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Quantum thermodynamics of coronal heating

Monday 14 November 2022 14:45 (15 minutes)

We show that convection cells in the stellar photosphere generate plasma waves by a process akin to sonic booms and Zeldovich superradiance. Our theoretical approach is based on the Markovian master equation for each mode of the quantum field corresponding to such waves. For the Sun, this mechanism is most efficient in quiet regions with small magnetic fields. Energy is mostly carried by Alfven waves with frequencies in the megahertz range. These waves scatter elastically until they reach a height at which they can dissipate via mode conversion. This gives the right power flux for coronal heating and can account for chromospheric evaporation, leading to impulsive heat transport in the corona. Our results may also help to clarify why quantum foundations are necessary to describe properly the statistical physics of irreversible process involving the interaction of macroscopic waves with thermal environments.

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