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Editorial

Editorial to the Special Issue "Solar Wind Structures and Phenomena: Origins, Properties, Geoeffectiveness, and Prediction"

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The heliosphere is filled with solar wind, which is formed due to the expansion of the plasma of hot solar corona. Solar wind has structures and phenomena with a wide range of scales, varying from large-scale structures and phenomena, associated with the non-stationarity and inhomogeneity of the solar corona, to small-scale structures and phenomena, associated with the development of local plasma processes. Solar wind is an open system with free energy transfer from the large to small scales. The study of solar wind structures and phenomena is the key to understanding solar, heliospheric, and solar-terrestrial physics [1–4]. The present Special Issue focuses on exploring certain aspects of these fundamental questions.

Three articles [5–7] report on studies in which models were developed that link the properties of large-scale solar wind to the conditions of the solar atmosphere. Berezin and Tlatov [5] developed an empirical model that relates the solar wind velocity near the Earth to the topology of the large-scale magnetic field in the photosphere. Shugay et al. [6] described the main principles involved in the development of the online, semi-empirical system known as the Space Monitoring Data Center (SMDC) of the Moscow State University, which forecasts arrival of ICMEs to Earth. Maiewski et al. [7] presented a model that permits the identification of the spatial distribution of the characteristics of the magnetic field and plasma over distances ranging from 20 to 1200 solar radii at almost all solar latitudes. This model takes into account the evolution of the Sun's magnetic field during the solar cycle, when the dominant dipole magnetic field is replaced by the quadrupole one.

In order to understand how the decrease in solar activity in solar cycles 23–24 affected the main drivers of magnetospheric disturbance, Yermolaev et al. [8] studied the average temporal profiles of the solar wind parameters and magnetospheric indices of the disturbed solar wind types CIR, Sheath, ejecta, and MC and found that the profiles remained similar in shape but noticeably decreased in magnitude. In another work, Yermolaev et al. [9] discussed the general effects of changes in the structure of the heliosphere and the decrease in the solar wind parameters on the solar wind/magnetosphere interaction. Rakhmanova et al. [10] investigated the transformation of a turbulent cascade behind a quasi-perpendicular bow shock in the magnetosheath depending on the type of large-scale phenomena of solar wind interacting with the Earth's magnetosphere. Li et al. [11] analyzed the dynamics of the solar wind that caused a complex, multistep, magnetic storm on 21–22 October 1999.

In the remaining three papers [12–14], the roles of solar wind helium ions (alpha particles) in shaping phenomena of different scales are studied. Khokhlachev et al. [12] compared the helium abundance N_α/N_p in large-scale ejecta and MC phenomena during epochs of high (21–22 SC) and low (23–24 SC) solar activity and showed that the helium abundance N_α/N_p not only dropped significantly in 23–24 SC, but its values became less dependent on the main parameters of the solar wind. N_α/N_p depends most strongly

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on the distance between the satellite and the center of the magnetic flux rope in the MC during epochs of strong solar activity. Lang et al. [13] investigated processes on the kinetic scale and showed that both anisotropic electrons and alpha beams lead to the excitation of several plasma waves, and the wave frequency, growth rate, and polarization properties are sensitive to the electron temperature anisotropy ($T_{e\perp}/T_{e\|}$), the parallel electron beta ($\beta_{e\|}$), and the alpha beam drift velocity (v_α/v_A). Sapunova et al. [14] compared the MHD parameters of helium ions (the bulk velocity V_α, temperature T_α, absolute density N_α, and helium abundance N_α/N_p) for 20 interplanetary shocks, with similar parameters for 25 Earth bow shock crossings. The following correlation was found to exist between the N_α/N_p and angle θ_{Bn}: the lower the value of θ_{Bn} is, the greater the reduction in the abundance of helium N_α/N_p behind the interplanetary shock front will be. For the Earth's bow shock crossings, a significant increase in N_α/N_p was found to occur in quasi-perpendicular events.

Conflicts of Interest: The authors declare no conflict of interest.

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