muskhelishvili.
(Strains and stresses) (Elastic rods and wires)

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

Rukhadze, A. K. Influence of transverse force on torque in bending of a bar. Appl. Math. Mech [Akad. Nauk SSSR. Prikl. Mat. Mech.] 11, 351-356 (1947). (Russian. English summary)

The paper deals with the flexure of a long cylindrical beam clamped at one end and bent by a couple and a transverse force applied at the other end. Nonlinear strains and F. D. Murnaghan's stress-strain relations are used to obtain the solution satisfying the boundary conditions and the compatibility and equilibrium equations.

I. S. Sokolnikoff (Los Angeles, Calif.)

[illegible] Vol [illegible], No. [illegible]

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A. K.

Rukhadze, A. K. On the deformation of naturally twisted bars. Akad. Nauk SSSR. Prikl. Mat. Meh. 11, 533-542 (1947). (Russian)

The problem of equilibrium of long naturally twisted rods of an arbitrary cross section was considered by P. M. Riz [Bull. Acad. Sci. URSS. Sér. Math. [Izvestia Akad. Nauk SSSR] 1939, 449-476; these Rev. 1, 287] and by Lourie and Janelidze [C. R. (Doklady) Acad. Sci. URSS (N. S.) 24, 24-27, 227-228 (1939); 27, 436-439 (1940); these Rev. 2, 176]. Riz considered the problems of extension, torsion and bending by couples by a method of perturbation of a small parameter characterizing the uniform twist. Lourie and Janelidze used the same method to solve the problem of bending by a transverse force and found that their results appeared in a form inconvenient for computations. The author [same journal 6, 123-138 (1942); these Rev. 4, 180] proposed a method of solution of these problems using the theory of functions of a complex variable. The case of uniform twist, determined along the axis of the rod by the function $\theta = kz$ with parameter k so small that one can neglect its second and higher powers, was considered. This paper contains an explicit solution of the problem of bending by a transverse force of naturally twisted rods, of elliptical cross section, by the method developed in the author's earlier article. *I. S. Sokolnikoff* (Los Angeles, Calif.).

Source: Mathematical Reviews, Vol 9 No. 6

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

AMR

Rods, beams, Shafts
Springs, Cables, etc.
29

419. **A. K. Rukdedze, "Influence of transverse shear on the bending of a bar"** (in Russian), *Appl. Math. Mech.* (*Prikl. Mat. i Mekh.*), May-June 1947, vol. 11, pp. 351-356

The author applies to this problem the generalized "nonlinear" theory of elasticity which was initiated by L. N. G. Filon and F. Murnaghan [*Amer. J. Math.*, 1937, vol. 59, no. 2]. He refers to work done and published in Russia from 1938 to 1944 on particular solutions of problems of nonlinear theory of elasticity, in which the elastic constants of the classic theory are kept unchanged and additional elastic constants are introduced to describe the deviations from linear behavior.

On the basis of this nonlinear theory the author gives the differential equations of equilibrium, the compatibility conditions and the boundary conditions for the present problem. In this way he derives rather complicated formulas for the bending stresses in a bar, which take into account the influence not only of the bending moment, but also of the transverse shear force, which is not considered in classic linear bending theory.

M. T. Huber, Poland

Mar '48

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

141 A. K. Nukhadze, "Deformation of a naturally twisted rod" (in Russian), *Appl. Math. Mech.* (*Prikl. Mat. i Mekh.*), Sept.-Oct. 1947, vol. 11, pp. 533-542.

The problem of the equilibrium of long naturally twisted rods of an arbitrary cross section was considered by P. M. Riz [*Bull. Acad. Sci. URSS, Sec. Math.*, 1939, no. 4] and by A. Lurje and G. Janelidze [*C. R. Acad. Sci. URSS*, 1939, vol. 24, nos. 1, 3, 4; 1940, vol. 27, no. 5]. Riz considered the problems of extension, torsion, and bending by couples by a method of perturbations of a small parameter characterizing the uniform twist. Lurje and Janelidze used the same method to solve the problem of bending by a transverse force, and found that their results appeared in a form inconvenient for computations.

In a previous paper the author [*Appl. Math. Mech.*, 1942, vol. 6] proposed a method of solution of these problems using the theory of functions of a complex variable. He considered the case of uniform twist determined along the axis of the rod by the function $\theta = kz$ with parameter k so small that one can neglect its second and higher powers. The present paper contains an explicit solution of the problem of bending by a transverse force of naturally twisted rods of elliptical cross section, by the method developed in the author's earlier paper.

I. S. Sokolnikoff, USA

Shafts, Springs, Cables, etc.
29

APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7"

"APPROVED FOR RELEASE: 08/22/2000 CIA-RDP86-00513R001446010017-7

RUKHADZE, A. K.

RUKHADZE, A. K., TSHETSHVILI, Ye. I "On the general characteristics of diseases of the nervous system, based on material on the clinical aspects of nervous diseases", In the collection: Pyatnadtsat' let nauch.-prakt. deyatel'nosti Kliniki i Otd-niy nervnykh bolezney (Tbilis, gos. med. in-t. I Gor. b-tsa), Tbilisi, 1948, p. 1-41.

SO: U-4631, 16 Sept 53, (Letopis 'Zhurnal 'nykh Statey, No. 24, 1949).

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RUKHADZE, A. A.

"The Problem of Deflecting a Rod Constructed of Various Elastic Materials With a Weakly Deflected Axis"
Soobshch. AN Gruz. SSR, Vol 14, No 9, 1953, pp 525-532

The author solves the problem of the deflection of a rod by a force couple. The following conditions are imposed: the lower end of the rod is fixed, the upper end carries a load equivalent to the couple with the moment lying in the plane of the end, and the lateral surfaces are free of stress. (RZhMat, No 2, 1955)

SO: Sum. 492, 12 May 55

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Translation from: Referativnyy zhurnal. Mekhanika, 1957, Nr 3, p 108 (USSR)

AUTHOR: Rukhadze, A. K.

TITLE: Secondary Effects in the Problem of the Bending Due to a Force Couple of Prismatic Girders Composed of Various Elastic Materials (Vtorichnyye effekty v zadache izgiba paroy prizmaticheskikh brus'yev sostavlennykh iz razlichnykh uprugikh materialov)

PERIODICAL: Tr. Gruz. politekhn. in-ta, 1954, Nr 30, pp 93-114

ABSTRACT: The paper analyzes the secondary effects in the problem of the bending due to a force couple of an arbitrary prismatic girder composed in some specified manner [Muskhelishvili, N. I., Nekotoryye osnovnyye zadachi matematicheskoy teorii uprugosti (Some Fundamental Problems of the Mathematical Theory of Elasticity). Moscow, Izd-vo AN SSSR, 1954, chapter VII] of various elastic materials. The elastic constants (the modulus of elasticity and the Poisson ratio) of the bars and the surrounding medium are assumed to be different. The solution of the problem is constructed in terms of the stresses on the basis of a nonlinear generalization of Hooke's law and is reduced to the finding of three functions of two variables

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Secondary Effects in the Problem of the Bending Due to a Force Couple (cont.)

which satisfy both certain differential equations in terms of partial derivatives and the boundary conditions. Bibliography: 21 references.

A. Ya. Gorgidze

Card 2/2

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