The Spitzer Space Telescope has revolutionized the observational characterization of exo-planets by detecting infrared emission from hot Jovian systems. At present, measurements have been reported in two systems (Deming et al. 2004, 2006, 2007; Charbonneau et al. 2005, Harrington et al. 2006, 2007). The detection of infrared emission from hot Jovian exo-planets has stimulated extensive theoretical work on the atmospheric structure and emission of these planets. Constraining the model predictions for infrared emission from hot Jovian atmospheres is an important motivation for current SNR of the final calibrated data is about ~1100. Though this would be enough to also observe planetary spectra shown in the right column on this poster. The nightside of the planet, our current calibration has not reached the dynamic range limit of SNR. The above figures show the secondary eclipse (left) and resulting spectrum (right) of HD 209458b. Using the IRS data, we have determined the broad-band eclipse depth to be 0.00315 ± 0.000315, which is consistent with reported 2.15-3.5 μm IRS photometry. The eclipse depth implies a significant redistribution of heat from the dayside to the nightside. Over much of this spectral range, the planet spectrum is consistent with featureless thermal emission, consistent with a T~1100 K black body. We do not find evidence of a strong peak at 10 μm complicated by some models due to dust. Between 7.5 and 8.5 μm, we find evidence for an unidentified spectral feature. This spectral modulation implies that the dayside vertical temperature profile of the planetary atmosphere is not entirely isothermal.

Spectroscopic detection of exo-planet emission has proven to be challenging. Space-based infrared spectroscopy, as Spitzer is providing, is in principle ideally suited for the task, due to the absence of an atmosphere, improved signal-to-noise ratio (SNR), and instrument stability. However, observations with the Spitzer IRS instrument are complicated by systematic errors that are large compared to the observable signature as can be seen in the left figure. One can observe (i) a flux offset between nods, (ii) a periodic flux modulation, (iii) initial flux stabilization, and (iv) monotonic flux drift within a nod. These temporal changes are not random, a scatter diagram shows that flux density values are highly correlated (correlation coefficients of 0.99). We find that these four major temporal flux density changes listed above are caused by (in order of importance) errors in telescope pointing, background subtraction, and latent charge accumulation.

To determine the initial pointing offset, pointing drift and SNR at the final program wavelength, the top panel of the figure to the left shows the source position along the slit's spatial axis. The lower panel shows the corresponding behavior of the source flux. We modeled the pointing error periodic motion in both the spatial and spectral axis. This leads to an elliptical motion that creates a symmetric profile about individual maxima and minima. The asymmetry profiles in these data require the addition of a harmonic term for angular velocity; when this is incorporated, the pointing error is given by

where \( t \) is time, \( x \) is the position parallel to the slit axis (the spatial dimension of the array), \( y \) is the position perpendicular to the slit axis (the spectral dimension of the array), \( x_0 \) and \( y_0 \) are initial offsets, \( m \) and \( n \) are the linear drift terms, \( \phi \) is the angular coordinate, \( A_4, A_3 \), and \( A_2 \) are the amplitudes, \( \omega \) is the frequency, and \( A_4, A_3 \), and \( A_2 \) are the phases. The fitting fits are plotted in the left figure. We applied a similar scheme as described above also for a series of measurements of the calibrator star etAl Dor, providing us with an absolute flux calibration for the observations of HD209458. The pointing corrections can be seen to the right. Note that the first 15 min of observations are being influenced by a latent charge accumulation, not corrected here. These calibrated and corrected data allowed us to determine the eclipse depth and to extract the planetary spectra shown in the right column on this poster. The nightside of the planet, our current calibration has not reached the dynamic range limit of the instrument, which is a factor of 2 higher, and we believe further improvements in the calibration method, together with changes in the observing strategy, could considerably improve the measurement SNR.