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Dynamo action sustaining turbulence: a subcritical transition

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Dynamo action in a stably stratified environment has been observed for the first time in global numerical simulations quite recently. The so-called Tayler Spruit dynamo interestingly exhibits a strong level of turbulent fluctuations, turbulence which can be maintained up to very low levels of differential rotation. A systematic parameter study shows that the relevant criterion for this dynamo is a constant magnetic Reynolds number, compatible with previous predictions. Besides this very general result, the simulations seem to suggest that the mechanism at hand is a subcritical transition to turbulence, relying on a possible α/Ω mechanism. This transition can be described by a dynamical system involving only three modes. In very good agreement with the direct numerical simulations, it offers a more general scenario for a subcritical transition to turbulence, which could also apply to other types of instabilities, such as magneto-rotational instability.

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