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Application of kinetic Alfven waves in solar corona heating

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Heating of the solar corona has been a fundamental astrophysical issue since the counter-intuitive high temperature corona above the much cooler photosphere was discovered more than seventy years ago. A number of studies have shown that MHD Alfven waves (AWs) generated by the photospheric turbulence can transport enough energy into the corona to heat it. However, there has been a key difficulty: how to convert the wave energy into the particles kinetic energy in the tenuous nearly collisionless corona where AWs propagate almost without damping.

Here I will describe a unified Alfvenic scenario for inhomogeneous heating of the magnetized solar atmosphere from the photosphere to the extended corona. In the almost neutral photosphere the heating is still dominated by the acoustic wave dissipation via the neutral atomic collisions. Above the photosphere, the Ohm dissipation of KAWs due to the classic Coulomb collision dominates the heating process in the partially ionized dense chromosphere. Higher up, in the fully ionized lower corona, the heating is dominated by the collisionless wave-particle interactions (mainly via Landau damping of KAWs). Finally, in the high corona and solar wind, the thermal equilibrium between plasma species is broken and they keep their own (different) thermal states influenced by KAWs. This KAW heating scenario can explain well complex spatial structures and temporal variations observed in solar imaging since the heating power by KAWs sensitively depends on local plasma parameters in the solar atmosphere.