situations, particularly in stimulated Mandel'shtam-Brillouin scattering of electromagnetic waves in a plasma), then the picture of the packet scattering is entirely different. If, for example, $v_2 < v_3 < v_1$, then collision of the "large" wave packets 1 and 3 can be accompanied by a complete decay (accurate to exponentially small terms) of the pump, as is indeed the case when the following condition is satisfied:

$$\frac{\max|u_3|^2}{\max|u_1|^2} > \frac{v_1 - v_2}{v_3 - v_2}. \qquad (9)$$

The produced wave packet 2 has in this case a spectral width $\Delta k \sim q[(v_1 - v_3)/(v_1 - v_2)]^{1/2} \cdot [(\max |u_1|)/(v_3 - v_2)]$. We emphasize that the condition (9), which, however, is valid only for sufficiently smooth packets) does not contain the characteristic dimensions of the packets or the "interaction constant" q. We note also that the energy transfer takes place (in collision of "large" packets) only in the indicated situation, i.e., when there are present in the "input channel" a pump wave and a secondary wave whose velocity is not extremal (wave 3 in our example). In collisions of the "large" packets 1 and 2 or 2 and 3, on the other hand, there is no redistribution of the energy.

We note in conclusion that the system (2), like other systems that are integrable by the inverse-problem method, has an infinite set of integrals of motion, which are simply connected with the scattering matrix of the operator L (6).

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INTERFERENCE EFFECTS IN COLLISION OF MAGNESIUM IONS WITH RUBIDIUM AND CESIUM ATOMS

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Submitted 30 July 1973
ZhETF Pis. Red. 18, No. 7, 417 – 420 (5 October 1973)

Experiments on inelastic collisions between rare-earth ions and alkali-metal atoms were performed for the first time in our laboratory. We report here the results on the excitation of certain spectral transitions that occur when magnesium ions collide with rubidium and cesium atoms. The experimental setup and procedure are described in [1].

For each pair of colliding particles, we investigated two inelastic channels:

$$\mathrm{Mg}^+ + \mathrm{Rb} \begin{array}{l} \nearrow \mathrm{Mg}^+ + \mathrm{Rb}^*(5^2P_{3/2}) + 1{,}59\ \mathrm{eV} \\ \searrow \mathrm{Mg}^*(4\,^3S_1) + \mathrm{Rb}^+ + 1{,}64\ \mathrm{eV} \end{array}, \qquad (1)$$

$$\mathrm{Mg}^+ + \mathrm{Cs} \begin{array}{l} \nearrow \mathrm{Mg}^+ + \mathrm{Cs}^*(6\,^2P_{3/2}) + 1{,}46\ \mathrm{eV} \\ \searrow \mathrm{Mg}^*(4\,^3S_1) + \mathrm{Cs}^+ + 1{,}36\ \mathrm{eV} \end{array} \qquad (2)$$

in the incident-ion energy range from 4 to 1000 eV. Figures 1a and 2a show plots of the effective cross sections for the excitation of the investigated transition against the reciprocal

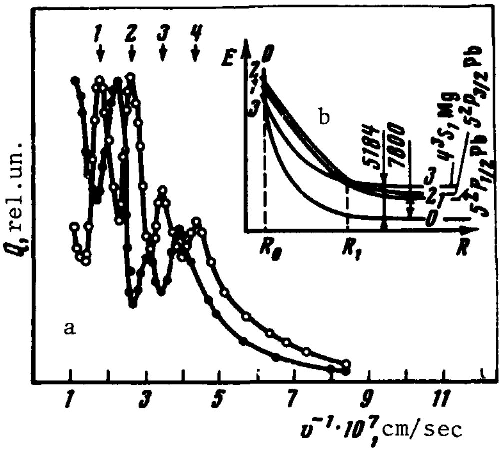

Fig. 1. a) Relative cross sections for the excitation of the λ = 5184 Å Mg line (light circles) and λ = 7800 Å Rb line (dark circles) plotted against 1/v. b) Term scheme of the quasimolecule (Mg^+Rb).

relative velocity of the interacting partners.

As seen from the figures, the total cross sections for the excitation of the investigated levels oscillate, and the maxima on the curves are arranged in a definite order. Thus, for the Mg^+ + Rb pair (Fig. 1a) the extrema (maxima and minima) for both transitions 4^3S_1 - 3^3P_1 of the Mg atom (λ = 5184 Å) and $5^2P_{3/1}$ - $5^2S_{1/2}$ of Rb (λ = 7800 Å) are equidistant with a period $\Delta v^{-1} = 8.5\times10^{-8}$ sec/cm and are in counterphase. Attention is called to the large amplitude of the oscillations and the accuracy with which the maxima and minima are in counterphase on the total excitation cross sections of the interfering levels.

Even more interesting is the behavior of the level excitation cross sections for the other pair, Mg^+ + Cs. The excitation function of the very same transition 4^3S_1 - 3^3P_i, with charge transfer from the magnesium atom, undergoes two types of oscillations with periods $\Delta v_1^{-1} = 1.8\times10^{-8}$ and $\Delta v_2^{-1} = 21.4\times10^{-8}$ sec/cm. Further, the minima on the excitation functions of the $6^2P_{3/1}$ - $6^2S_{1/2}$ transition of Cs (λ = 8521 Å) are in counterphase with the maxima of the first period (Fig. 2a) on the excitation cross section of the 4^3S_1 level of magnesium. To our knowledge, no one has previously observed two regular periods of the oscillations of the total level excitation cross sections in ion-atom collisions.

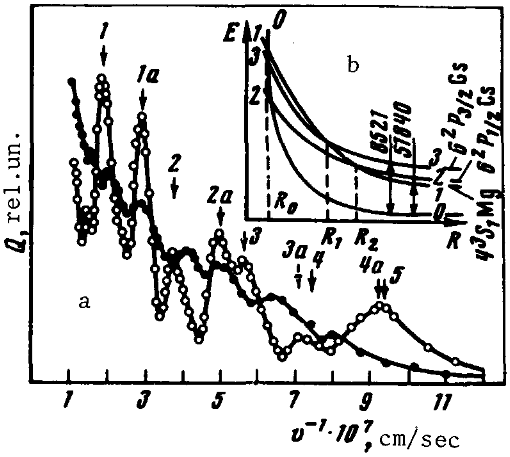

Fig.2.a) Relative cross sections for the excitation of the λ = 5184 Å Mg line (light circles) and the λ = 8521 Å Cs line (dark circles) against 1/v. b) Term scheme of the quasimolecule (Mg^+Cs).

Let us examine the results in greater detail. The character of the obtained energy dependences of the total excitation cross sections allows us to propose the following mechanism of interaction between the colliding partners, based on the notion of interference between the terms of the interacting particles (see Figs. 1b and 2b) [2]. The term 0 of the ground state of the Mg^+ + Rb pair crosses in succession three vacant excited terms 1, 2, and 3 when the particles come closer together in the vicinity of the internuclear distance R ; these terms correspond to the excited 4^3S_1 level of Mg and $5^2P_{3/2,\ 1/2}$ levels of rubidium, respectively. Since the distance between the resonant rubidium levels $5^2P_{1/2}$ and $5^2P_{3/2}$ is only 0.03 eV, we can assume that the terms corresponding to them are very close to each other (parallel) and cross the term 3 in the vicinity of R_1 (Fig. 1b). The interference reaction occurring when the particles move apart leads therefore to regular oscillations of the total excitation cross sections of the investigated inelastic channels. From the law of conservation of the total probability of population of the levels of the quasimolecule (Mg^+Rb) it follows that the energy dependence of the cross section for the excitation of the second inelastic channel (excitation of the resonant λ = 7800 Å line of the rubidium atom) should be in counterphase. This is indeed confirmed by our experiment. Knowing the equidistance period Δv^{-1} and the energy difference ΔE between the two competing terms at the point of their intersection with the ground term, we can determine the distance $\Delta R = R_1 - R_0$ (Fig. 1b) over which the excited terms interfere, using the formula [3]

$$\Delta E \Delta R = \frac{2\pi h}{\Delta v^{-1}} \cdot \qquad (3)$$

Since the experimental thresholds were determined by us with high accuracy, we can determine from them ΔE, which for the $Mg^+ + Rb$ pair is equal to 0.4 eV, and we obtain $\Delta R = 24$ a. u.

For the $Mg^+ + Cs$ pair, the 4^3S_1 level of Mg lies below the resonant levels $6^2P_{1/2}$ and $6^2P_{3/2}$ of the cesium atom1), the distance between which is 0.07 eV. In this case, the potential curve crosses in succession the curves 3 and 2 as the particles move apart; the intersection points R_1 and R_2 are quite far from each other (Fig. 2b). This gives rise to two periods in the total excitation cross section of the 4^3S_1 level of Mg, and therefore, in contrast to the $Mg^+ + Rb$ pair, the interaction between the terms corresponding to the excited $6^2P_{1/2}$ and $6^2P_{3/2}$ levels of Cs and the 4^3S_1 level of Mg must be considered independently. Then, in accord with the law of conservation of the probabilities of excited-state population, an exact counterphase relation should be observed also for the excitation function of the $\lambda = 8943$ Å line of Cs, the initial level $6^2P_{1/2}$ of which is only 0.031 eV removed from the interfering 4^3S_1 level of the magnesium atom, and it is natural to assume a stronger interaction between these levels.

Calculation by formula (3) of the crossing (pseudocrossing) distances of the potential curves for the $Mg^+ + Cs$ pair yields $\Delta R_1 = 10.4$ a.u. and $\Delta R_2 = 8.4$ a.u. (at $\Delta E = 0.5$ eV).

Thus, the two oscillation periods, which we were the first to observe, are a direct experimental confirmation of the theoretical conclusions made in [3], that several oscillation modes can appear in the total level-excitation cross sections in ion-atom collisions due to interaction of several inelastic channels.

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1)The transition from the $6^2P_{1/2}$ level of Cs ($\lambda = 8943$ Å) which lies closer to the 4^3S_1 level of Mg, could not be measured because of the lack of sensitive receivers for this region of the spectrum.

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EXPERIMENTAL OBSERVATION OF CONFIGURATION EMF's

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Submitted 30 July 1973
ZhETF Pis. Red. 18, No. 7, 421 – 424 (5 October 1973)

We have investigated the nonlinear properties of single-crystal Bi and n-GaAs films, governed by the sample configuration. The observed nonlinearity is attributed to the existence of an intrinsic Hall effect (in the Bi films) and to an effect similar to the Bernoulli effect in an incompressible liquid (in the GaAs films).

When current flows through a conductor of variable cross section, one can expect to observe in it an emf due to the change in the current density along it. The appearance of this emf is usually ascribed to an effect analogous to the Bernoulli effect in an incompressible liquid [1 - 4], or to the Hall effect in the current's own magnetic field (the intrinsic Hall effect) [5]. There are, however, no reliable reports of actual observation of these effects. Thus, the experiments of Ivashenko [1] were subsequently refuted by Dorfman and Kagan [2], who have shown that what Ivashenko actually observed was the thermal emf produced in the experiments. Chester [3], in experiments on bismuth films, obtained a "Bernoulli emf" larger by about four orders of magnitude than the expected value, apparently also because of the produced thermal emf. There is no methodological assurance that in the experiments of Jaggi [5], which were aimed at observing the intrinsic Hall-effect emf, it was possible to prevent the occurrence of a thermal emf (low frequencies, 30 – 60 Hz, a strong dependence of the effect on the sample temperature, impossibility of comparing the Hall coefficient calculated from the observed emf with direct measurement data). Thus, it cannot be assumed the configuration emf's have been observed experimentally.