THE EFFECT OF HETEROGENEOUS STELLAR PHOTOSPHERES ON SEARCHES FOR TRANSITING EXOPLANET BIOSIGNATURES. B. Rackham[1], D. Apai[2]. [1]Dept. of Astronomy, University of Arizona, 933 North Cherry Ave., Tucson, AZ 85721, USA (brackham@as.arizona.edu); [2]University of Arizona, Tucson, AZ.

Introduction: Transmission spectroscopy offers the exciting possibility of observing an exoplanet biosignature in the near-term future. Ground- and space-based facilities in the coming decade may identify biologically produced molecules from opportune targets with this technique [1, 2, 3], which can constrain the chemical composition in the upper atmosphere of a transiting exoplanet. This method relies on the underlying assumption that the spectrum of the transit chord does not differ substantially from that of the unocculted stellar disk or, if it does, the contribution of photospheric heterogeneities such as star spots to the transmission spectrum can be constrained by photometric monitoring. However, persistent unocculted photospheric features, including spots and faculae, can strongly affect transmission spectra [4, 5], and their presence cannot be deduced from variability monitoring. As new facilities come online and more precise measurements become available, there is a clear need for a more robust understanding of the effect photospheric heterogeneities have on transmission spectra.

In a recent study on the transiting sub-Neptune GJ 1214b, for example, we found its optical transmission spectrum to be strongly influenced by unocculted stellar faculae in the photosphere of the host star [4]. Follow-up work utilizing our same modeling framework for assessing the stellar and exoplanetary contributions to transmission spectra (CPAT) shows that a large subset of published spectra are likewise affected by heterogeneous stellar photospheres, leading to misinterpretations of spectral feautres purportedly originating in the exoplanets' atmospheres [5]. In order to successfully identify and interpret biosignatures, the community will need to develop metrics for understanding when heterogeneous stellar photospheres will be important and methods for handling their effects.

This Work: Here we summarize our findings on the impact of heterogeneous stellar photospheres on transmission spectra and detail their implications for future searches for biosignatures. Applying our CPAT model [4], we investigate the potential for false positives and negatives arising from stellar photospheric features mimicking and masking atmospheric features, respectively. We place special emphasis on studying circumstances in which stellar photospheres may confound: 1) high-resolution observations of the O_2 *A* band at 0.76 μm with ground-based Extremely Large Telescopes, and 2) low-resolution observations of near-infrared H_2O features with space-based facilities. We explore the effects of spectral type, exoplanet size, and measurement precision on our results and outline guidelines for identifying when stellar heterogeneity may be important.

References: [1] Kaltenegger L. and Traub W. A. (2009) *ApJ* 698, 519. [2] Rodler F. and López-Morales M. (2014) *ApJ* 781, 54. [3] Barstow J. K. and Irwin P. G. J. (2016) *MNRAS* 461, L92. [4] Rackham, B. V. et al. (2017) *ApJ* 834, 151. [5] Rackham, B. V. and Apai D. (2017) *in prep*.