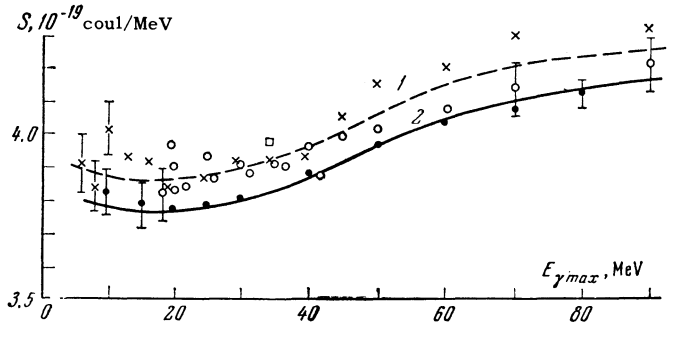
eral laboratories in Germany (where it has been calibrated calorimetrically at 34.5 MeV[4]), as well as in France, Switzerland, Yugoslavia, and Japan.[5]

In order to compare our absolute measurements with the data of the other laboratories we constructed a copy of the duraluminum chamber and determined its sensitivity by comparison with our standard chamber. All essential dimensions of the chamber as well as the composition of the duraluminum were the same as in the original. The measurements were performed with the bremsstrahlung beam of the synchrotron of the Physico-technical Institute in the energy range $E_{\gamma max}$ = 10—90 MeV. The photon beam emerging from the donut of the accelerator (the wall thickness is equivalent to 2.5 g/cm^2 aluminum) was collimated, went through a thin-walled ionization chamber (1.5 g/cm^2) serving as a monitor, was cleared of electrons and positrons by a magnetic field, and entered the duraluminum chamber. The charges collected simultaneously in the duraluminum chamber (q_d) and in the monitor (q_m) were measured by a compensation method.[1] The ratio of q_d to q_m gives the relative sensitivity of the duraluminum chamber and the monitor. The duraluminum chamber was then removed from the beam and replaced by the standard chamber, for which the analogous ratio to the monitor was determined. From these two ratios follows the ratio of the sensitivities of the two chambers; since the absolute sensitivity of the standard chamber has been calibrated earlier by means of a calorimeter, we can compute from this ratio the absolute sensitivity S of the duraluminum chamber.

The experiments were performed at ten values of the energy $E_{\gamma max}$. The obtained dependence of S on the maximum energy of the bremsstrahlung spectrum is shown in Fig. 1. The data obtained by the U.S. National Bureau of Standards and by the Max Planck Institute for Biophysics at Frankfurt are also shown. As can be seen the results of the measurements performed by different methods at different accelerators agree to an accuracy of 2%, which lies within the limits of the experimental errors.



Dependence of the sensitivity of the duraluminum chamber on the maximum energy of the bremsstrahlung spectrum: Curve 2 corresponds to the results of this paper; Curve 1 is drawn from the data of the US National Bureau of Standards (o – calorimetric measurements, x – scintillation spectrometer) and of the Max Planck Institute for Biophysics (□ – calorimetric measurements).

This comparison of the calibrations makes it possible to compare precisely the results of measurements of absolute cross sections, reaction yields etc., which have been obtained at different accelerators (when using either chamber for the measurement of the intensity).

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STANDING MAGNETOPLASMA WAVES IN BISMUTH, CONNECTED WITH HYBRID RESONANCE

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WE have previously investigated[1,2] standing magnetoplasma waves of frequency ω in bismuth, in the region of strong magnetic fields for which $\omega_c \gg \omega$ (ω_c — cyclotron frequency). However, as shown by Smith, Hebel, and Buchsbaum (SHB)[3], undamped plasma waves with nonlinear dispersion can also propagate in bismuth in a field interval between the electron-electron hybrid resonance and the dielectric anomaly, if the carrier spectrum

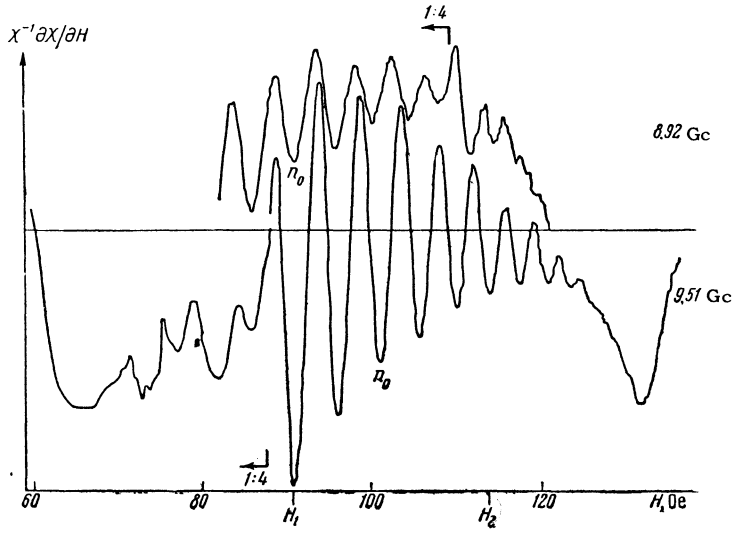

FIG. 1. Recorded oscillations of the surface reactance X of a single crystal of bismuth (D_1 = 0.47 mm) at the two frequencies indicated on the right. The symbol n_0 indicates the oscillations of the same number. On the left of the lower curve is seen the cyclotron resonance and on the right the minimum corresponding to the dielectric anomaly.

is assumed quadratic. This region corresponds to positive k^2 (k —wave vector, see Fig. 2 of SHB).

Standing plasma waves were studied in two bismuth single-crystal discs 18 mm in diameter and D_1 = 0.47 and D_2 = 0.39 mm thick[4]. The trigonal axes of the crystals was nearly normal (4—5°) to the sample surface. The measurements were made by the frequency-modulation method[5] at 9.7 Gc. The magnetic field was parallel to the flat surface of the sample, whose temperature was 1.7°K.

The presence of standing waves in the bismuth was manifest by oscillations of the surface reactance (Fig. 1). The oscillations were observed for a magnetic field H parallel to the bisector axis; the distances between neighboring peaks decrease as the field is rotated. Tilting the field by ~ 2° to the sample plane does not influence the effect. The amplitude of the oscillations is maximal when H ∥ J (J —high-frequency current vector); no oscillations were observed for H ⊥ J.

The existence of plasma waves in the metal is confirmed by the experiments on samples of different thickness. If the oscillations are connected with the excitation of standing plasma waves, then the wave number is $k_n(\omega, H) = \pi n/D$, where n is the number of half waves equivalent to the thickness D of the specimen. It is possible to obtain by experiment (Fig. 1) the variation of n with the field, but not its absolute value. Since assignment of arbitrary n to some definite oscillation involves only transfer of the $k(\omega, H)$ curve along the ordinate axis (Fig. 2), the corresponding curves plotted for two samples of different thickness can be aligned by suitable choice of the values of n. In Fig. 2 the experimental curves were aligned for the values of n indicated in the figure. The error in the determination of n, due to the scatter of the experimental points, can amount to ±1. In addition, for a sample thickness ratio 5:4 (as in our

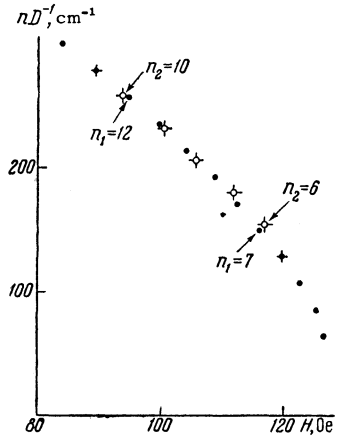

FIG. 2. Comparison of results of experiments made with samples of different thickness: ● – D_1 = 0.47mm; ○ – D_2 = 0.39 mm. The measurement accuracy is indicated near some of the points; the values of n_1 and n_2 designate the numbers of the oscillations.

case), the curves will coincide also when integers that are multiples of 5 and 4 respectively are added simultaneously to the values of n. Figure 2 indicates the most probable smallest values of n. For such values of n, the wavelengths are $\lambda \cong (3—0.6) \times 10^{-2}$ cm, and their velocities $v \cong (3—0.6) \times 10^8$ cm/sec.

Along with measurements of samples of different thickness, we carried out experiments at frequencies between 8.92 and 9.51 Gc; these experiments have shown that the dispersion of the observed plasma waves is not linear. If we assume a linear relation $\omega = v(H)k$, then we have for a fixed field H the equality $\omega_1/\omega_2 = k_1/k_2 = n_1/n_2$. Taking into account the aforementioned uncertainty in n, we can attempt to choose n in a way as to satisfy this relation. However, if we apply such a procedure successively in fields H_1 and H_2 (Fig. 1), then we obtain for one and the same oscillation two different values for n_0, 30 ± 3 and 48 ± 3 thus proving the nonlinearity of the dispersion.

Measurements were made at different temperatures in a sample 0.47 mm thick. When the temperature was reduced from 3.3 to 1.7°K the ampli-

tude of the oscillations increased by approximately seven times (the oscillations were barely noticeable at 4.2°K). The amplitude of the oscillations was quite sensitive to the quality of the single crystal. That the specimens used in the experiments differed in quality was evidenced by the fact that up to ~ 15 harmonics of cyclotron resonance were observed in the specimen with $D_1 = 0.47$ mm, but only ~5 in the sample with $D_2 = 0.39$ mm. Accordingly, in the second sample the amplitude of the oscillations was two orders of magnitude lower, thus accounting in particular for the smaller number of experimental points on the curve of Fig. 2 pertaining to this sample. Together with the temperature-dependence data, this indicates that the attenuation of the waves depends strongly on the mean free time of the electrons.

The existence of the described magnetoplasma waves in bismuth and their main properties are in qualitative agreement with the SHB theoretical premises, except for one fact. As indicated above, the conditions for wave excitation are optimal when $\mathbf{H} \parallel \mathbf{J}$, whereas according to SHB $\mathbf{E} \perp \mathbf{H}$; these relations are compatible only when $\mathbf{E} \perp \mathbf{J}$ which, generally speaking, does not take place. In addition, the analysis in [3] was made for quadratic dispersion, which does not hold for bismuth [2-6]. For the same reason, a quantitative comparison of the experimental results and the calculations based on the SHB theory cannot be illustrative. It will be rational to carry out such a comparison following an exact calculation of the real spectrum of the carriers in bismuth in accordance with the theory of Abrikosov and Fal'kovskiĭ [6].

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MEASUREMENT OF THE SPECIFIC HEAT C_v OF OXYGEN NEAR THE CRITICAL POINT

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A logarithmic temperature dependence of the specific heat C_V of argon was previously observed [1] near the critical point. To check whether this is a general phenomenon, we measured C_V of oxygen near its critical point ($T_c = 154.565$°K, $\rho_c = 0.408$ g/cm^3). The choice of oxygen was dictated by its relative availability in pure form and by the proximity of its critical temperature to that of argon, making the previously developed measurement procedures [2,3] usable.

The oxygen was obtained by decomposition of chemically pure $KMnO_4$, with strict adherence to the methodological instructions of [4,5], so that a purity not worse than 99.99% could be expected.

The dependence of the specific heat of oxygen on the temperature was measured in the region of transition from the heterogeneous system to the homogeneous system at constant volume, differing from critical by ~ 0.5 per cent (the curve was measured twice at densities 0.408_3 and 0.408_5 g/cm^3, with different batches of oxygen). The width of the temperature interval reached ~ 0.04°K.

The data obtained are shown in Fig. 1. They are

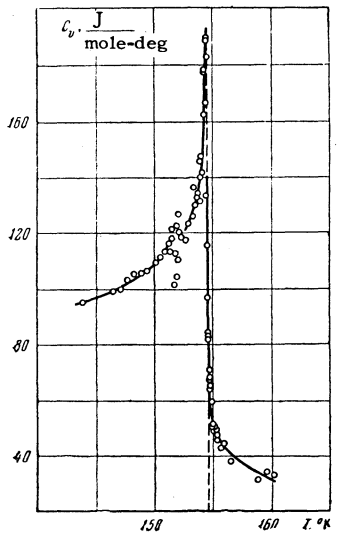

FIG. 1. Temperature dependence of C_V of oxygen at $\rho \sim \rho_c = 0.408$ g/cm^3.