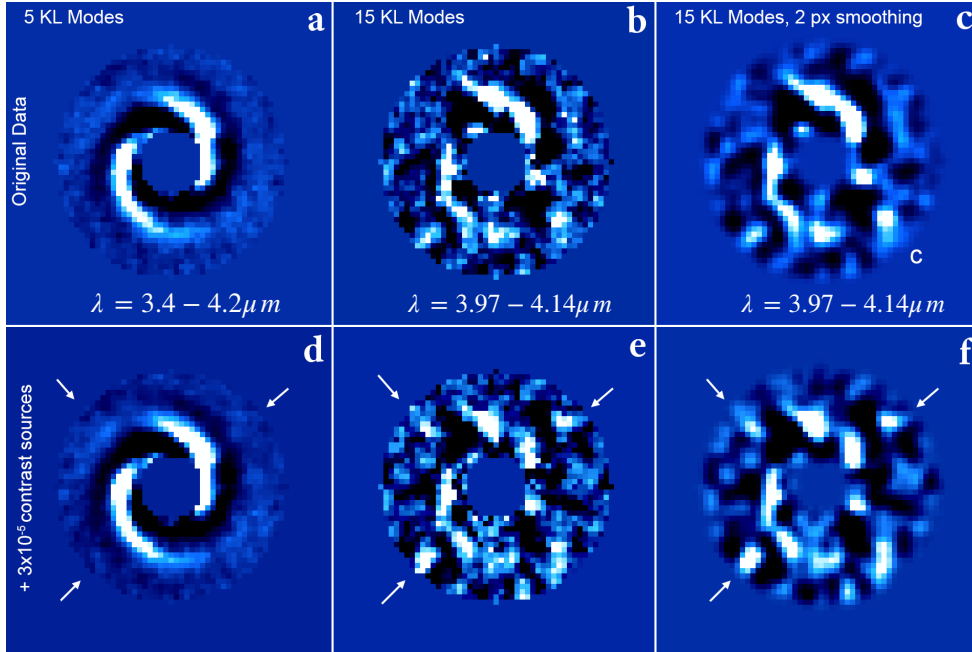
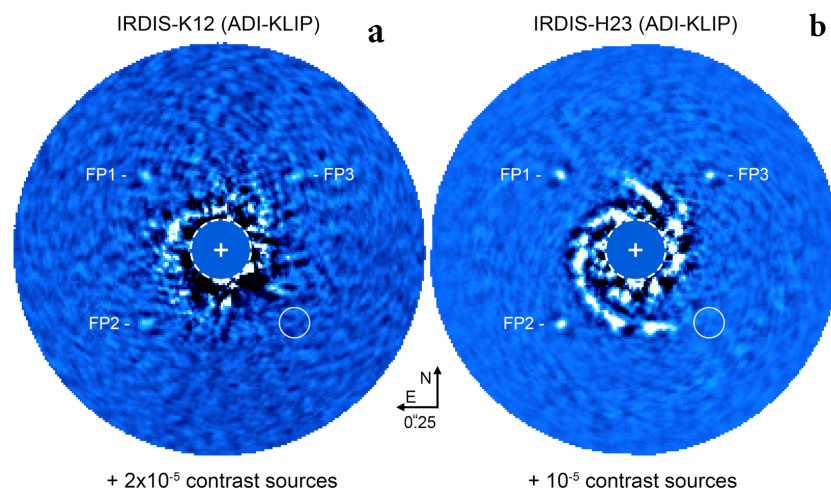

Direct images and spectroscopy of a giant protoplanet driving spiral arms in MWC 758

In the format provided by the
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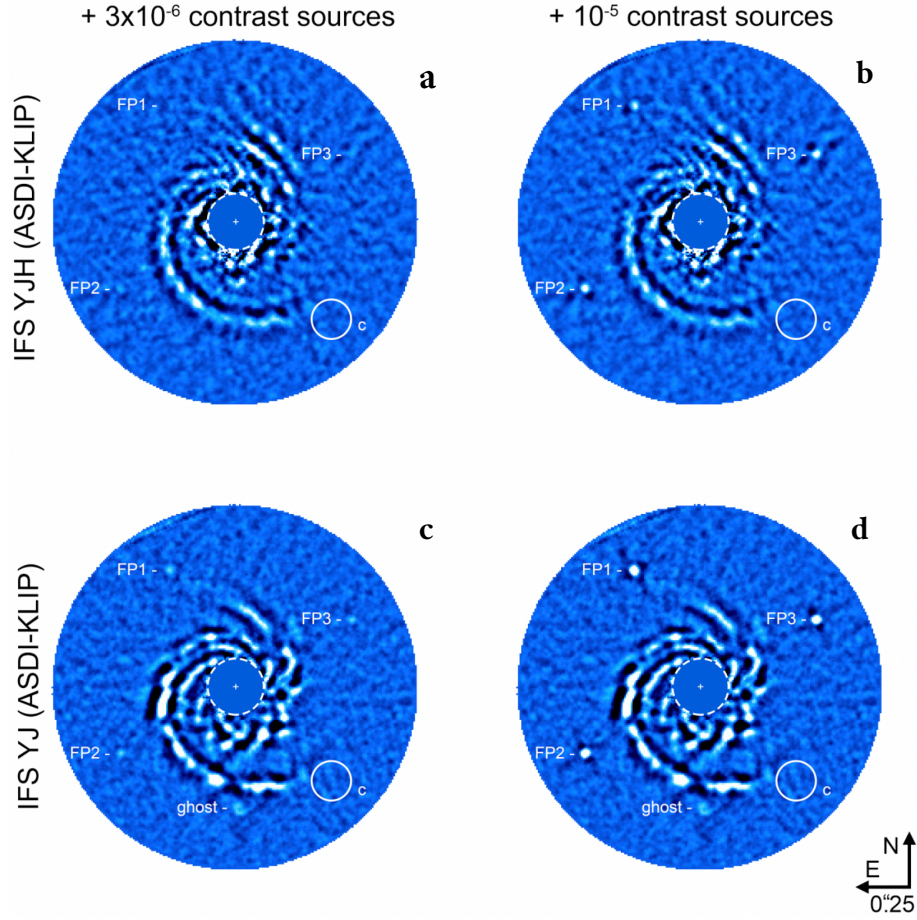
This document includes:
Supplementary Figures 1-11



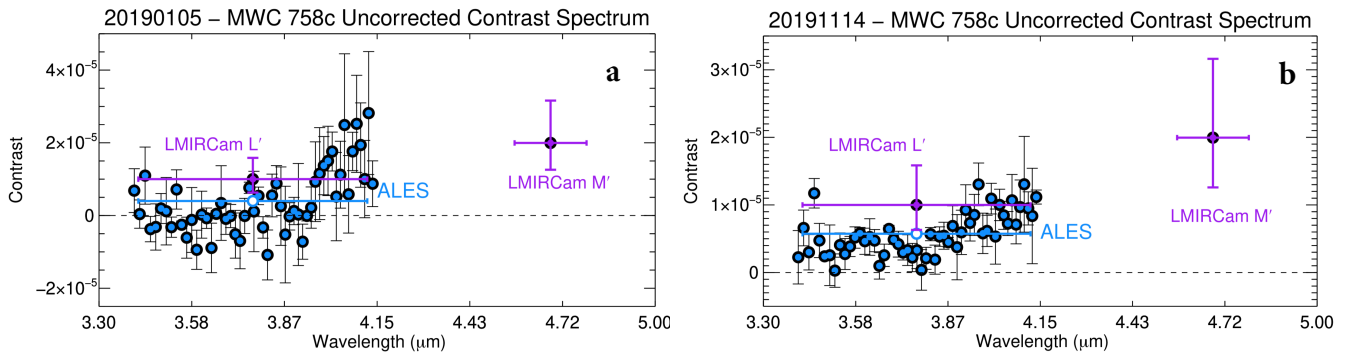
Supplementary Figure 1. Various reductions of the 20191114 LBTI/ALES data. The panels on the top (in particular **a**, **c**) are the versions shown in Fig. 1, whereas panels on the bottom (**d-f**) have three sources injected at -90° , $+90^\circ$, and 180° from MWC 758c that are marked by arrows. The non-aggressive reduction (with 5 KL modes, panels **a,d**) does not show the injected sources, or MWC 758c, but does reveal the disk with less signal degradation compared to the reduction with 15 KL modes. Panel **b** illustrates that MWC 758c is detected at the pixel-to-pixel level.



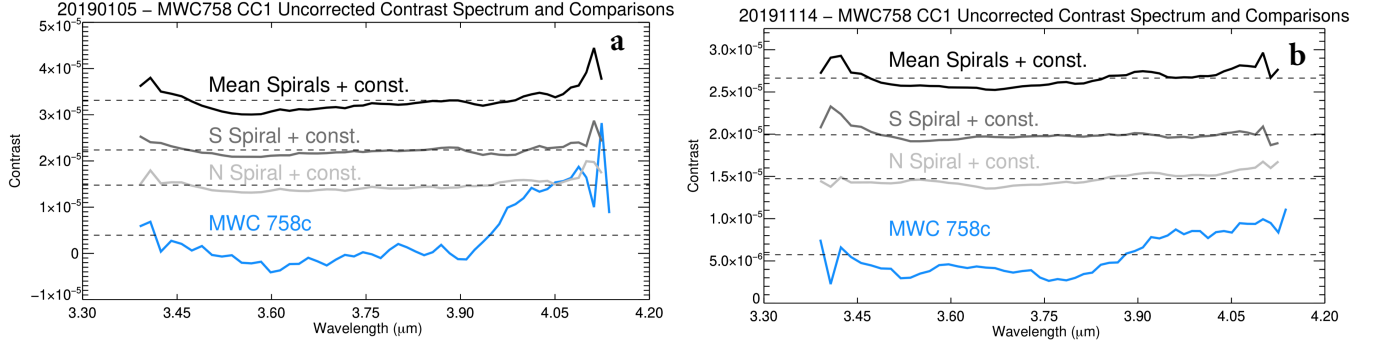
Supplementary Figure S2. SPHERE-IRDIS Images of MWC 758. Images taken in the *K12* (**a**; UT 2016-01-01) and *H23* (**b**; UT 2018-12-17) filters. Synthetic sources (fake planets, or FPs) were injected into the datasets to assess sensitivity limits. The position of MWC 758c is marked by a circle with radius equivalent to the FWHM of the PSF from LBTI/ALES.



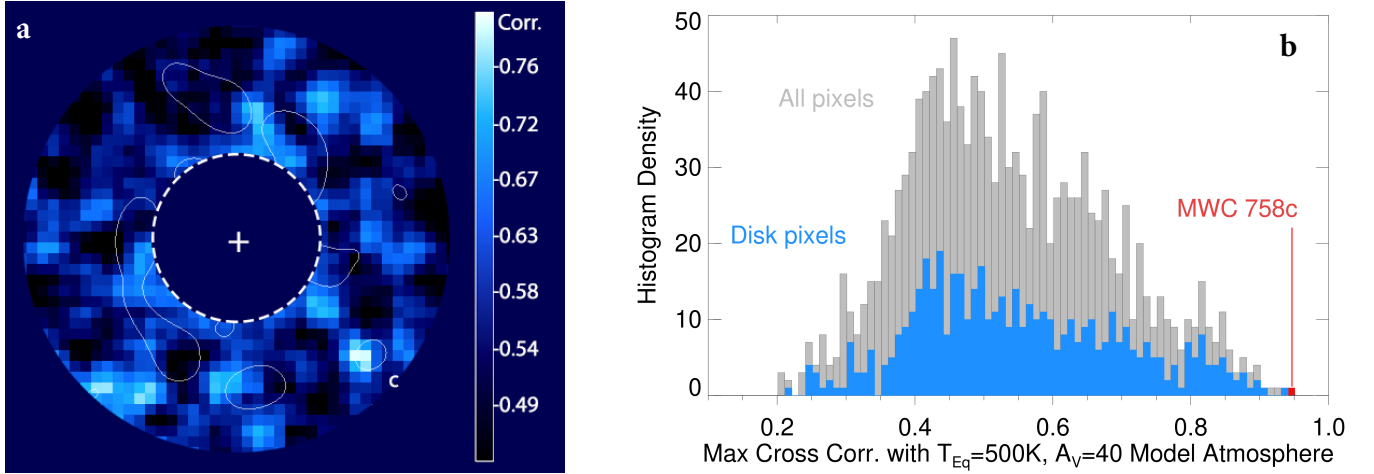
Supplementary Figure 3. SPHERE-IFS images of MWC 758. Data were taken in *YJH* (a, b; UT 2016-01-01) and *YJ* modes (c, d; UT 2018-12-17). Synthetic point sources (fake planets, or FPs) were injected into each dataset in order to assess detection limits.



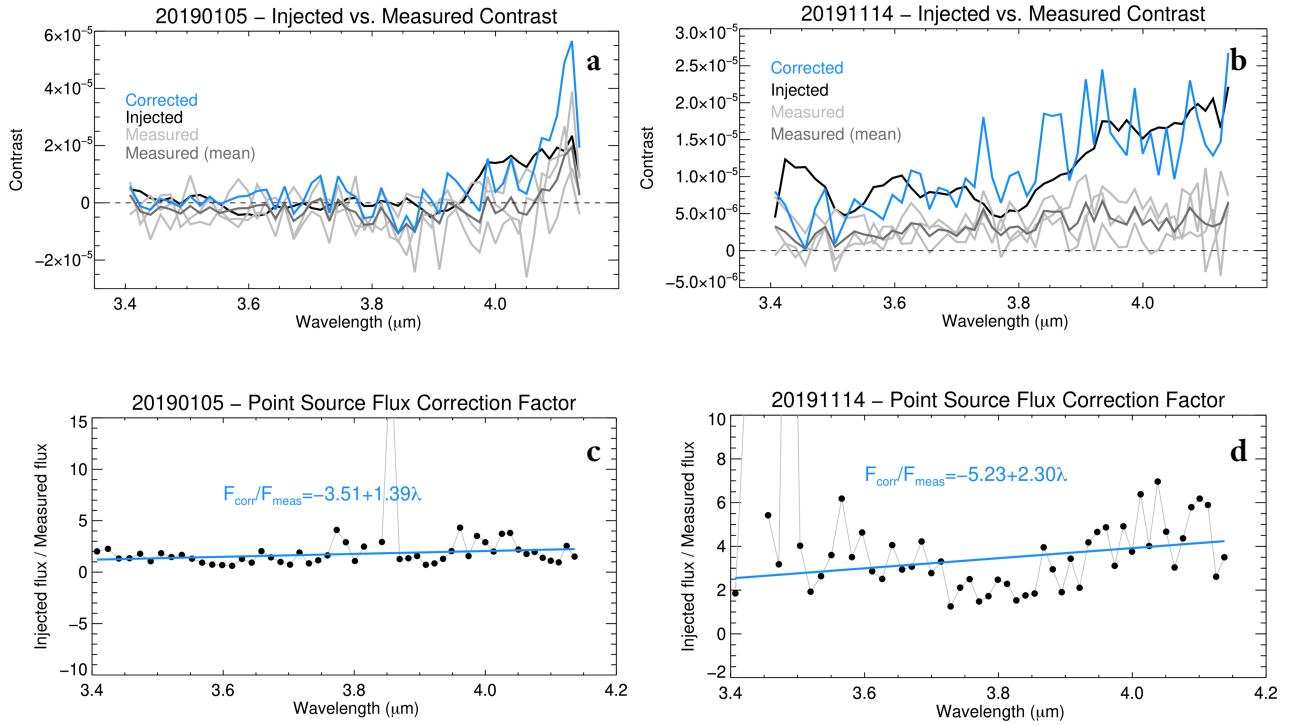
Supplementary Figure 4. Uncorrected ALES contrast spectra of MWC 758c from 20190105 (a) and 20191114 (b). The LMIRCam *L'* and *M'* photometry, reproduced from [11](#), are corrected via negative synthetic planet injections (see step 3 below). The binned ALES *L'* measurements (prior to correction) are consistent with the corrected *L'* photometry at the 1σ level. Error bars represent the standard deviation of recovered flux of three injected sources.



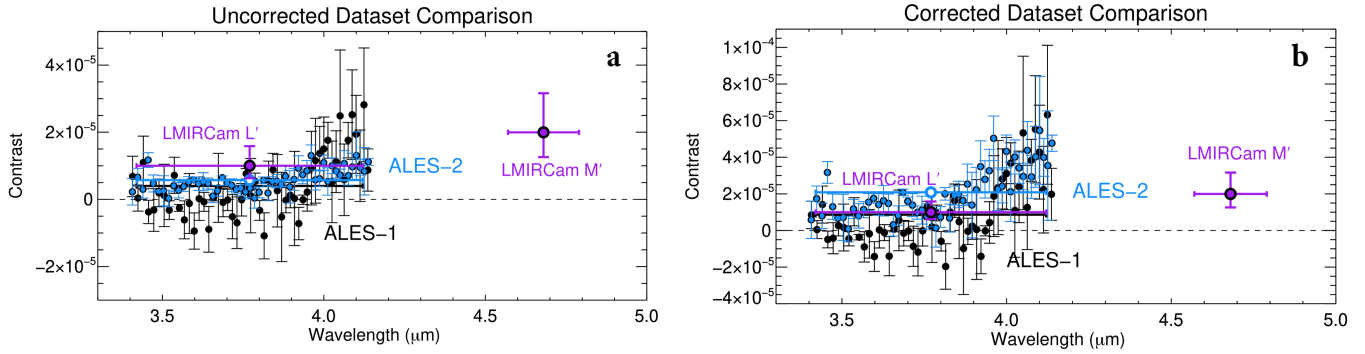
Supplementary Figure 5. Comparisons between extracted spectra of MWC 758c and the circumstellar disk from 20190105 (a) and 20191114 (b). The flatness of the disk’s contrast spectrum is consistent with scattered light. Note that telluric absorption is strongest at the first and last few wavelength channels, causing sharp increases at these wavelengths.



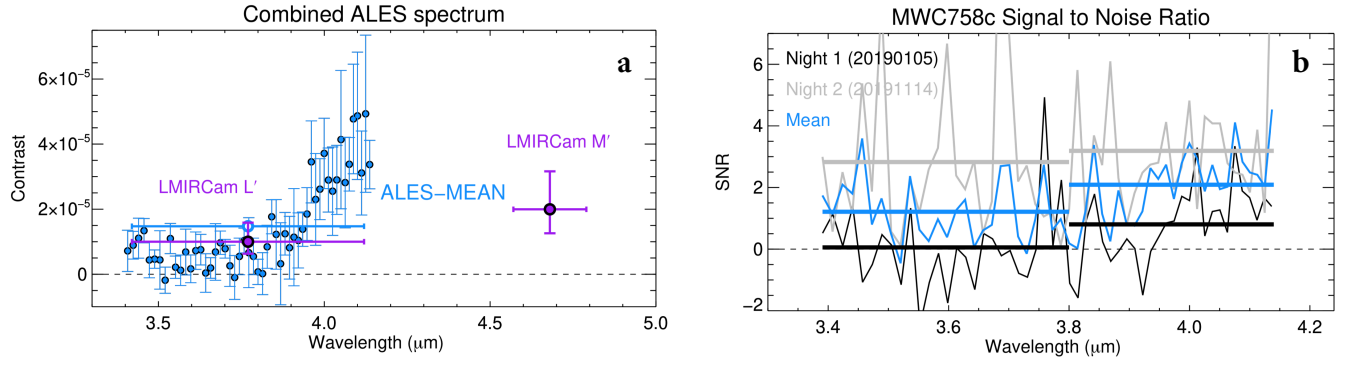
Supplementary Figure 6. Cross correlation map and resulting histogram. Two-pixel smoothed cross-correlation map of each pixel’s spectrum vs. a $T_{\text{eff}} = 500$ K, $A_V = 40$ BT-Settl spectrum (32) for the higher-quality 20191114 dataset (a) and histogram (b, pre-smoothing), which demonstrates that MWC 758c stands out as the reddest point in the image. The contours show the disk and MWC 758c (i.e., the total intensity image).



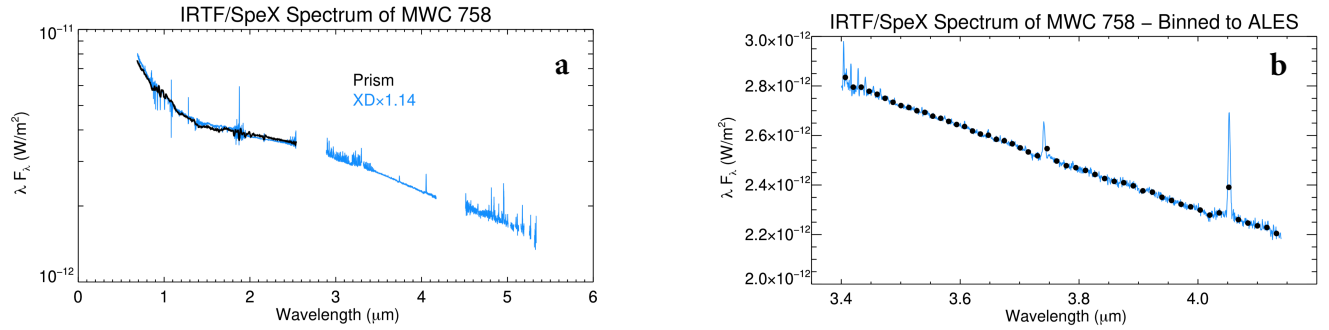
Supplementary Figure 7. Forward modeling results. Injected vs. measured contrast of injected sources (a, b) and derived point source flux correction models (c, d) from UT 2019-01-05 and 2019-11-14, respectively.



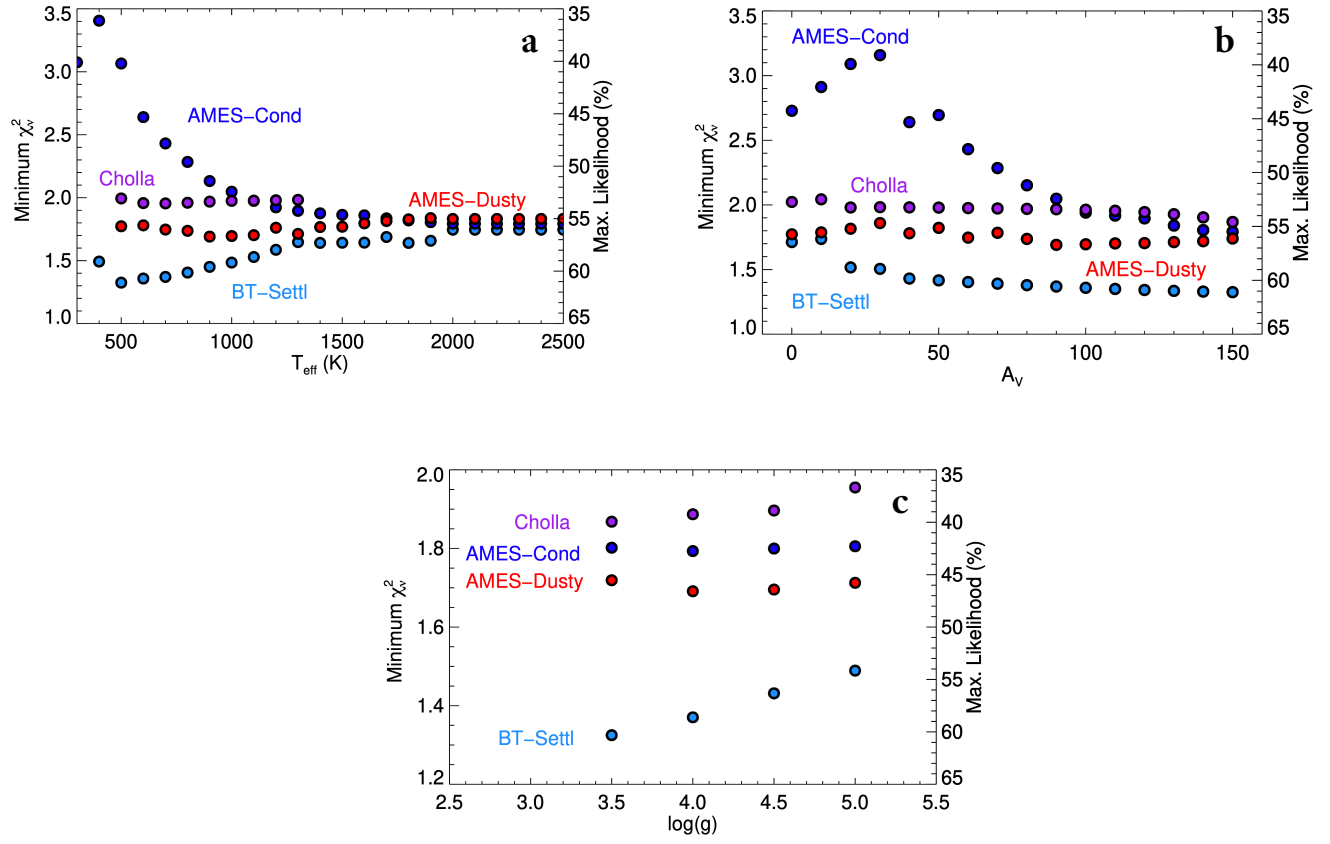
Supplementary Figure 8. Corrected contrast spectra of MWC 758c (a). The binned ALES L' measurements (post-correction, b) are consistent with the corrected L' photometry at the $\sim(0, 1)\sigma$ level (i.e., bracketing the previous LMIRCam measurement). Error bars represent the standard deviation of recovered flux of three injected sources.



Supplementary Figure 9. Averaged ALES spectrum (a), which is consistent with the L' photometry to $<1\sigma$. b Signal to noise ratio of the two ALES epochs and their averaged spectrum (with propagated uncertainties). Error bars represent the standard deviation of recovered flux of three injected sources.



Supplementary Figure 10. a IRTf/SpeX spectrum of MWC 758 (including contributions from both the star and unresolved inner disk emission). The cross-dispersed (XD, blue) spectrum is scaled to the lower resolution prism spectrum (black) by 15% to account for light losses along the slit. b IRTf/SpeX spectrum of MWC 758 (blue) binned to the resolution of ALES (black).



Supplementary Figure 11. Minimum reduced chi-squared (χ^2_v) values and corresponding maximum likelihoods (**a** vs. effective temperature; **b** vs. A_V , **c** vs. surface gravity) for Cholla, COND, DUSTY, and BT-Settl models compared to the ALES and LMIRCam data.