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Turbulence and Self-Organization in the Universe

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High resolution images, obtained by the aid of modern telescopes, illustrate the existence of dynamically evolving chaotic structures in many areas of our Universe. Turbulent flow processes probably influenced major cosmic events already in the early Cosmos. Such processes can be observed for example in molecular and dust clouds in star forming regions, in the accretion disks around young stars, in the vicinity of supernova explosions, in the hot solar corona and in stellar winds or in the atmospheres of gas giants like planet Jupiter.

On the other hand, one finds very orderly appearing, more or less symmetrically structured celestial objects everywhere. In many galaxies concisely formed spirals structures have developed. Compact objects like protostars, white dwarfs, neutron stars or galactic nuclei are often surrounded in a systematic manner by characteristic dust and gas disks as well as by polar outflows, more or less strongly collimated jets of matter and energy. The orbits of planets in different solar-like star systems reveal a fundamental cosmic principle of order. How could our Universe manage the building of galaxies, stars and planets with their well-formed global structures by self-organization processes in a complex and turbulent medium?

Supported by clear illustrations, animations and real video recordings the basic principles of the self-organized formation of ordered structures, the "assembly" of our universe, due to nonlinear interaction processes in an initially turbulent medium will be made plausible in this presentation. Basic ideas of chaos theory and the physics of turbulence in magnetized plasma will be discussed. The key influencers in cosmic self-organization processes are presented, that finally have allowed as well the evolution of life on Earth.

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