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Machine learning meets mechanism: Mechanism of roll reversal in Rayleigh-Bénard Convection XI CHEN, XIAOJUE ZHU, MICHAEL BRENNER, Harvard University — Understanding the precise physical events that underlie the reversal of circulation direction in Rayleigh-Bénard (RB) convection has long been a mystery. We aim to solve this problem by using a machine learning model to classify the events related to a reversal in convection. We found a unique time scale indicating the transition between the two circulation directions of reversal, which is much shorter than the periodicity of reversal. We then try to invert the neural network, to discover the precise flow events that cause the physics on this timescale. This allows us to identify local patterns of the flow field that are critical to the reversal phenomena. We use these as the basis for building a phenomenological theory of reversal. We believe using interpretable machine learning in this way can be applied for the study of other fluid dynamics problems and even a lot of science problems.

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