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Electron transport and magnetic turbulence in coronal loops: the need for a numerical evaluation of the Kolmogorov entropy of magnetic field lines in the percolation regime

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Mechanisms for coronal heating based on the dissipation of magnetic turbulence require a substantial level of magnetic fluctuations to be efficient. Recently it was shown that electron transport in coronal loops falls within the regime known as Rechester and Rosenbluth diffusion, and that studies of transport can be used to assess the turbulence level within loops. We briefly review the theoretial model leading to the Rechester and Rosenbluth regime, which involves the so called Kolmogorov entropy h of magnetic field lines, and the features of transport in the percolation regime. Due to the very alongated loop geometry, a numerical evaluation of the Kolmogorov entropy of magnetic field lines in the percolation regime is needed. Then we report the first numerical computation of h extending from the quasilinear up to the percolation regime, using a numerical code where one can change both the turbulence level $\delta B/B_0$ and the turbulence anisotropy $l_\|/l_\perp$. We find that the proposed percolation scaling of h is not reproduced, but rather a saturation of h is obtained. Also, we find that the Kolmogorov entropy depends only on the Kubo number $R = (\delta B/B_0)(l_\|/l_\perp)$, and not separately on $\delta B/B_0$ and $l_\|/l_\perp$. Computing the diffusion coefficient with the obtained values of h, and using TRACE observations, a substantial level of magnetic fluctuations is deduced to be present in coronal loops, of the order of $\delta B/B_0 = 0.2$ or more, which can give an important contribution to coronal heating.