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Understanding the formation of flare-productive active regions using realistic flux emergence simulations

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Solar active regions are thought to be formed by the emergence of magnetic flux from the deep convection zone and, therefore, it is important to use a large computational domain covering the entire convection zone to understand the physics behind. However, the high acoustic speed makes it difficult to conduct magneto-hydrodynamic simulations in such a deep domain. The R2D2 code overcomes this difficulty by implementing the reduced sound of speed technique, which allows us to conduct the simulations of active region formation in a much more realistic way. In this presentation, we will discuss how the large-scale convections in the deep layers affect the flux emergence process and contribute to the formation of complex-shaped active regions, which are prone to produce massive solar flares and coronal mass ejections.

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