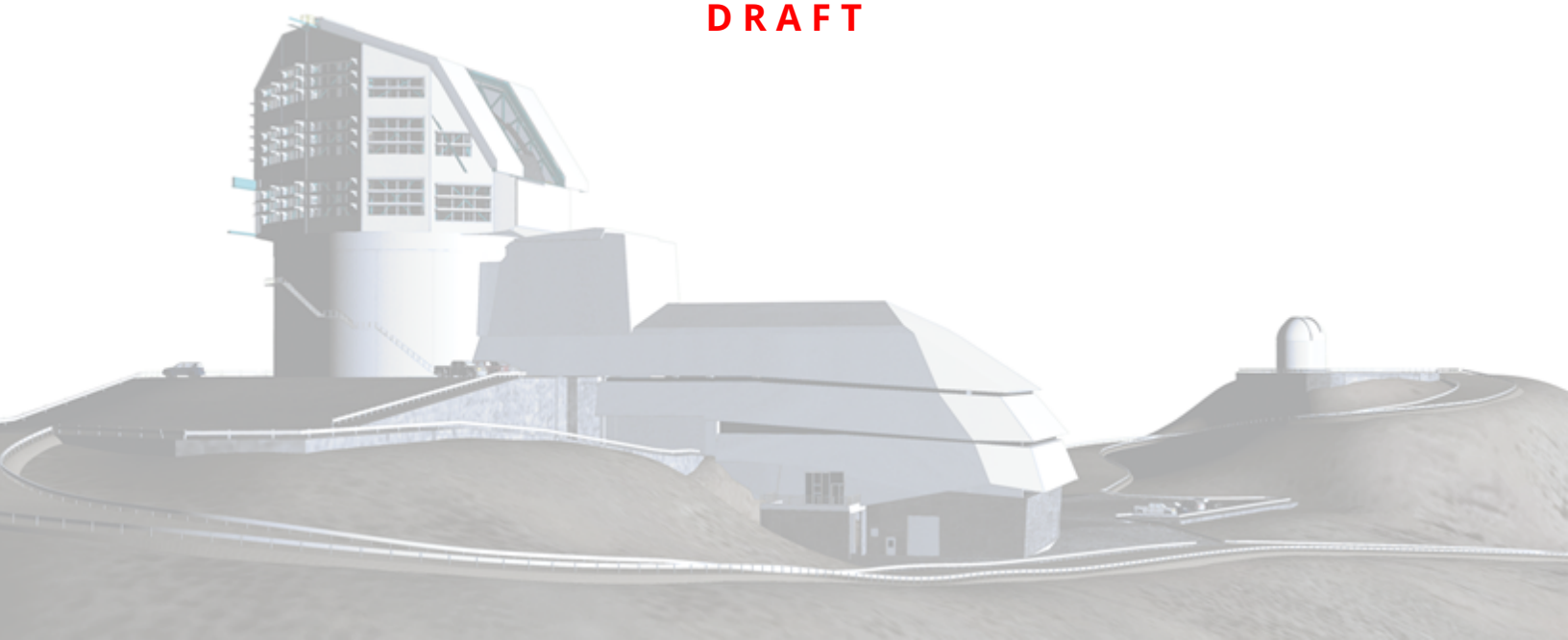

Vera C. Rubin Observatory
Systems Engineering

An Interim Report on the ComCam On-Sky Campaign

Many authors

SITCOMTN-149

Latest Revision: 2024-11-26

DRAFT

Abstract

A summary of what we have learned from the initial period of ComCam observing

Change Record

Version	Date	Description	Owner name
1	YYYY-MM-DD	Unreleased.	Robert Lupton

Document source location: `https://github.com/lsst-sitcom/sitcomtn-149`

Contents

An Interim Report on the ComCam On-Sky Campaign

1 Introduction

The Vera C. Rubin Observatory on-sky commissioning campaign using the Commissioning Camera (ComCam) began on 24 October 2024 and is forecasted to continue through mid-December 2024. This interim report provides a concise summary of our understanding of the integrated system performance based tests and analyses conducted during the first weeks of the ComCam on-sky campaign. The emphasis is distilling and communicating what we have learned about the system. The report is organized into sections to describe major activities during the campaign, as well as multiple aspects of the demonstrated system and science performance.

Warning: Preliminary Results

All of the results presented here are to be understood as work in progress using engineering data. It is expected at this stage, in the middle of on-sky commissioning, that much of the discussion will concern open questions, issues, and anomalies that are actively being worked by the team. Additional documentation will be provided as our understanding of the demonstrated performance of the as-built system progresses.

1.1 Charge

We identify the following high-level goals for the interim report:

- **Rehearse workflows for collaboratively developing documentation** to describe our current understanding of the integrated system performance, e.g., to support the development of planned Construction Papers and release documentation to support the Early Science Program [RTN-011]. This report represents an opportunity to collectively exercise the practical aspects of developing documentation in compliance with the policies and guidelines for information sharing during commissioning [SITCOMTN-076].
- **Synthesize the new knowledge** gained from the ComCam on-sky commissioning cam-

paign to inform the optimization of activities between the conclusion of the ComCam campaign and the start of the on-sky campaign with the LSST Camera (LSSTCam).

- **Inform the Rubin Science Community** on the progress of the on-sky commissioning campaign using ComCam.

Other planned systems engineering activities will specifically address system-level verification ([LSE-29] and [LSE-30]) using tests and analysis from the ComCam campaign. While the analyses in this report will likely overlap with the generation of verification artifacts for systems engineering, and system-level requirement specifications will serve as key performance benchmarks for interpreting the progress to date, formal acceptance testing is not an explicit goal of this report.

The groups within the Rubin Observatory project working on each of the activities and performance analyses are charged with contributing to the relevant sections of the report. The anticipated level of detail for the sections ranges from a paragraph up to a page or two of text, depending on the current state of understanding, with **quantitative performance** expressed as summary statistics, tables, and/or figures. The objective for this document is to **summarize the state of knowledge of the system**, rather than how we got there or "lessons learned". The sections refer to additional supporting documentation, e.g., analysis notebooks, other technotes with further detail, as needed. Given the timelines for commissioning various aspects of the system, it is natural that some sections will have more detail than others.

The anticipated milestones for developing this interim report are as follows:

- 18 Nov 2024: Define charge
- 4 Dec 2024: First drafts of report sections made available for internal review
- 11 Dec 2024: Revised drafts of report sections made available for internal review; editing for consistency and coherency throughout the report
- 18 Dec 2024: Initial version of report is released

Warning: On-sky Pixel Image Embargo

All pixel images and representations of pixel images of any size field of view, including individual visit images, coadd images, and difference images based on ComCam commissioning on-sky observations must be kept internal to the Rubin Observatory Project team, and in particular, cannot be included in this report. Embargoed pixel images can only be referenced as authenticated links. See [SITCOMTN-076] for details.

2 System Performance Analysis

Topics to convert into text

- M1M3 and M2 glass installed on the Simonyi Survey Telescope.
- Since then, we have been operating the telescope with limited velocity, acceleration, and jerk limits following the performances defined in TMA Motion Settings.
- For each configuration, defined in terms of a percentage of the maximum velocity, acceleration, and jerk, we ran multiple gateway tests.
- The gateway tests are described in the subsection 2.1 below.

2.1 Gateway Tests

The three gateway tests defined below are required for each increase in the velocity, acceleration, and jerk limits. They are associated with glass and telescope safety. So far, we have been able to run the telescope up to 10% its maximum velocity, acceleration, and jerk limits. For simplicity, we will show only the last results.

2.1.1 Long and short slews at different elevations

These tests ensure that the force balance systems on M1M3 and on M2 can protect the mirrors on different telescope positions and while slewing. As we increase velocity, acceleration, and

jerk limits, both mirrors suffer higher inertial forces and the force actuators must counteract them.

For M1M3, the criteria is to keep the measured forces on the hardpoint actuators below the operational limit (15% the breakaway limit). For M2, the criteria is ??????? (check with Holger, Gabriele, and Pablo).

Test cases associated:

- BLOCK-T227 Dynamic Tests at El = 34º
- short and long slews
- BLOCK-T293 Dynamic Tests at El = 70º
- short and long slews
- BLOCK-T294 Dynamic Tests at El = 70º
- short and long slews
- LVV-T2813 M1M3 Dynamic Test, increasing speed, increasing acceleration
- LVV-T2944 M2 Dynamic Test, increasing speed, acceleration, jerk

Detailed analysis (both TNs are still under development):

- SITCOM-TN092 M1M3 Force Balance System
- Inertia Compensation
- SITCOM-TN147 M2 Response to short and long slews

2.1.2 M2 close-loop breakout tests

- LVV-T3034 M2 closed-loop break-out during TMA slew
- BLOCK-T241 M2 closed-loop break-out brake test during TMA slew

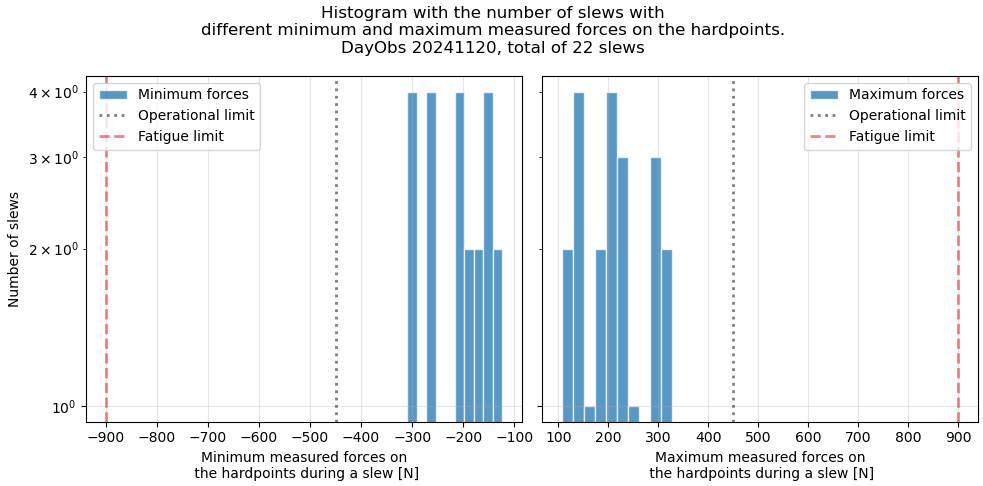

FIGURE 1: Number of slews with minimum/maximum measured forces on the M1M3 hardpoint actuators.

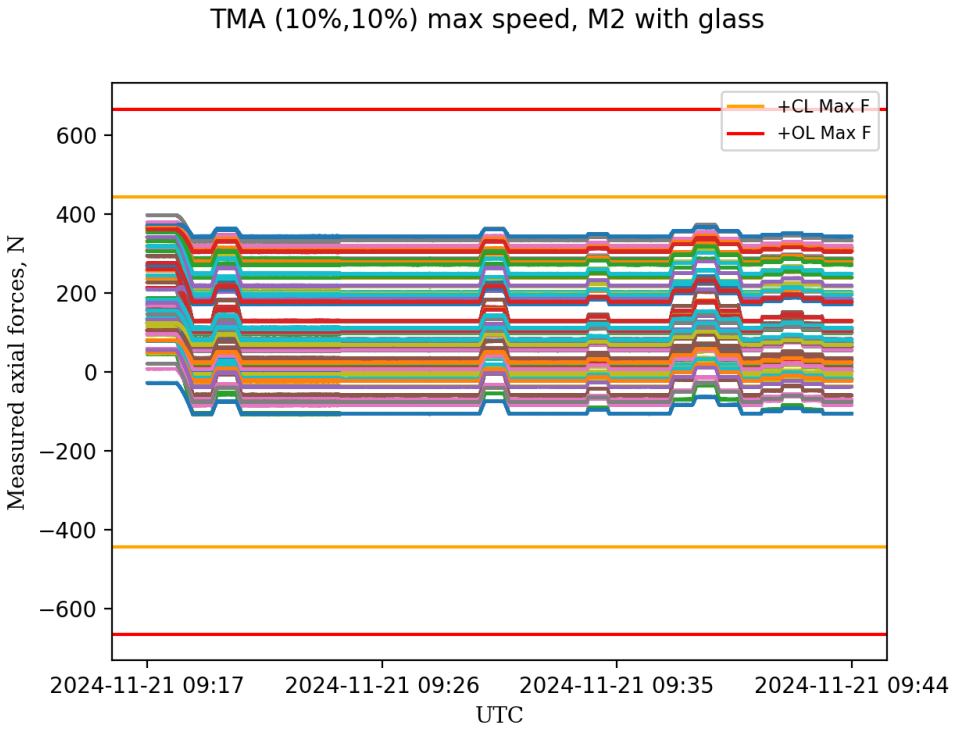

FIGURE 2: Measured axial force on the M2 force actuators during short and long slews.

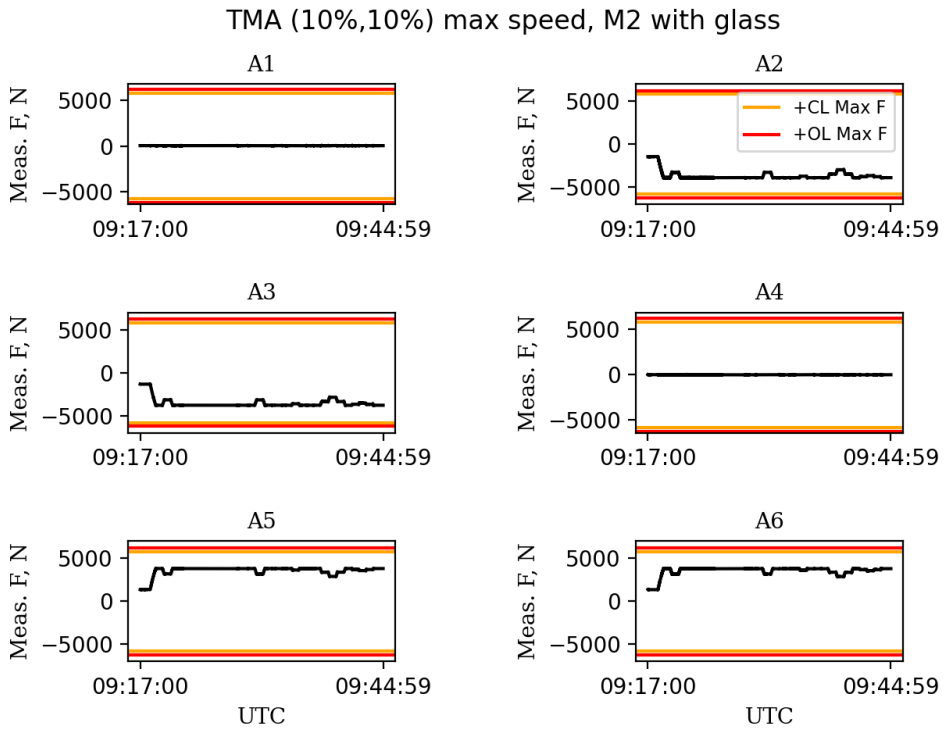

FIGURE 3: Measured tangent force on the M2 force actuators during short and long slews.

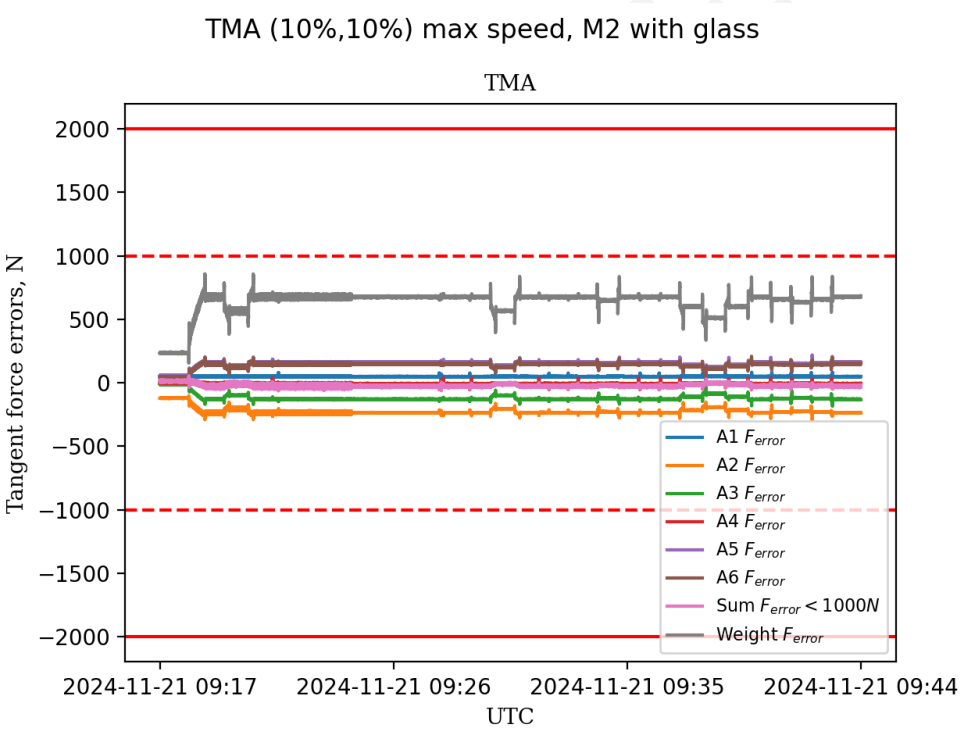

FIGURE 4: Measured tangent force errors on the M2 force actuators during short and long slews.

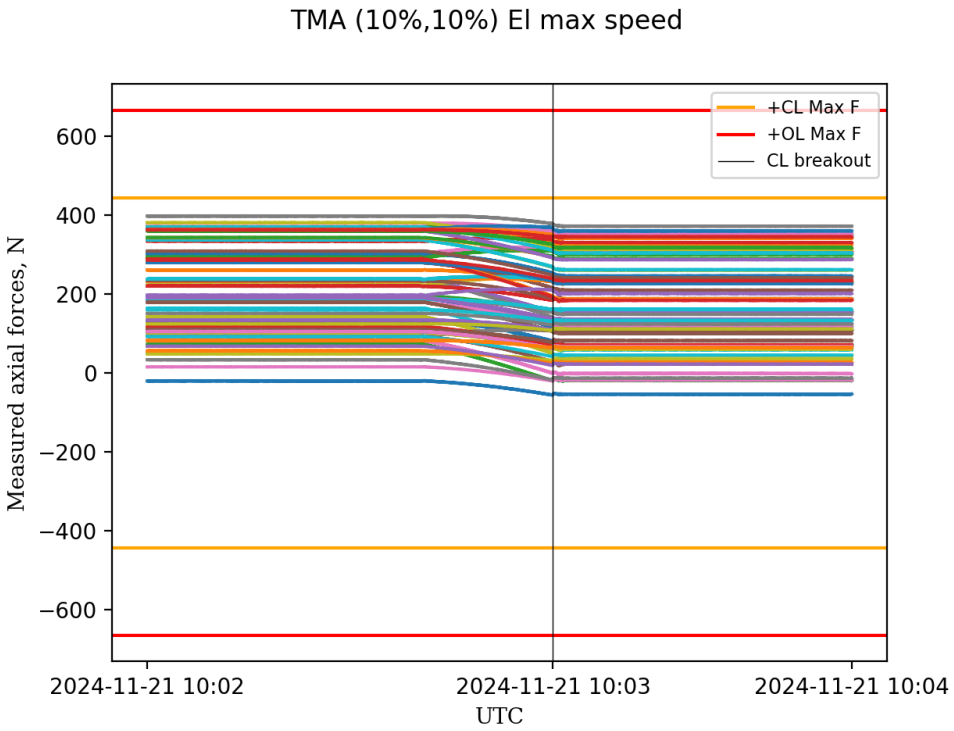

FIGURE 5: M2 axial forces during the closed-loop breakout test.

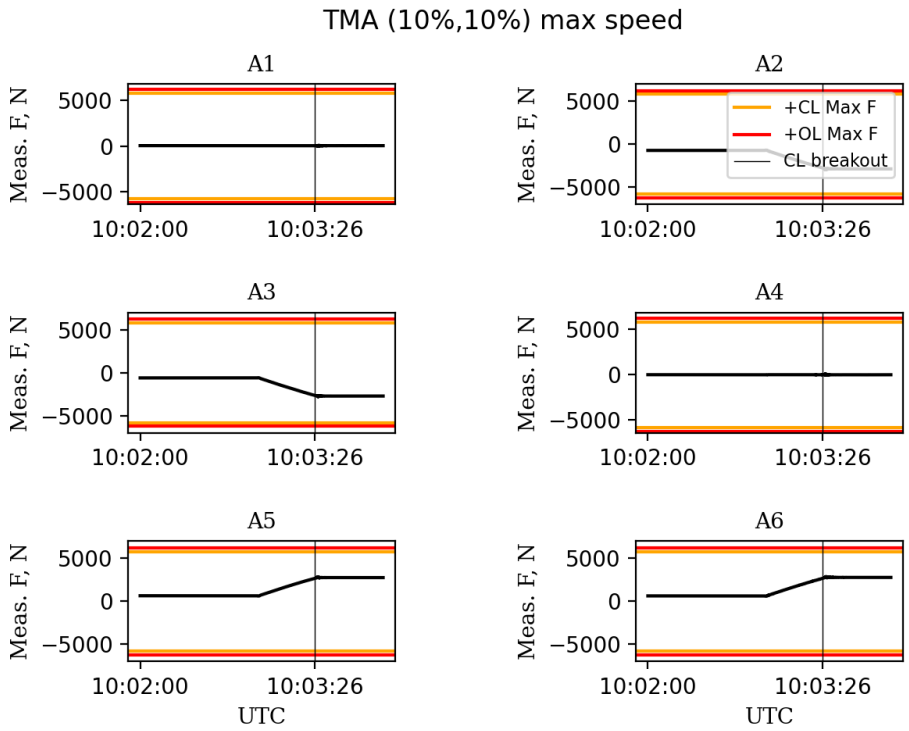

FIGURE 6: M2 tangent forces during the closed-loop breakout test.

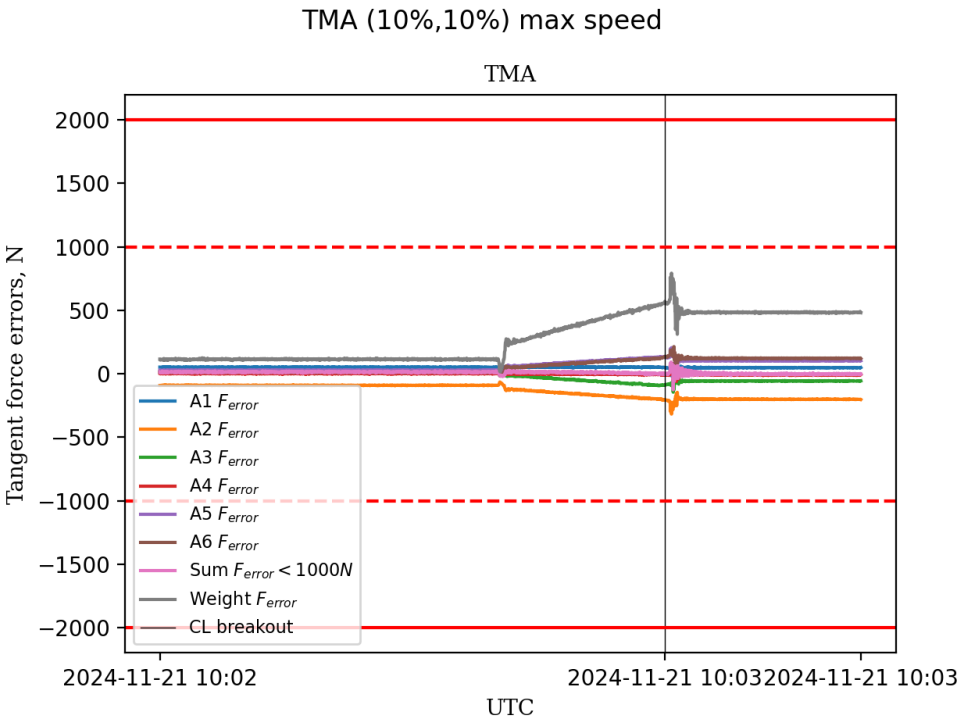

FIGURE 7: M2 tangent force errors during the closed-loop breakout test.

2.1.3 TMA azimuth and elevation brake tests

Test cases associated:

- BLOCK-T231 TMA Azimuth Brake Test
- BLOCK-T240 TMA Elevation Brake Distance

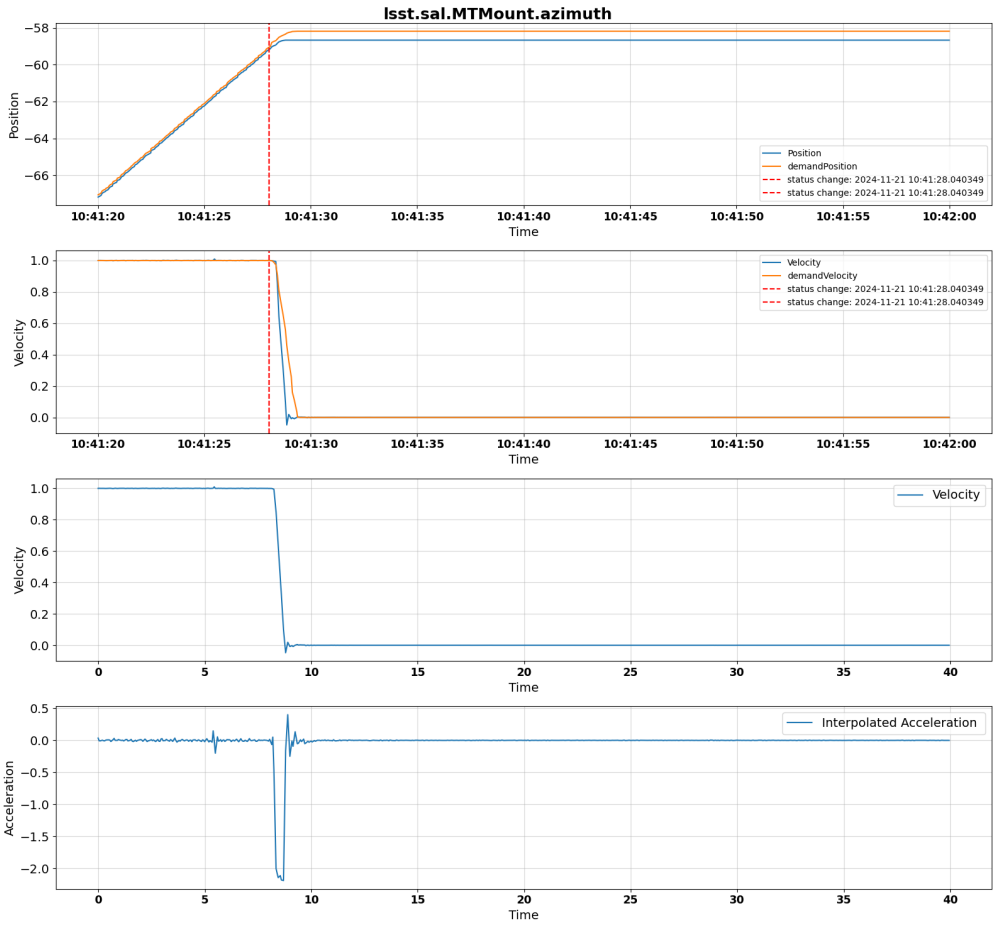

FIGURE 8: TMA azimuth brake test.

2.2 Night Performance

Statistical reports/summaries during the night?

- Measured m1m3 hardpoint histograms min/max HP forces.

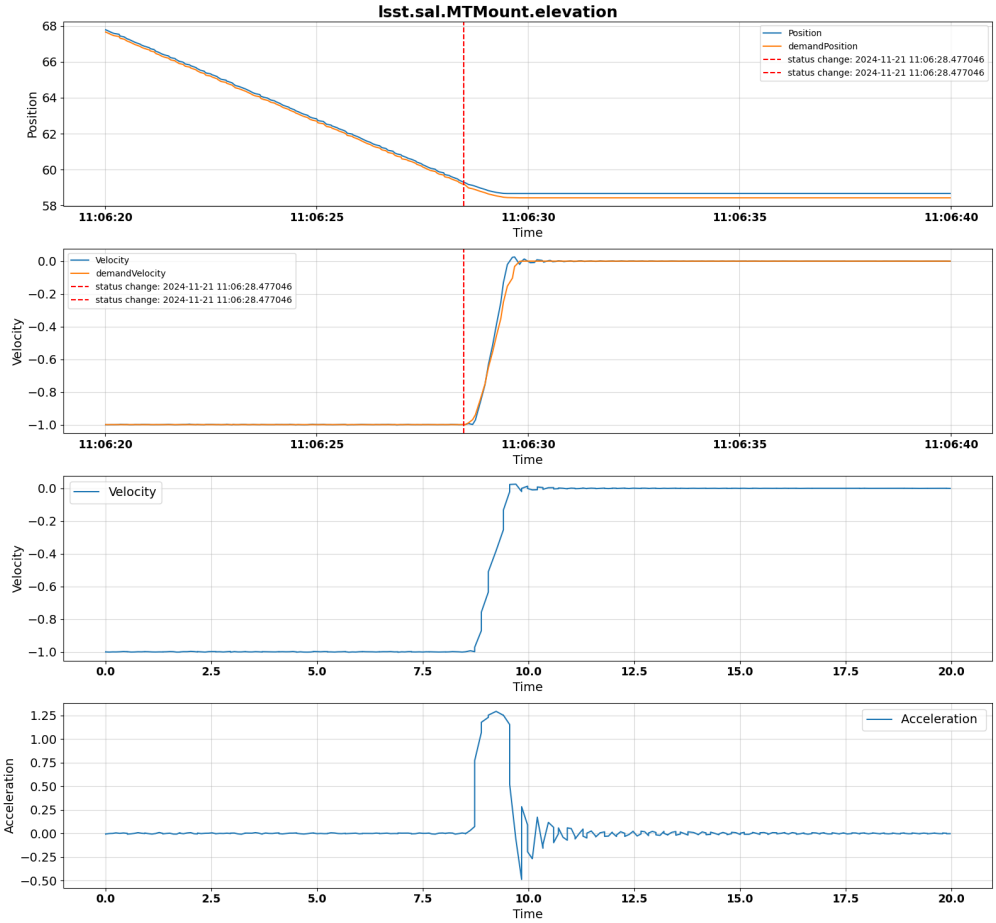

FIGURE 9: TMA elevation brake test.

- FRACAS-158 / SITCOMTN-081 / SITCOM-1758 - Oscillations on HP forces and on azimuth torques

16 Difference Image Analysis: Transience and Variable Objects

17 Difference Image Analysis: Solar System Objects

18 Galaxy Photometry

19 Weak Lensing Shear

20 Crowded Stellar Fields

21 Image Inspection

A References

[SITCOMTN-076], Bechtol, K., on behalf of the Rubin Observatory Project Science Team, S.R., 2024, Information Sharing during Commissioning, URL https://sitcomtn-076.lsst.io/, Vera C. Rubin Observatory Commissioning Technical Note SITCOMTN-076

[LSE-29], Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2017, LSST System Requirements (LSR), URL https://ls.st/LSE-29, Vera C. Rubin Observatory LSE-29

[LSE-30], Claver, C.F., The LSST Systems Engineering Integrated Project Team, 2018, Observatory System Specifications (OSS), URL https://ls.st/LSE-30, Vera C. Rubin Observatory LSE-30

[RTN-011], Guy, L.P., Bechtol, K., Bellm, E., et al., 2024, Rubin Observatory Plans for an Early Science Program, URL https://rtn-011.lsst.io/, Vera C. Rubin Observatory Technical Note RTN-011

B Acronyms

Acronym	Description
FRACAS	Failure Reporting Analysis and Corrective Action System
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
LVV	LSST Verification and Validation
M1M3	Primary Mirror Tertiary Mirror
M2	Secondary Mirror
PSF	Point Spread Function
RTN	Rubin Technical Note
SE	System Engineering
SITCOM	System Integration, Test and Commissioning
TMA	Telescope Mount Assembly