National Aeronautics and Space Administration

CELESTIAL ASPECTS OF MARS SCIENCE LABORATORY CHEMCAM SUN-SAFETY

Stephen Peters, Lauren DeFlores, Noah Warner, and Todd Litwin

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Jet Propulsion Laboratory, California Institute of Technology

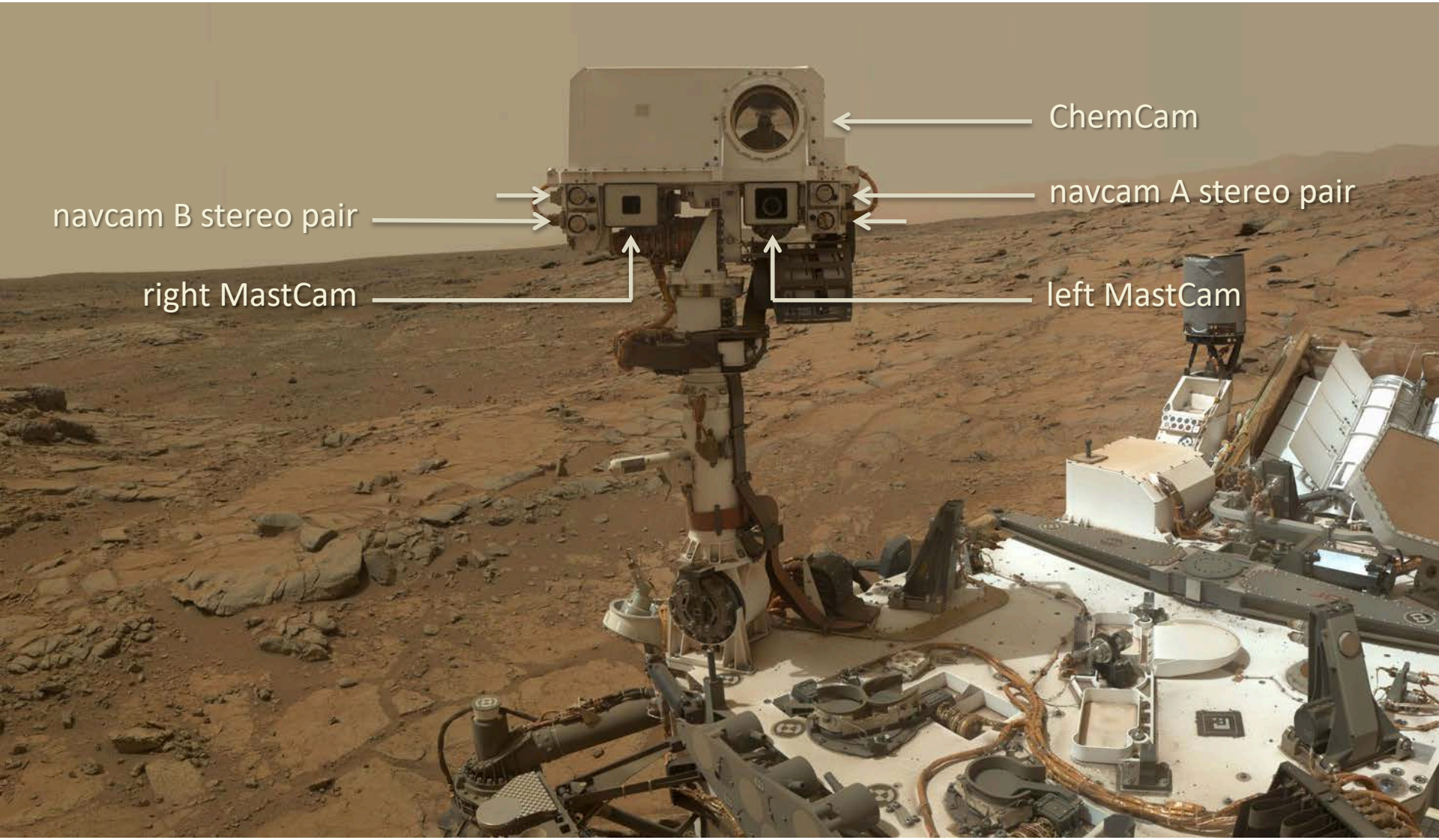


Image: NASA/JPL-Caltech/MSSS

topics

two sun-safety regimes

- "sun-safe" focus for general operations
- "sun-unsafe" focus for ChemCam observations
- ground tools supporting sun-safety checks

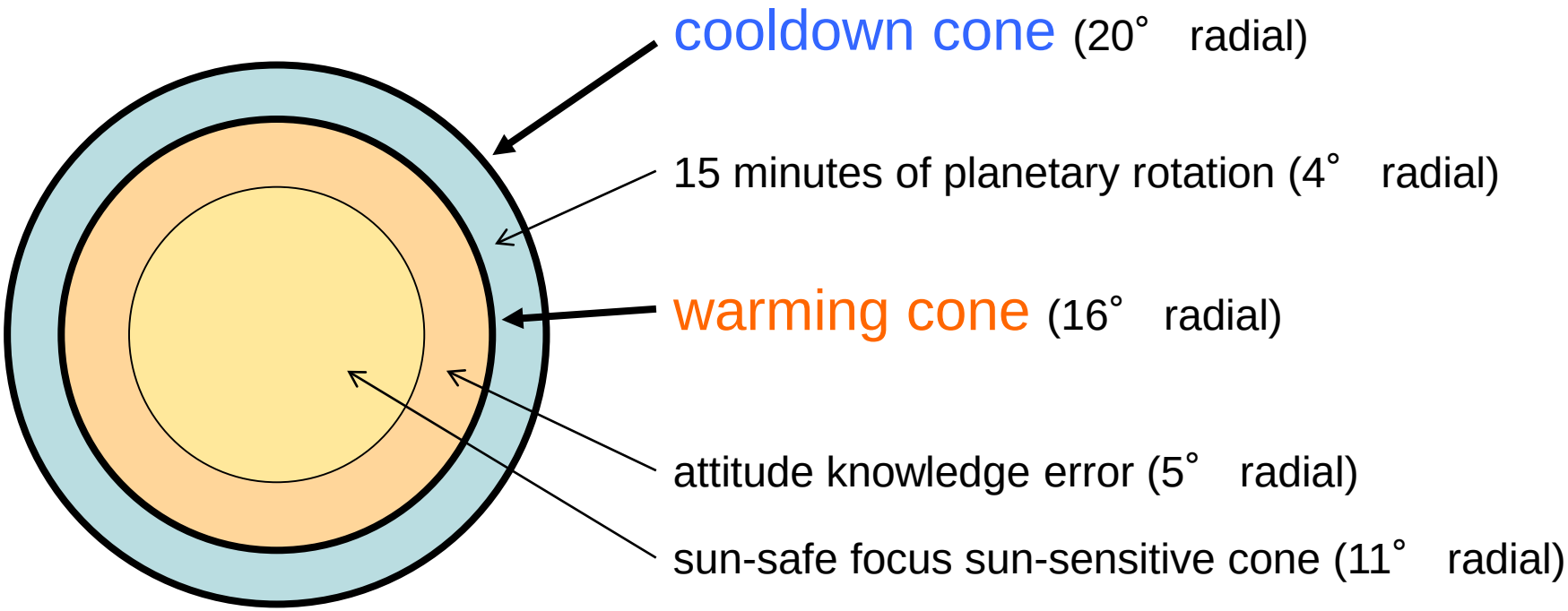
special case for initial attitude determination

- sun-safe sun search

"sun-safe" focal range

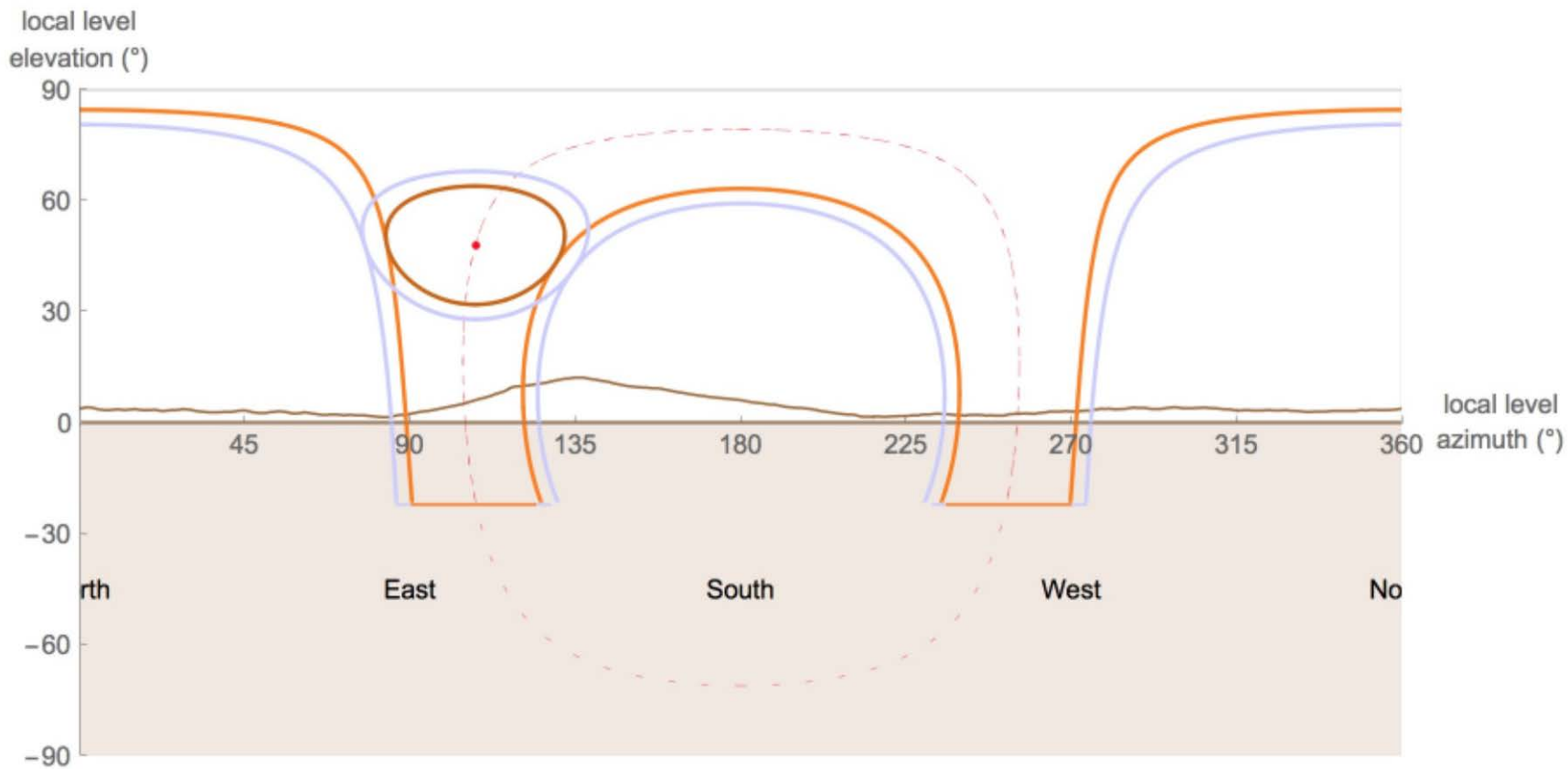
cooling and warming

cones about the ChemCam boresight



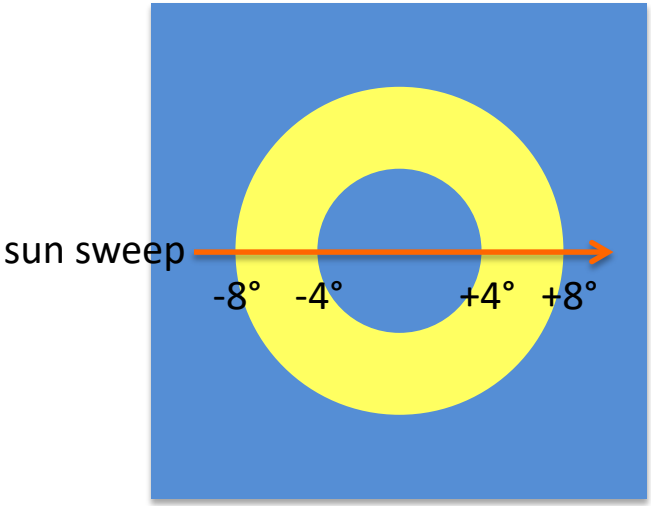
cooling and warming

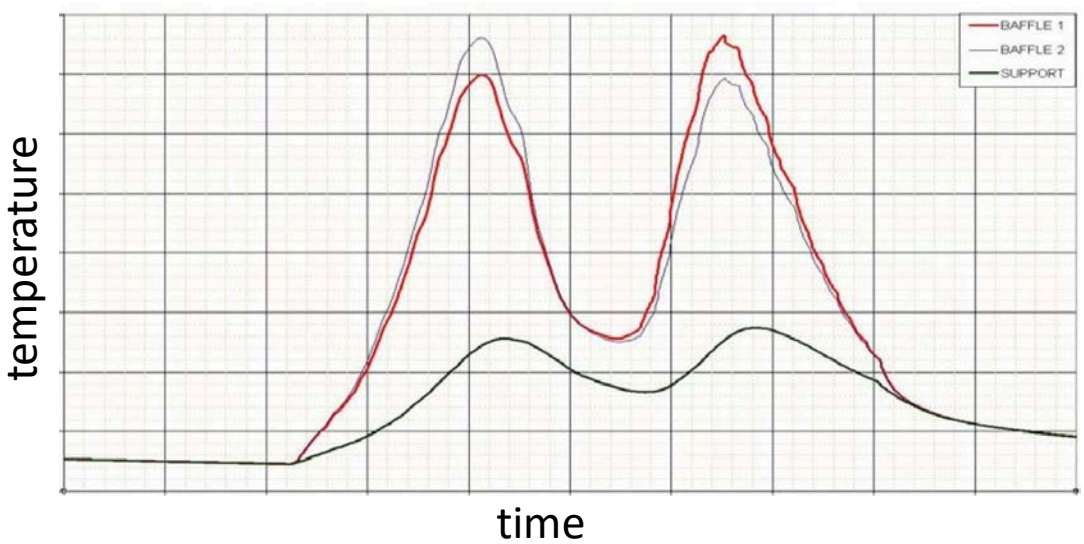
swept cones about the sun, cut off at the horizon



heating annulus

about the ChemCam boresight

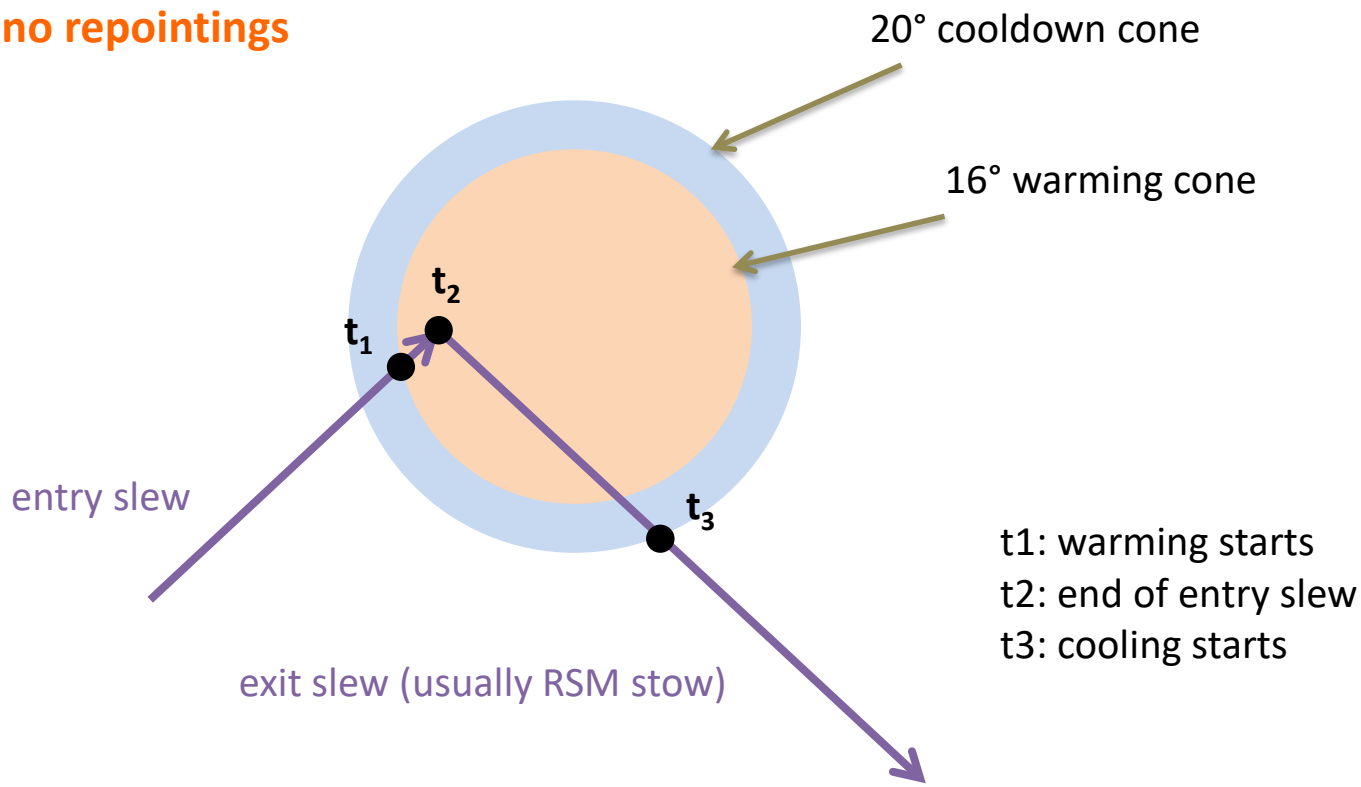




analysis demonstrated ability to tolerate "passive" sun transit due to planetary rotation

allowable tracking time

1 pointing
no repointings



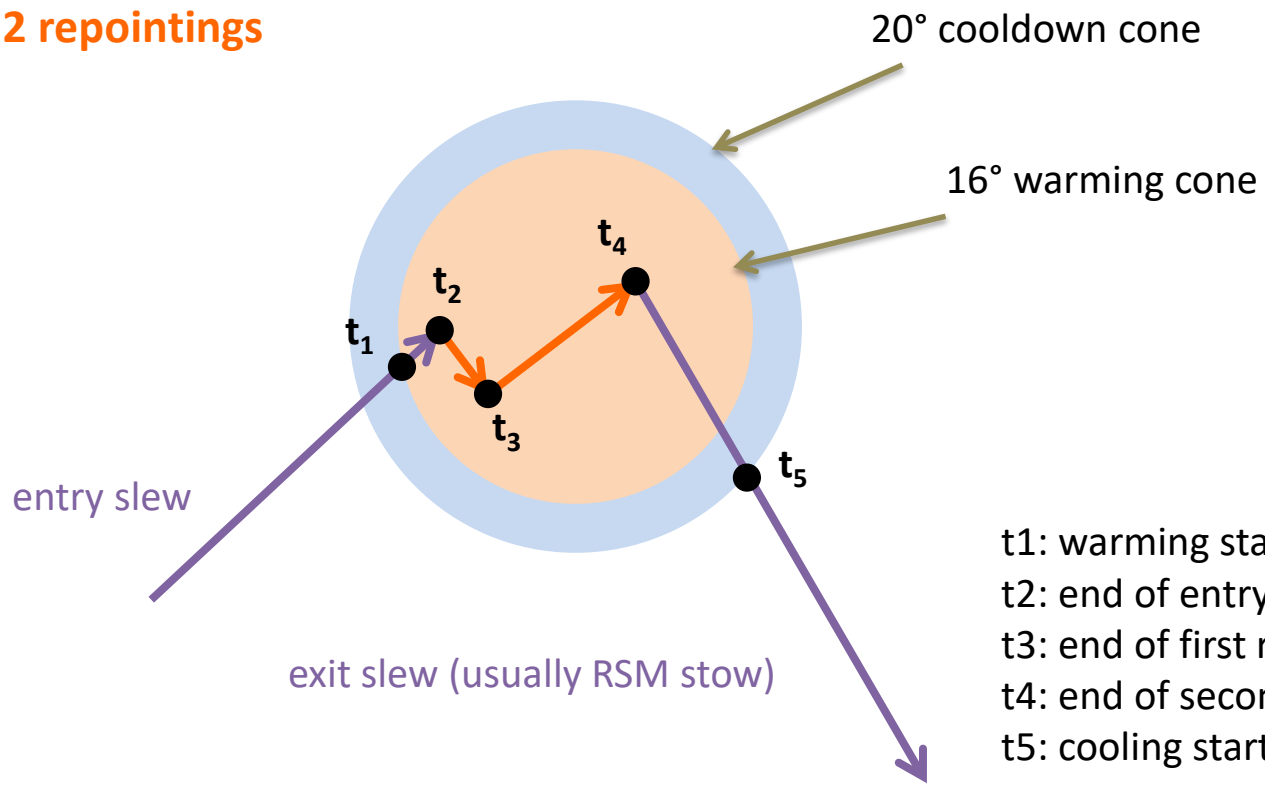
t1: warming starts
t2: end of entry slew
t3: cooling starts

time inside the sun sensitive cone = $\mathbf{t_3} - \mathbf{t_1}$

tracking time = 0

allowable tracking time

3 pointings
2 repointings



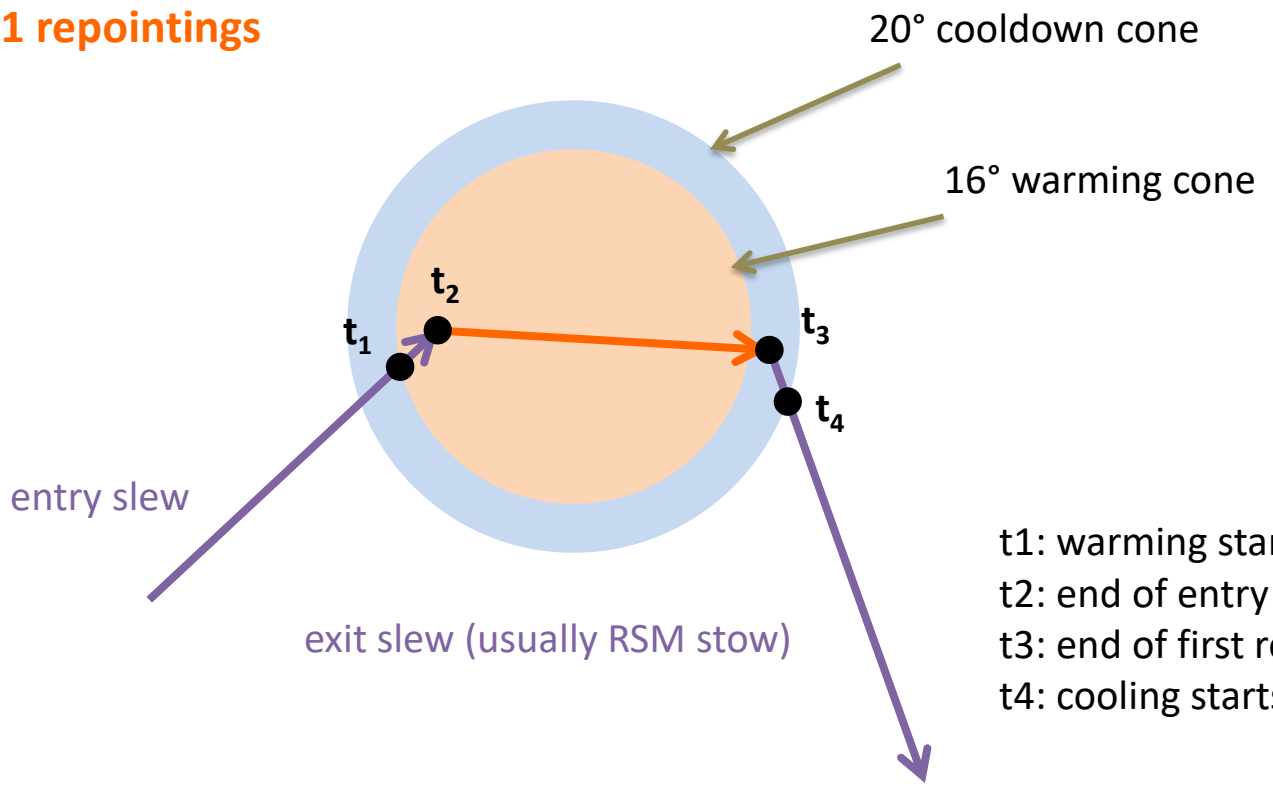
t1: warming starts
t2: end of entry slew
t3: end of first repointing
t4: end of second repointing
t5: cooling starts

time inside the sun sensitive cone = $\mathbf{t_5 - t_1}$

tracking time = $\mathbf{t_4 - t_1}$

allowable tracking time

2 pointings
1 repointings



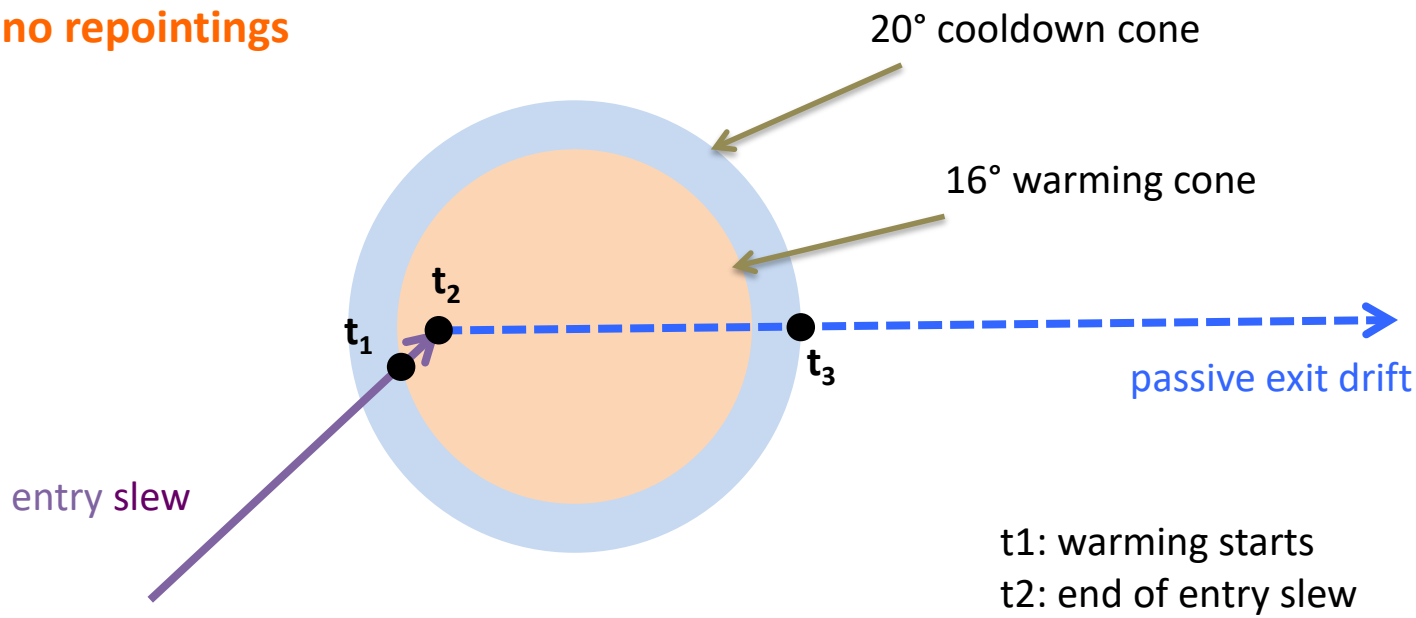
t1: warming starts
t2: end of entry slew
t3: end of first repointing
t4: cooling starts

time inside the sun sensitive cone = $\mathbf{t_4 - t_1}$

tracking time = $\mathbf{t_3 - t_1}$

allowable tracking time

1 pointing
no repointings

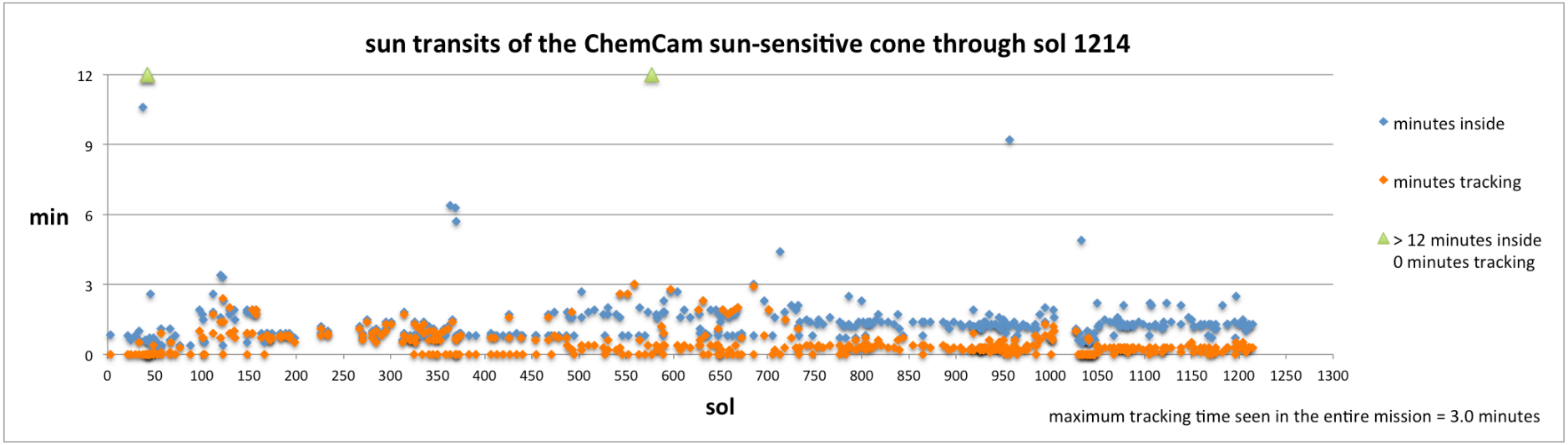


t1: warming starts
t2: end of entry slew
t3: cooling starts

time inside the sun sensitive cone = $\mathbf{t_3} - \mathbf{t_1}$

tracking time = 0

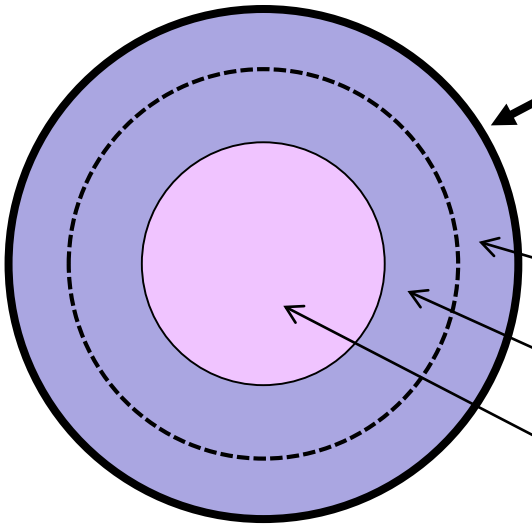
transit and tracking time history



"sun-unsafe" focal range

sun keepout

cone about ChemCam boresight



keepout cone (17° radial)

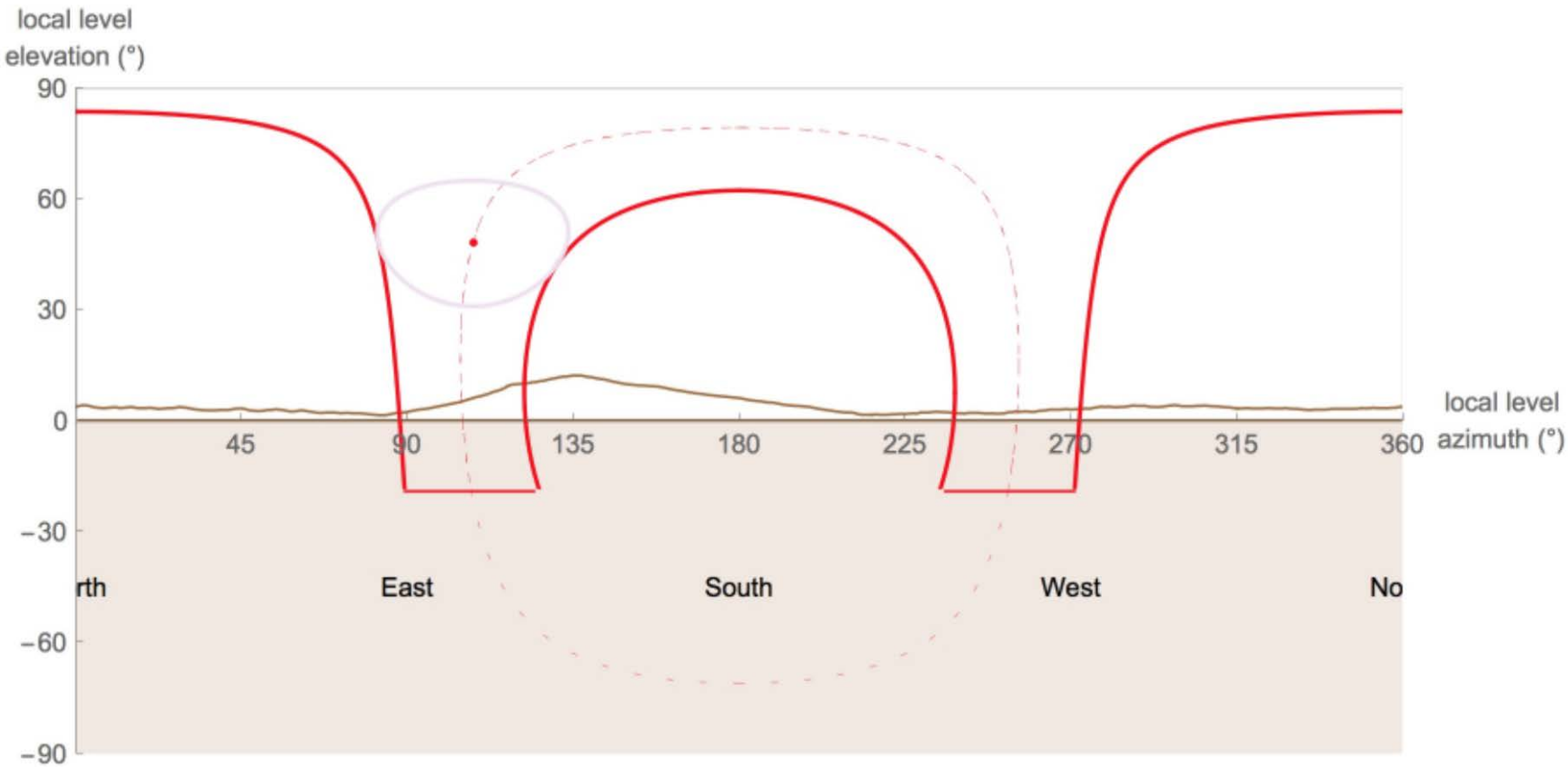
≥ 16 sols of orbital motion (4° radial)

attitude knowledge error (5° radial)

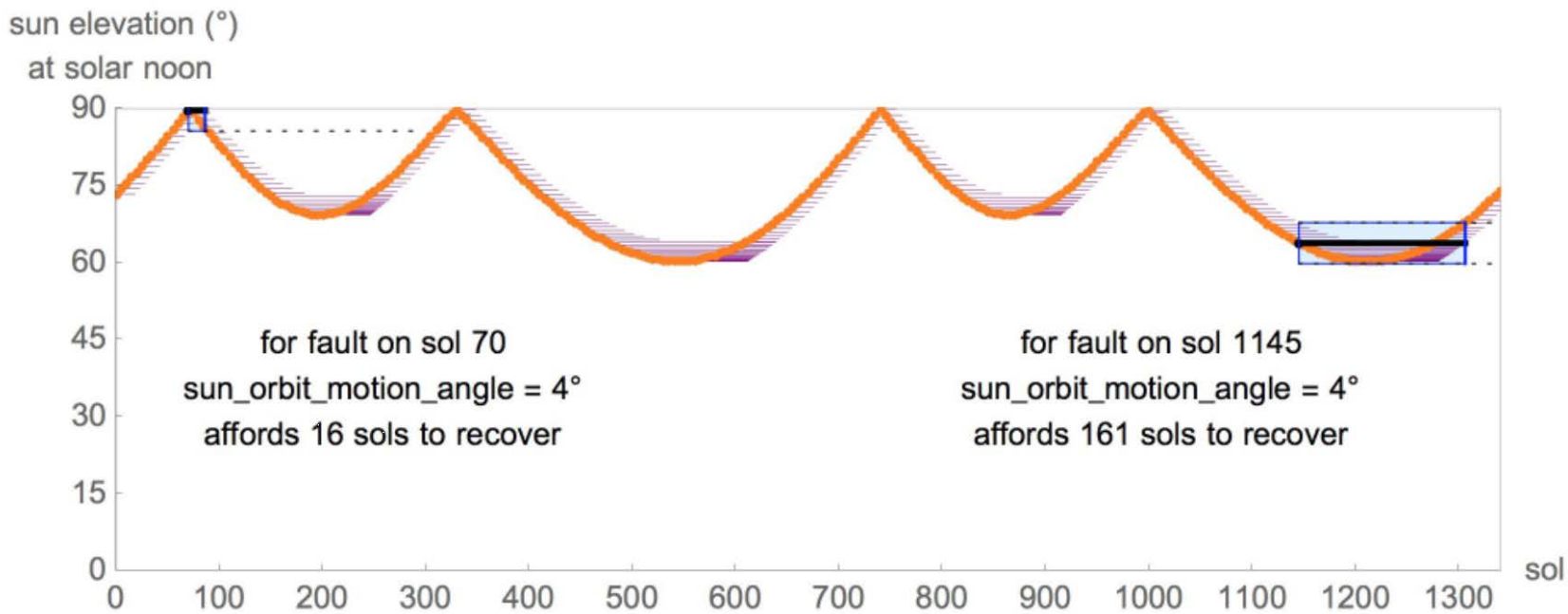
sun-unsafe focus sun-sensitive cone (8° radial)

ChemCam keepout

swept cone about the sun, cut off at the horizon



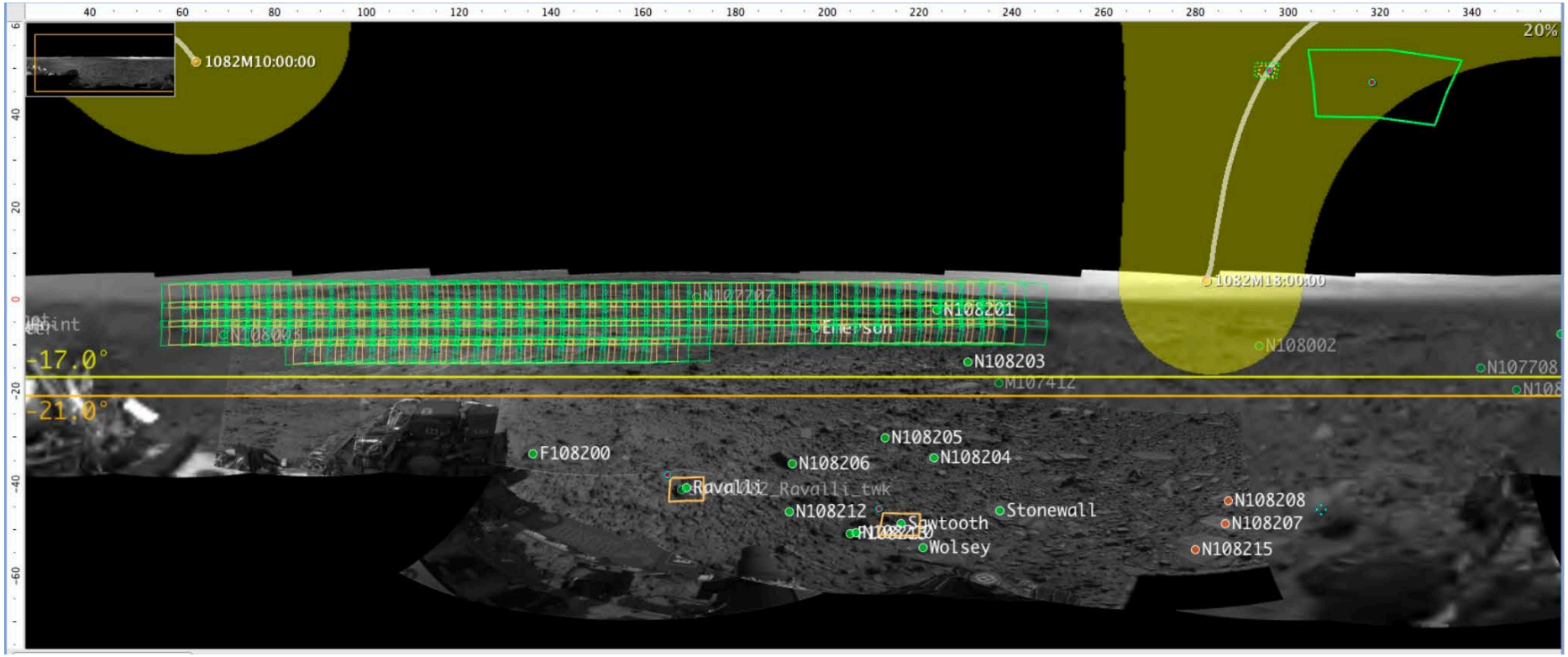
4° of orbital motion for fault recovery



ground tools

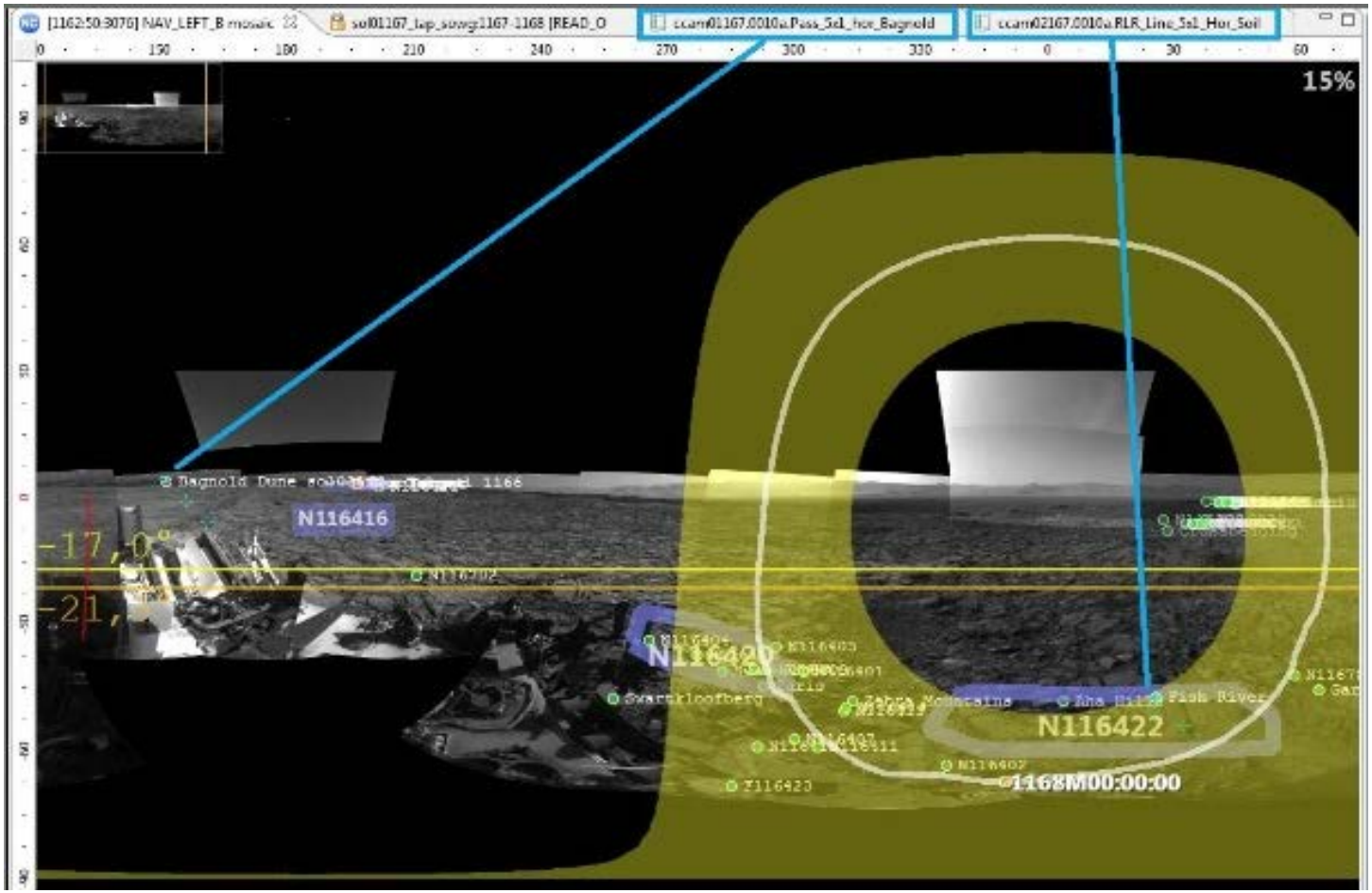
ChemCam sun-risk plot

MastCam and navcam observations

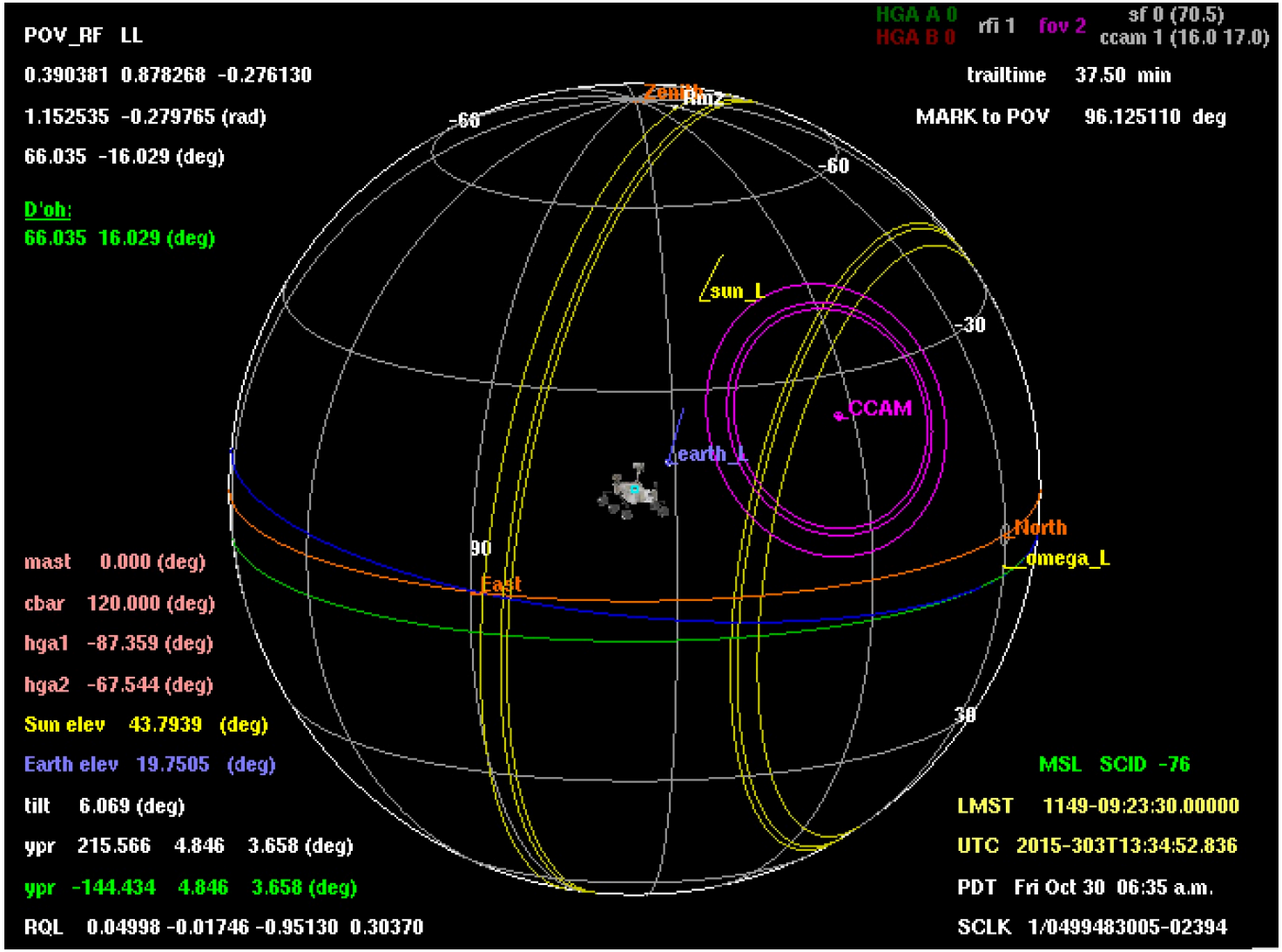


ChemCam sun-risk plot

ChemCam observations



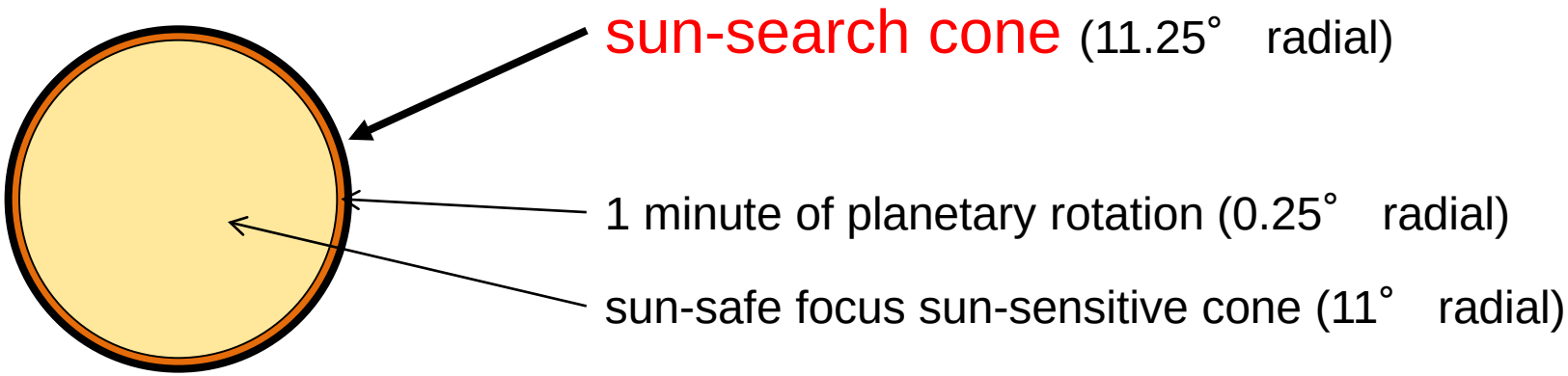
ChemCam hazard plot

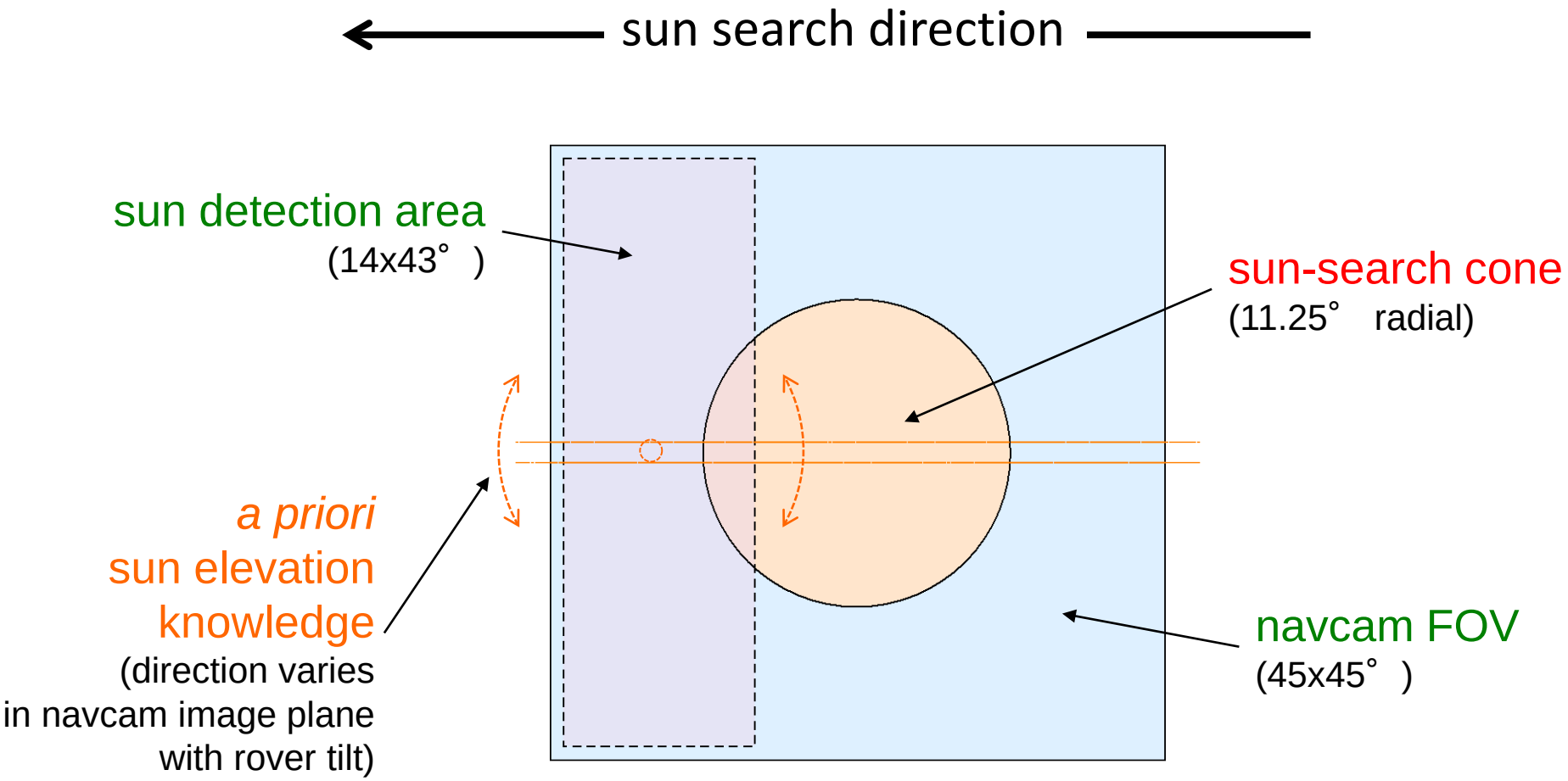


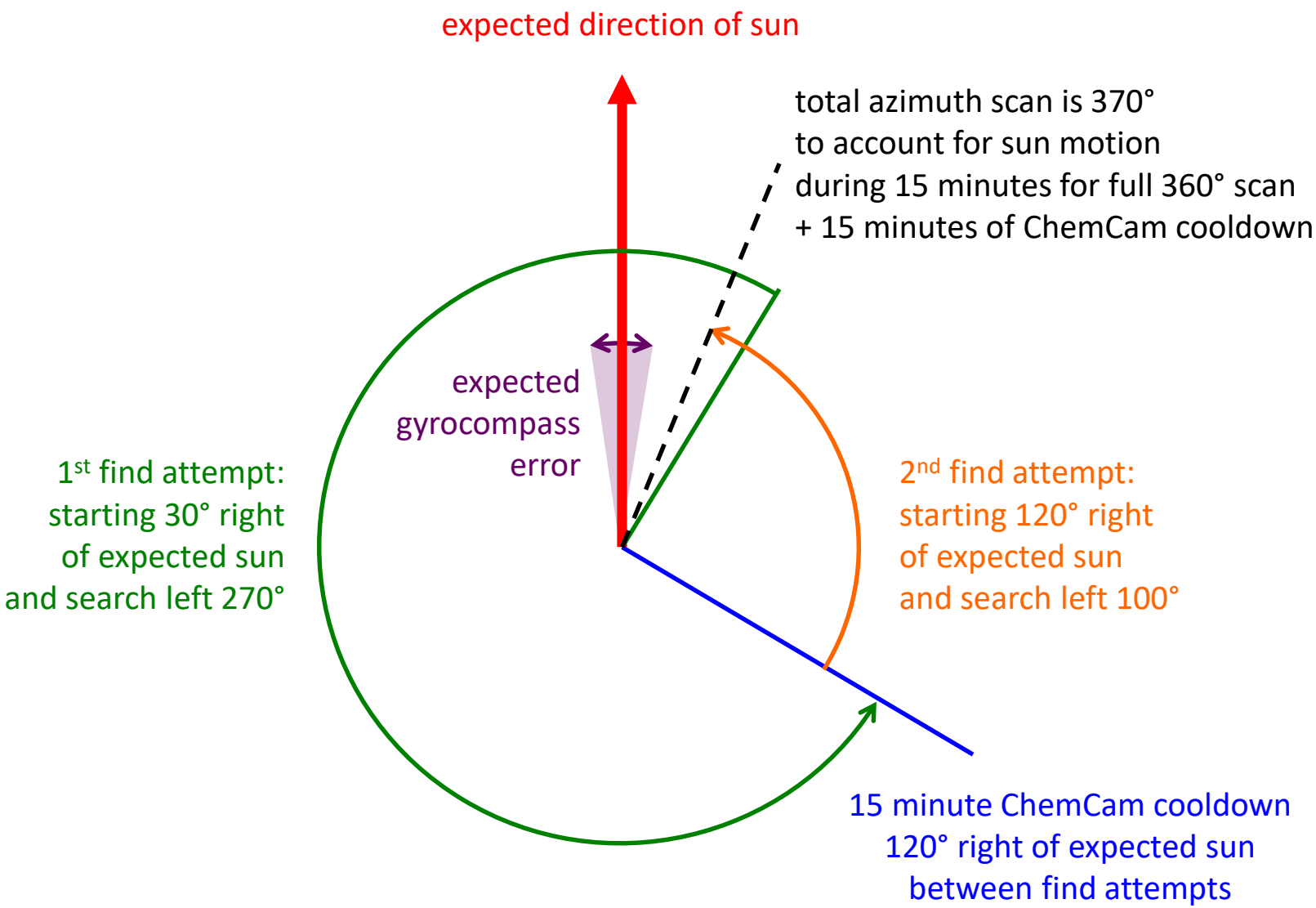
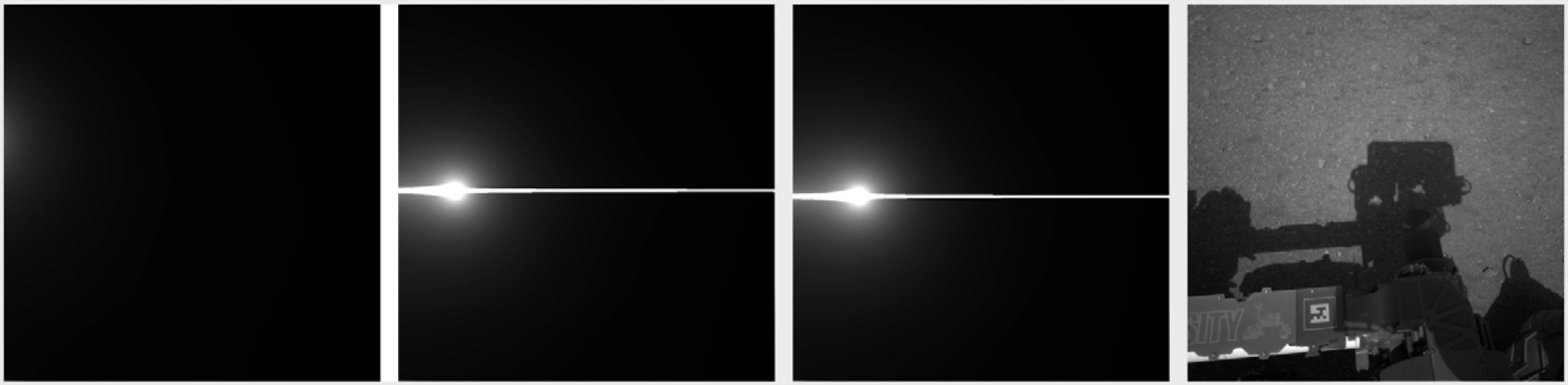
sun-safe sun search

sun search

cone about ChemCam boresight




sun search direction
sun detection area
(14x43°)
sun-search cone
(11.25° radial)
a priori
sun elevation
knowledge
(direction varies
in navcam image plane
with rover tilt)
navcam FOV
(45x45°)


expected direction of sun
total azimuth scan is 370°
to account for sun motion
during 15 minutes for full 360° scan
+ 15 minutes of ChemCam cooldown
expected
gyrocompass
error
1st find attempt:
starting 30° right
of expected sun
and search left 270°
2nd find attempt:
starting 120° right
of expected sun
and search left 100°
15 minute ChemCam cooldown
120° right of expected sun
between find attempts

initial attitude determination images