The measurements have shown that the threshold of the second instability is anisotropic. For certain ferrites, the second threshold, just as the first, is accompanied by auto-modulation oscillations. These are observed particularly clearly in nickel ferrits (Fig. 2). The observed effects do not depend on the surface finish of the samples. With increasing sample diameter, the thresholds have a tendency to come closer together.

The region where the secondary thresholds are observed, and the independence of this region of the magnetization suggest that the observed effects are connected with excitation of the wave group (2). The auto-modulation can be attributed either to the inertial nonlinearity mechanism proposed by Monosov [4], or else possibly to a phenomenon well known in radio, wherein the energy becomes redistributed among parametrically coupled systems.

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MEASUREMENT OF THE DIFFERENTIAL ELASTIC SCATTERING AND IONIZATION CROSS SECTIONS OF ATOMIC SYSTEMS

V.B. Leonas and A.V. Sermyagin
Space Research Institute, USSR Academy of Sciences
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The differential scattering cross sections of atomic systems, as is well known, yield the most detailed information concerning the character of their interaction. In this paper, for the purpose of investigating the interactions at short distances (interaction-energy interval 1 - 100 eV), we determine the differential elastic scattering and ionization cross sections and the interaction potentials of the systems He-He, Ne-Ne, Ar-Ar, Kr-Kr, Xe-Xe, N_2-N_2.

The differential cross sections were obtained by measuring the angular distribution of I(α), the current of particles scattered in a movable detector inclined at different angles α to the beam axis, at different initial beam energies. In these measurements we used the method of setup described in detail in [1]. Besides the neutral particles, we observed particles with altered charge states in the scattered current, and therefore we registered in the measurements not only the neutral current $I^0(\alpha)$, but also the current $I^+(\alpha)$ produced by ion scattering. To eliminate the differences between the efficiencies with which the detector registered the ions and the neutrals, the first dynode of the electron multiplier was grounded.

In analogy with the determination of the current of particles scattered in the energy interval between θ and $\theta + d\theta$, we can write for the current intercepted by a detector subtending an angle range from $\theta_{min}(\alpha)$ to $\theta_{max}(\alpha)$ the following expression:

$$I(\alpha) = 2\pi n \ell I_0 \int_{\Delta\theta(\alpha)} f_\alpha(\theta)\sigma(\theta, E)\, d\cos\theta. \qquad (1)$$

Here I_0 is the initial intensity of the monoenergetic beam, n the density, and ℓ the target length. The function $f_\alpha(\theta)$ in (1) defines the registration efficiency, normalized to unity, for beam particles scattered through an angle θ at a given detector position α. A detailed description of the method used to calculate $f_\alpha(\theta)$ was reported by us in [2]. If $f_\alpha(\theta)$ is known, it is possible to invert expression (1), thus determining from the measured values of $I^0(\alpha)$ and $I^+(\alpha)$ the corresponding differential elastic-scattering cross section $\sigma^0(\theta, E)$ and ionization cross section $\sigma^+(\theta, E)$. This inversion was realized by us with the aid of a BESM-4 computer. Typical results of the inversion procedure are shown in Fig. 1 for the N_2-N_2 case.

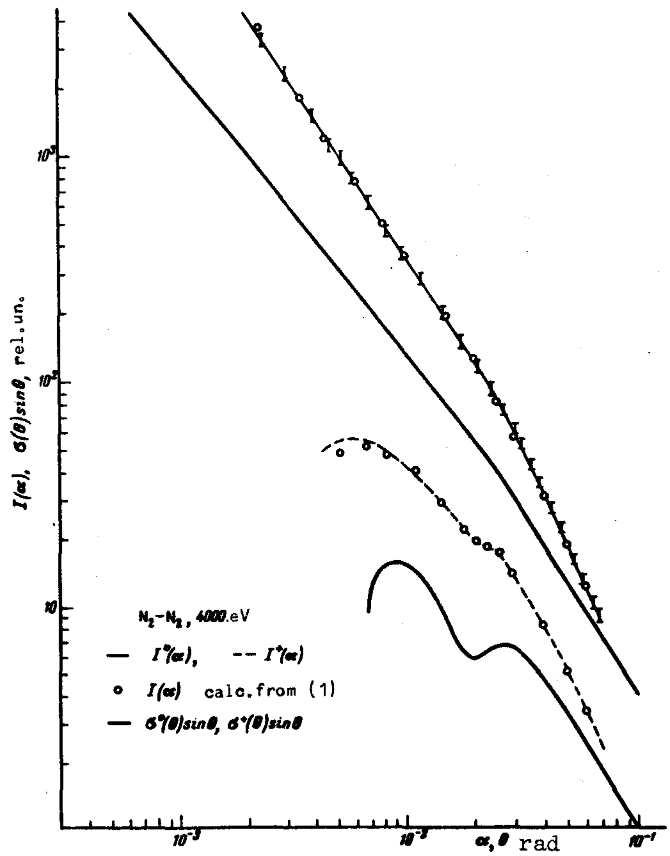

Fig. 1

To determine the interaction potential U(r), it is more correct to use the differential cross section determined from the quantity $I^0(\alpha) + I^+(\alpha)$ under the assumption that the deflection function θ(b) of particles of both types are identical. Calculation of U(r) was with the aid of a computer, using the method proposed by Firsov [3]. The obtained values can be approximated by the exponential dependence $U = \exp(-\alpha r)$; the parameters A and α, and the corresponding ranges of the investigated distances, obtained in the present work, are in good agreement with those determined earlier in [4].

System	A, eV	α, Å⁻¹	Δr, Å	b_n, Å	$\sigma_{01}(4000)$, Å²
He – He	542 212	7.05 4.30	0.20 – 0.35 0.35 – 1.60	0.51 —	0.28 —
Ne – Ne	4550 44000	4.51 6.20	0.60 – 1.35 1.35 – 1.80	1.19 —	3.60 —
Ar – Ar	2540	3.56	0.80 – 2.20	1.44	2.20
Kr – Kr	4800 668	3.49 2.60	1.00 – 2.25 2.20 – 3.00	1.65 —	— —
Xe – Xe	7150 1635	3.46 2.64	1.20 – 1.80 1.80 – 3.30	— —	— —
N_2 – N_2	4120 8200	3.37 3.72	0.80 – 2.00 2.00 – 2.80	1.66 —	2.56 —

The data in the table may be of interest in connection with investigations of the thresholds of optical excitation in ion-atom collisions [5]. In particular, the threshold energies of [5] can be set in correspondence with more quasi-intersection distances r_0 (for example, for K^+-Ar ($K^+ \equiv$ Ar) a more reliable value is $r_0 = 0.8$ Å, as against $r_0 = 1$ Å of [5]; accordingly, the cross section of the process should be decreases by a factor 1.5).

Of considerable interest are the differential cross sections for atom-atom ionization, obtained here for the first time. For the systems He-He and N_2-N_2, Fig. 2 shows the dependence of the probability of electron loss by the fast particle, P on the impact distance b (here $P = \sigma^+(\theta)/[\sigma^0(\theta) + \sigma^+(\theta)]$, and $\theta(b)$ was assumed to be the same for both types of particles). The next to last column of the table gives the threshold values of b_n marked by arrows in Fig. 2.

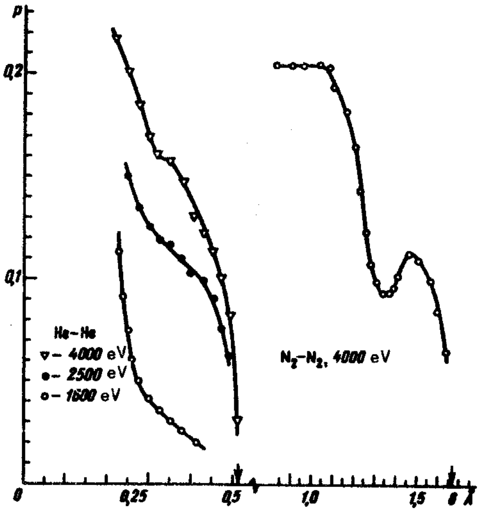

Fig. 2

The absolute values of P(b) depend on the velocity (Fig. 2); moreover, in the case of Xe-Xe in the investigated range of angles (albeit in the corresponding interaction energy 1 - 100 eV), it was impossible to register any ions. Assuming the values of $\theta(b)$ to be the same, the interaction energy at the ionization threshold $U(b_n)$ exhibits a distinct correlation with the ionization potential: $U(b_n) = E_u$. Attention is called to the presence of a structure on the P(b) curves. The N_2-N_2 system is the most remarkable in this respect; from the values of U(b) it is possible to assume that the second increase of P(b) is apparently connected with the opening of a channel for double ionization of fast particles. Using the measured values of $\sigma^+(\theta, E)$ it is possible to extrapolate the behavior of $\sigma^+(\theta)$, to estimate the ionization cross section σ_{0I}, which was measured earlier by a number of workers (for a bibliography, see [6]); a comparison of these values (at 4000 eV) with the data in the last column of the table reveals a reasonable agreement.

The $\sigma^+(\theta, E)$ and P(b) plots obtained in the present work make it possible to evaluate critically various theoretical approaches to the description of ionization process in atomic collisions and to choose the most suitable one.

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SRS IN RUBIDIUM VAPOR WITH FREQUENCY VARIATION NEAR RESONANCE

F.A. Korolev, S.A. Bakhramov, and V.I. Odintsov
Physics Department of the Moscow State University
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Although stimulated Raman scattering (SRS) has already been obtained by several workers in alkali-metal vapors [1 - 4], the dependence of its threshold