Constraining the initial entropy of directly-detected exoplanets

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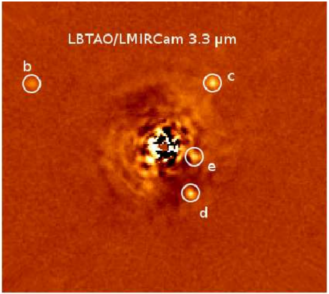
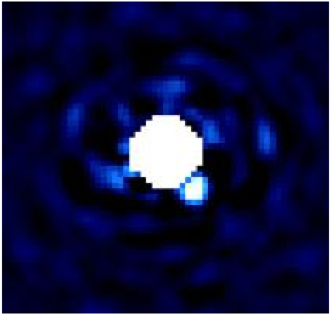


Skemer et al. (2012)



Currie et al. (2011)

Overview

1. Motivation
   - Direct detection surveys
   - Uncertainty in post-formation conditions
2. Inferring M and S_i from L and age
   - Cooling models
   - Applications
3. Conclusion

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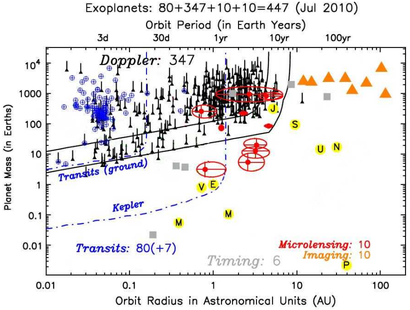
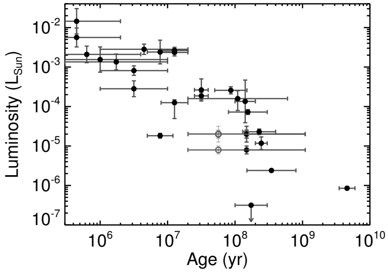
Direct imaging

- Bias towards young, massive, and hot planets
- Many surveys on now or soon: SPHERE, GPI, VLT, HiCIAO, JWST, etc.

→ Dramatic increase in number and detection of core-accretion candidates



Dominik (2011), modif.



Neuhäuser & Schmidt (2012)

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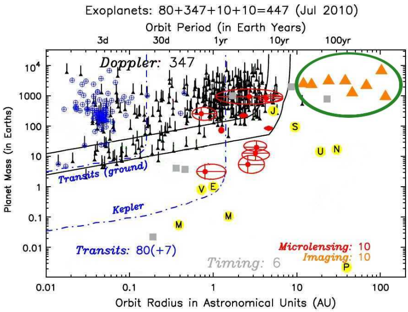

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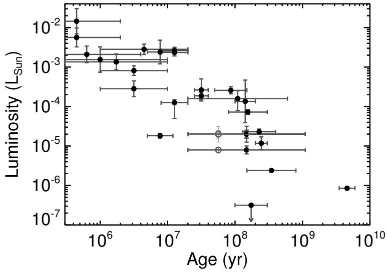

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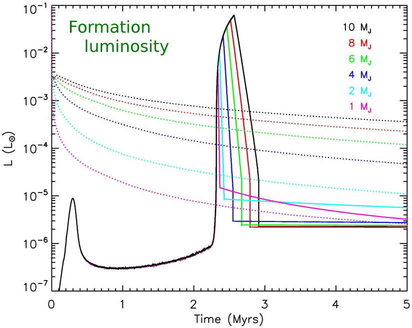
- Core accretion: closer-in, less massive, colder (lower S)
- Gravitational instability: tens of AU, heavier, hotter

⋆ Actually, uncertain initial conditions →



Marley et al. (2007)

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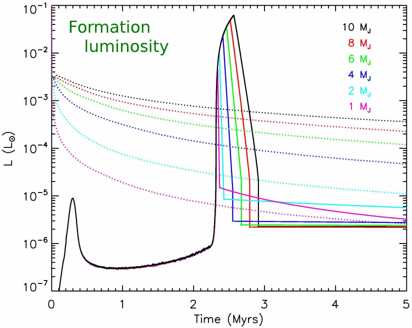

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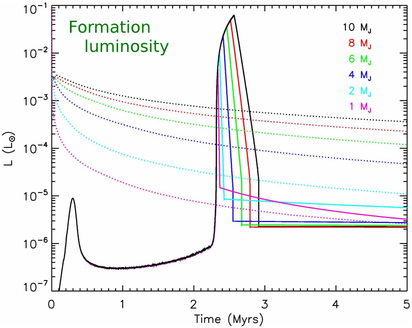

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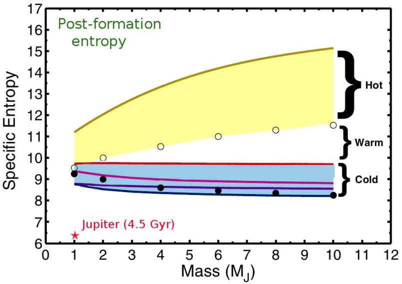

Spiegel & Burrows (2012)

Consequences

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- Masses assigned from hot starts → wrong statistics
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- Standard opacities and composition
- Usual constant-S structure equations
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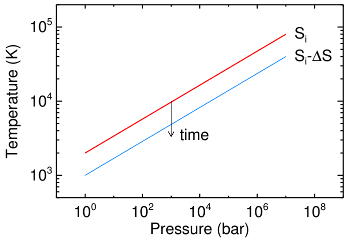
- (Found $L_{\mathrm{bol}}(M, S)$) explanable)



Marleau & Cumming 2012 (in prep.)

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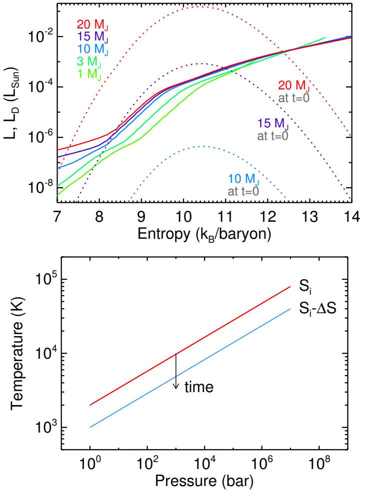

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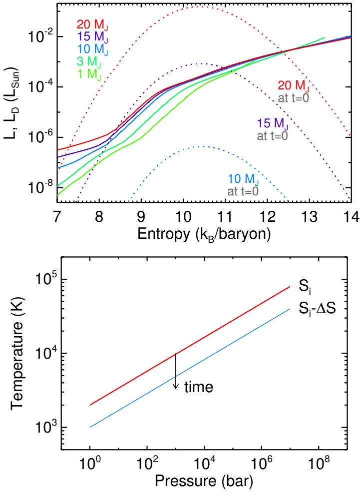

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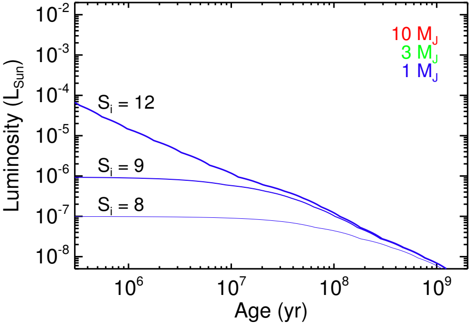

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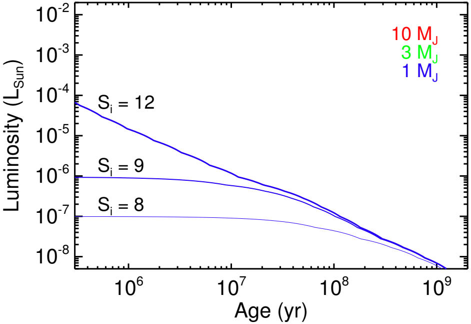

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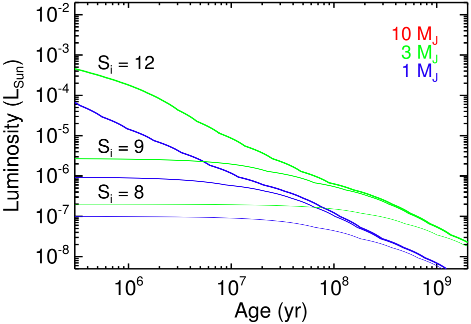

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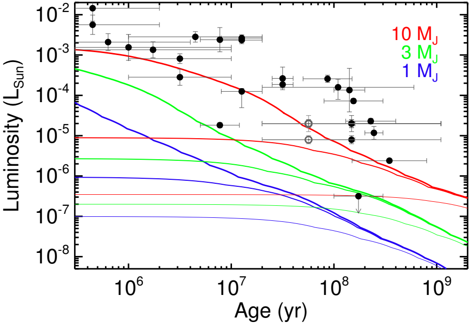

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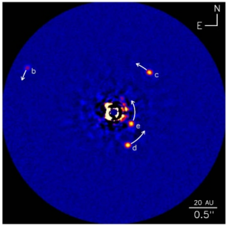
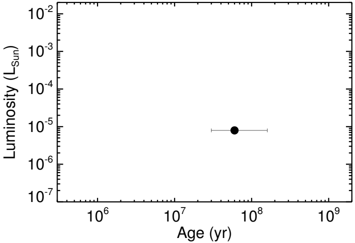
Neuhäuser & Schmidt (2012)

HR 8799 b



Marois et al., Zuckerman (2010)



- Hot-start masses

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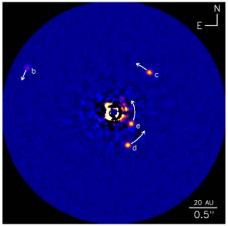

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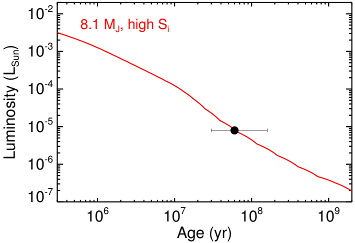

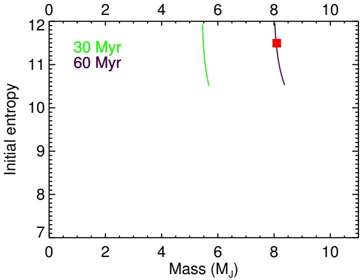

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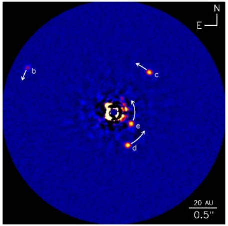

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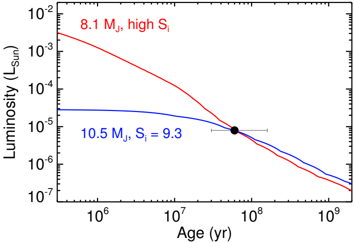

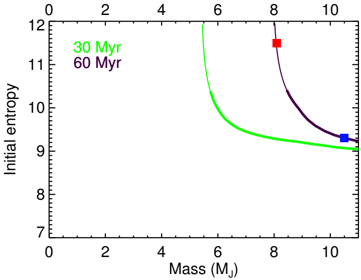

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→ Lower bound on S_i

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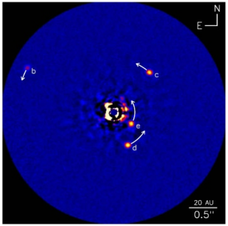

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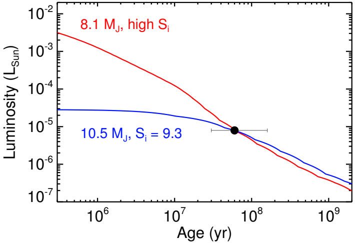

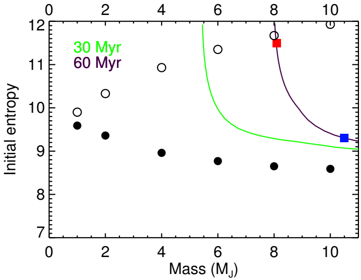

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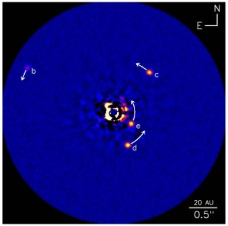

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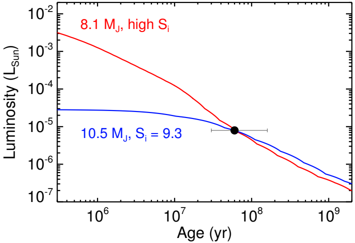

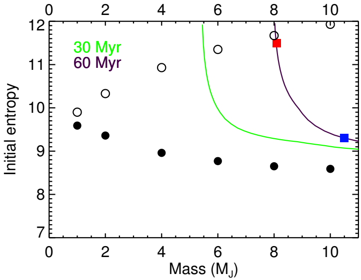

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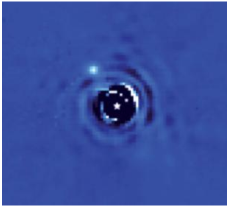

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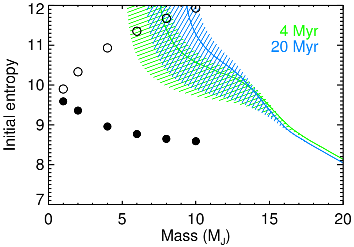

Marleau & Cumming 2012 (in prep.)

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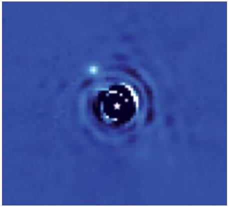

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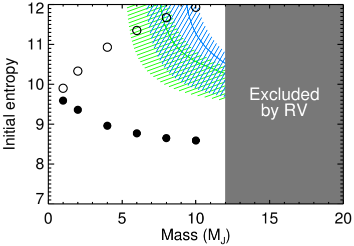

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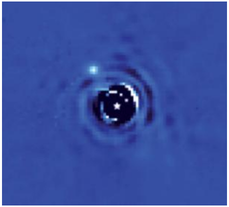

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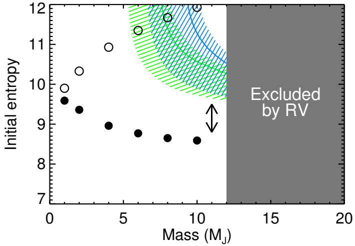

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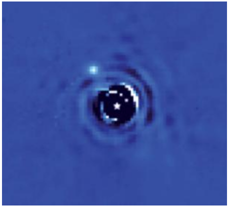

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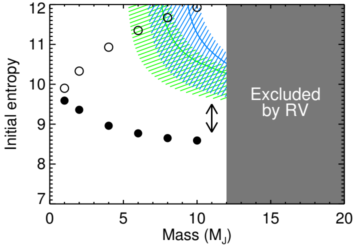

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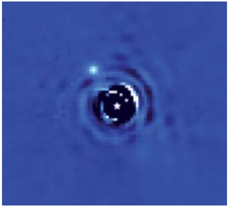

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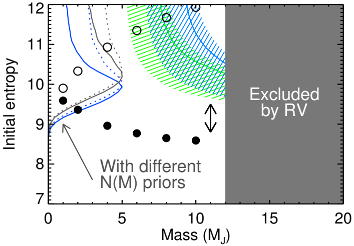

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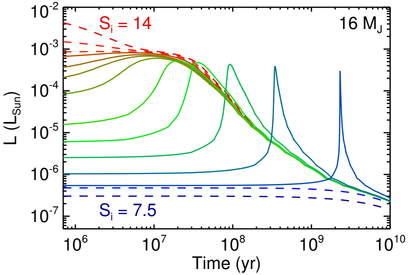

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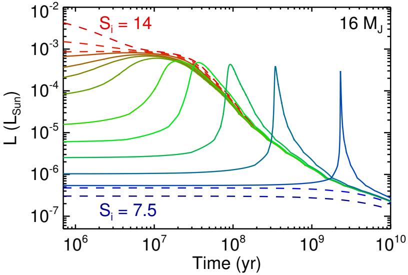

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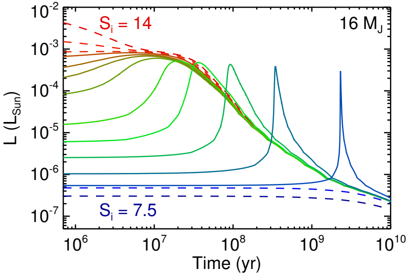

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Summary and outlook

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