

Multi-scale studies of the solar corona and wind

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The solar corona and its dynamic expansion, the solar wind, are turbulent media. They have been observed through spacecraft in situ measurements and remote sensing imagers for decades, yielding many constraints on the temperature, density, composition and turbulent properties of the sun's atmosphere. Yet, as most astrophysical plasmas, the solar atmosphere has a very high (magnetic) Reynolds number and resolving all the relevant scales through numerical models is extremely challenging (not to say impossible). In this talk, I will review typical problems that can be addressed through direct numerical simulations, mostly in the formalism of magneto-hydrodynamics. These problems are necessarily reduced, either only 1D or 2D, or focusing on small structures in the low coronal atmosphere. To model the entirety of the solar corona and wind, one must rely on subgrid models of the turbulent transport and heating. I will thus attempt to show how to build a minimal, yet relevant, turbulent transport model that can account for an increasing number of observables. Finally, I will discuss the prospects offered by new accelerated HPC architectures.