Exoplanet Dust Tails as Windows to the Planetary Interior. E. H. L. Bodman[1,2], S. J. Desch[1], and J. T. Wright[3], [1]Arizona State University, Tempe, AZ 85287, [2]NASA Postdoctoral Program Fellow, NExSS, [3]Pennsylvania State University, University Park PA 16802.

Introduction: Disintegrating planets provide a unique opportunity to probe the interiors of exosolar planets and the possible range of planetary interior compositions. This class of sub-Mercury-sized planets transit near enough to their host star (an orbital period of a day or less) that material from the rocky surface evaporates, recondenses in the atmosphere, escapes in a wind, and forms into a comet-like dust tail. These planets display a characteristic asymmetric, triangular dip that is typically highly variable from transit to transit (KIC 1255 [1]; KOI 2700 [2]; K2-22 [3]). Since the dust is condensing from the components of planetary material, the mineralogy of the dust will be linked to the surface composition, which allows for direct examination of planetary interior composition. Detailed study of the dynamics of the dust tail constrains the composition of the dominant dust species [4,5] but these models assume only a single species and cannot constrain interior composition. Relative abundances of the common rock forming elements such as Mg, Si, Fe, O, and C are necessary to determine the dominant mineralogy of the planet's interior. The interior mineralogy has significant impact on the possible habitability of the planet as it constrains the plate tectonics and other mantle dynamics [6]. Determination of relative abundances requires a model with multiple dust species. Many dust species we expect, such as corundum, pyroxene, and olivine, have notable spectral features in the near- and mid-IR. Despite the transits being less than 1 percent deep, the transit is entirely due to the surrounding optically-thin dust cloud, making these planets strong targets for spectroscopic follow-up observations.

Methods: We model the observable effects of composition dependencies of the dust tail in two stages. First, using a particle simulation, we follow the path taken by a grain released near the planet determined by gravitational, radiation and magnetic forces and assume dust species that are probable condensates from evaporated Earth-like crust and mantle compositions. The temperature of the grain is also tracked for the inclusion of sublimation. The dust grains in the tails are near the sublimation temperature for the species of interest and have lifetimes comparable to or much less than the period of the host planet. We track the change in size of the grain since the radiation and magnetic forces are dependent on grain size; both increase with decreasing size. From the grain paths, we determine the size and density distribution of the dust tail and then simulate the transit light curve to compare with the averaged *Kepler* transit.

Using the dust size and density distributions from our simulations, we simulate the IR spectra of dust grains for each of the different dust species. We assume spherical dust grains and, with Mie theory, calculate extinction over the wavelength range covered by *JWST*. Currently, we are restricting ourselves to the simpler single dust species model.

Discussion: Stellar magnetic fields only significantly affect the paths of grains smaller than 0.05 microns and based on previous fits to forward scattering [7] and color information [3,8,9], the grains are 0.1-1.0 microns, so magnetic fields do not change the shape of the dust tail or the transit shape. However, the small, nanometer-sized grains become trapped in the magnetic field instead of being blown out by radiation pressure which increases the IR excess.

Comparing synthetic spectra, we examine where in the IR spectrum the dust species are most distinguishable for the NIRISS, NIRSPEC, and MIRI instruments on *JWST*. The most notable features of many silicates are in the 9-10 micron range but the SNR is also larger, making it more difficult to distinguish those features. We will present the results of our analysis and discuss the implications for the follow-up observations of these objects.

References: [1] Rappaport S. et al. (2012) *ApJ,* 752:1. [2] Rappaport S. et al. (2014) *ApJ.,* 784:40. [3] Sanchis-Ojeda R. et al. (2015) *ApJ,* 812:112. [4] van Lieshout R. et al. (2014) *A&A,* 572, A76. [5] van Lieshout R. et al. (2016) *A&A,* 596, A32. [6] Unterborn et al. (2014) *ApJ*, 793:124. [7] Brogi et al. (2012) *A&A*, 545, L5. [8] Bochinski et al. (2015) *ApJ,* 800:L21. [9] Croll et al. (2014) *ApJ,* 786:100.