COUPLING BETWEEN EXTERNAL AND INTERNAL SCALES IN THE POWER LAW TURBULENCE OF THE SOLAR ATMOSPHERE AND THE HELIOSPHERE

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We investigate limitations and approximations imposed by observations on theoretical spectra and structures of kinetic and MHD turbulence on the Sun and in the solar wind. Power law spectra are often used as useful empirical tools for theoretical descriptions of turbulence. We demonstrate, that applicability domains and accuracy of empirical distributions should be always indicated. Otherwise they can be the source of unjustified theoretical extrapolations and wrong observational expectations. For example, it occurs in the case of the coronal heating paradigm based on small scale energy releases as dominant heating processes. It is especially true for divergent energy integrals at small scales if the unrealistic ‘universal’ spectral index is larger than 2 in the energy space. Such spectra should be truncated. The turbulence in the solar corona and in the solar wind is not fully developed. It is not homogeneous in space. It can be strong, moderate or weak. It is intermittent in time and can vary from exceptionally quiet to strongly perturbed states. It is not isotropic. It can be sometimes arbitrary decomposed in many propagating waves and non-modal convective components. This decomposition is not unique as a rule and depends on the selected basis as well as on assumed ground states. The components are non-linearly superimposed and coupled both in MHD and kinetic regimes. As a result of all these circumstances, local power laws and exponents broadly differ from case to case depending on the situation. Theoretical interpretations of “direct” and “inverse” energy flows over the spectra can be misleading if no boundary conditions and ground states clearly specified. We show that the memory about imposed initial and boundary conditions plays the role in the formation of the slopes in these laws. When direct and inverse energy cascades coexist, their relative proportions determine the effective indexes in the slopes of power law spectra together with their effective external and internal scales. We discuss the lack of universality of turbulence structure in the solar corona and the solar wind. Our consideration has more general physical implications.