Why an intrinsic magnetic field does not protect a planet against atmospheric escape

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The presence or absence of a magnetic field determines the nature of how a planet interacts with the solar wind and what paths are available for atmospheric escape.[1] Magnetospheres form both around magnetised planets, such as Earth, and unmagnetised planets, like Mars and Venus,[2] but it has been suggested that magnetised planets are better protected against atmospheric loss.[3] However, the observed mass escape rates from these three planets are similar,[4,5] putting the hypothesis into question. Modelling the effects a planetary magnetic field has on the major atmospheric escape processes, we show that the escape rate can be higher for magnetised planets over a wide range of magnetisations due to escape of ions through the polar caps and cusps.[6] Thus, contrary to what previously has been believed,[1,3,7] magnetisation is not a sufficient condition for protecting a planet from atmospheric loss. Estimates of the atmospheric escape rates from exoplanets[7] must therefore address all escape processes and their dependence on the planet's magnetisation.

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