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A scientific session of the Division of General Physics and Astronomy of the USSR Academy of Sciences was held on June 23 and 24, 1971, in the Conference Hall of the P. N. Lebedev Physics Institute. The following papers were delivered:

1. A. Z. Dolginov, Physical Processes in Comets.
2. V. I. Moroz, The Atmosphere of Mars.
3. A. F. Aleksandrov and A. A. Rukhadze, Heavy-current Electric-discharge Light Sources.
4. V. N. Andreev, A. G. Aronov, and F. A. Chudnovskiĭ, The Phase Transformation in V_2O_3 in an Electric Field.

We publish below brief contents of some of the papers.

A. Z. Dolginov. Physical Processes in Comets.

Despite the long history of the study of comets, a number of fundamental aspects still remain unclear in the physics of cometary phenomena. One of the serious difficulties is the absence of direct data on the nature of the molecules vaporized from the surface of the comet nucleus, since all of the observed molecules C_2, CN, OH, etc., are products of chemical reactions and dissociation processes in the vicinity of the nucleus. Nevertheless, an attempt can be made to determine the conditions at the boundary of this region from observations of the more remote regions of the coma. To this end, we solved the kinetic equation describing the spatial and velocity distributions of the particles that are emitted by the region around the nucleus and move under the pressure of sunlight. It was taken into account that a region of frequent collisions exists near the nucleus and that the hydrodynamic outflow regime is supplanted at a certain distance by free molecular outflow. Various hypotheses as to the distribution of particle velocities at the boundary of the frequent-collision region were examined, and the finite lifetime of the molecules with respect to dissociation and ionization processes was taken into account. Estimates of the physical parameters in the vicinity of the nucleus were arrived at from comparison of the resulting particle distribution with the observed distribution (see the table). It is seen from the table, in particular, that molecules moving toward the sun have shorter lifetimes than those moving away from the sun. This suggests a high optical thickness of the coma with respect to the radiation causing the decay of the molecules. The theoretical isophots of the coma were found to agree well with the observed ones. A comparison for the hydrogen atmosphere of Comet Bennett (with allowance for the charge exchange of solar-wind protons) made it possible to estimate the solar wind flux outside the plane of the ecliptic (heliocentric latitude 37.5° at a distance of 0.6 a.u.). It was found equal to 6×10^8 $\text{cm}^{-2}\text{-sec}^{-1}$. The theory had also predicted that pulling of individual isophots toward the sun was possible at the high hydrodynamic outflow velocity that may arise in dust-poor comets. This was indeed observed for Comets Encke and Ikeya-Seki.

Conditions near the nucleus are such that many cometary gases, such as C_2, should be in a strongly supersaturated state and should condense into dust particles. An investigation of the condensation kinetics indicates that the dust particles reach dimensions of 10^{-5}–10^{-4} cm. Such particles are observed in the atmospheres of comets and in meteor streams. This makes it possible to explain the entire dust component of comets by condensation, without resorting to the hypothesis that the dust particles are already present in the nucleus in their final form.

When it is remembered that the surface of the nucleus may consist of two (or more) zones with widely differing heats of evaporation, it becomes possible to explain the appearance and grouping of synchrones in type II tails. If such a nucleus rotates, the quantity of matter evaporated is modulated with the period of the rotation. For example, this yielded a period of rotation of ~ 0.6 day for Comet 1910 I.

Cometary dust particles acquire a charge as a result of the photoeffect and collisions with electrons and protons. This results in formation of a plasma in which the dust particles act as heavy ions. The propagation velocity of perturbations, e.g., Alfven waves, in a dust plasma differs from the velocity of the waves in an electron-proton plasma.

The orientation of the dust particles must be taken into consideration in analyzing data on the scattering and polarization of light in dust tails. Orientation under the action of the directional luminous flux from the sun is possible. It is especially effective if the dust particles have optical activity and the probabilities of absorption of right-hand and left-hand quanta are different. However, it is evident that orientation under the influence of solar-wind-proton impacts is most effective.

Values of the parameters characterizing the region near the nucleus and the corresponding theoretical isophots

Comet	v, cm/sec	T, °K	b, cm/sec²	τ, sec⁻¹
1955 g, 0.93 a.u., C_2	10^5	$1.7 \cdot 10^3$	0.395	$1.35 \cdot 10^5$
1956 h, 0.64 a.u., C_2	$9.6 \cdot 10^4$	$1.6 \cdot 10^3$	0.844	$\tau_0 = 3 \cdot 10^6$ $\tau_1 = 3.4 \cdot 10^5$
1959 k, 1.055 a.u., C_2	$8.1 \cdot 10^4$	$1.1 \cdot 10^3$	0.308	$1.48 \cdot 10^5$
1951 I, 1.2 a.u., CN	$1.2 \cdot 10^5$	$2.5 \cdot 10^3$	0.365	$2 \cdot 10^5$
1956 h, 0.64 a.u., CN	$1.36 \cdot 10^5$	$3.15 \cdot 10^3$	1.28	$\tau_0' = 1.8 \cdot 10^5$ $\tau_1' = 1.26 \cdot 10^5$

An oriented dust medium is anisotropic and, in many cases, gyrotropic. There are many common features in the scattering of light (see, for example, Astrophys. J. **160**, L101 (1970)) by cometary dust particles and by dust particles of the interstellar medium and those of nebulae. The cometary dust medium might be a convenient model for study of the galactic dust. For example, interest attaches to observations of stars (and especially of the polarization of their radiation) through the densest parts of the coma.

The materials of the paper are being published in the collected transactions of the 45th IAU Symposium (Leningrad, 1970). Earlier papers by the author were also used: Astron. Zh. **44**, 434 (1967) [Sov. Astron.-AJ **11**, 345 (1967)]; Dokl. Akad. Nauk SSSR **179**, 1070 (1968) [Sov. Phys.-Doklady **13**, 281 (1968)]; Transactions of the 39th IAU Symposium (Crimea, 1969); Transactions of the Sixth Winter School on Space Physics (Apatity, 1969), as were papers written jointly with Yu. N. Gnedin and G. G. Novikov: Planet. and Space Sci. **19**, 143 (1971); Astron. Zh. **47**, 870 (1970); **43**, 181 (1966) [Sov. Astron.-AJ **14**, 700 (1971); **10**, 143 (1966)]; Icarus **5**, 64 (1966).

A. F. Aleksandrov and A. A. Rukhadze. Heavy-current Electric-discharge Light Sources.

With the increasing demand witnessed in recent years for high-powered ultraviolet sources for laser pumping, interest has grown in the heavy-current self-compressed discharges (the pinch effect)[6]. Investigations of such discharges with the purpose of obtaining controlled thermonuclear fusion have shown that owing to the development of force instabilities such as constrictions and bends, such discharges break down during a time $\tau_c \approx R/v_s$, where v_s is the speed of sound and R is the radius of curvature of the discharge surface. Under thermonuclear conditions, τ_c is no more than a few microseconds, while in radiating discharges with a heavy-element plasma temperature $T_0 \approx 2$–5 eV and a density $N \approx 10^{18}$–10^{20} cm^{-3}, we have $\tau_c \approx R/v_s = 30$–$100$ μsec, which is of the same order or even greater than the time necessary to pump lasers. The basic requirements made of the radiating discharges—near-black-body plasma radiation, uniformity of temperature, and optimum efficiency of transformation of the energy invested in the discharge into radiant energy—place limits on the total discharge current[1]:

$$I_{\min} \leqslant I_n \leqslant I_{\max}. \qquad (1)$$

For the z pinch in a plasma with multiply ionized atoms (silver, tungsten, lead, aluminum, etc.), $I_{\min} \approx 10^5$ A and $I_{\max} \approx 4.3 \times 10^5$ A. At currents $I_n < I_{\min}$, the discharge becomes optically transparent and subject to a dangerous and rapidly developing ($\tau_n < \tau_c$) overheating instability, and when $I_n > I_{\max}$, the radiator's efficiency drops off sharply as a result of plasma-temperature nonuniformity. Experiments with electrical explosion of short metallic wires in a vacuum, carried out on appar-