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Parametric decay of Alfvén wave in the solar wind acceleration

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Large amplitude Alfvén waves are commonly observed in the solar wind and it is widely believed that these magnetic waves may contribute to the solar wind heating and acceleration through turbulent dissipation and ponderomotive force. In-situ observations show that a nonlinear cascade of Alfvén waves, mainly propagating outward, is taking place, and that it evolves with heliocentric distance. In spite of the well defined observational signatures, the evolution of such Alfvénic turbulence in the solar wind is still a matter under debate.
Parametric decay of large amplitude Alfvén waves has been invoked as a possible driver of such evolution: the decay of an outward Alfvén wave into an inward one and, on the other hand, into a sound wave which naturally tends to steepen, provides the key ingredients for the onset of a turbulent cascade as well as for energy dissipation. In spite of many theoretical and numerical studies on the parametric decay instability, possible effects of the solar wind radial expansion have not yet been taken into account. However, the expansion of the underlying solar atmosphere is an indiscernible element to the extent that the observed decrease in overall rms energies is well accounted for by expansion effects.
We provide here a study on the onset and evolution of the parametric decay within the Accelerating Expanding Box model. This model takes into account the effects of the accelerating radial expansion of the solar wind, including the crossing of the critical Alfvén point, where wave amplitudes are expected to peak. The aim is to inspect if and in which manner the non-uniform radial expansion of the solar wind affects the growth and evolution of the instability itself and in which way it may affect the alfvénic spectrum at large heliocentric distances.