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Non-thermal escape on magnetized planets in the TRAPPIST-1 system

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The TRAPPIST-1 system constists of at least seven Earth-like planets orbiting a red dwarf star. Little is known about the atmospheres of these planets, or whether they were even able to keep them during their lifetime. Since the stellar wind of M dwarf stars is strong enough to evaporate the atmospheres of close-in habitable zone planets, we found it essential to give an estimate on the non-thermal atmospheric escape loss rates on the TRAPPIST-1 planets. Magnetospheres are known to have important roles in these processes, such as providing an obstacle for the stellar wind, but they also permit escape through the polar regions. While some escape mechanisms, like sputtering and ion pickup can be significantly limited given a strong planetary magnetospere, polar wind outflow on the other hand can enhance the total escape rates. In order to account for the effects of magnetic fields, we estimated the magnetic dipole moments, surface magnetic field strength, magnetospheric standoff distances and polar cap areas on all seven planets. We used our calculated dipole moments as input parameters in our simulations to estimate the non-thermal escape loss rates.