Scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the Academy of Sciences of the USSR (28–29 November 1984)

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A joint scientific session of the Division of General Physics and Astronomy and the Division of Nuclear Physics of the USSR Academy of Sciences was held on November 28 and 29, 1984 at the P. N. Lebedev Physics Institute of the USSR Academy of Sciences. The following reports were heard at the session:

November 28

1. *É. R. Mustel', V. E. Chertoprud, and N. B. Mulyukova*. Energy sources for atmospheric cyclones.
2. *E. I. Golovenchits, V. A. Sanina, and G. A. Smolenskiĭ*. Electric-dipolar glass in crystals with Jahn-Teller ions.

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3. *I. K. Kamilov*. Magnetic critical phenomena.
4. *Z. D. Kvon, I. G. Neizvestnyĭ, and V. N. Ovsyuk*. Effect of a surface superlattice on a two-dimensional electron gas.
5. *I. A. Shcherbakov*. Energy transfer in solids, new active media for solid-state lasers.

The brief contents of all reports are published below.

É. R. Mustel', V. E. Chertoprud, and N. B. Mulyukova. *Energy sources for atmospheric cyclones.* This report consists of two parts. The results of a statistical analysis of a 100-year series of daily data on the atmospheric pressure field near the surface in the earth's northern hemisphere and on the indices of solar and magnetic activity are presented in Part 1.[1–7] It is established that on the second-fourth day after the earth enters the solar corpuscular stream (SCS) the variance of the diurnal pressure differences at moderate latitudes in the northern hemisphere increases, i.e., the instability of the troposphere increases. It is shown that this effect persists for all geomagnetic disturbances (characterizing the moment the earth enters the SCS), epochs of observations, seasons, and phases of the 11-year cycle of solar activity. It is found that during the winter the region of maximum growth of the instability of the troposphere after the earth enters the SCS is located above the northern Atlantic, where the most intense thermal and cold flows encounter one another (one possible explanation for the increase in instability is proposed in Ref. 8). A statistical analysis revealed large-scale variations in the atmospheric pressure field near the surface after the earth enters the SCS. The pattern of wave-like alternation of the extended regions with positive and negative difference $\Delta\bar{p}$ can be followed on the isallobar charts.

In the second part of the report É. R. Mustel's hypothesis on the mechanism of corpuscular-tropospheric links is presented.[9,10] Attention is called to the results of Brazilian researchers, who concluded that in the region of the southern magnetic anomaly, high-energy particles are "dumped" during geomagnetic storms from the earth's radiation belt "downwards" toward the stratosphere. Assuming that analogous processes occur in the earth's nothern hemisphere, it is shown based on the Brazilian data that the total energy flux contained in the indicated "dumpings" can reach 10^{24} ergs.[10]

It is pointed out that four low-pressure regions on the isallobaric charts Δp (Icelandic, East-Siberian, North-American, and Aleutian regions) coincide with the two main magnetic anomalies and two regions of elevated magnetic fields. It is concluded that the above-described "dumpings" of high-energy particles play the main role precisely in the regions of magnetic anomalies.

[1] V. E. Chertoprud, É. R. Mustel', and N. B. Mulyukova, Astron. Zh. **56**, 106 (1979) [Sov. Astron. **23**, 60 (1979)].
[2] É. R. Mustel', V. E. Chertoprud, and N. B. Mulyukova, Astron. Zh., **56**, 876 (1979) [Sov. Astron. **23**, 493 (1979)].
[3] V. N. Chertoprud, É. R. Mustel', and N. B. Mulyukova, Astron. Zh. **57**, 138 (1980) [Sov. Astron. **24**, 82 (1980)].
[4] É. R. Mustel', V. E. Chertoprud, and N. B. Mulyukova in: Sun and Climate, Intern. Conference, Toulouse (1980), p. 151.
[5] V. E. Chertoprud, N. B. Mulyukova, and É. R. Mustel', Astron. Zh. **58**, 1063 (1981) [Sov. Astron. **25**, 605 (1981)].
[6] É. R. Mustel', N. B. Mulyukova, and V. E. Chertoprud, Astron. Zh. **59**, 750 (1982) [Sov. Astron. **26**, 457 (1982)].
[7] N. B. Mulyukova, É. R. Mustel', and V. E. Chertoprud, Astron. Zh. **60**, 1172 (1983) [Sov. Astron. **27**, 680 (1983)].
[8] V. E. Chertoprud, Astron. Zh. **59**, 1030 (1982) [Sov. Astron. **26**, 622 (1982)].
[9] M. N. Markov and É. R. Mustel', Astron. Zh. **60**, 417 (1983) [Sov. Astron. **27**, 243 (1983)].
[10] É. R. Mustel', Astron. Zh. **61**, 1179 (1984) [Sov. Astron. **28**, 689 (1984)].

E. I. Golovenchits, V. A. Sanina, and G. A. Smolenskiĭ. *Electric-dipolar glass in crystals with Jahn-Teller ions.* Rare-earth ions in crystals have, as a rule, low-lying excited states, whose population can change substantially when the temperature of the crystal is changed. In the case of crystals containing Jahn-Teller rare-earth ions, whose local environment in the lattice becomes distorted as the electronic state of the ions changes, it may be expected that the dielectric properties of the crystal will change when the excited states of the ions are populated as the temperature is increased. In this respect, compounds with Eu^{3+} ions are especially interesting. The ground state of Eu^{3+} ions is nondegenerate ($^7F_0$) and the lowest excited state ($^7F_1$) is degenerate (Jahn-Teller). The magnitude of the splitting of the single-ion $^7F_0$–$^7F_1$ states is $\sim 300\ cm^{-1}$, so that the changes in the dielectric properties owing to the change in the population of the $^7F_1$

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