Useful and universal tools for the investigation of heliogeophysical plasma processes: dimensionless parameters and scaling

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Study of universal plasma processes in space around us is one of main aims of the scientific program of the International Heliophysical Year (IHY). Dimensionless parameters allow quantitative representation and characterization of the similarity and diversity degree. They are also useful for the overall qualitative evaluation of known physical situations for the better understanding what is important and what is not. They are needed for the correct physical problem position in the case of new phenomena and when more detailed theoretical approaches are hindered by complicity of obtaining the unique solutions and the experimental information is not sufficiently complete (ill posed problems).The talk presents the complete sets of dimensionless parameters met in fundamental kinetic and macroscopic approaches. Magneto-hydrodynamics (MHD) with dissipation and radiation generates well known parameters like Mach, Mach-Alfven, Strouhal and several other numbers. They play the important role in MHD descriptions and often used in literature, but others, like 'velocity-emission' ratios, Trieste and Faraday numbers are still not so common and remain poorly evaluated in the solar-terrestrial physics. We demonstrate several examples when these 'new' parameters respectively allow clear quantitative delimitation and classification of flare-like and CME-like events on the Sun, physically open and closed systems against the energy, momentum and mass transports in the case of quiescent and eruptive prominences, inductive and Coulomb dominated plasma regimes in electric and magnetic fields. Dimensionless analysis is really general and universal physical and mathematical approach which allows better understanding of processes. It can be not substituted by other methods in many instances. It is objective and free from personal biases. We strongly recommend its broader use during IHY.