

Dynamical deviations from superrotation in hot Jupiters

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Abstract

We present as 'proof of concept' a 3D global circulation model for the fast rotating ($P_{orb} = 0.835$ days), high surface gravity ($g = 47.4$ m/s 2) hot Jupiter WASP-43b [1] with anomalous dynamics that at least partly breaks the 'superrotation paradigm'. We will discuss the difference between this model and a 3D model for HD 209458b, the dynamics of which is dominated by unperturbed superrotation. We will show that the anomalous dynamical effect can at the very least explain the reduced east-ward hot spot shift in hot Jupiters and naturally leads to very large day to night side temperature gradients.

Our results suggest that we have to fundamentally question basic assumptions in 3D atmosphere modelling of exoplanets to explain observations of some hot to ultra-hot Jupiter atmospheres. Indeed, there are currently two exoplanets that outright question the paradigm that the hottest spot of a hot Jupiter is always eastward shifted due to superrotation: CoRoT-2b with an apparent westward shift [2] and HAT-P-7b [3], the hot spot of which appears to oscillate between eastward and westward shift with respect to the substellar point.

References

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