constant stable value, given by the relation

$$\frac{1}{\pi}\int_0^{\pi}(a+v_0\cos\psi)\,\gamma\left(\sqrt{v_0^2+a^2+2v_0a\cos\psi}\right)d\psi=0. \qquad (2)$$

The drift motion remains and is determined by the relations in Eq. (1).

Equation (2) has a root $0 < a < v_0$ if the condition

$$\frac{1}{\gamma(v_0)}\left(\frac{d\gamma}{dv_0}\right)_{v_0} < -\frac{2}{v_0}, \qquad (3)$$

which is the oscillation excitation condition, is satisfied.

The theorem proposed applies if the parameter γ/ω_H is small, and can be verified by averaging[1] the equations for a and ψ. It will be apparent from the expression for $\gamma(v)$ given in reference 2 that a charge in a plasma can oscillate. In this case the excitation condition (3) is given approximately by $cE/H > v_T$. Here v_T is the thermal velocity of the charges which surround the charge and damp its motion.

In conclusion we wish to thank Ya. P. Terletskiĭ for discussion of the present work.

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49

DIRECT ELECTRON-POSITRON PAIR PRODUCTION BY ELECTRONS

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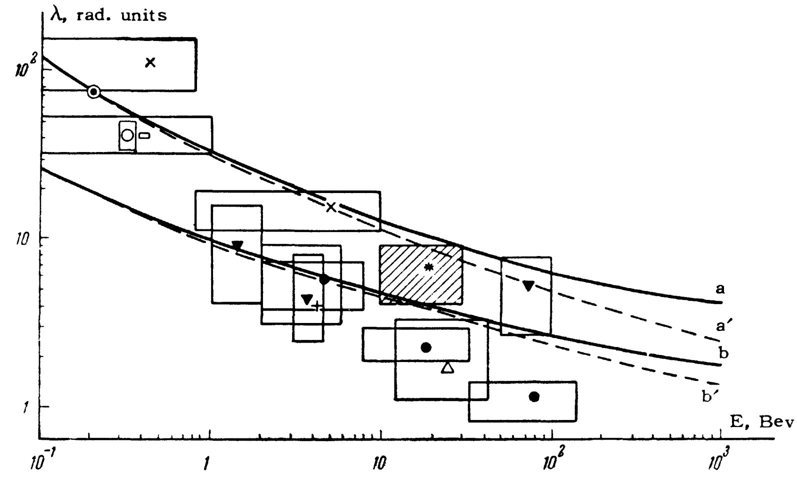
In this note we follow the terminology used in the paper by Tumanyan et al.,[1] in which 25 cases of production of visible tridents were analyzed in the experimental part. Up to this time 29 additional visible tridents have been registered as a result of a study of the photon component of two high energy ($\gtrsim 10^{13}$ ev) nuclear interactions* and a study of three isolated electron-photon showers.

The energies of the electron-positron pairs created by the photon component were determined from measurements of relative multiple scattering. In the isolated electron-photon showers the energy of the primary electron-positron pairs was also determined from the characteristics of the longitudinal development of the electromagnetic cascade.[2]

In a total length of electron track of 107.5 radiation length units 54 visible tridents were observed, which should be referred to an average electron energy of 20 Bev. The true number of tridents obtained with the help of the results of a Monte Carlo calculation[1] turned out to be 19.6. Our results on the determination of the mean free path λ, together with the results of other authors, are shown in the figure (taken from the paper by Weill et al.[3] which contains references to the literature for the appropriate sources; our data are represented by the star and the crosshatched cell). The curves show the theoretical dependence of λ on the electron



energy. The upper curves a′ and a correspond to the calculations by Bhabha[5] as corrected by Block, King, and Wada[4] for the cases of no screening (a′) and complete screening (a). The two lower curves b′ and b (b′ — no screening, b — complete screening) were calculated by us from the results of Murota, Ueda, and Tanaka,[6] whose calculation is more exact than Bhabha's.

As can be seen from the figure, the totality of the experimental results on the determination of λ for an energy interval of primary electrons 1 — 100 Bev is in satisfactory agreement with the theory of Murota et al. A certain disagreement between experiment and the predictions of the above mentioned theory for electrons in the energy interval 0.1 — 1 Bev is apparently due to an illegitimate extrapolation into the indicated energy region of the correction calculated by Koshiba and Kaplon[7] for the number of false tridents, which should lead to a substantial underestimate of the true number of tridents.

Thus the experimental results on the determination of the cross section for direct electron-positron pair production by electrons should apparently be considered as being in agreement with the predictions of quantum electrodynamics up to 100 Bev energies for the primary electrons.

I am grateful to Prof. I. I. Gurevich for valuable advice received in the course of this work.

*These events were found by A. A. Varfolomeev's group.

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50

CYCLOTRON ABSORPTION OF ELECTROMAGNETIC WAVES IN A PLASMA

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THE propagation of electromagnetic waves in a magnetoactive plasma at frequencies ω, close to $m\omega_H^{e,i}$ (m = 1, 2, ... ; where ω_H^e is the gyromagnetic frequency of the electron and ω_H^i is the gyromagnetic frequency of the ion) is characterized by strong absorption; this absorption is due to the thermal motion of the electrons and ions (cyclotron absorption)[1-5] and is of interest in connection with problems of microwave diagnostics and radio-frequency heating of plasmas.

The damping of waves characterized by $\omega \approx m\omega_H^e$, m = 2, 3, ... , is especially pronounced in the case of a double resonance, i.e., when $m\omega_H \approx \omega_+$, where ω_+ is the frequency given by the condition

$$A = 1 - u_e - v_e + u_e v_e \cos^2\theta = 0,$$

$$u_e = (\omega_H^e / \omega)^2, \quad v_e = (\Omega_e / \omega)^2,$$

Ω_e is the electron Langmuir frequency, and θ is the angle between the direction of propagation of the wave and the direction of the magnetic field. As is well known,[2,6] when $\omega \approx \omega_+$ the index of refraction for the extraordinary wave n_2 become very large and a plasma wave can appear. When $\omega \approx m\omega_H^e \approx \omega_+$ and m = 3, 4 the complex indices of refraction for these waves, determined from the dispersion equation which has been reported earlier,[2] are

$$n' = n_{2,3} + i\varkappa_{2,3},$$

where

$$n_{2,3}^2 = \{-A_0 \pm (A_0^2 - 4\beta_e^2 B_0 A_1)^{1/2}\} / 2\beta_e^2 A_1 \gg 1,$$

$$\varkappa_{2,3} = \sigma_m^e \sin^2\theta\,(1 - u_e)\, n_{2,3}^3\,(2B_0 + A_0 n_{2,3}^2)^{-1},$$

$$B_0 = (2 - v_e)\,u_e - 2\,(1 - v_e)^2 - u_e v_e \cos^2\theta,$$

$$A_1 = -v_e\,\{3\cos^4\theta\,(1 - u_e) + \cos^2\theta \sin^2\theta\,(6 - 3u_e + u_e^2) \times (1 - u_e)^{-2} + 3\sin^4\theta\,(1 - 4u_e)^{-1}\},$$

$$\sigma_m^e = \frac{\sqrt{\pi}\, m^{2m-2} \sin^{2m-2}\theta\,\Omega_e^2}{2^{m+3/2}\, m! \cos\theta\,\omega_H^{e2}}\,(\beta_e n_{2,3})^{2m-3} \exp(-z_m^{e2}),$$

$$z_m^e = (1 - m\omega_H^e / \omega)\,(\sqrt{2}\,\beta_e n_{2,3} \cos\theta)^{-1}, \qquad \beta_e = (T_e / m_e c^2)^{1/2}, \tag{1}$$

T_e is the temperature of the electron gas and m_e is the mass of the electron. If, however, $\omega \approx 2\omega_H^e \approx \omega_+$,