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A common process for magnetic reconfigurations at Earth, Jupiter and Saturn.

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Repeatable magnetic reconfigurations (MRs) appear to be common to the magnetotails of the magnetised planets Mercury, Earth, Jupiter, Saturn, and Uranus. Close to the magnetotail current sheet, they can be identified by a unipolar or bipolar fluctuation of the magnetic field component parallel to the planetary magnetic dipole, which has been interpreted as a signature of magnetic reconnection that changes the magnetic topology and relaxes a stressed magnetotail magnetic field. MRs are also correlated with a variety of particle and radio signatures throughout the magnetosphere, highlighting their importance to the transport, energisation, and loss of magnetospheric plasma. Whilst MRs at different planets have morphological similarities, the very different physical regimes of the planets have led to uncertainty and controversy as to whether, or to what extent, they can be considered signatures of a common dynamical and physical process. Here we show that MRs at Jupiter and Saturn are both consistent with an integrate-and-fire process, comprising specifically a random walk with mean drift and positive random innovations between two barriers. This places them in the same category of process as MRs at Earth. Thus, at least, we have identified a unifying mathematical process by which the dynamical properties of MRs can be quantitatively compared. Moreover, in combination with other knowledge, we anticipate that such a comparison will also provide important clues and constraints to unifying theories of the underlying physics.