Rotating convection and magnetically-driven flows in Europa's subsurface ocean.

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Jupiter's icy moons are believed to host subsurface liquid oceans. Among them, Europa is of particular interest as it is one of the most promising candidate to host extraterrestrial life. How water can remain liquid beneath the ice layer is however not entirely clear. We study in this work how the subsurface ocean of Europa can be influenced by the nonlinear coupling between the magnetic field of Jupiter and thermal convection. Indeed, observations tend to suggest that this ocean is salty, making it an electrically-conducting fluid which can be subjected to the action of the Jovian field. Previous studies have shown that this process can draw a large scale zonal flow [2]. We particularly focus on how the presence of this flow modifies well known properties of rotating convection in a spherical shell geometry (e.g. [1]), relevant to the ocean of Europa. Studying how the heat flux latitudinal profiles evolve in the problem, we find a new regime resulting from the interaction between the magnetically-driven flow and convection. Using past models relating the heat flux coming from the ocean to the ice thickness evolution [3] [4], we make some predictions about the latter, which are compared against past measurements [3]. In the perspective of upcoming missions JUICE and Europa Clipper, we discuss how the comparisons between our model with an improved precision of the measurements can be used to infer some of the ocean's properties.

Références

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