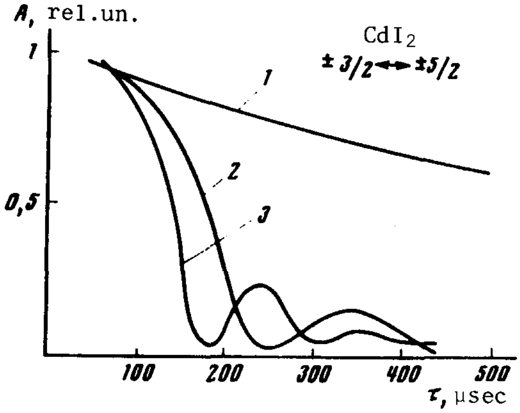

Effect of pulsed magnetic field on the NQR spin-echo envelope: 1 — H_{const} = 3 Oe, 6 Oe; 2 — H_{pulse} = 3 Oe, 3 - H_{pulse} = 6 Oe.

The investigations were performed with an IS-2 NQR spectrometer at liquid-nitrogen temperature. The SEE was registered with a "boxcar" integrator and a special program unit. The magnetic field was produced with Helmholtz coils and pulsed power supply.

The figure shows, with CdI_2 ($I = 5/2$, $\eta = 0$) as an example, the effect of a pulsed magnetic field on the SEE.

If beats due to interference effects are observed in the SEE, then the SEE is additionally modulated in a pulsed magnetic field by the Fourier transform of the function $h_H(\nu)$. This phenomenon was observed by us on the transitions ±1/2 — ±3/2 in CdI_2 and in the transitions ±1/2 - 3/2 and ±3/2 - ±5/2 in $(CO)_{10}Re_2$ ($\eta = 0.88$).

The phenomenon of SEE beats in a pulsed magnetic field is to some extent the dual of the phenomenon of SEE beats of EPR in a pulsed electric field, and is closely connected with the technique of double NQR-NQR resonance [8].

The observed phenomenon will undoubtedly stimulate further studies of the influence of external factors on NQR spectra, and further development of the techniques of double NQR-NQR resonance.

[1] A. A. Boguslavskii and G. K. Semin, Fiz. Tverd. Tela 11, 3617 (1969) [Sov. Phys.-Solid State 11, 3034 (1970)].
[2] A. A. Boguslavskii, Abstract of Candidate's Dissertation, M., 1973.
[3] M. Bloom, E. L. Hahn and R. Herzog, Phys. Rev. 97, 1699 (1955).
[4] M. Bloom and R. E. Norberg, Phys. Rev. 93, 638 (1954).
[5] N. E. Ainbender, V. S. Grechishkin, A. D. Gordeev, and N. I. Osipenko, Fiz. Tverd. Tela 10, 2026 (1968) [Sov. Phys.-Solid State 10, 1592 (1969)].
[6] M. I. Podgoretskii and O. A. Khrustalev, Usp. Fiz. Nauk 81, 217 (1963) [Sov. Phys.-Usp. 6, 682 (1964)].
[7] W. B. Mims, Phys. Rev. 133, 835 (1964).
[8] M. Emshwiller, E. L. Hohn, and D. Kaplan, Phys. Rev. 118, 414 (1960).

FEATURES OF EXCITATION OF AUTOIONIZATION STATES OF Ne ATOMS IN SLOW COLLISIONS WITH Na^+ IONS

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Submitted 17 September 1973
ZhETF Pis. Red. 18, No. 9, 547 — 549 (5 November 1973)

The excitation of discrete groups of fast electrons by collision of Na^+ ions with Ne atoms has been investigated at the relative-motion energies W from 80 to 320 eV. Resonant excitation of the autoionization states of neon has been observed at W near 150 eV.

Principal attention in investigations of the energy distributions of electrons released in atomic collisions has been focused on the identification of the discrete electron groups. The conditions for the excitation of the auto-ionization states with which the appearance of such groups is connected have been little investigated. In particular, the excitation functions of the indicated groups in slow ion-atom collisions, insofar as we know, have been directly investigated only in [1, 2].

A systematic investigation of the integral energy distributions of electrons released in collisions of alkali-metal ions (Na^+, K^+, Rb^+, and Cs^+) with atoms of all inert gases [3] has shown that the conditions for the excitation of discrete groups depend strongly on the partner combination, and cases can be separated in which their excitation is very strongly pronounced (e.g., for the Na^+-Ne pair), when the partners have electron shells of identical structure.

We have investigated the differential energy distribution of the electrons for the pair Na^+-Ne at relative-motion energies W from 80 to 320 eV. The investigation was made with an electrostatic analyzer using a procedure similar to that described by us earlier [1, 4]. We investigated electrons emitted at an angle 90 ± 10° to the Na^+-ion beam direction. The electrons were registered with an open electron multiplier operating in the single-electron counting regime.

The excitation threshold of the discrete electron groups observed experimentally at the sensitivity of our measurement system is W ≃ 107 eV[1]. At larger energies (but still close to the threshold), one observes in practice in the energy distribution only one group of electrons, corresponding to the auto-ionization state $2s2p^6(^2S)3s(^3S)$ of the Ne atom. With increasing W, the spectrum becomes more complicated. Fig. 1 shows the differential distribution of the investigated electrons at W = 294 eV. Contributing to the discrete group of electrons with energies from 22 to 28 eV is the excitation of a series of closely-lying auto-ionization states of Ne:

$$2s\,2p^6(^2S)\,np\,(^{1,3}P)$$
$$2s\,2p^6(^2S)\,ns\,(^{1,3}S)$$
$$2p^4(^3P)\,3s\,(^2P)\,np\,(^1P)$$
$$2p^4(^3P)\,3p(^4D)\,np\,(^3\ \ )\quad [6].$$

Figure 2 shows the excitation function of the first discrete group connected with the auto-ionization state $2s2p^6(^2S)3s(^3S)$.

Attention is called to the following essential features of this excitation function.

1. The excitation threshold for the discrete groups observed by us (near W ∿ 100 eV) lies in the region close to the energy thresholds for the excitation of spectral lines in the ultraviolet and visible regions of the spectrum as observed for the Na^+-Ne pair in [7, 8]. (It must be borne in mind here that the excitation potentials of the indicated spectral lines are much smaller (by more than a factor of two) than the excitation potential of the indicated discrete groups.)

2. The most intensive excitation of the considered group occurs in resonant fashion in a relatively narrow interval of W.

3. The excitation function has a form that differs noticeably from that observed for another (Ar, Ar) case in [2], which could be approximated with the aid of the formulas of the Landau-Zener theory [9].

We can conclude from the foregoing that the interaction of the ions with the atoms has a complicated character even at relatively low energies of relative motion. One can expect further investigations of the excitation functions of the discrete groups of electrons and a comparison with data obtained by analyzing the inelastic energy losses [10] to reveal which of the distinguishing features of the terms of a quasimolecule made up of the colliding particles are responsible for the observed anomalies.

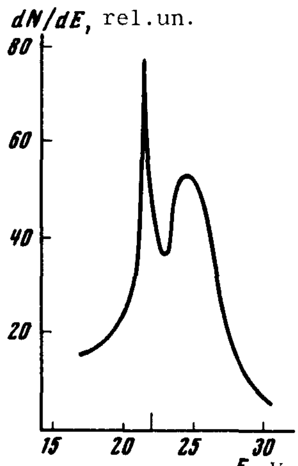

Fig. 1

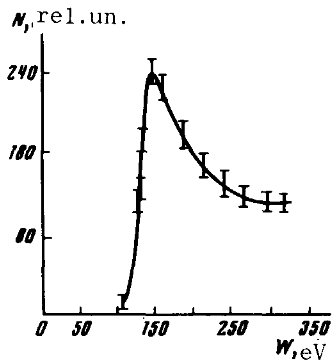

Fig. 2

Fig. 1. Differential energy spectrum of electrons released when Ha^+ ions collide with Ne atoms. W = 294 eV.

Fig. 2. Excitation function of auto-ionization state $2s2p^6(^2S)3s(^3S)$ of the Ne atom. N is the yield of the electrons connected with the decay of the auto-ionization state.

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1)At energies W not exceeding 107 eV, only slow electrons were emitted, and their energy distribution was in agreement with the Demkov-Komarov theory [5].

[1] Yu. F. Bydin, ZhETF Pis. Red. 6, 857 (1967) [JETP Lett. 6, 297 (1967)].
[2] G. Gerber, R. Morgenstern, A. Niehaus, and M. W. Ruf, Abstracts VI ICPEAC (Amsterdam, 1971), p. 610.
[3] Yu. F. Bydin and V. I. Ogurtsov, Abstracts of the 5-th All-Union Conference on the Physics of Electronic and Atomic Collisions, Uzhgorod, 1972 (in Russian), p. 123.
[4] V. I. Ogurtsov and Yu. F. Bydin, ZhETF Pis. Red. 10, 134 (1969) [JETP Lett. 10, 85 (1969)].
[5] Yu. N. Demkov and I. V. Komarov, Zh. Eksp. Teor. Fiz. 50, 286 (1966) [Sov. Phys.-JETP 23, 189 (1966)].
[6] A. K. Edwards and M. E. Rudd, Abstracts V ICPEAC (Leningrad, 1967), p. 134.
[7] S. V. Bobashev, ZhETF Pis. Red. 11, 389 (1970) [JETP Lett. 11, 260 (1970)].
[8] N. H. Tolk, C. W. White, S. H. Dworetsky, and D. L. Simms, Abstracts VII ICPEAC (Amsterdam, 1971), p. 584.
[9] L. D. Landau and E. M. Lifshitz, Kvantovaya mekhanika (Quantum Mechanics), Fizmatgiz, 1963 [Pergamon, 1965].
[10] V. V. Afrosimov, Yu. S. Gordeev, V. M. Lavrov, and V. K. Nikulin, Abstracts VII ICPEAC (Amsterdam, 1971), p. 143.

COEXISTENCE OF FERRO- AND ANTIFERROMAGNETIC ORDER IN INVAR IRON-NICKEL ALLOYS

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ZhETF Pis. Red. 18, No. 9, 550 – 554 (5 November 1973)

A neutron-diffraction method was used to investigate the magnetic structure of the disordered alloy $Fe_{0.63}Ni_{0.37}$. It is shown for the first time that an antiferromagnetic order of the (½ ½ 0) type is produced at liquid-helium temperature on top of the usual ferromagnetic order. The Neel point T_N determined by measuring the temperature dependence of the peak intensity of the antiferromagnetic reflection was found to equal 15°K. The measurements results are interpreted within the framework of the noncollinear magnetic structure.

To explain the properties of invars, Kondorskii [1] advanced the hypothesis that in ferromagnetic Fe-Ni alloys with FCC crystal lattice the exchange integrals satisfy the relation

$$I_{11} > 0; \quad I_{12} > 0; \quad I_{22} < 0, \tag{1}$$

where the subscripts 1 and 2 stand for the nickel and iron atoms, respectively. This hypothesis was confirmed experimentally in [2].

A canted-magnetic-structure model proposed in [3] for binary disordered alloys in which the exchange integrals satisfy the condition (1) has made it possible to explain the anomalous concentration dependences of the average magnetic moment per alloy atom in Fe-Ni alloys at 0°K [4], of the Curie temperature [5], and of the small-angle neutron scattering [6], and also the temperature dependneces of the magnetization and of the coefficient of linear expansion [5].

This model suggests that ferromagnetic and antiferromagnetic long-range order can coexist in invar alloys at low temperatures (since I_{22} is appreciably smaller than I_{11} and I_{12}), so that the mean values of the projection of the magnetic moment on the direction of the spontaneous magnetization form a ferromagnetic structure, while the projections of the magnetic moment on the perpendicular direction form an antiferromagnetic structure.

The presence of an antiferromagnetic transformation in Fe-Ni invar alloys is indirectly corroborated also by the data of [7].