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Evidence for Rotational Parametric Instability in Earth's Core from Analysing Relative Paleointensity Data

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We have developed an algorithm to search records of relative paleointensity for evidence of a rotational parametric instability in Earth's core. Under the assumption that the spectrum of magnetic field intensity is a proxy for that of fluid velocity, properties of this instability will be seen in records of the magnetic field intensity. As long as the strain rate produced by either precessional or tidal forces exceeds the dissipation rate, a parametric instability will grow and subsequently decay repeatedly as observed in laboratory experiments. In the event that the externally imposed strain rate is close to the dissipation rate, a balance will result in what we call a steady state.

Our algorithm has searched records of relative paleointensity from sedimentary cores from the past 2 million years. We smooth the data and set a threshold of significant change in the field which is then segmented into intervals of growth, decay or steady state. According to our model of parametric instability, adjacent decays and growths recovered by our algorithm can be combined to give the magnitude of the external strain rate that drives the instability. Application of this algorithm to paleointensity data reveals distinct maxima that correspond to all the reversals of the field in the interval studied. Thus our model for parametric instability in Earth's core is consistent with the occurrence of magnetic field reversals at times when the external straining is largest.