KOVRIZHNYKH, L. M., Cand Phys-Math Sci -- (diss) "Kinetics of plasma under external fields." Moscow, 1960. 7 pp; (Physics Inst im P. N. Lebedev of the Academy of Sciences USSR); 150 copies; free; (KL, 17-60, 139)

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AUTHOR: Kovrizhnykh, L. M.

TITLE: Instability of Longitudinal Oscillations of an Electron - Ion Plasma Located in an External Electric Field

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1960, Vol. 30, No. 10, pp. 1186 - 1192

TEXT: The instability of longitudinal oscillations of an electron - ion plasma located in an external electric field was studied for the case of adiabatic variations of its parameters. Stability criteria and formulas for the growth increment were determined. The following results were obtained: Application of an external electric field to the plasma leads to a drift of electrons with respect to the ions. On the other hand, fluctuations of the charge density cause plasma oscillations. At sufficiently small relative velocities, the existence of a drift has practically no effect on the character of oscillations. As soon as this velocity exceeds a certain value determined by the plasma parameters, the oscillation amplitude starts increasing with a wavelength that is larger than

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Instability of Longitudinal Oscillations of an Electron - Ion Plasma Located in an External Electric Field

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the Debye ionic radius. The energy of the orientated particle motion passes over into the oscillation energy. The period of time during which the oscillation amplitude of the harmonic increases with the proper wavelength, is determined by the law of the change in time of the mean orientated velocity of the electrons with respect to the ions, and increases with a decrease of the wave number k. The greatest danger is caused by disturbances whose wavelengths are larger than the Debye ionic radius, and for which the duration of instability is sufficiently long. The instabilities under consideration may occur in the case of an apparatus for which an external electric field is used to heat the plasma or for other purposes (e.g., "gas betatron" - Ref.9). The anomalously short lifetime of plasma in a stellarator (Refs. 10 and 11) is obviously also related to such instabilities. The author thanks M. S. Rabinovich for his interest in this work. G. V. Gordeyev is mentioned. There are 2 figures and 11 references: 8 Soviet.

Phys. Inst. im P. N. Lebedev

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KOVRIZHNYKH, L.M.; RUKHADZE, A.A.

Instability of longitudinal oscillations of an electron-ion plasma. Zhur.eksp.i teor.fiz. 38 no.3:850-853 Mr '60. (MIRA 13:7)

1. Fizicheskiy institut im. P.N.Lebedova Akademii nauk SSSR.
(Plasma (Ionized gases))

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S/056/60/039/004/027/048
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AUTHOR: Kovrizhnykh, L. M.

TITLE: Shock Waves in Relativistic Magnetohydrodynamics

PERIODICAL: Zhurnal eksperimental'noy i teoreticheskoy fiziki, 1960, Vol. 39, No. 4(10), pp. 1042 - 1045

TEXT: As equation for a relativistic Stoßadiabate shock adiabatic was given by Hoffman and Teller in their magnetohydrodynamics studies (Ref.1). The properties of this shock adiabatic are studied more exactly by the author of the present paper, and a relation between the various thermodynamic quantities holding on both sides of the discontinuity are obtained for the case where the shock wave propagates perpendicular to the field direction, and so the magnetic field vector lies parallel to the plane of discontinuity. First, the continuity equations are written down, wherefrom equations for the front velocities are derived and the following relation is obtained for the shock adiabatic:

$w_1^*/n_1^2 - w_2^{*2}/n_2^2 + (p_2^* - p_1^*)\left[w_1^*/n_1^2 + w_2^*/n_2^2\right] = 0$ (w - thermal function,

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Shock Waves in Relativistic Magnetohydrodynamics

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p - pressure, n - particle density; the subscripts 1 and 2 refer to the regions in front of and behind the wave front, respectively; $p^* = p + H^2/8\pi$, $w^* = e^* + p^* = e + H^2/8\pi + p + H^2/8\pi$; e - internal energy per unit volume). The general equations (4) obtained for v_1 and (5) obtained for the shock adiabatic are then studied for various limiting cases: a) Non-relativistic equation of state, $p \ll m_0 nc^2$, $H^2/8\pi \gg m_0 nc^2$ (m_0 - rest mass of the particles); b) ultrarelativistic equation of state, $p_1 = \frac{1}{3} e_1 \gg H_1^2/8\pi$; c) very strong fields and high temperatures, $H_1^2/8\pi \gg p_1 = \frac{1}{3} e_1$. Finally, the author discusses the possibility of reflection of charged particles from the front of a shock wave, which is of interest in connection with the possibility of particle acceleration by shock waves. For the occurrence of such a reflection, the following condition is obtained for the velocity of the shock wave: $v_2 < v_0'/\sqrt{1+x^2} \approx v_0'/4.6$, where $0 < x < 3\pi/2$ is the first non-trivial root of

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AUTHOR: Kovrizhnykh, L. M.

TITLE: Effect of disturbances on the structure of a screw magnetic field

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 31, no. 7, 1961, 888 - 890

TEXT: As is known, particles moving in the direction of a magnetic field follow exactly the lines of force. If the magnetic field is disturbed strong disturbances of the separatrix occur. A strict solution of the effect of the disturbances on the structure of the magnetic field requires numerical methods. For inner magnetic surfaces, however, which are far away from the separatrixes, and for small disturbances, the problem may be investigated with the "neutralization" method by Bogolyubov. With it, most of the dangerous types of disturbances and the orders of magnitude of the magnetic surface disturbances may be determined. H_0 denotes the longitudinal field, $\vec{\tilde{H}} = (H_r, H_\varphi, H_z)$ the screw field and $\delta\vec{H}$ the disturbances, assuming that $\tilde{H}/H_0 \ll 1$ and $\delta H/H_0 \ll 1$. With restriction to the links

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of first order of $\delta H/H_0$ and second order of $\widetilde{H}/H_0$, the lines of force may be described by

$$\left.\begin{aligned}\frac{dx}{d\zeta}&=\frac{nH_r}{H_0}-\frac{nH_rH_z}{H_0^2}+\frac{n\delta H_r}{H_0}-\frac{nH_r\delta H_z}{H_0^2}-\frac{nH_z\delta H_r}{H_0^2},\\ \frac{d\varphi}{d\zeta}&=\frac{nH_\varphi}{xH_0}-\frac{nH_\varphi H_z}{xH_0^2}+\frac{n\delta H_\varphi}{xH_0}-\frac{nH_\varphi\delta H_z}{xH_0^2}-\frac{nH_z\delta H_\varphi}{xH_0^2},\end{aligned}\right\}\qquad(1)$$

where

$$\left.\begin{aligned}H_r&=nH_nI_n'(x)\sin n\theta,\\ H_\varphi&=n^2H_n\frac{I_n(x)}{x}\cos n\theta,\\ H_z&=-nH_nI_n(x)\cos n\theta,\end{aligned}\right\}\qquad(2)$$

$I_n(x)$ is here a modified Bessel function, $\theta = \varphi - \zeta$, $\zeta = \alpha z$, $x = n\alpha r$, $\alpha = 2\pi/L$, L the pitch of the screw, n the number of the harmonic and H_n the amplitude of the latter. It is assumed that the disturbances may be described by

$$\left.\begin{aligned}\delta\Phi&=\delta H_{m,k}I_m(kr)e^{\pm im\varphi+ikz},\\ \delta H&=\nabla\delta\Phi,\ m=1,2,3,\ldots\end{aligned}\right\}\qquad(3)$$

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Effect of disturbances...

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In the case of a torus, $k = l/R_0$, where $l = 1, 2, 3, \ldots$, and R_0 the great radius of the torus. The two cases $k \neq 0$ and $k = 0$ are investigated. For $k \neq 0$, the disturbances only occur during "resonance", i. e., when the three-dimensional frequencies of the disturbances are equal to or smaller than the frequency of radial "oscillations" of the undisturbed lines of force. Thus, the lines of force for which

$$1 - \omega(x) = \pm \frac{k}{anp}; \quad p = 1, 2, 3 \ldots, \qquad (4)$$

holds, are disturbed most, where

$$\omega(x) = \frac{n^4 \varepsilon^2}{4} \left(\frac{1}{x} \frac{\partial}{\partial x}\right)^2 I_n^2(x). \qquad (5)$$

holds for small $\varepsilon_n = H_n/H_0$ for the mean rate of screwing of the lines of force. The greatest effects are produced by disturbances with $m = 0$, where the magnetic surfaces assume the shape of rosettes with n leaves, and the maximum deviation of the magnetic surfaces from the undisturbed one may be described by

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Effect of disturbances...

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$$\Delta r \approx \frac{\pm 1}{an}\sqrt{\frac{\pi A}{2n\frac{\partial\omega}{\partial x}}}; \quad A = \left|\frac{kn^4\varepsilon_n\delta H_k}{2H_0}\frac{I_n(x)\,I_0'(x)}{x^2}\right|, \qquad (6)$$

For k = 0,

$$\int_0^\infty \omega(x)\,x\,dx - \alpha\frac{\delta H_m}{H_0}n^2x^m\sin m\varphi = \mathrm{const.} \qquad (7)$$

is obtained at $\varepsilon_n \leqslant 1$ for the magnetic surface with existence of disturbances. This integral may be easily calculated by using (5). If the longitudinal field is produced by a coil with the pitch L_1, the cross component $H_\perp$ may be calculated by

$$H_\perp = \frac{H_0}{\alpha_1 R_0}\,\frac{l + 3}{4} \qquad (8).$$

Here, $\alpha_1 = 2\pi/L_1$, a_1 the radius of turns, R_0 the great radius of the torus, $l = 2\left\{\ln 8R_0/a_1 - 2\right\}$. There are 2 references: 1 Soviet-bloc and 1 non-Soviet-bloc.

Card ~~4/5~~
4/4 Physics Inst im P. N. Lebedev AS USSR

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AUTHOR: Kovrizhnykh, L. M.

TITLE: A helical magnetic field in a cylindrical chamber with slits

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 5, 1962, 517-525

TEXT: The author calculates the magnetic-field and the Foucault-current distributions inside a conducting tube which is cut into equal sections. The tube is assumed to be placed in a helical magnetic field which varies harmonically with time, and in a longitudinal magnetic field, the frequency of which is such that the skin layer is thick as compared with the chamber walls. For an infinite cylinder of $r = a_0$ and with a surface current density

$$\mathbf{j} = j_0 \{\mathbf{e}_r 0 + \mathbf{e}_\varphi \alpha a_0 + \mathbf{e}_z\} \cos n\theta \sin \omega t, \qquad (1.1),$$

the distribution of the surface density of the Foucault currents is obtained as

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$$\mathbf{j}=\begin{cases}\mathbf{j}_1 & \text{при} \quad z<-\Delta,\\ 0 & \text{при} \quad -\Delta<z<\Delta,\\ \mathbf{j}_2 & \text{при} \quad z>\Delta,\end{cases} \tag{1.12}$$

$$\mathbf{j}_{1,2}=j_0\left\{\mathbf{e}_\varphi\left[\frac{x_1}{n}\cos n\theta \pm \sin n(\varphi \pm \alpha\Delta)\, e^{\pm\frac{n^2\alpha}{x_1}(z\pm\Delta)}\right]+\right.$$
$$\left.+\mathbf{e}_z\left[\cos n\theta-\cos n(\varphi\pm\alpha\Delta)\, e^{\pm\frac{n^2\alpha}{x_1}(z\pm\Delta)}\right]\right\}. \tag{1.13}$$

The presence of the longitudinal field (H_0) induces additional currents with the density

$$\mathbf{j}_\parallel=-\frac{H_0\sigma h a_1 \omega}{2c}\begin{cases}\mathbf{e}_\varphi\cdot 1 & \text{при} \quad |z|>\Delta,\\ \mathbf{e}_\varphi\cdot 0 & \text{при} \quad |z|<\Delta.\end{cases} \tag{1.15}$$

2Δ is the gap width, 2L is the length of a section, L_0 is the screw pitch,

$\xi = \varphi - \alpha z$, $\alpha = 2\pi/L_0$, $x = \alpha nr$, and $x_0 = \alpha na_0$. The solutions are valid for quasisteady conditions. The total current consists of five components:

$$\mathbf{J}=\mathbf{j}_{\parallel}^{(0)}+\tilde{\mathbf{j}}_{\parallel}+\mathbf{j}_{b}^{(0)}+\mathbf{j}_{b}^{(1)}+\mathbf{j}_{b}^{(2)}, \qquad (2.1)$$

$$\left.\begin{array}{l}
\mathbf{j}_{\parallel}^{(0)}=j_{\parallel}^{(0)}\{\mathbf{e}_r\cdot 0+\mathbf{e}_\varphi\cdot 1+\mathbf{e}_z\cdot 0\},\\
\tilde{\mathbf{j}}_{\parallel}=-j_{\parallel}^{(0)}\{\mathbf{e}_r\cdot 0+\mathbf{e}_\varphi\cdot 1+\mathbf{e}_z\cdot 0\}\,\varepsilon(z),\\
\mathbf{j}_{b}^{(0)}=\tilde{J}_0\{\mathbf{e}_r\cdot 0+\mathbf{e}_\varphi \alpha a_1+\mathbf{e}_z\cdot 1\}\,e^{in\vartheta},\\
\mathbf{j}_{b}^{(1)}=-\tilde{J}_0\{\mathbf{e}_r\cdot 0+\mathbf{e}_\varphi \alpha a_1+\mathbf{e}_z\cdot 1\}\,e^{in\vartheta}\varepsilon(z),\\
\mathbf{j}_{b}^{(2)}=-\tilde{J}_0\begin{cases}\beta\,[\mathbf{e}_r\cdot 0+\mathbf{e}_\varphi i+\mathbf{e}_z\cdot 1]\,e^{in\varphi+\gamma z} & \text{при} \quad z<-\Delta,\\ 0 & \text{при} \quad |z|<\Delta,\\ \beta^*[\mathbf{e}_r\cdot 0-\mathbf{e}_\varphi i+\mathbf{e}_z\cdot 1]\,e^{in\varphi-\gamma z} & \text{при} \quad z>\Delta,\end{cases}\\
j_{\parallel}^{(0)}=-\dfrac{H_0\sigma h a_1\omega}{2c},\quad \beta=e^{i(n\alpha+\gamma)\Delta},\quad \gamma=\dfrac{n^2\alpha}{x_1},
\end{array}\right\} . \qquad (2.2),$$

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$\varepsilon(z) = \begin{cases} 1 & \text{for } |z| < \Delta \\ 0 & \text{for } |z| > \Delta \end{cases}$, and so does the magnetic potential:

$$\Phi = \Phi_{\parallel}^{(0)} + \tilde{\Phi}_{\parallel} + \Phi_{b}^{(0)} + \Phi_{b}^{(1)} + \Phi_{b}^{(2)}. \qquad (2.3).$$

$\phi_{\parallel}^{(o)} = \frac{4\pi j_{\parallel}^{(o)}}{c} z$; $\phi_{b}^{(o)} = \frac{\tilde{H}_n}{\alpha} I_n(x) \sin n\theta$; the fairly complex expressions for $\phi_{b}^{(o)}$, $\phi_{b}^{(1)}$, and $\phi_{b}^{(2)}$, which are given explicitely, can be simplified if $0 \leqslant k \lesssim 1/a_1$ and $z^2 + a_1^2 \gg r^2$:

$$\tilde{\Phi}_{\parallel} = \frac{4\pi j_{\parallel}^{(0)} \Delta}{c} \left[\frac{z}{\sqrt{z^2 + a_1^2}} + 1 \right], \qquad (2.19)$$

$$\Phi_b = -\frac{4q_n a_1 j_0}{c}\left(\frac{r}{a_1}\right)^n\left\{\left(1+\frac{n\Delta}{a_1}\right)\left[\Psi_n\left(\frac{z}{a_1}\right)+\Psi_n\left(-\frac{z}{a_1}\right)\sin n\varphi - \right.\right.$$

$$\left.\left. - \alpha n\Delta\left[\Psi_n\left(\frac{z}{a_1}\right)-\Psi_n\left(-\frac{z}{a_1}\right)-\frac{\frac{2z}{a_1}}{n\left(1+\frac{z^2}{a_1^2}\right)^{n+\frac{1}{2}}}\right]\cos n\varphi\right\}. \qquad (2.23);$$

$\Phi_b = \Phi_b^{(1)} + \Phi_b^{(2)}$. All these solutions hold for a conducting tube with a single slit. If the tube consists of an infinite number of equal sections arranged at equal distances (2Δ),

$$\Phi_{\parallel} = -\frac{8\pi j_{\parallel}^{(0)} a_1}{cL}\sum_{l=0}^{\infty} I_0(k_l r)K_0'(k_l a_1)\frac{\sin kl\Delta}{kl}\sin k_l z, \qquad (2.25)$$

A helical magnetic field in a ... S/057/62/032/005/001/022
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$$\tilde{\Phi}_b = \Phi_b^{(1)} + \Phi_b^{(2)} = -\frac{4\pi j_0 a_1}{cL} \sum_{l=-\infty}^{\infty} \frac{I_n(|k_l| r) K'_n(|k_l| a_1)}{k_l^2 + \gamma^2} \times$$

$$\times \left\{ \cos(k_l + n\alpha)\Delta + \frac{(\gamma^2 - k_l n\alpha)\sin(k_l + n\alpha)\Delta}{\gamma(k_l + n\alpha)} \right\} |k_l| \sin(n\varphi + k_l z). \quad (2.26).$$

The Foucault-current distribution obtained is the same as that of a sectional coil of helical busbars in a system with straight-lined spacings. There are 2 figures and 1 table.

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

SUBMITTED: May 22, 1961 (initially)
November 13, 1961 (after revision)

Card 6/6

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B102/B104

AUTHOR: Kovrizhnykh, L. M.

TITLE: Effect of perturbations on the structure of a helical magnetic field

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 32, no. 5, 1962, 526-535

TEXT: The author calculates the field distortions that arise in a helical magnetic field used as a charged-particle trap; these distortions may cause some or even all field lines (i.e., some or all trapped particles) to escape. An exact solution to this (nonlinear) problem can only be obtained by numerical methods. For the internal magnetic surfaces far from the separatrices and for weak perturbations, however, Bogolyubov's method of averaging can be used. In a previous paper (ZhTF, 31, 888, 1961), the author used it for calculating axisymmetric perturbations. The problems treated there are now dealt with in a more general manner. This approximate method (first order in $\delta H/H_0$, second order in H/H_0; confinement to straight-lined problems and fields which can be described by one harmonic only) is based on representing the magnetic potential $\delta\varphi$ as

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Effect of perturbations on the ... S/057/62/032/005/002/022
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a sum of separate harmonics. H_0 is the longitudinal magnetic field, H is the helical magnetic field, and δH is the perturbation ($H/H_0 \ll 1$, $\delta H/H_0 \ll 1$, $\delta H > H$). With $\theta = \varphi - \zeta$, $\zeta = \alpha z$, $x = \alpha nr$, and $\alpha = 2\pi/L_0$ (L_0 = screw pitch), r, φ, z = coordinates), a system of equations is obtained for $dx/d\zeta$ and $d\varphi/d\zeta$. An integral of this system is found if the inequality $\left|\varkappa_{(\mp)}\right| \ll \left|\frac{d\bar{\varphi}}{d\zeta}\right| \sim \varepsilon_n^2$ holds for the "detuning quantity" $\varkappa$: $\phi = \int \frac{d\bar{\varphi}}{d\zeta} x dx$ = const. If $\varkappa$ is relatively great ($\varkappa \sim \varepsilon_n$) and if only one resonant harmonic is assumed to exist (no multipole perturbations), simple expressions are found for $dx/d\zeta$ and $d\varphi/d\zeta$, and the perturbed magnetic surface can be described by ${}_2 xa(x)\cos(p\varphi - \varkappa\zeta + \varphi_{ml}) + \int^x \Omega(x) x dx$ = const; $\Omega(x) = p\omega(x) - \varkappa$; $\omega(x) = \frac{n^4 \varepsilon_n^2}{4}\left(\frac{1}{\varkappa}\frac{\partial}{\partial x}\right)^2 I_n^2(x)$; $\varepsilon_n = H_n/H_0$, n = number of harmonics, and H_n = their amplitude. Finally, the author studies the effect of "corrugating" the longitudinal field upon the

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B187/B102

AUTHOR: Kovrizhnykh, L. M.

TITLE: Magnetic surfaces of a toroidal helical field

PERIODICAL: Zhurnal tekhnicheskoy fiziki, v. 33, no. 4, 1963, 377-381

TEXT: The magnetic surfaces of a "straight" helicoid field are studied in the papers by L. Spitzer (Second Geneva Conference for the Peaceful Use of Atomic Energy), (Paper 2170, 1958, A. I. Morozov and L. S. Solov'yev, ZhTF, 30, 271, 1960 and DAN SSSR, 128, 506, 1959, L. M. Kovrizhnykh, ZhTF, 31, 889, 1961 and ZhTF, 32, 517, 1962). In practice, frequently helicoid fields occur in the form of toroidal systems. In the present paper the approximation equations are derived for the magnetic surfaces of such toroidal helicoid fields. This is done with the aid of the averaging method for the case that the helicoid field is small compared to the longitudinal field. For the special case where the field is realized by n_0 pairs of band-shaped, symmetrically arranged conductors around to the spiral $\varphi = -\frac{\theta}{N}$ in such a way that in two neighboring bands currents

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Magnetic surfaces of a ... B187/B102

flow of equal amounts but of opposite direction, the magnetic surfaces of the field are studied with restriction to a slight toroidal form ($u_0 \gg 1$) and to the internal areas ($u \gg n_0 N$). R_0 and r_0 are the two radii of the torus, (ϱ, ψ', s) are the cylindrical coordinates and (η, θ, ψ) are the torus coordinates; N is the pitch of the screw field on the large perimeter 2 R_0;

η_0 = arcch $\frac{R_0}{r_0}$; u_0 = ch η_0 = $\frac{R_0}{r_0}$. For a field with double input (n_0 = 2) the curves of intersection of the magnetic surfaces and the plane ψ = const deviate only little from the circular shape; their center is shifted by the amount $\Delta\varrho \approx \frac{r_0}{4} \cdot \frac{r_0}{R_0}$ with respect to the axis $\varrho = R_0$ in direction of the decreasing ϱ. For a field with triple input the curves of intersection are a family of double-folium rosettes with a center shifted by the amount $\Delta\varrho \approx \frac{r_0}{4} \cdot \frac{r_0}{R_0}$ also in the direction of the

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decreasing ϱ. Two new magnetic axes, symmetrical to the plane $z = 0$, are formed at a distance $\sim \frac{r_o^2}{3R_o}$. For fields of higher symmetries the situation becomes more complex. The characteristic feature in all these cases is, however, that the domain at a distance of the order of magnitude of $\sim \frac{r_o^2}{R}$ from the torus axis ($\varrho = R_o$, $z = 0$) is divided into a number of subdomains where the magnetic surfaces comprise an own magnet' axis. Outside this domain all magnetic surfaces comprise the axis $\eta = \infty$ and have approximately the shape of a toroid. If the winding of the spiral is not $\varphi = -\frac{\theta}{N}$ but arbitrary $\varphi = \varphi(\theta)$ then the character of the field is maintained in general, although the concrete shape of the magnetic surfaces and the dimensions of the perturbed field vary. For $\varphi = -\frac{\theta + u^{-1}\sin\theta}{N}$ the dimensions of the perturbed field increase. This

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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

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

82

[redacted]

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

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)

GRIDNA, V.P., mlad. nauchn. sotr., starshiy bibliograf; RAYZER, M.D., kand. fiz.-mat. nauk; KOLESNIKOV, V.N., kand. fiz.-matem. nauk; ANTROPOV, Ye.T., ml. nauchn. sotr.; SHPIGEL', I.S., kand. tekhn. nauk, otv. red.; KOVRIZHNYKH, L.M., kand. fiz.-matem. nauk, otv. red.

[Plasma physics; bibliographic index, 1955-1961] Fizika plazmy; bibliograficheskii ukazatel', 1955-1961. Moskva, Nauka, 1964. 354 p. (MIRA 17:11)

1. Moscow. Fizicheskiy institut. Biblioteka.

KOVRIZHNYKH, L.M.; TSYTOVICH, V.N.

Interaction of longitudinal and transverse waves in a plasma.
Zhur.eksp.i teor.fiz. 46 no.6:2212-2220 Je '64.

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

(MIRA 17:10)

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ACCESSION NR: AP4047912

4

large number of super-thermal particles with relativistic velocities,
processes are possible for thermal plasma

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L 15314-65
ACCESSION NR: AP4047912

SUBMITTED: 15Apr64 ENCL: 00

SUB CODE: ME NR REF SOV: 015 OTHER: 001

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L 22569-65
ACCESSION NR: AP5003231

1) A beam existing in plasma for a sufficiently long time, in which there are only "inherent" noises, i.e., there are no outside sources. This investigation provided information concerning beam evolution. 2) The presence of sufficiently intense "outside" noise sources (e.g., "transverse" noises). The analysis of this problem provided information on the influence of external radiation on the dynamics of the electron beam and, particularly, on the possibility of its acceleration with the aid

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WW/AT

ACCESSION NR: AP5010507 UR/0056/65/048/004/1114/1131

Card 2/2

KOVRIZHNYKH, L.M.

Interaction between transverse waves and a turbulent plasma. Zhur.eksp.i teor.fiz. 49 no.4:1332-1344 O '65.
(MIRA 18:11)

1. Fizicheskiy institut imeni Lebedeva AN SSSR.

KOVRIZHNYKH, L.

Heating of ions due to nonlinear absorption of transverse waves in a plasma. Pis'. v red. Zhur. eksper. i teoret.fiz. 2 no.3:142-146 Ag '65. (MIRA 18:12)

1. Fizicheskiy institut imeni Lebedeva AN SSSR. Submitted June 14, 1965.

L 12793-66 EWT(l)/ETC(F)/EPF(n)-2/EWG(m) IJP(c) AT

ACC NR: AP5026627 SOURCE CODE: UR/0056/65/049/004/1332/1344

44,55

AUTHOR: Kovrizhnykh, L. M.

44,55

60

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

B

TITLE: Interaction of transverse waves with a turbulent plasma

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 4, 1965, 1332-1344

TOPIC TAGS: plasma wave absorption, turbulent plasma, plasma radiation, nonlinear effect, plasma decay, plasma diagnostics

ABSTRACT: The author deals with a number of effects that result from the nonlinear interaction of randomly phased transverse waves (radiation) with intense plasma and ion-acoustic waves of a noisy nature (plasma noise), and treats problems that involve the propagation of radiation 21,44,55 through a bounded turbulent plasma. 21,44,55 The analysis is confined to a weakly anisotropic nonmagnetic plasma and the point of departure is a system of nonlinear equations for a turbulent plasma derived by the author earlier (ZhETF v. 49, 1114, 1965). It is assumed that the trans-verse radiation is relatively weak, so that the transverse waves do not

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ACC NR: AT6033041 SOURCE CODE: UR/2504/66/032/000/0112/0129

AUTHOR: Danilkin, I. S.; Kovrizhnykh, L. M.; Rayzer, M. D.; Tsytovich, V. N.

ORG: none

TITLE: Nonlinear effect in a plasma without collisions and possible prospects for their use

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 32, 1966. Fizika plazmy (Plasma physics), 112-129

TOPIC TAGS: nonlinear effect, plasma dynamics, plasma electromagnetic wave

ABSTRACT: The present article is of the review type (35 literature references) and the authors state that it is primarily based on the theoretical results of a series of previously published articles. After an extended mathematical introduction, the authors consider the subject of the induced dissipation of transverse waves and their transformation into longitudinal waves. The next two subsections deal with processes of disintegration and merging of waves in a plasma, and processes of three-plasma dissipation. The next main heading is the nonlinear transformation of transverse electromagnetic waves into longitudinal plasma waves. Following this is a treatment of the acceleration of clusters in a plasma using electromagnetic waves. The final section of the article concerns the possibility of the generation of transverse

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ACC NR: AT6033044 SOURCE CODE: UR/2504/66/032/000/0173/0205

AUTHOR: Kovrizhnykh, L. M.

ORG: none

TITLE: Theory of nonlinear interaction of waves in a plasma

SOURCE: AN SSSR. Fizicheskiy institut. Trudy, v. 32, 1966. Fizika plazmy (Plasma physics), 173-205

TOPIC TAGS: traveling wave interaction, nonlinear plasma

ABSTRACT: The article is devoted to the derivation of equations which make it possible to describe processes taking place in a plasma, taking account of nonlinear effects. A long mathematical exposition is followed by calculations of the probability of processes of the second order. The succeeding section treats the probability of dissipation processes. This is followed by the derivation of equations for the interaction of transverse waves in a plasma. The article concludes with a mathematical treatment of several partial cases of the problem. "The author feels it his duty to express his thanks to V. N. Tsytovich for valuable advice and discussion." Orig. art. has: 104 formulas.

SUB CODE: 20/ SUBM DATE: none/ ORIG REF: 025/ OTH REF: 005

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L 45919-66 EWT(1) IJP(c) AT

ACC NR: AP6028604 SOURCE CODE: UR/0057/66/036/008/1339/1350

38
B

AUTHOR: Kovrizhnykh, L.M.; Liperovskiy, V.A.; Tsytovich, V.N.

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

TITLE: Nonlinear production of plasma waves by a beam of transverse waves. 2.

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 8, 1966, 1339-1350

TOPIC TAGS: mathematic physics, nonlinear effect, nonlinear plasma, plasma wave, plasma wave absorption, transverse wave, longitudinal wave

ABSTRACT: One of the authors has previously discussed the passage through an isothermal plasma of a parallel monochromatic beam of transverse waves whose frequency f is much higher then the Langmuir frequency f_0 of the plasma and the accompanying decay of the transverse waves into longitudinal plasma waves V.N.Tsytovich, ZhTF, 35, No.5, 773, 1965). In the present paper these calculations are extended to the case when the transverse wave beam is not strictly parallel, but has a small angular divergence. The present calculations are based on the results of the earlier ones, and notation employed in the earlier paper is sometimes used in the present discussion without definition. It is found that there is a critical angular spread of the beam given by $\theta_c = (f_0/f)^{3/2}$. When the angular spread of the beam is small compared with θ_c the results previously obtained for a strictly parallel beam are valid. When the

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L 30984-66 EWT(1)/ETC(f)/EPF(n)-2/EWG(m) IJP(c) AT

ACC NR: AP6004943 SOURCE CODE: UR/0056/66/0050/001/0251/0254

51
B

AUTHOR: Kovrizhnykh, L. M.

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

21,44,55 21,44,55

TITLE: Interaction of electron beam with a nonisothermal plasma, and nonlinear stabilization of the beam instability

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 50, no. 1, 1966, 251-254

TOPIC TAGS: plasma instability, plasma beam interaction, plasma oscillation

ABSTRACT: This is a continuation of earlier work by the author (ZhETF v. 48, 1114, 1965; Report EUR-CEA-FC-258, Fontenay-aux-Roses, France, 1964), where elimination of beam instability by using nonlinear interaction of Langmuir waves (nonlinear damping) was proposed. In the present article the author calls attention to a different and possibly more promising way of stabilizing beam

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L 11416-67 EEC(k)-2/EWT(1)/FSS-2 IJP(c) TT/GW

ACC NR: AP6031262 SOURCE CODE: UR/0057/66/036/009/1585/1593

AUTHOR: Kovrizhnykh, L. M.

53

52

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

TITLE: On the interaction of high-frequency transverse waves with a turbulent plasma

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 36, no. 9, 1966, 1585-1593

TOPIC TAGS: turbulent plasma, plasma diagnostics, electromagnetic wave, nonlinear equation, mathematic physics

ABSTRACT: The author employs the nonlinear equations for a weakly turbulent plasma, which he has presented elsewhere (ZhETF, 48, 1118, 1965), to discuss in a one-dimensional approximation the passage of high frequency transverse electromagnetic waves through a layer of turbulent plasma of finite thickness. The incident signal is assumed to cover a narrow band of frequencies centered on a frequency F_0 that is much greater than the electron Langmuir frequency f_0 of the plasma, and the phases of the Fourier components of the incident wave are assumed to be randomly distributed. Separate treatments are given for the two cases in which F_0 is greater than, or much less than f_0/v, with $v^2 = T/m$, where T is the electron temperature in the plasma and m is the electron mass. In the low frequency case it is still assumed that F_0 is much

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ACC NR: AP6031262

greater than f_0. Both cases are characterized by the production of satellites at frequencies $F = F_0 \pm nf_0$, where n is an interger. Formulas are derived for the intensities of these satellites in terms of the parameters characterizing the turbulence of the plasma, and other relevant parameters. It is found that the satellites as well as waves of the fundamental frequency continue to be emitted by the plasma with decreasing intensity for a short time after the incident wave has been cut off. The low frequency waves interact much more strongly with the plasma than do the high frequency waves. In the high frequency case all the satellites propagate in the direction of the incident wave, whereas in the low frequency case the even satellites propagate in that direction and the odd ones propagate in the opposite direction. An approximate treatment of the three-dimensional problem (not presented in the paper) showed that the main difference between the three- and the one-dimensional cases is that in the former the propagation directions of the satellites are not parallel to that of the incident wave. It is suggested that the presented formulas may be useful for diagnosis of turbulent plasmas. Orig. art. has: 25 formulas.

SUB CODE: 20/ SUBM DATE: 16Apr65/ ORIG REF: 003/ OTH REF: 000

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ACC NR: AP7003219 SOURCE CODE: UR/0056/66/051/006/1795/1810

AUTHOR: Kovrizhnykh, L. M.

ORG: none

TITLE: Nonlinear theory of current instability in a nonisothermal plasma

SOURCE: Zh eksper i teor fiz, v. 51, no. 6, 1966, 1795-1810

TOPIC TAGS: plasma instability, nonlinear plasma, nonlinear theory, plasma electron interaction, electron scattering

ABSTRACT: In view of the fact that instability of a nonisothermal plasma in an external electric field cannot be explained within the framework of the linear theory, the author presents an analytic solution of the nonlinear problem of instability of ion sound in a plasma situated in an external electric field. Account is taken of both the interaction of the electrons with the ion-sound noise and the pair interactions. The allowance for the pair interaction makes it possible to analyze in greater detail the conditions under which the results of the solution converge and determine the value of the electric field below which the number of runaway electrons is negligibly small. The form of the quasistationary noise spectrum is determined, and it is shown that allowance for the scattering of the electrons by the ion sound leads to an anomalously high resistance that limits the electron current and prevents the appearance of runaway electrons. Equations are obtained for the time variation of the average kinetic energies of the electrons and ions of the plasma. It follows

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ACC NR: AP7003219

from these equations that the presence of ion absorption leads to an intense heating of the ionic component of the plasma whose rate is proportional to the external electric field. Orig. art. has: 57 formulas.

SUB CODE: 20/ SUBM DATE: 24May66/ ORIG REF: 007/ OTH REF: 005

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Kovalev, I.D.-

to

Kovrizhnykh, L.M

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