Warm Ice Giant GJ 3470b:
A Metal-rich, Hazy, or Low-Methane Atmosphere

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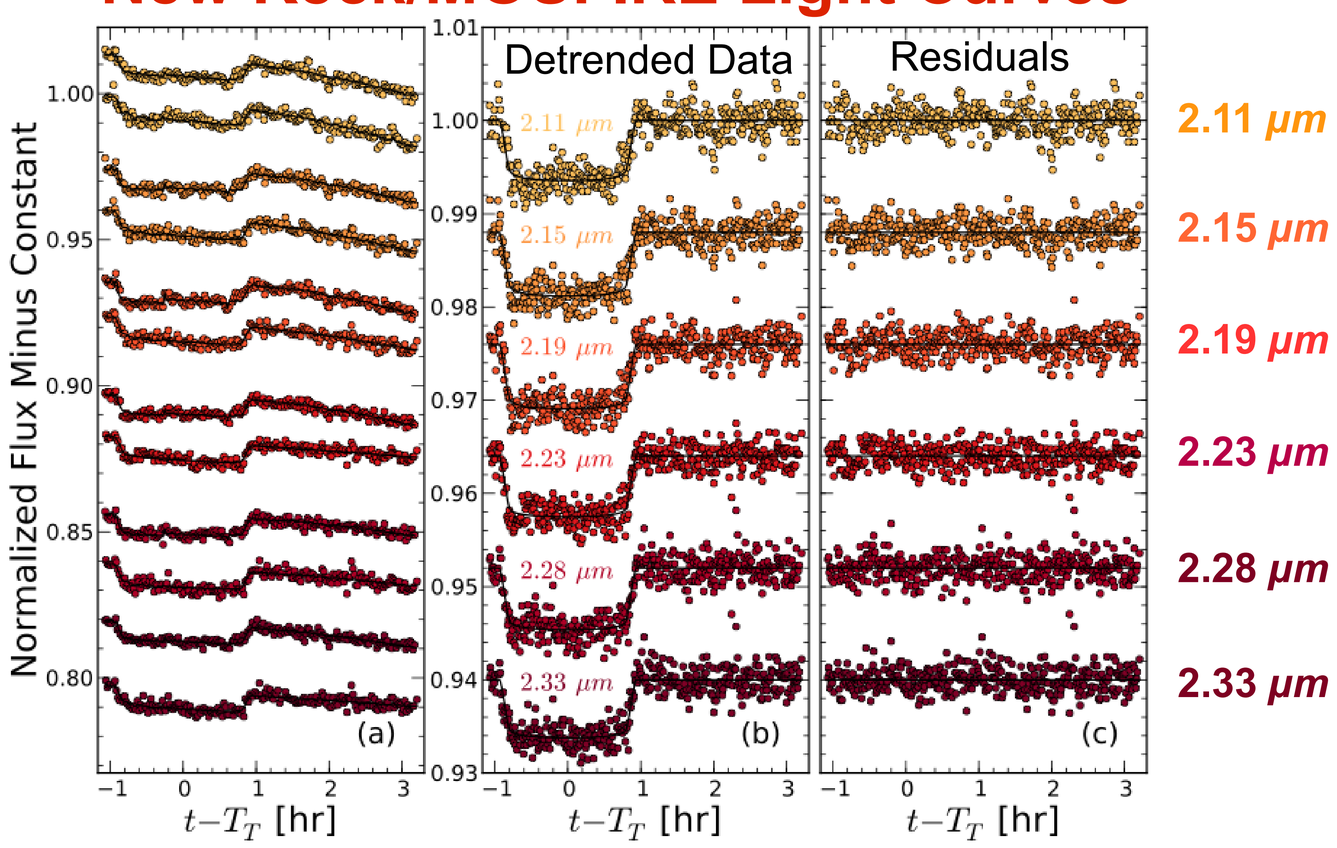
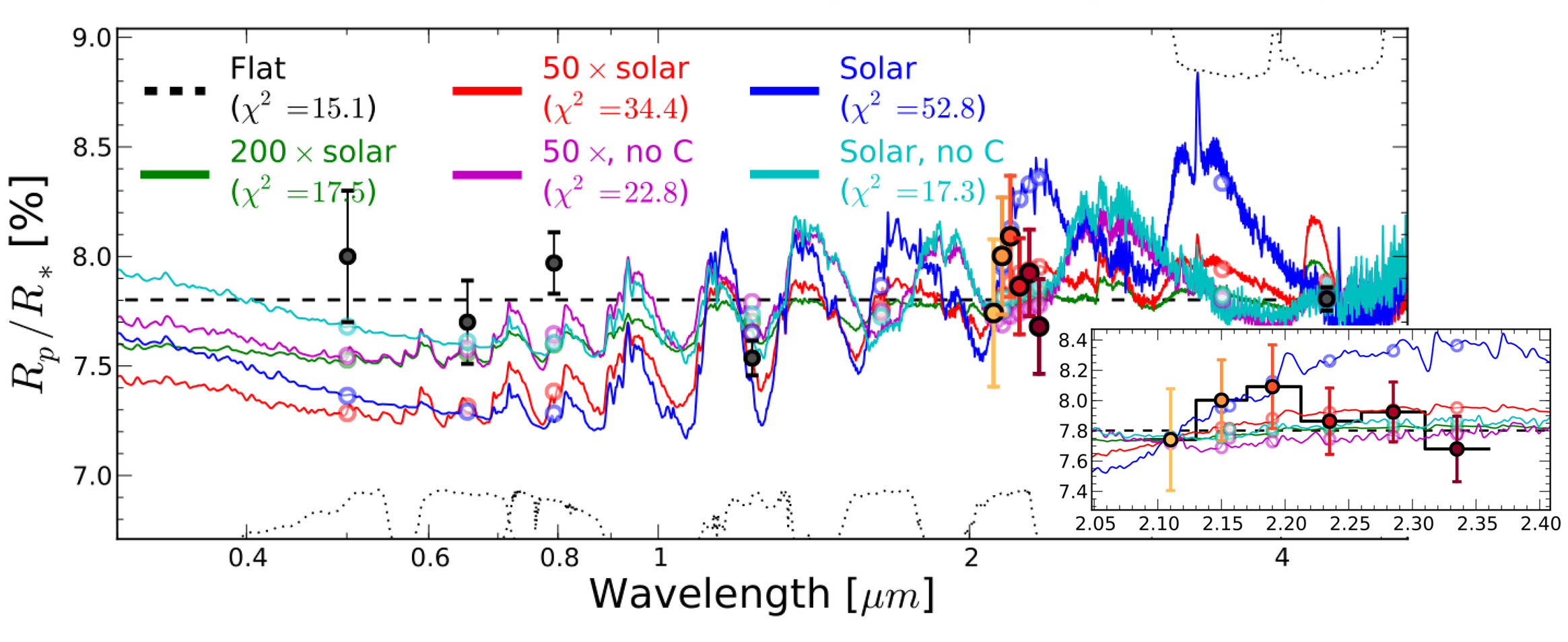
Low-mass, low-density planets are a common product of planet formation processes. Studying these planets' atmospheres – via measurements of atmospheric transmission during transit – can reveal their composition and, perhaps, the history of their formation and migration.
The **warm ice giant GJ 3470b** (~700 K, 14 $M_\oplus$, 4.8 $R_\oplus$) is an especially good target because of its bright host star (K=8) and relatively deep transit (0.6%). We observed GJ 3470b using the new **Keck/MOSFIRE** infrared multi-object spectrograph, which performs well when on-slit nodding is employed. As described below, we find a **featureless planetary spectrum**:

We observed one transit of GJ 3470b, using wide (10") slits to avoid seeing-dependent slit losses and a single comparison star to correct for telluric variations. As shown at **right**, we fit six spectroscopic light curves with a single, global model to extract the desired parameters.

Below, we compare these new spectroscopic transit measurements, along with previous broadband photometry (Demory et al. 2013, Fukui et al. 2013), to atmospheric models. We rule out atmospheres with ≤50x solar heavy element abundances, but other scenarios remain plausible:

New Keck/MOSFIRE Light Curves





Implications for GJ 3470b's atmosphere:

- The planet's atmosphere either
  - is **extremely metal-rich** (~200–300x solar abundances), or
  - is covered in **optically thick clouds** or haze, or
  - is **CH_4-depleted** by a low C abundance or disequilibrium processes.
- Optical photometry and J- and H-band spectroscopy can best distinguish between these scenarios.
- To date, **all cool, low-mass planets** show featureless transmission spectra, which suggests that **a single common factor** is responsible.

Also ask me about:

- Our ongoing GJ 3470b transit photometry program
- Nearby brown dwarf binary Luhman 16AB
- Possibilities for future collaborations

References:

- Bonfils et al. 2012
- Demory et al. 2013
- Fukui et al. 2013