Rocky Worlds DDT: HST Scheduling Report for LTT 1445 A

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Rocky Worlds is a joint JWST and HST Director's Discretionary Program designed to implement the top recommendations from the Working Group on Strategic Exoplanet Initiatives with HST and JWST (Redfield et al., 2024). The HST side of the Rocky Worlds DDT focuses on ultraviolet (UV) characterization of the nearby M-dwarf hosts of the rocky planets observed with JWST. We use COS and STIS to measure the UV to blue-optical spectra of these stars, including UV flare monitoring and measuring the wings of the Ly-alpha profile where appropriate. With these observations we constrain the high-energy output of these host M dwarfs in the UV, which can be applied to planetary models of atmospheric escape, as well as photochemistry if a planetary atmosphere is present. As detailed below, the HST Target Scheduling Team has constructed a plausible SED for LTT 1445 A (§1) and has used these values to calculate APT inputs (§2).

1 Stellar Parameters

We adopt parameters for LTT 1445 A primarily from Winters et al. (2019), who provided detailed stellar parameters based on high resolution spectroscopy. The parameters are presented in Table 1.

Since LTT 1445 A has archival HST observations, we assessed the utility of these exsiting observations. Table 2 lists the program IDs, PIs, Modes, and exposure times.

For our ETC calculations, we used a combination of the "Panchromatic Spectra of M stars" HSLPs[1] v01 of the `adapt-const-res.fits` of the LTT 1445 A SED to determine exposure times in the NUV-Optical (Diamond-Lowe et al., 2024), and custom HSLA coadds (Sankrit et al., 2025) for COS FUV observations. Table 3 has the estimated SNRs from archival data. The Rocky Worlds team assessed that these line SNRs would be sufficient for the goals of the Rocky Worlds project.

2 APT INPUTS

The goal for each target host star is to obtain a) flare monitoring in the FUV, b) UV coverage of as many emission lines as is feasible, c) an NUV-Visible spectral energy distribution (SED), and d) high enough SNR observations of the wings of the Lyman-α line to reconstruct the intrinsic Lyman-α profile.

For LTT 1445 A, we meet our science goals by scheduling 12 orbits of flare monitoring using G130M/1222 which, together with archival data, provides complete UV coverage from 1070–1710 Å. We will additionally obtain NUV/Vis low resolution spectroscopy with STIS G230L and G750L using the 52x0.2 slit for SED construction in concert with archival G230L and G430L observations. We determined that archival data

[1] https://archive.stsci.edu/prepds/mstarpanspec/

Parameter	Value
T_{eff} (K)	3337±150
log g	4.96
Radius ($R_\odot$)	0.27
Spectral Type	M4V
H-α EQW (Å)	0.20±0.02
RV (km s^{-1})	-5.44±0.01

Table 1: Adopted Stellar Parameters from Winters et al. (2019)

was sufficient to measure the wings of the Lyman-α line in order to reconstruct the intrinsic line profile (Youngblood et al., 2017). We repeat STIS/G230L observations to verify that the Mg II 2800 Å lines have not significantly changed compared to our archival data.

3 LTT 1445 BC

LTT 1445 A is a hierarchical triple M dwarf system (Winters et al., 2019), with a subarcsecond secondary binary component located ∼46 au away designated as LTT 1445 BC. While the details of this orbit are not directly relevant to our science program, the location of LTT 1445 BC was an important consideration when determining the safety of the COS and STIS UV observations. Unlike LTT 1445 A, LTT 1445 BC has evidence for high activity and H-α emission, raising the risk of a bright flare from the secondary or tertiary stars during an HST observation. According to the COS ISR 2017-01 and STIS ISR 2017-02, we must also assess the flaring safety of LTT 1445 BC.

Figure 1 shows a recent WFC3/IR acquisition image of the triple system. Given that it appears that the three components have small relative inclinations to the line of sight, we anticipate that in 2026 LTT 1445 BC will be moving nearly radially closer to LTT 1445 A at roughly the same PA. Based on the available photometry and estimated stellar parameters in the literature, LTT 1445 BC is consistent with two active M4-M4.5 stars, with the C component being the most active component (Brown et al., 2022; Diamond-Lowe et al., 2023). The safety risk comes if the COS bright object aperture (BOA) happens to fall onto LTT 1445 BC. We assumed a flare with ΔU=8 and U=14.66 for the brighter B component of LTT 1445 BC, with a 9000 K blackbody SED. Since the proposed COS FUV observations avoid all bright flare lines, by definition that observing mode is safe. We also assess that the binary is safe to observe for all COS NUV modes during acquisitions, but will pose a safety risk for STIS/G230L if the slit is aligned with the binary PA. We thus enforce orient constraints with a $\pm 20^\circ$ margin that will prevent that from happening. Detailed safety ETC calculation for LTT 1445 A under assumed flaring for COS/NUV acquistions is `COS.ta.2221757`, while for LTT 1445 BC it is `COS.ta.2260993`. For STIS/G230L, the calculation is `STIS.sp.2260994`.

Program ID	Instrument	Grating	T_{exp} (s)
16701	STIS	G140M	4488
16701	STIS	G230L	2053
16701	STIS	G430L	60
16722	COS	G130M	7657
16722	COS	G160M	12125
16722	COS	G230L	540
16722	STIS	G140M	2208

Table 2: Archival observations of LTT 1445 A

Line	SNR	Grating
Lyman-α(1216Å)	24-14	STIS/G140M
Si II(1261Å)	3	COS/G130M
Si II(1264Å)	5	COS/G130M
Si III(1206Å)	18	COS/G130M
Si III(1294Å)	0.1	COS/G130M
Si IV(1393Å)	33	COS/G160M
Si IV(1402Å)	24	COS/G160M
C II(1334Å)	15	COS/G130M
C II(1335Å)	21	COS/G130M
C III(1175Å)	11	COS/G130M
C IV(1548Å)	40	COS/G160M
C IV(1550Å)	27	COS/G160M
O IV(1401Å)	8	COS/G160M
O V(1371Å)	9	COS/G160M
N V(1238Å)	18	COS/G130M
N V(1242Å)	13	COS/G130M
Mg II(2796)	43	STIS/G230L
Mg II(2803)	26	STIS/G230L

Table 3: Estimated Line SNR for key UV Lines, based on archival observations.

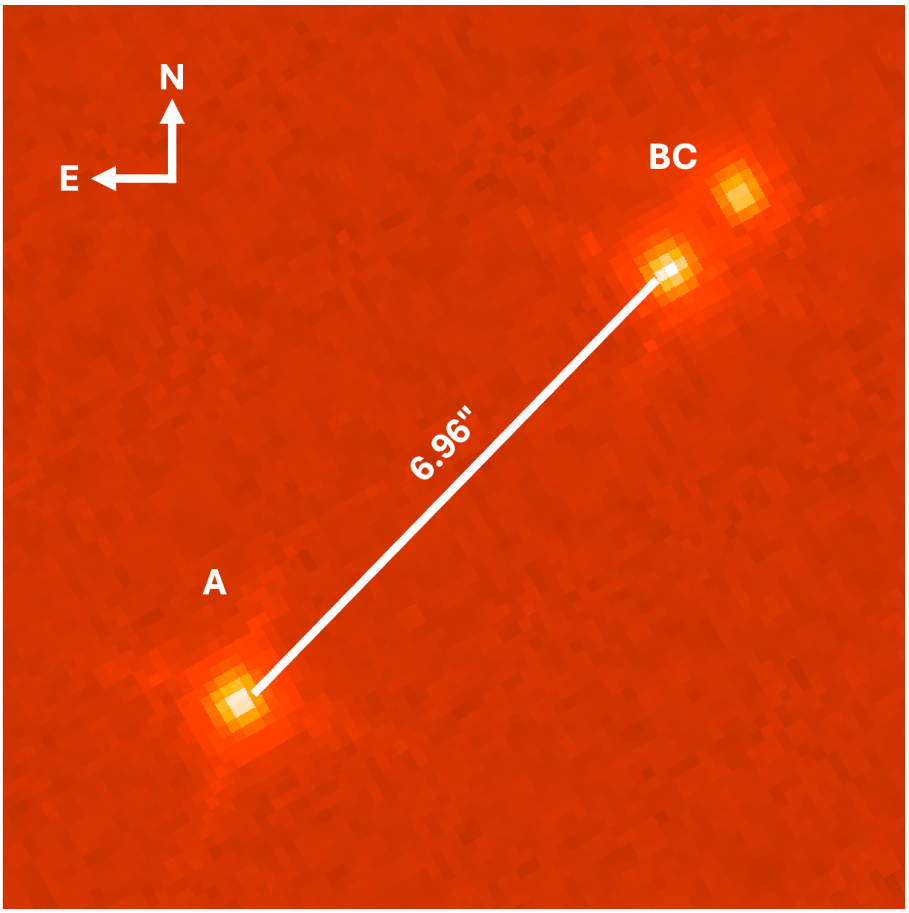

Figure 1: WFC3/IR F132N image obtained on 7 January 2021 of the LTT 1445 triple system (Program 16039; PI: Sing), showing the separation of the components. The PA to the B component is 315°. In addition to WFC3, NICMOS and the ACS HRC has observed the triple system (Program 9485; PI: Golimowski–2003 and 10525; PI: Hawley–2005).

References

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