

# Slew, Track and Image taking with ComCam

This notebook is used for the level 3 integration tests from test plan LVV-P81 (<https://jira.lsstcorp.org/secure/Tests.jspa#/testPlan/LVV-P81>) as part of test cycle LVV-C176 (<https://jira.lsstcorp.org/secure/Tests.jspa#/testCycle/LVV-C176>). The following tests are currently run as part of this notebook:

- LVV-T2290 (<https://jira.lsstcorp.org/secure/Tests.jspa#/testCase/LVV-T2290>)

Execution steps are separated by horizontal lines. Upon completion, save the notebook and its output as a pdf file to be attached to the test execution in JIRA.

```
In [1]: from lsst.ts import utils

# Extract your name from the Jupyter Hub
__executed_by__ = os.environ["JUPYTERHUB_USER"]

# Extract execution date
__executed_on__ = utils.astropy_time_from_tai_unix(utils.current_tai())
__executed_on__.format = "isot"

# This is used later to define where Butler stores the images
summit = os.environ["LSST_DDS_PARTITION_PREFIX"] == "summit"

print(f"\nExecuted by {__executed_by__} on {__executed_on__}."
      f"\n At the summit? {summit}")
```

```
|lsst.ts.utils.tai INFO: Update leap second table
|lsst.ts.utils.tai INFO: current_tai uses the system TAI clock
Executed by isotuela on 2022-05-31T15:30:05.636.
At the summit? True
```

---

Run the setup.ipnyb notebook to bring all components up and in their enabled position. Check Chronograph.

---

Bring ComCom online and tranistion it to EnabledState. Check Chronograph.

```
In [2]: %load_ext autoreload
        %autoreload 2
```

```
In [3]: import rubin_jupyter_utils.lab.notebook as nb
        nb.utils.get_node()
```

```
/tmp/ipykernel_23483/1665379685.py:2: DeprecationWarning: Call to deprecate
d function (or staticmethod) get_node. (Please use lsst.rsp.get_node())
nb.utils.get_node()
```

Out [3]: 'yagan03'

```
In [4]: import os
import sys
import asyncio
import logging

import pandas as pd
import numpy as np

from matplotlib import pyplot as plt

from lsst.ts import salobj
from lsst.ts.observatory.control.maintel import MTCS, ComCam
from lsst.ts.observatory.control import RotType
```

```
In [5]: logging.basicConfig(format="%(name)s:%(message)s", level=logging.DEBUG)
```

```
In [6]: log = logging.getLogger("setup")
log.level = logging.DEBUG
```

```
In [7]: domain = salobj.Domain()
```

```
In [8]: mtcs = MTCS(domain=domain, log=log)
mtcs.set_rem_loglevel(40)
```

```
| setup.MTCS DEBUG: mtmount: Adding all resources.
| setup.MTCS DEBUG: mtptg: Adding all resources.
| setup.MTCS DEBUG: mtaos: Adding all resources.
| setup.MTCS DEBUG: mtm1m3: Adding all resources.
| setup.MTCS DEBUG: mtm2: Adding all resources.
| setup.MTCS DEBUG: mthexapod_1: Adding all resources.
| setup.MTCS DEBUG: mthexapod_2: Adding all resources.
| setup.MTCS DEBUG: mtrotator: Adding all resources.
| setup.MTCS DEBUG: mtdome: Adding all resources.
| setup.MTCS DEBUG: mtdometrajectory: Adding all resources.
| MTHexapod INFO: Read historical data in 0.00 sec
| MTHexapod INFO: Read historical data in 0.05 sec
| MTHexapod.application WARNING: tel_application DDS read queue is fillin
| g: 15 of 100 elements
| MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 16
| of 100 elements
```

```
In [9]: await mtcs.start_task
```

Out [9]: [None, None, None, None, None, None, None, None, None, None]

```
In [10]: comcam = ComCam(domain=domain, log=log)
```

```
| setup.ComCam DEBUG: cccamera: Adding all resources.
| setup.ComCam DEBUG: cheaderservice: Adding all resources.
| setup.ComCam DEBUG: ccoords: Adding all resources.
```

```
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling:
10 of 100 elements
MTHexapod.application WARNING: tel_application DDS read queue is fillin
g: 11 of 100 elements
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 10
of 100 elements
CCHheaderService INFO: Read historical data in 0.04 sec
CCCamera INFO: Read historical data in 0.06 sec
CCCamera.logevent_image_handling_ImageHandler_FitsHandlingConfiguration
WARNING: evt_image_handling_ImageHandler_FitsHandlingConfiguration DDS r
ead queue is filling: 16 of 100 elements
CCCamera.logevent_focal_plane_Reb_RaftsLimitsConfiguration WARNING: evt_
focal_plane_Reb_RaftsLimitsConfiguration DDS read queue is filling: 31 o
f 100 elements
CCCamera.logevent_rebpower_Rebpps_LimitsConfiguration WARNING: evt_rebpow
er_Rebpps_LimitsConfiguration DDS read queue is filling: 31 of 100 elemen
ts
CCCamera.logevent_rebpower_Rebpps_PowerConfiguration WARNING: evt_rebpowe
r_Rebpps_PowerConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_rebpower_Reb_LimitsConfiguration WARNING: evt_rebpower
_Reb_LimitsConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_vacuum_VacPluto_DeviceConfiguration WARNING: evt_vacuu
m_VacPluto_DeviceConfiguration DDS read queue is filling: 31 of 100 elem
ents
CCHheaderService.logevent_summaryState WARNING: evt_summaryState DDS read
queue is filling: 15 of 100 elements
CCCamera.logevent_vacuum_VQMonitor_LimitsConfiguration WARNING: evt_vacu
um_VQMonitor_LimitsConfiguration DDS read queue is filling: 31 of 100 el
ements
CCCamera.logevent_vacuum_VQMonitor_CryoConfiguration WARNING: evt_vacuum
_VQMonitor_CryoConfiguration DDS read queue is filling: 31 of 100 elemen
ts
CCCamera.logevent_vacuum_Rtds_LimitsConfiguration WARNING: evt_vacuum_Rt
ds_LimitsConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_vacuum_IonPumps_LimitsConfiguration WARNING: evt_vacuu
m_IonPumps_LimitsConfiguration DDS read queue is filling: 31 of 100 elem
ents
CCCamera.logevent_vacuum_Turbo_LimitsConfiguration WARNING: evt_vacuum_T
urbo_LimitsConfiguration DDS read queue is filling: 27 of 100 elements
CCCamera.logevent_vacuum_Cryo_CryoconConfiguration WARNING: evt_vacuum_C
ryo_CryoconConfiguration DDS read queue is filling: 23 of 100 elements
CCCamera.logevent_vacuum_Cryo_LimitsConfiguration WARNING: evt_vacuum_Cr
yo_LimitsConfiguration DDS read queue is filling: 14 of 100 elements
CCCamera.logevent_vacuum_Rtds_DeviceConfiguration WARNING: evt_vacuum_Rt
ds_DeviceConfiguration DDS read queue is filling: 28 of 100 elements
CCHheaderService.logevent_logMessage WARNING: evt_logMessage DDS read que
ue is filling: 60 of 100 elements
CCCamera.logevent_vacuum_IonPumps_CryoConfiguration WARNING: evt_vacuum_
IonPumps_CryoConfiguration DDS read queue is filling: 31 of 100 elements
CCHheaderService.logevent_largeFileObjectAvailable ERROR: evt_largeFileOb
jectAvailable DDS read queue is full (100 elements); data may be lost
```

```

CCCamera.logevent_vacuum_Cold2_LimitsConfiguration WARNING: evt_vacuum_C
old2_LimitsConfiguration DDS read queue is filling: 31 of 100 elements
CCHheaderService.logevent_heartbeat ERROR: evt_heartbeat DDS read queue i
s full (100 elements); data may be lost
CCCamera.logevent_vacuum_Cold2_CryoconConfiguration WARNING: evt_vacuum_
Cold2_CryoconConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_vacuum_Cold1_LimitsConfiguration WARNING: evt_vacuum_C
old1_LimitsConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_vacuum_Cold1_CryoconConfiguration WARNING: evt_vacuum_
Cold1_CryoconConfiguration DDS read queue is filling: 31 of 100 elements
CCCamera.logevent_rebpower_PeriodicTasks_timersConfiguration WARNING: ev
t_rebpower_PeriodicTasks_timersConfiguration DDS read queue is filling:
31 of 100 elements
CCCamera.logevent_quadbox_PDU_48V_LimitsConfiguration WARNING: evt_quadb
ox_PDU_48V_LimitsConfiguration DDS read queue is filling: 31 of 100 elem
ents
CCCamera.logevent_quadbox_PDU_24VD_QuadboxConfiguration WARNING: evt_qua
dbox_PDU_24VD_QuadboxConfiguration DDS read queue is filling: 31 of 100
elements
CCCamera.logevent_focal_plane_Reb_RaftsConfiguration WARNING: evt_focal_
plane_Reb_RaftsConfiguration DDS read queue is filling: 31 of 100 elemen
ts
CCCamera.logevent_focal_plane_Reb_HardwareIdConfiguration WARNING: evt_f
ocal_plane_Reb_HardwareIdConfiguration DDS read queue is filling: 31 of
100 elements
CCCamera.logevent_focal_plane_Raft_RaftTempControlStatusConfiguration WA
ARNING: evt_focal_plane_Raft_RaftTempControlStatusConfiguration DDS read
queue is filling: 31 of 100 elements
CCCamera.logevent_focal_plane_Raft_RaftTempControlConfiguration WARNING:
evt_focal_plane_Raft_RaftTempControlConfiguration DDS read queue is fill
ing: 31 of 100 elements
CCCamera.logevent_focal_plane_Raft_HardwareIdConfiguration WARNING: evt_
focal_plane_Raft_HardwareIdConfiguration DDS read queue is filling: 31 o
f 100 elements
CCCamera.logevent_focal_plane_PeriodicTasks_timersConfiguration WARNING:
evt_focal_plane_PeriodicTasks_timersConfiguration DDS read queue is fill
ing: 31 of 100 elements
CCCamera.logevent_focal_plane_InstrumentConfig_InstrumentConfiguration W
ARNING: evt_focal_plane_InstrumentConfig_InstrumentConfiguration DDS rea
d queue is filling: 31 of 100 elements
CCOODS INFO: Read historical data in 0.42 sec

```

```
In [11]: comcam.set_rem_loglevel(40)
```

```
In [12]: await comcam.start_task
```

```
Out[12]: [None, None, None]
```

```
In [ ]: await comcam.enable()
```

Find four targets separated by 5° in azimuth and elevation in a square pattern around az = 120° and el = 60° and rotator angle at PhysicalSky and 1.8°.

At this position, the rotator stays within a couple of degrees of its initial position. This is because the CCW is not running (MTmount in simulation mode).

target\_1 -> az = 117.5°, el = 57.5°

target\_2 -> az = 122.5°, el = 57.5°

target\_3 -> az = 122.5°, el = 62.5°

target\_4 -> az = 117.5°, el = 62.5°

```
In [13]: target_1 = mtcs.radec_from_azel(az=117.5, el=57.5)
target_2 = mtcs.radec_from_azel(az=122.5, el=57.5)
target_3 = mtcs.radec_from_azel(az=122.5, el=62.5)
target_4 = mtcs.radec_from_azel(az=117.5, el=62.5)

print(f"Target 1: {target_1}\n"
      f"Target 2: {target_2}\n"
      f"Target 3: {target_3}\n"
      f"Target 4: {target_4}\n")
```

WARNING: AstropyDeprecationWarning: Transforming a frame instance to a frame class (as opposed to another frame instance) will not be supported in the future. Either explicitly instantiate the target frame, or first convert the source frame instance to a `astropy.coordinates.SkyCoord` and use its `transform\_to()` method. [astropy.coordinates.baseframe]

astroquery WARNING: AstropyDeprecationWarning: Transforming a frame instance to a frame class (as opposed to another frame instance) will not be supported in the future. Either explicitly instantiate the target frame, or first convert the source frame instance to a `astropy.coordinates.SkyCoord` and use its `transform\_to()` method.

Target 1: <ICRS Coordinate: (ra, dec) in deg  
(88.94371721, -39.72935142)>

Target 2: <ICRS Coordinate: (ra, dec) in deg  
(88.54568438, -42.3951589)>

Target 3: <ICRS Coordinate: (ra, dec) in deg  
(81.96036455, -41.40162519)>

Target 4: <ICRS Coordinate: (ra, dec) in deg  
(82.54988136, -39.13770191)>

Slew to target 1:

```
In [14]: await mtcs.slew_icrs(ra=target_1.ra, dec=target_1.dec, rot_type=RotType.Phys

setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator
will track sky.
MTM1M3.powerSupplyData ERROR: tel_powerSupplyData DDS read queue is full
(100 elements); data may be lost
```

```
MTRotator.rotation ERROR: tel_rotation DDS read queue is full (100 elements); data may be lost
MTHexapod.electrical ERROR: tel_electrical DDS read queue is full (100 elements); data may be lost
MTMount.elevation ERROR: tel_elevation DDS read queue is full (100 elements); data may be lost
MTHexapod.electrical WARNING: tel_electrical DDS read queue is filling: 85 of 100 elements
MTHexapod.application ERROR: tel_application DDS read queue is full (100 elements); data may be lost
MTRotator.motors ERROR: tel_motors DDS read queue is full (100 elements); data may be lost
MTM1M3.pidData ERROR: tel_pidData DDS read queue is full (100 elements); data may be lost
MTHexapod.application WARNING: tel_application DDS read queue is filling: 86 of 100 elements
MTPtg.mountPosition ERROR: tel_mountPosition DDS read queue is full (100 elements); data may be lost
MTHexapod.actuators WARNING: tel_actuators DDS read queue is filling: 84 of 100 elements
MTMount.azimuth ERROR: tel_azimuth DDS read queue is full (100 elements); data may be lost
MTRotator.electrical ERROR: tel_electrical DDS read queue is full (100 elements); data may be lost
MTHexapod.actuators ERROR: tel_actuators DDS read queue is full (100 elements); data may be lost
MTM1M3.inclinometerData ERROR: tel_inclinometerData DDS read queue is full (100 elements); data may be lost
MTRotator.ccwFollowingError ERROR: tel_ccwFollowingError DDS read queue is full (100 elements); data may be lost
setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
MTM1M3.imsData ERROR: tel_imsData DDS read queue is full (100 elements); data may be lost
MTM1M3.hardpointMonitorData ERROR: tel_hardpointMonitorData DDS read queue is full (100 elements); data may be lost
MTM1M3.hardpointActuatorData ERROR: tel_hardpointActuatorData DDS read queue is full (100 elements); data may be lost
MTM1M3.gyroData ERROR: tel_gyroData DDS read queue is full (100 elements); data may be lost
MTM1M3.forceActuatorData ERROR: tel_forceActuatorData DDS read queue is full (100 elements); data may be lost
MTM1M3.accelerometerData ERROR: tel_accelerometerData DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedThermalForces ERROR: evt_appliedThermalForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedStaticForces ERROR: evt_appliedStaticForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedForces ERROR: evt_appliedForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedElevationForces ERROR: evt_appliedElevationForces DDS read queue is full (100 elements); data may be lost
```



```
MTM1M3.logevent_appliedCylinderForces ERROR: evt_appliedCylinderForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedBalanceForces ERROR: evt_appliedBalanceForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedAzimuthForces ERROR: evt_appliedAzimuthForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedActiveOpticForces ERROR: evt_appliedActiveOpticForces DDS read queue is full (100 elements); data may be lost
MTM1M3.logevent_appliedAberrationForces ERROR: evt_appliedAberrationForces DDS read queue is full (100 elements); data may be lost
setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rotator to its current position: 0.10
setup.MTCS DEBUG: Wait for MTRotator in position event.
setup.MTCS DEBUG: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator already in position. Handling potential race condition.
setup.MTCS INFO: MTRotator in position: False.
setup.MTCS INFO: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
setup.MTCS DEBUG: Sending slew command.
setup.MTCS DEBUG: Scheduling check coroutines
setup.MTCS DEBUG: process as completed...
setup.MTCS DEBUG: Monitor position started.
setup.MTCS DEBUG: Waiting for Target event from mtmount.
setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
setup.MTCS DEBUG: mtdome: <State.ENABLED: 2>
setup.MTCS DEBUG: mtdometrajectory: <State.ENABLED: 2>
setup.MTCS DEBUG: Wait for mtmount in position events.
setup.MTCS DEBUG: Wait for dome in position event.
setup.MTCS DEBUG: Wait for MTRotator in position event.
setup.MTCS DEBUG: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator already in position. Handling potential race condition.
setup.MTCS DEBUG: Wait for MTMount elevation in position event.
setup.MTCS DEBUG: MTMount elevation in position: True.
setup.MTCS DEBUG: MTMount elevation already in position. Handling potential race condition.
setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
setup.MTCS DEBUG: MTMount azimuth in position: True.
setup.MTCS DEBUG: MTMount azimuth already in position. Handling potential race condition.
```

```

setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndSt
amp: 1654011052.5088162, private_rcvStamp: 1654011052.508944, private_se
qNum: 2422, private_identity: MTMount, private_origin: 28805, elevation:
57.58459519676972, elevationVelocity: 0.003200231805051531, azimuth: 11
7.51231642755394, azimuthVelocity: 0.0005204604106838395, taiTime: 16540
11052.5679603, trackId: 1, tracksys: SIDEREAL, radesys: ICRS, priority:
0
setup.MTCS INFO: MTMount elevation in position: False.
setup.MTCS INFO: MTMount azimuth in position: False.
setup.MTCS INFO: MTRotator in position: False.
setup.MTCS INFO: MTRotator in position: True.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
setup.MTCS DEBUG: [Tel]: Az = +000.006[+117.5]; El = +089.997[ -32.4] [R
ot]: +000.100[ +0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: Dome azimuth in position.
setup.MTCS DEBUG: Dome elevation in position.
setup.MTCS DEBUG: [Tel]: Az = +040.394[ +77.1]; El = +069.834[ -12.2] [R
ot]: +002.055[ -0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS INFO: MTMount elevation in position: True.
setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle tim
e 3.0s
setup.MTCS DEBUG: [Tel]: Az = +081.573[ +35.9]; El = +057.624[ +0.0] [R
ot]: +002.036[ +0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS INFO: MTMount azimuth in position: True.
setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time
3.0s
setup.MTCS DEBUG: [Tel]: Az = +117.522[ +0.0]; El = +057.644[ +0.0] [R
ot]: +002.011[ -0.0] [Dome] Az = +000.000; El = +000.000
Out[14]: (<ICRS Coordinate: (ra, dec) in deg
          (88.94371721, -39.72935142)>,
          <Angle 1.9 deg>)

```

---

Once on target\_1 and tracking, take an image with ComCam

```

In [15]: exp1 = await comcam.take_object(15)
         print(f"Target 1 exposure: {exp1}")

setup.ComCam DEBUG: Generating group_id
setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configure
d.
Target 1 exposure: [2022053100001]

```

---

Slew to target\_2:

```

In [16]: await mtcs.slew_icrs(ra=target_2.ra, dec=target_2.dec, rot_type=RotType.Phys

setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator
will track sky.
setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.

```



```

| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rota
| tor to its current position: 1.85
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdome: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdometrajectory: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race
| condition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potent
| ial race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potentia
| l race condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndSt
| amp: 1654011102.4255176, private_rcvStamp: 1654011102.4256144, private_s
| eqNum: 3419, private_identity: MTMount, private_origin: 28805, elevatio
| n: 57.70667204030417, elevationVelocity: 0.003041090403186118, azimuth:
| 122.56230256749193, azimuthVelocity: 0.0009683480681082517, taiTime: 165
| 4011102.4847648, trackId: 2, tracksys: SIDERREAL, radesys: ICRS, priorit
| y: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTMount azimuth in position: False.
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle tim
| e 3.0s
| setup.MTCS DEBUG: [Tel]: Az = +117.540[ +5.0]; El = +057.744[ -0.0] [R
| ot]: +001.853[ -0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.

```

```

| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS INFO: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time
| 3.0s
| setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MT
| Rotator in position.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
Out[16]: (<ICRS Coordinate: (ra, dec) in deg
          (88.54568438, -42.3951589)>,
          <Angle 1.9 deg>)

```

---

Once on target\_2 and tracking, take an image with ComCam

```

In [17]: exp2 = await comcam.take_object(15)
          print(f"Target 1 exposure: {exp2}")

| setup.ComCam DEBUG: Generating group_id
| setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configure
| d.
          Target 1 exposure: [2022053100002]

```

---

Slew to target\_3

```

In [18]: await mtcs.slew_icrs(ra=target_3.ra, dec=target_3.dec, rot_type=RotType.Phys

| setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator
| will track sky.
| setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rota
| tor to its current position: 1.75
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race
| condition.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>

```

```

| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdome: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdometrajectory: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race
condition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potent
ial race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potentia
l race condition.
| setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndSt
amp: 1654011137.1208167, private_rcvStamp: 1654011137.120937, private_se
qNum: 4112, private_identity: MTMount, private_origin: 28805, elevation:
62.81062546696179, elevationVelocity: 0.0030376774917456866, azimuth: 12
2.66540399233178, azimuthVelocity: 0.001686841021912451, taiTime: 165401
1137.1799994, trackId: 3, tracksys: SIDERREAL, radesys: ICRS, priority: 0
| setup.MTCS INFO: MTMount elevation in position: False.
| setup.MTCS INFO: MTMount azimuth in position: False.
| setup.MTCS INFO: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time
3.0s
| setup.MTCS DEBUG: [Tel]: Az = +122.606[ +0.1]; El = +057.812[ +5.0] [R
ot]: +001.753[ -0.0] [Dome] Az = +000.000; El = +000.000
| setup.MTCS DEBUG: Dome azimuth in position.
| setup.MTCS DEBUG: Dome elevation in position.
| setup.MTCS INFO: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle tim
e 3.0s
| setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MT
Rotator in position.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
Out[18]: (<ICRS Coordinate: (ra, dec) in deg
(81.96036455, -41.40162519)>,
<Angle 1.9 deg>)

```

---

Once on target\_3 and tracking, take an image with ComCam

```

In [19]: exp3 = await comcam.take_object(15)
print(f"Target 1 exposure: {exp3}")

| setup.ComCam DEBUG: Generating group_id
| setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configure
d.

```

Target 1 exposure: [2022053100003]

---

Slew to target 4

```
In [20]: await mtcs.slew_icrs(ra=target_4.ra, dec=target_4.dec, rot_type=RotType.Phys
| setup.MTCS DEBUG: Setting rotator physical position to 1.9 deg. Rotator
| will track sky.
| setup.MTCS DEBUG: Wait 5.0s for rotator to settle down.
| setup.MTCS DEBUG: Workaround for rotator trajectory problem. Moving rota
| tor to its current position: 1.65
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race
| condition.
| setup.MTCS INFO: MTRotator in position: False.
| setup.MTCS INFO: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 5.0s
| setup.MTCS DEBUG: Sending slew command.
| setup.MTCS DEBUG: Scheduling check coroutines
| setup.MTCS DEBUG: process as completed...
| setup.MTCS DEBUG: Monitor position started.
| setup.MTCS DEBUG: Waiting for Target event from mtmount.
| setup.MTCS DEBUG: mtmount: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtptg: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtaos: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm1m3: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtm2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_1: <State.ENABLED: 2>
| setup.MTCS DEBUG: mthexapod_2: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtrotator: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdome: <State.ENABLED: 2>
| setup.MTCS DEBUG: mtdometrajectory: <State.ENABLED: 2>
| setup.MTCS DEBUG: Wait for mtmount in position events.
| setup.MTCS DEBUG: Wait for dome in position event.
| setup.MTCS DEBUG: Wait for MTRotator in position event.
| setup.MTCS DEBUG: MTRotator in position: True.
| setup.MTCS DEBUG: MTRotator already in position. Handling potential race
| condition.
| setup.MTCS DEBUG: Wait for MTMount elevation in position event.
| setup.MTCS DEBUG: MTMount elevation in position: True.
| setup.MTCS DEBUG: MTMount elevation already in position. Handling potent
| ial race condition.
| setup.MTCS DEBUG: Wait for MTMount azimuth in position event.
| setup.MTCS DEBUG: MTMount azimuth in position: True.
| setup.MTCS DEBUG: MTMount azimuth already in position. Handling potentia
| l race condition.
```

```

setup.MTCS DEBUG: Mount target: private_revCode: bdc00ba, private_sndSt
amp: 1654011171.8167942, private_rcvStamp: 1654011171.8168488, private_s
eqNum: 4805, private_identity: MTMount, private_origin: 28805, elevatio
n: 62.9373909665944, elevationVelocity: 0.003196229184786793, azimuth: 1
17.6528671702757, azimuthVelocity: 0.0011734903660559415, taiTime: 16540
11171.8761551, trackId: 4, tracksys: SIDERREAL, radesys: ICRS, priority:
0
setup.MTCS INFO: MTMount elevation in position: False.
setup.MTCS INFO: MTMount azimuth in position: False.
setup.MTCS INFO: MTMount elevation in position: True.
setup.MTCS DEBUG: MTMount elevation in position True. Waiting settle tim
e 3.0s
setup.MTCS DEBUG: [Tel]: Az = +122.722[ -5.1]; El = +062.917[ +0.0] [R
ot]: +001.653[ -0.0] [Dome] Az = +000.000; El = +000.000
setup.MTCS DEBUG: Dome azimuth in position.
setup.MTCS DEBUG: Dome elevation in position.
setup.MTCS INFO: MTMount azimuth in position: True.
setup.MTCS DEBUG: MTMount azimuth in position True. Waiting settle time
3.0s
setup.MTCS DEBUG: No new in position event in the last 3.0s. Assuming MT
Rotator in position.
setup.MTCS DEBUG: MTRotator in position True. Waiting settle time 3.0s
Out[20]: (<ICRS Coordinate: (ra, dec) in deg
          (82.54988136, -39.13770191)>,
          <Angle 1.9 deg>)

```

---

Once on target\_4 and tracking, take an image with ComCam

```

In [21]: exp4 = await comcam.take_object(15)
         print(f"Target 4 exposure: {exp4}")

setup.ComCam DEBUG: Generating group_id
setup.ComCam DEBUG: imagetype: OBJECT, TCS synchronization not configure
d.
Target 4 exposure: [2022053100004]

```

---

Stop tracking to prevent hitting the Rotator soft limit.

```

In [22]: await mtcs.stop_tracking()

setup.MTCS DEBUG: Stop tracking.

```

---

Use ComCam recent images CCS to ensure that the images were taken  
<http://ccs.lsst.org/RecentImages/comcam.html>).

---

Query the butler to verify that the images are there and check the metadata. This step must be verified using a separate notebook.

---

### Wrap Up and Shut Down

This cell is not currently included as part of the test execution, but included here as needed to shutdown the systems

```
In [ ]: await mtcs.set_state(salobj.State.STANDBY, components=["mtaos"])
```

```
In [ ]: await mtcs.lower_m1m3()
```

```
In [ ]: await mtcs.set_state(salobj.State.STANDBY, components=["mtm1m3"])
```

```
In [ ]: await mtcs.set_state(salobj.State.STANDBY, components=["mtm2"])
```

```
In [ ]: await mtcs.set_state(salobj.State.STANDBY, components=["mthexapod_1"])
```

```
In [ ]: await mtcs.set_state(salobj.State.STANDBY, components=["mthexapod_2"])
```

```
In [ ]: await mtcs.standby()
```

```
In [ ]: await comcam.standby()
```