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ABSTRACT

The EXoplanet Climate Infrared TElescope (EXCITE) is a 0.5 meter near-infrared spectrograph that will fly from a high altitude balloon platform. EXCITE is designed to perform phase-resolved spectroscopy – continuous spectroscopic observations of a planet's entire orbit about its host star – of transiting hot Jupiter-type exoplanets. With spectral coverage from 0.8 – 4 um, EXCITE will measure the peak of a target's spectral energy distribution and the spectral signatures of many hydrogen and carbon-containing molecules. Phase curve observations are highly resource intensive, especially for shared-use facilities, and they require exceptional photometric stability that is difficult to achieve, even from space. In this work, we introduce the EXCITE experiment and explain how it will solve both these problems. We discuss its sensitivity and stability, then provide an update on its current status as we work toward a 2024 long duration science flight.

Keywords: Exoplanet spectroscopy, hot Jupiters, spectroscopic phase curves, balloon-borne instrumentation

1. INTRODUCTION

The EXoplanet Climate Infrared TElescope (EXCITE)[1] is a NASA-funded balloon experiment designed to measure spectroscopic phase curves of hot Jupiter-type exoplanets in the near-infrared (NIR) band from 0.8 – 4 μm. A spectroscopic phase curve measurement is a continuous spectroscopic observation of a transiting exoplanet as it performs an entire orbit of its host star. Such observations are rich scientifically. Even at relatively low spectral resolution, phase curve observations can provide significant insights into an exoplanet atmosphere's composition and how energy is distributed in the atmosphere. They also provide information about the planet's

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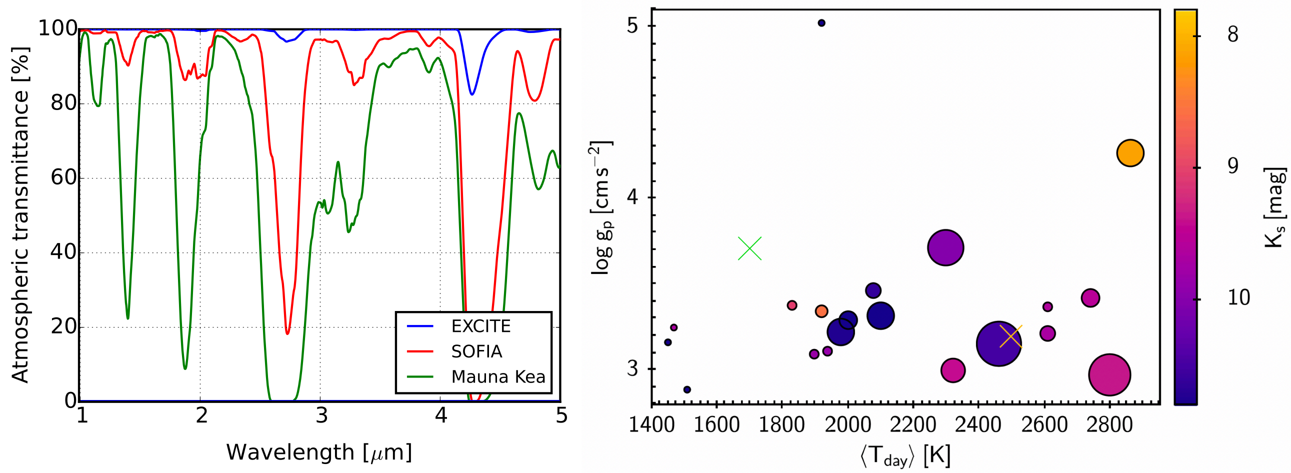

Figure 1. Left: Atmospheric transmittance as a function of wavelength for observations from a LDB platform (blue), airplane (red), or the ground (green). EXCITE's science band is from 0.8–4 μm. The detector is sensitive out to 5 μm, but at wavelengths longer than $\sim$ 4 μm the signal is dominated by emission from Earth's atmosphere and the warm optics. Bandpass filters will prevent this light from reaching EXCITE's focal plane. Right: Properties of suitable targets visible during a single Antarctic LDB flight. These targets were identified using the TEPCat catalogue of well-studied transiting exoplanets.[2] The mean dayside effective temperature $\langle T_{\rm day} \rangle$ is estimated using an empirical relation calibrated on observed transiting hot Jupiters. These planets range in temperature from 1450 K to 2800 K. The symbol size is proportional to predicted K_s-band eclipse depth, ranging from 260 ppm to 2850 ppm. Planets in this plot with low surface gravities ($\log g_p$) are also suitable targets for study with transmission spectroscopy during transits. The crosses show the properties of WASP-43b and WASP-103B, the two of the three planets for which phase-resolved spectroscopy has been published to date.[3,4] Figure from Nagler et al.[5]

atmospheric composition as a function of pressure and altitude, and if performed over a wide enough spectral band, can constrain the planet's temperature. But even for short period planets, such observations are both difficult and time consuming. They require excellent photometric stability, and ideally, minimally-interrupted continuous stares of the target system. EXCITE achieves this by combining a highly-stable instrument design with deployment from high altitude near Earth's poles, where its science targets are always visible from an observation platform above $\sim$ 99.9% of Earth's atmosphere.

In the following, we introduce EXCITE's science goals, present an overview the EXCITE mission and instrument design, and provide an update of its current status. We are currently anticipating a North American engineering flight in the fall of 2023, followed by an Antarctic long-duration balloon (LDB) science flight in the winter of 2024/2025. By combining largely commercial components in a robust architecture, we expect EXCITE to deliver the performance required to greatly enhance our understanding of the target planets, while also testing technologies that will be central to future NIR space-based observatories.

2. EXCITE SCIENCE

EXCITE's primary science goal is to measure spectroscopic phase curves of transiting hot Jupiters in the spectral band from 0.8 – 4.0 μm. A complete description of EXCITE's science motivation is provided by Nagler et al.[5] We summarize it here.

As a transiting exoplanet orbits its host star, a distant observer can measure a time-varying flux whose amplitude is some small faction of the planet:star flux ratio ρ. There are two well-known discontinuities in this signal: the transit (where the planet passes between its host star and the observer), and the eclipse (where the planet is occulted by its star). Measurements of each can yield insights into the composition and physics of the exoplanet's atmosphere (e.g., see Burrows[6] and references therein). In the case of the transit, star light is filtered by the exoplanet's atmosphere. Observed spectroscopically, transit measurements can constrain the atmosphere's composition, but only in the low-pressure region near the limb of the planet. Eclipse measurements can constrain a planet's emission spectrum, which provides information about a planet's atmospheric composition, vertical thermal structure, and circulation patterns. Still, eclipse measurements only provide a hemispheric average of a planet's characteristics.

More complete than either measurement alone is spectroscopically observing the planet's entire orbit about its host star, including the transit and eclipse. Known as a spectroscopic phase curve measurement – and the general technique as "phase-resolved spectroscopy" – the resultant signal is used to probe a wide range of pressure levels in the planet's atmosphere as the atmosphere's opacity changes as a function of wavelength. Comparisons between phase curves measured at a range of wavelengths reveal how the relevant radiative, chemical, and dynamical timescales vary as a function of atmospheric pressure and therefore altitude. Spectroscopic phase curves measured through the peak of the planet's spectral energy distribution (typically at a wavelength of ~ 2 μm for hot Jupiters) reveal how the chemistry and dynamics of exoplanet atmospheres vary with equilibrium temperature and surface gravity. Phase curve measurements are the only observations that directly constrain the global energy budget and circulation patterns that result from the extreme irradiation of hot Jupiters.

Despite this wealth of information that can be derived from spectroscopic phase curve measurements, few exist in the literature. There are several related reasons for this. Observing from above the Earth's atmosphere is necessary to avoid telluric contamination of measured data in the NIR (see Fig. 1). As a result, only space-based measurements have been made in the NIR, using either *Hubble Space Telescope (HST)*[3,7] or a combination of *HST* and *Spitzer*.[4] Even for targets with orbital periods of less than at day, however, these observations are resource intensive, especially for space instruments that operate from low earth orbit (LEO) where multiple observations necessarily need to be stitched together to generate a phase curve. For example, Stevenson et al.[3] needed 60 *HST* orbits (95h) to measure the spectroscopic phase curve of a planet with a 19.5h orbital period, and Kriedberg et al.[4] needed 60h of *HST* time and 46h of *Spitzer* time to measure the spectroscopic phase curve of a 22.5h orbital period planet. NIR phase curve measurements will be similarly time-consuming for *James Webb Space Telescope (JWST)*, which cannot measure broadband spectra of the brightest phase curve targets with any single instrument.[8]

The most efficient way to make a phase curve measurement is instead to continuously stare at a target for the duration of its orbit. This not only prevents wasted observing time when a target is not visible, but it also enables a stable observing environment where achieved photometric stability is less impacted by instrument settling times or stellar variation (e.g., see Kreidberg et al.[4] for a description of the impact of these systematics on *HST* phase curve observations). EXCITE will do exactly this. By taking advantage of a ∼15–30 day circumpolar flight, the stability of both the instrument and the upper stratosphere during the polar summer, and the constant visibility of targets, EXCITE is capable of delivering up to ~ 10 background-limited spectroscopic phase curve measurements in a single LDB flight, vastly increasing the physical parameter space probed by phase curve measurements (see Figure 1).

Figure 2 shows a simulated spectral retrieval and a pressure-temperature profile as a function of orbital phase using EXCITE's calculated sensitivity, accounting for correlated systematic effects studied via end-to-end simulations.[5] In measuring phase curves, we expect to have similar sensitivity to *HST*, but over a much wider spectral bandpass, and with a much more efficient observing strategy. The data needed to generate this plot would be collected over a single continuous observation of the planet's orbit.

3. PAYLOAD DESIGN

In this section, we describe the EXCITE payload design. The overall architecture is based on the SuperBIT experiment.[10] EXCITE uses a nearly-identical gondola, telescope, and pointing system to those deployed by SuperBIT, but features a cryogenic receiver that is unique to EXCITE. The receiver consists of a cryogenic spectrometer and the detector. Together, the system is designed to enable extended stares of science targets with background-limited photometric stability.[5] The gondola and telescope are described in Section 3.1, the spectrometer in Section 3.2, the detector in Section 3.3, and the cryostat in Section 3.4.

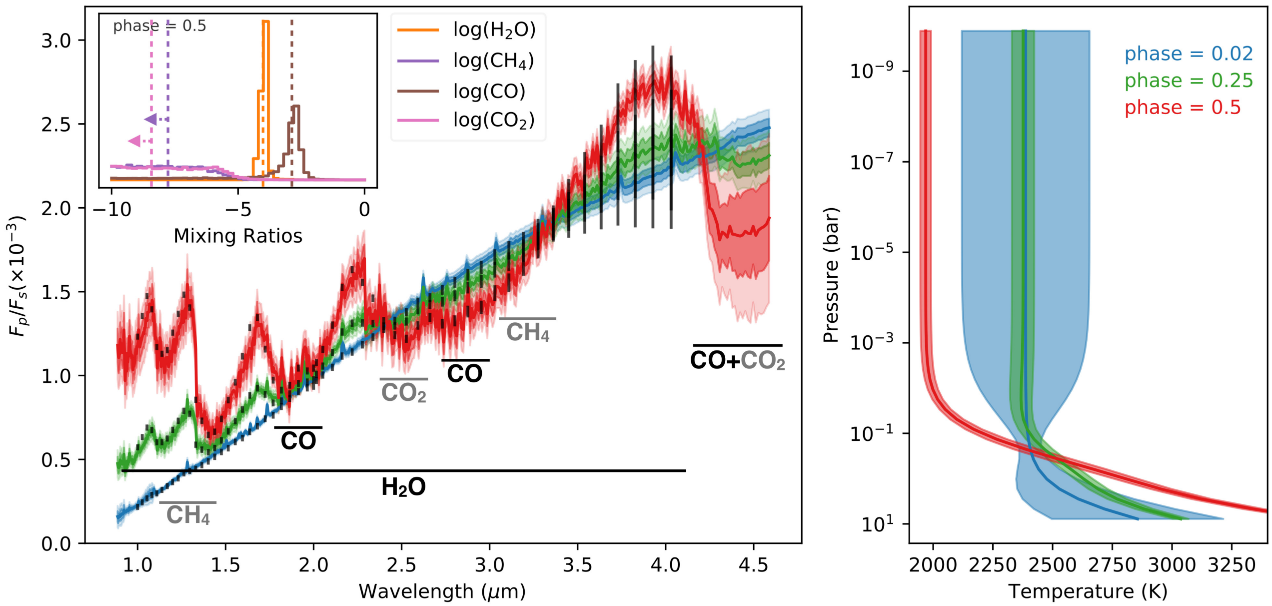

Figure 2. Spectroscopic retrieval simulations for the phase curve of a moderate brightness, short period hot Jupiter observed by EXCITE. Using the TauREx retrieval framework, a chemical equilibrium day and night-side chemistry with C/O = 0.8 and solar metallicity was calculated. We base the day-side temperature profile on[9] and assume an isothermal profile for the night contribution. Left: Resulting emission spectra at phases 0.02 (transit, blue), 0.25 (quarter orbit, equal day-night side, green) and 0.5 (eclipse, red). The error bars correspond to calculated noise from a radiometric model, with an additional added noise floor that is equivalent to 50 ppm in an hour of integration. The insert plot in the left figure shows the volume mixing ratios retrieved at eclipse (phase = 0.5). At C/O = 0.8 the main observables are water and carbon monoxide. These could be accurately retrieved with high degree of confidence; dotted lines show input values. At higher C/O ratios, CH_4, CO_2 and other species become increasingly abundant. We labeled their strongest absorption bands in gray. Right: Temperature profiles retrieved for varying phases. As expected, as more and more day-side emission becomes visible, the temperature profile departs strongly from the initial isothermal temperature profile retrieved in transit. Depending on clouds and atmospheric composition, the pressures probed by the EXCITE wavelength range are typically between 1 bar and the top of the atmosphere. The instrumental performance here can be directly compared to the *HST* results presented by Stevenson et al.[3] Figure from Nagler et al.[5]

3.1 Gondola and telescope

The EXCITE gondola is a near-copy of the SuperBIT gondola[10] and is built by StarSpec Technologies, Inc. Shown in Fig. 3, the gondola consists of three nested frames – an outer, middle, and inner frame – that stabilize three nearly-orthogonal axes to better than 1” rms. The science instrument – which consists of the telescope, receiver, and associated electronics – is supported by the inner frame. Fine pointing control (∼ 50 mas rms) is achieved with a piezo-driven tip/tilt stage with centroid feedback from a star camera positioned at the telescope focus (see Figure 4). Power for the instrument is generated by an array of solar panels that mount to the gondola’s outer frame (not shown in Fig. 3), and stored by conventional lead-acid batteries that are supported by the outer frame. The position of the solar panels, along with the azimuthal coordinates of the science targets relative to the Sun, set the operational azimuthal range of the instrument (+/- 45° anti-Sun). The elevation range is limited to 22° – 57°, which prevents the telescope from directly seeing either the ground or the balloon.

All of EXCITE’s science targets are continuously visible within the prescribed elevation and azimuth ranges. The SuperBIT platform is capable of staring at the targets continuously for at least 4h, and up to 8h, assuming typical Antarctic flight latitudes. This time is ultimately limited by the rotational travel of flexure bearings which support the pitch and roll axes (corresponding to the inner and middle frames, respectively). These bearings have a travel of +/- 6°, with no torque discontinuities in their range of motion. When the travel reaches its limit, the bearings can be reset, a process which takes ∼ 30s. The system has the absolute pointing accuracy to place the science signal on the same detector pixels before and after a reset, and the system configuration otherwise

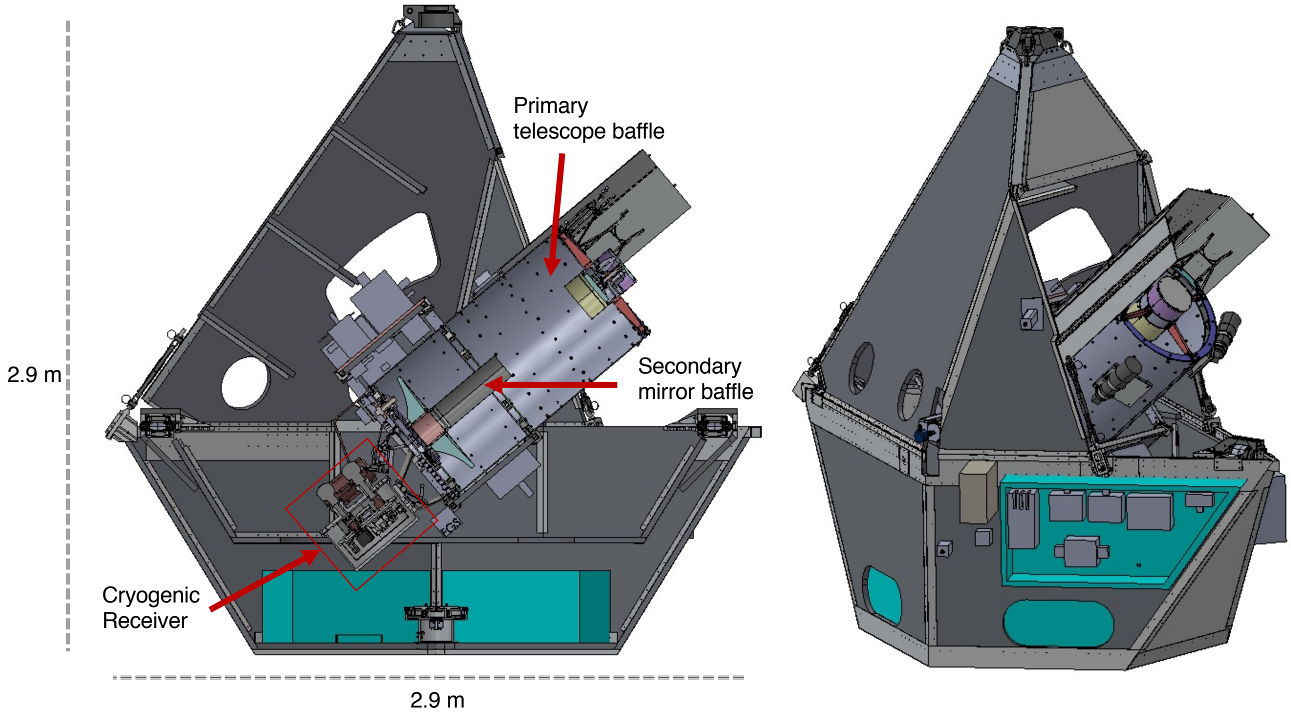

Figure 3. CAD model of the EXCITE gondola supporting the science instrument. The gondola is a near-copy of SuperBIT, and the telescope is minimally changed from the one that flew on SuperBIT. Visible are the science instrument's radiator panels – seen cantilevered beyond the telescope's baffle tube – which reject heat dissipated by the cryocoolers to space.

will change minimally. As a result, we do not expect bearing resets to result in low frequency systematics related to instrument settling.

EXCITE uses a 0.5m f/12 telescope built by Officina Stellare. It is minimally changed from the telescope used by SuperBIT, with only small modifications made to its optical specifications and to the specifics of how it interfaces to the receiver and associated components. Both the primary and secondary mirrors are made from fused silica and are coated with protected silver, providing average reflectivity of $> 97\%$ from 0.8 – 4 μm. The secondary mirror features 3-axis actuation, allowing focus adjustment on the ground and in flight. The telescope has a carbon fiber baffle tube. The interior of the tube is lined with 5-layer aluminized mylar blankets to help passively cool the primary and secondary mirrors. Similar schemes have been employed on previous LDB flights to achieve mirror temperatures as low as -20 C.[11] Also mounted to the inside of the baffle tube are a series of vanes employed to reject stray light from either the Antarctic ice or the balloon. Several components are mounted to the exterior of the baffle tube: a star camera, gyroscopes, and radiators that dissipate heat generated by the science instrument.

The telescope interfaces to the receiver through a "transfer box" mounted to its carbon fiber back plate (see Section 3.4). The telescope mounts to inner frame via two dovetail plates fastened to the sides of the baffle tube. Tested on SuperBIT, the dovetail plate configuration allows fine tuning of the science instrument's balance relative to the elevation axis.

Construction and laboratory pointing tests of the EXCITE gondola's outer and middle frames have already been completed, with stability of < 0.7" RMS achieved in both the yaw and roll axes. Delivery of the complete gondola is expected in fall 2022, and the telescope delivery is expected in winter 2022/2023.

3.2 Spectrometer

The EXCITE spectrometer is described in these proceedings by Bernard et al.[12] It is a compact and high-throughput design, and with relatively loose alignment tolerances, can easily achieve diffraction-limited performance across its bandpass. A ray trace of the spectrometer, including the fore optics that steer the beam into the

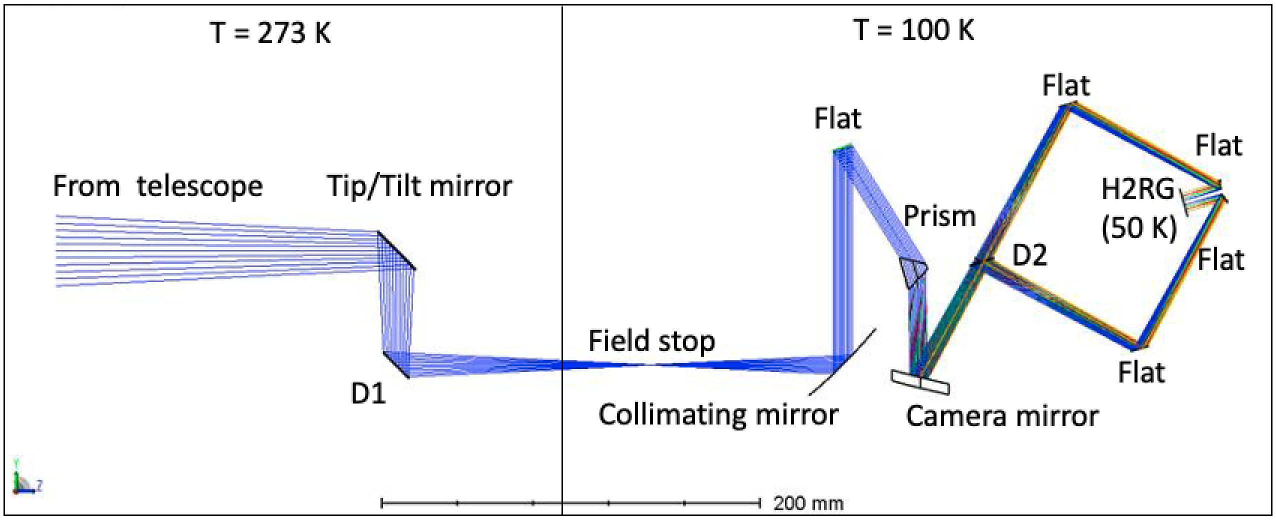

Figure 4. Ray trace showing the light which passes through the central aperture of the primary mirror. The warm optics will operate near 273 K. The spectrometer is cooled to 100 K to limit thermal emission on the detector. The focal plane itself is cooled to 50 K and is housed inside a 50 K box. Not shown in the guide camera focal plane, which measures light transmitted by D1.

cryostat, is shown in Figure 4. Light collected by the telescope passes through a central aperture in the primary mirror (see Figure 3), then reflects off a piezo-actuated tip/tilt mirror stage. The light then encounters the first dichroic ("D1") which reflects wavelengths 0.8 – 4 μm and transmits wavelengths 0.6 – 0.8 μm. The short wave channel is then incident on a fine guidance star camera at the telescope focus (not shown in the ray trace). This camera is used to lock on the target star, and provides pointing feedback to the tip/tilt mirror in the band from $\sim$1 – 45 Hz. Based on SuperBIT's flight performance, we expect this system to stabilize the line-of-sight to better than 50 mas RMS. Longer timescale drifts can be corrected using feedback from the science focal plane.

Light that reflects off D1 enters the cryostat through an antireflection-coated sapphire vacuum window. Sapphire was chosen for its ability to achieve high transmittance in the EXCITE science band ($>$ 90% broadband) and for its mechanical strength. The light next passes through a field stop positioned at the telescope focus to block stray light, and is incident on a collimating mirror. An optical flat steers the collimated beam to a prism made from CaF_2. The prism disperses the light, which next reflects off the camera mirror. The light then encounters the second dichroic ("D2"), which transmits the short band (0.8 – 2.5 μm, known as "Ch1") and reflects the long band (2.5 – 4 μm, "Ch2"). Each channel is steered by a series of optical flats onto the focal plane ("H2RG"). The package that holds the detector has two baffles with band-defining filters for each spectrometer channel, correcting any spectral spillover from D2. The magnification of the spectrometer is 2.7, resulting in an f/32.4 optical system, and a detector plate scale of 227 mas/pixel. The prism dispersion results in a resolving power $R \sim 50$, and the beam is Nyquist sampled at all wavelengths longer than 1 μm.

3.3 Detector and readout electronics

EXCITE uses a Teledyne H2RG 2k$\times$2k detector cooled to 50 K. It is sensitive from 0.8 – 5.3 μm and is read out by the ACADIA readout electronics[13] developed for the *Roman Space Telecope (RST)*. The particular H2RG used for EXCITE is a former flight candidate detector from the NIRSpec instrument on *JWST*. Its performance is described by Rauscher et al.[14] EXCITE will be the first instrument to fly ACADIA, providing an important demonstration of the technology in a space-like environment before it is deployed on *RST*.

NIRSpec-style H2RG detectors are read out in four quadrants, each consisting of 512 columns and 2048 rows. Both the long and short wave spectra are $\sim$ 300 pixels wide in the dispersion direction. We will read out a similar number of pixels in the cross-dispersion direction. Each spectrum will be incident on its own detector quadrant. From a radiometric model of EXCITE observations of a bright target,[15] the maximum per-pixel flux

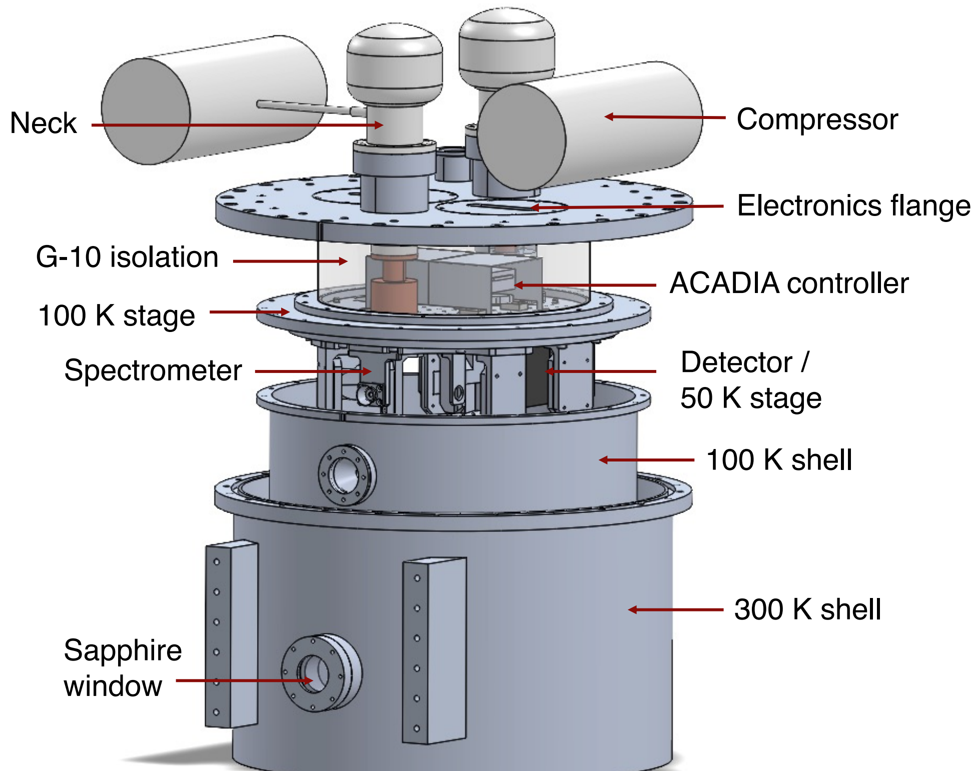

Figure 5. Exploded view of the cryostat. It uses two Thales LPT9310 cryocoolers to cool the spectrometer to 100 K and the detector to 50 K. The ACADIA controller is stood off from the 100 K stage and has its own temperature control system. The system is remarkably compact, with a top flange diameter of only 35.6 cm.

expected in Ch1 is 4980 e^-/sec, and 912 e^-/sec in Ch2, corresponding to saturation times of 14s and 76s in each channel, respectively. Because we employ band-defining filters at the entrance to the detector package, we do not expect stray light from outside of the intended spectral bands to impact exposure times.

We will use the ACADIA to operate the H2RG in window mode, reading out the two 300×300 pixel windows corresponding to the two spectra. We intend to sample up-the-ramp at nominal rates of 100 kHz in Ch1 and 20 kHz in Ch2, resulting in ~ 1 Hz non-destructive frame rates (note that Ch2 can also be read out at 100 kHz and decimated in post-processing to yield an effective 20 kHz sampling rate). With read noise well subdominant to photon noise,[5] we will likely reset the entire detector at the cadence required to avoid saturation in Ch1.

3.4 Cryogenic system

The EXCITE cryogenic system is described in these proceedings by Rehm et al.[16] It consists of a dewar, two Thales LPT9310 pulse tube cryocoolers, and a heat dissipation scheme based upon copper-methanol thermosyphons and radiators. An exploded view of the cryostat is shown in Figure 5. The 300 K shell is the vacuum can and also forms the mechanical interface between the receiver and the transfer box via the two vertical columns of bolt holes on either side of the sapphire window. The two cryocoolers mount to the top plate. One cryocooler cools the spectrometer and its enclosure to 100 K. The 100 K stage is stood off from the 300 K top plate by a G10 cylinder. The other cryocooler cools only the detector and its enclosure to 50 K. The estimated heat loads on the 100 K and 50 K cryocoolers are 4.9 W and 60 mW, respectively. The coolers are capable of rejecting 9.5 W at 100 K and 1 W at 50 K,[17] thus we expect to have significant performance margin. The spectrometer can run as warm as 120 K without impacting science performance. At 120 K, the cryocooler can reject > 12 W.

Each cryocooler is expected to dissipate 150 W during operation. Roughly half is dissipated at the compressor, and half at the neck. We designed a thermal dissipation scheme that uses copper-methanol thermosyphons and

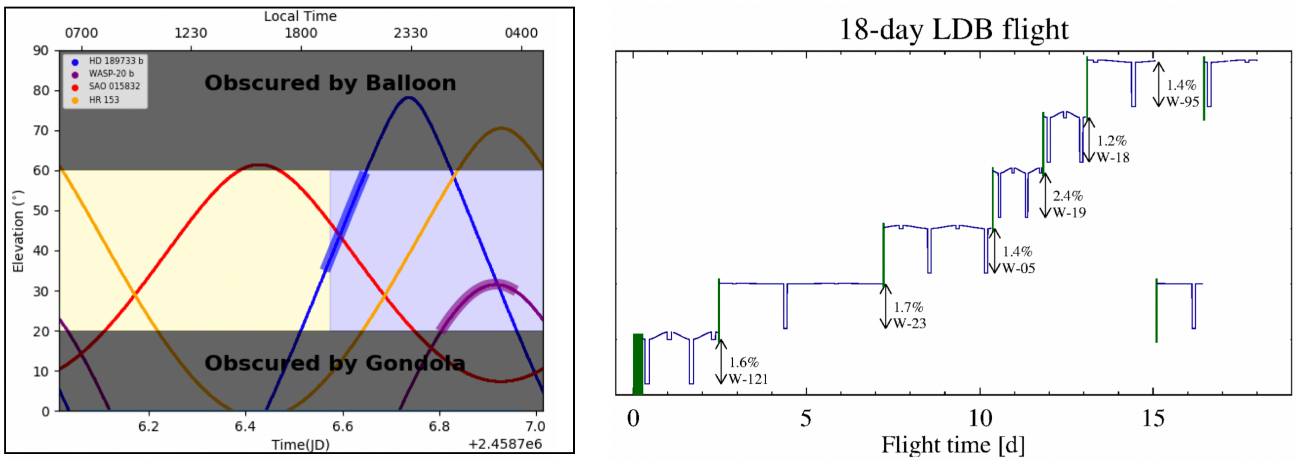

Figure 6. Left: A possible North American (NA) test flight observing schedule. During this flight EXCITE will observe calibration stars to test systematics (yellow region) and two eclipsing exoplanets (blue region). Wide lines indicate eclipses. Multiple eclipsing targets are visible during any NA flight. Right: A possible schedule of observations for a sample 18-day LDB flight from the Antarctic. Setup (6 hours) and overheads for acquisition and calibration (1 hour per target) are blocked out in green. The vertical axis is signal amplitude with each target offset. The amplitudes of the eclipses, transits and photometric phase curves at K-band in the cartoon light curves are approximately correct.

radiator plates to reject this heat to space. Jackets which mount to either the compressors or the necks act as the evaporators, and the radiators as the condensers. Laboratory tests of prototype components, along with simulations of complete system performance, indicate that this scheme will work with sufficient margin to meet the temperature stage requirements (see Rehm et al.[16]).

The use of cryocoolers enables the realization of a lighter and more compact receiver for a long duration flight than is possible with liquid cryogens. It also significantly reduces operational and logistical complexity, particularly when deploying from the Antarctic. The cryocooler-equipped EXCITE receiver takes up roughly the same volume as the ambient-temperature SuperBIT receiver. As a result, no EXCITE-specific changes to the gondola configuration – e.g., to accommodate a larger receiver – needed to be made, thereby preserving the gondola's flight heritage. In addition, we investigated the impact of exported vibrations from the cryocoolers on the instrument's line-of-sight stability. Both rigid-body analytic calculations (an effective worst-case scenario), and numerical elastic calculations, show that vibrations from the coolers will have negligible impact on EXCITE's pointing stability.

4. MISSION DESIGN

Here we descibe EXCITE's observing strategy and the target selection process. The EXCITE baseline mission includes two flights: a ∼24 hour test flight launched from Ft. Sumner, NM and a long duration ∼15–30 day circumpolar flight launched from McMurdo Station, Antarctica. While this section focuses on a southern hemisphere science flight, it can also be re-optimized for a northern hemisphere LDB flight. The key goals of the NM flight are testing the stability of the instrument photometry, spectroscopy, and pointing. A possible test flight observing sequence is summarized by Fig. 6. In this example EXCITE observes two known systems with visible eclipses. EXCITE will observe HD189733b with up to 3 hour stares. The eclipse of WASP-20b is also visible. In addition to the known transiting systems, two bright spectrophotometric standards from the ESO-HST standard list will be included in the flight plan. The star camera will be used to check pointing and photometry, while the spectral data will check the consistency of the spectral shape. The standards cover the full range of visible elevations not blocked by the balloon or gondola, and will also be observed for multi-hour sequences enabling measurements of Earth's atmospheric transmission as a function of telescope altitude and elevation. The standard observations will also switch between the two sources to determine the settling time of the instrument.

Suitable targets for the science flight have been identified using the TEPCat catalogue of well-studied transiting extrasolar planets.[2,18] We assumed a flight during the austral summer and set a minimum allowable observation elevation of 27°, to avoid high airmass observations, and a maximum elevation of 57°, to avoid observing the balloon. The mean day-side temperature of short-period hot Jupiter is given to good accuracy by $\langle \mathrm{T_d} \rangle = \mathrm{T}_{\mathrm{eff},\star} \left(\frac{1}{2}\right)^{1/4} \sqrt{R_\star/a}$, where $\mathrm{T}_{\mathrm{eff},\star}$ and $R_\star$ are the effective temperature and radius of the host star and a is the semi-major axis of the planet's orbit. Using this value and assuming blackbody radiation from the planet's day side we estimated the eclipse depth at $\mathrm{K_s}$-band, $\Delta\mathrm{K_s}$, i.e., the maximum peak-to-trough amplitude of the phase-curve. Where observed values of the eclipse depth are available, they are in good agreement with this estimate. The range of physical parameters occupied by the targets is shown in Figure 1. Shown are all southern hemisphere targets with $\Delta\mathrm{K_s} > 250$ ppm.

The discovery rate for transiting hot Jupiters has accelerated in recent years. Many EXCITE targets were discovered by WASP.[19] We expect additional targets to become available prior to the first LDB flight from ongoing ground-based surveys and *TESS*.[20,21] All the targets will be bright, short-period planetary systems for which the fundamental properties of the system (planet mass, radius, etc.) are accurately known from existing observations.

Final target selection for the science flight will depend on the performance of the instrument and what is known about available targets at the time of launch. Targets will be prioritized according to the availability of complementary observations (particularly phase curves), brightness, and orbital period. We can maximize the number of targets observed if we focus on those with shorter orbital periods, but this must be balanced against the science aim to understand how the atmospheres of hot Jupiters vary with irradiation levels. Thus we will observe both short and long period planets. For a sample 18 day mission from the Antarctic, our target selection based on currently-known systems is WASP-18, WASP-41, WASP-121 and WASP-122, which sample a range of temperatures between 1,400 K and 2,800 K. The timeline of the resulting observing sequence is shown in Fig. 6.

5. CURRENT STATUS AND CONCLUSIONS

Most of EXCITE's flight hardware is now in hand and is in the process of being assembled and/or tested. Integration at the instrument level will begin in fall 2022. The primary integration location will be Brown University, with large laboratory and highbay spaces reserved for EXCITE integration and system-level testing. Prior to our engineering flight, which we expect to take place in the fall of 2023 from Ft. Sumner, NM, we will perform on-sky pointing tests of the complete instrument, likely from either Palestine, TX or Ft. Sumner, NM. Certain components will also undergo thermal vacuum testing, likely in Palestine. A successful test flight, confirming EXCITE's designed photometric stability, will ready EXCITE for its planned Antarctic science flight in winter 2024/2025.

EXCITE is poised to deliver breakthrough exoplanet science. Spectroscopic phase curve observations are unique in their ability to constrain so many properties of exoplanets and their atmospheres that cannot be measured by other means. With broad and continuous spectral coverage, the ability to efficiently measure the brightest and best hot Jupiter phase curve targets, and exceptional photometric stability, EXCITE will perform observations that are not possible with any existing ground, airborne, or space-based observatory.

The landscape of space-based observatories that operate in EXCITE's band is rapidly changing. With the recent launch of *JWST*, the upcoming launches of both *ARIEL* and *RST*, and the continued operation of *HST*, there are soon to be four observatories that overlap some portion of EXCITE's spectral bandpass. It is in this context that EXCITE will also make a large impact. By performing unique exoplanet science that has not proven practical from shared-use platforms,[22] while also serving as a test bed for the exoplanet observational techniques, data analysis, and enabling technologies that support these space missions, EXCITE will help maximize the exoplanet science that can be accomplished by all.

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