Thermal Inversions in Hot Jupiter Atmospheres and Problems with the TiO Hypothesis

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Why so bright in the optical?

Spiegel & Burrows 2010



Bright in the optical and also in IR...

Spiegel & Burrows 2010

Flagstaff 5/3/2011



Can infer thermal inversions! See also Hubeny+ 2003, Fortney+ 2008, Madhusudhan & Seager 2009, 2010.

Spiegel & Burrows 2010





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inversions!

2009, 2010.

Suggestion: Some hot Jupiters have thermal inversions caused by TiO

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We'd expect previous plot to look like this with more data:



It actually looks like this with more data:



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Suggestion: Some EGPs have thermal inversions caused by TiO

We'd expect plot on left to look like this with more data:



> Flagstaff 5/3/2011

Spiegel, Silverio, & Burrows 2009

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3. Night-side condensation



Spiegel, Silverio, & Burrows 2009





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Unclear. Showman+ 2010 models suggest $v_{vert} \sim 10$ m/s, so if $K_{zz} \sim (H_p)(v_{vert})/3$, then $K_{zz} \sim 10^{10}$ cm²/s. (But is 1/3 the right multiplying factor?)

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Might lead to over-inflation via "The Mechanical Greenhouse" (Youdin & Mitchell 2010)







See collection of models at:

<u>http://www.astro.princeton.edu/~dsp/exoneptunes/</u> <u>http://www.astro.princeton.edu/~burrows/neptune/index.html</u>



Models include different metallicity, different host stellar types, different distances from stars.

> (Supersolar models calculated with Pressure and Entropy reflecting the effect of higher metallicity.)



Burrows, Rauscher, Spiegel, & Menou 2010