High-resolution Transmission Spectroscopy of GJ 1214b:

Ruling out H-rich atmospheres in equilibrium

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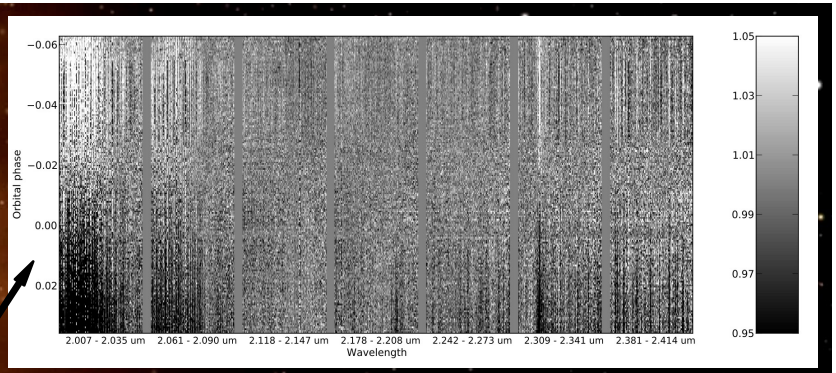
The low-mass planet GJ 1214b is intermediate in mass, radius, and density between Earth and Neptune; atmospheric observations can provide insight into the planet's composition and break the degeneracies of interior models.

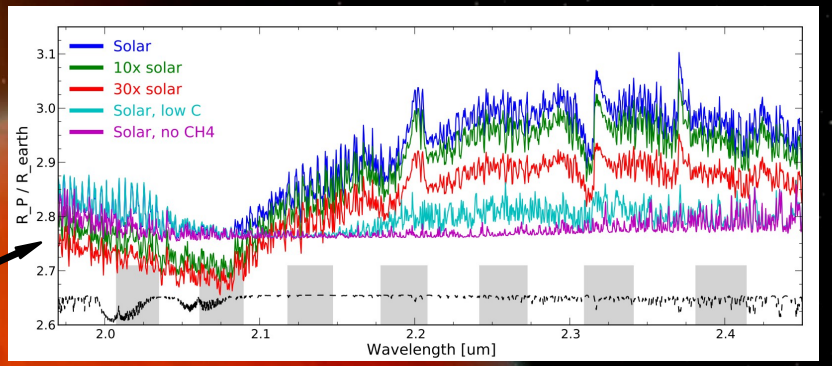
(1) We observed GJ 1214b during transit with the NIRSPEC infrared spectrograph (R ~ 17,000) at Keck to search for the planet's differential transmission spectrum – the variations in transit depth due to wavelength-dependent atmospheric opacity.

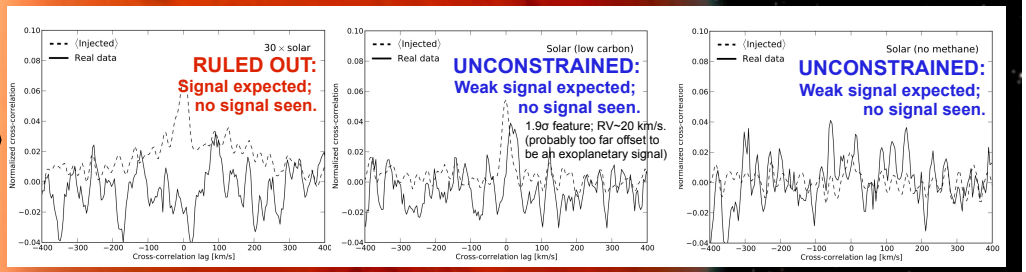
(2) Our suite of high-resolution atmospheric models shows the transmission spectra expected for various compositions, and provides the basis against which we compare our observations.

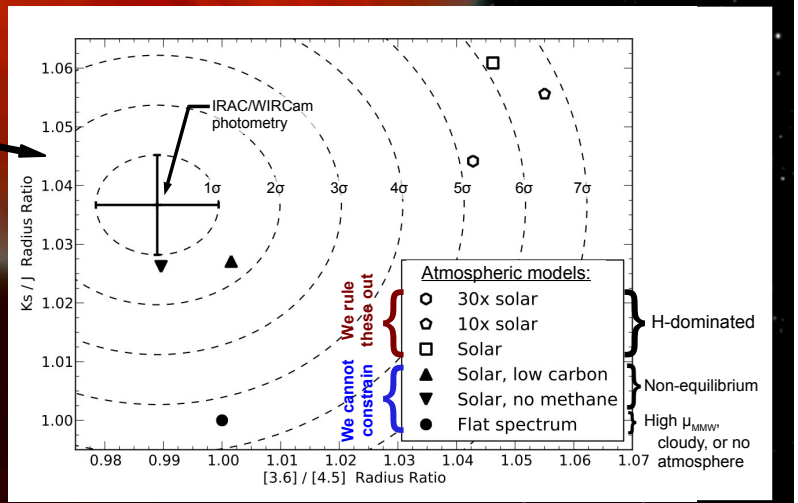
(3) After fitting a transit light curve to each wavelength channel, cross-correlations test whether each model gives a confirmed detection, rules out the model, or leaves the particular model unconstrained. We find no positive detections, strongly rule out various H-dominated atmospheres in equilibrium, and cannot constrain models low in methane, with small scale heights, or covered in clouds.

(4) When taken in concert with infrared photometric observations, **our results support a model in which the atmosphere of GJ 1214b contains significant H and He, but where methane is depleted.** Such depletion (if caused by photochemical processes) could produce an optical haze consistent with observations there.









References:

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Coming soon:

A ground-based infrared spectrum of the extremely irradiated Hot Jupiter WASP-12b. Stay tuned!