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Editorial
Special issue: Macroscopic randomness in astrophysical plasmas: The legacy and vision of Ya. B. Zeldovich

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This issue commemorates an outstanding scientist of the twentieth century, Yakov Borisovich Zeldovich, in connection with the centenary of his birth (8 March 1914), with a collection of reviews and research articles broadly related to large-scale random phenomena in astrophysical plasmas.

Zeldovich was active in this wide area of research, especially during the last years of his life. His interest resulted, in particular, in a vigorous activity of his group in dynamo theory. It is not a coincidence that his last book is entitled '*The Almighty Chance*' (Zeldovich et al. 1990). It completed a conceptual, generic picture of large- and small-scale structures in the spatial-temporal distribution of passive scalar and vector fields embedded into a random flow. These concepts had been developed in a specific application to astrophysical magnetic fields in an earlier seminal book (Zeldovich et al. 1983). The interest of Yakov Borisovich in random media and spontaneous formation of structures in them was deep and persistent. Applications to cosmology (Shandarin and Zeldovich 1989) and astrobiology (Zeldovich 1988) are notable in this respect. He did not spend equal amounts of his working time on all of these applications, but rather focused on astrophysical magnetic fields, where the mathematical elegance of broken mirror symmetry and the richness of physical applications provided special attraction. His approach to these problems was typical of him, being based, firstly, on penetrating physical and mathematical intuition, and then on rigorous mathematical justification of the key results (Zeldovich and Ruzmaikin 1980; Molchanov et al. 1984; Zeldovich et al. 1987, 1988). Two of the editors of the Special Issue (DS and ASh) have had an opportunity to appreciate the power of Zeldovich's practical aspiration 'to make complicated problems avoidable and the unavoidable problems uncomplicated' ('сделать нужное несложным, а сложное – ненужным'). This approach requires deep physical understanding of the subject and mathematical proficiency to formulate a mathematically solvable problem that captures the essence of the physical phenomenon at hand. This is related to another prominent feature of Zeldovich's approach to science: his work was invariably systematic, with the fundamental features of the system explored and

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FIGURE 1. Ya. B. Zeldovich at the international astronomical union (IAU) meeting in Prague in 1967. At this meeting, Zeldovich famously impressed the audience by demonstrating his stretch–twist–fold dynamo with his trousers' belt (or a shoe lace by other reports). (Photograph by Leo Goldberg, courtesy AIP Emilio Segre Visual Archives).

understood first, and more complicated models then built on this secure basis. This profoundly scientific approach is well illustrated by an important paper on the dynamo action in an irreducibly simple and yet conceptually realistic linear velocity field (Zeldovich et al. 1984). Another example, that has become a legend, is the stretch–twist–fold dynamo model (Fig. 1), which has deeply influenced our understanding of the dynamo action in random media and inspired innumerable papers revolving around this idea. As a result, the progress in the understanding of turbulent dynamo action achieved by Zeldovich's group in the 1980's was far ahead of their time. The importance of the small-scale (fluctuation) dynamo action and the contribution of the random helical magnetic fields to the saturation of mean-field dynamos, studied by his group in the 1980's, were not widely appreciated in the West until nearly twenty years later. Many of Zeldovich's ideas still await further development (e.g. Zeldovich 1983).

To reflect the scope of Zeldovich's interests and contributions to science, the topics covered in the Special Issue are broad and not necessarily connected directly with Zeldovich's specific work interpreted narrowly. An important aspect of many contributions is their focus on the growth points that are likely to frame the future research. Zeldovich was famous for his deep knowledge of an incredibly wide range

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of areas and his ability to cross-pollinate them. We hope that the Special Issue papers will help the reader to look into the future rather than into the past, and breach fruitfully the boundaries of narrow branches within mathematics, physics and astrophysics. The list of topics included is broad, reflecting the fundamental nature of plasma physics, and includes cosmological plasmas, structure formation in the Universe, magnetohydrodynamics of random flows and dynamo theory, and turbulence in collisional and collisionless plasmas among others.

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