



Integrated Observations Timeline

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The Mars Spacecrafts' Goals

- To survive
 - aided by maneuvers to get into the right geometry and position to avoid damage.
- To get good science from this unprecedented closest approach. There are two campaigns:
 - The comet itself – the nucleus and coma
 - The comet's impact on the Mars atmosphere
- Comet timeline:
 - Will pass closest to Mars (CA) 138,800km @ 18:27:20 UTC ;
 - ~20min after that Mars will skirt the comet coma and begin the period for potential particle impacts;
 - The peak fluence occurs @ 20:08:30 UTC.



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The NASA Spacecraft



Orbiters

- Mars Reconnaissance Orbiter (MRO)
 - HiRISE, CTX, CRISM, MCS, MARCI, SHARAD
- Mars Odyssey (ODY)
 - THEMIS
- MAVEN
 - IUVS, SEP, SWIA, SWEA, STATIC, MAG, LPQ

Rovers

- Mars Science Laboratory/Curiosity
 - ChemCam, Mastcam
- Mars Exploration Rover/Opportunity
 - PanCam



> 3 weeks before CA



Date	Activity	Purpose
July 2	MRO orbit maneuver to put spacecraft behind Mars (1 st of 2)	Risk mitigation (against potential impacting particles).
Aug 5	ODY orbit maneuver to put spacecraft behind Mars	Risk mitigation.
Aug 6	MRO CRISM/HiRISE stellar scan to check boresite (successful)	Observation prep.
Sept 19	This meeting	
Sept 22 UTC	MAVEN Orbit Insertion (September 21, 10pm EDT)	
Sept 24	India's Mars Orbit Mission (MOM) goes into orbit around Mars	
Sept 25	MRO orbit maneuver to put spacecraft behind Mars (2 nd of 2)	Risk mitigation.



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~10 days before CA



Date	Activity	Purpose
Oct 7	MRO HIRISE imaging of comet.	Check comet trajectory.
Oct 9	MAVEN last course correction to put spacecraft behind Mars at time of peak flux.	Risk mitigation.
Oct 12 and later	Curiosity and Opportunity may image comet at night.	Image comet in Mars sky (likely a point source).



3-1 days before CA

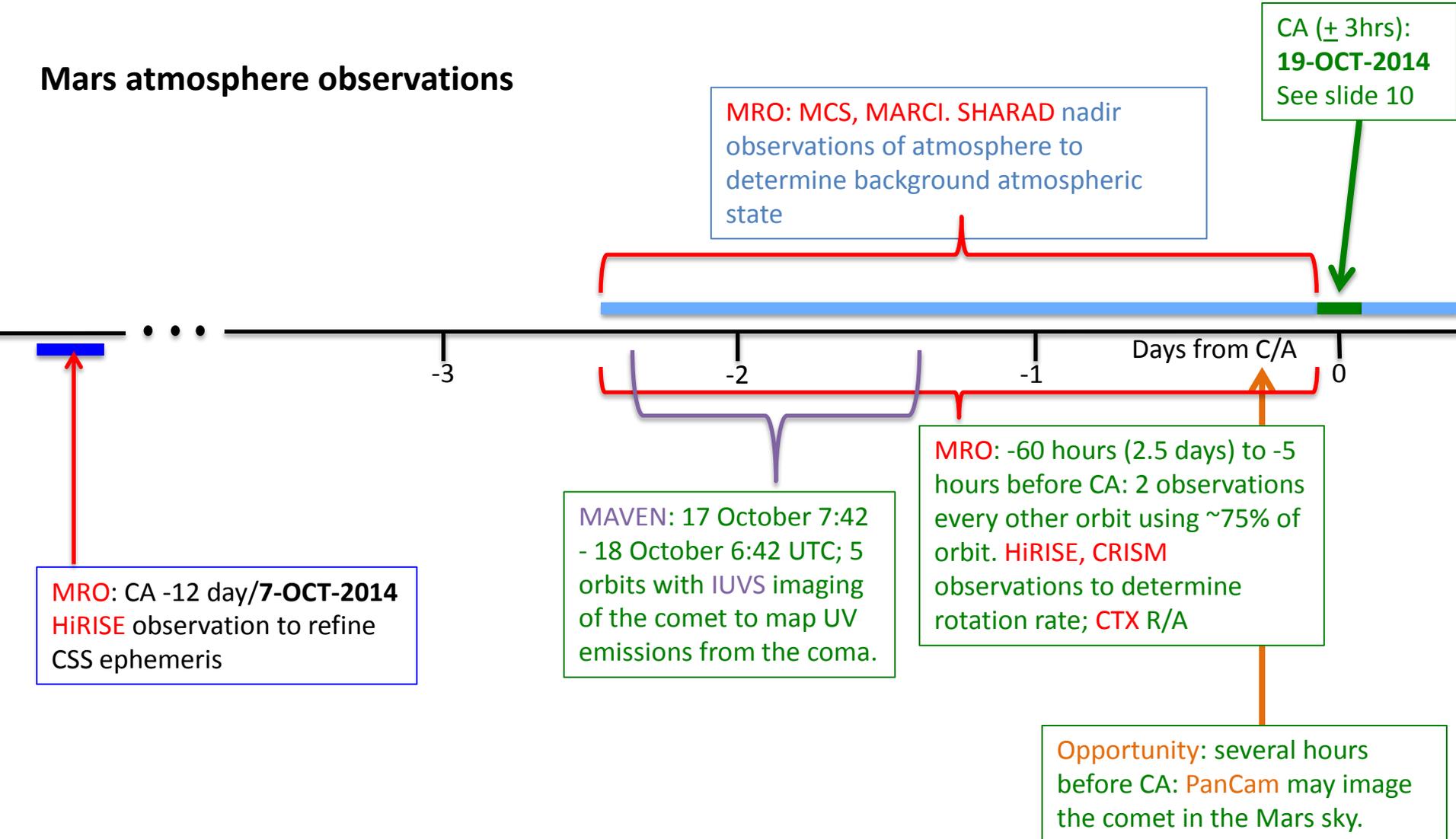


Date	Activity	Purpose
Oct 17	MAVEN will image the comet with the IUVS.	Ultraviolet (UV) images of the coma.
Oct 17-19	MRO will monitor Mars' atmosphere (MARCI, MCS and SHARAD).	Determine nominal state of Mars' atmosphere (pre-comet).
	MRO (HiRISE, CRISM, CTX) will image the comet.	Measure comet nucleus rotation rate.
	MAVEN will monitor the Mars upper atmosphere and solar wind (SWIA, SWEA, STATIC, MAG).	Determine nominal state of Mars' atmosphere (pre-comet).
	Curiosity may image comet at night using the ChemCam, Mastcam.	ChemCam will take UV and VNIR images of the coma to study mineral makeup. Both cameras will image comet in Mars sky.
	Opportunity may image the comet with PanCam.	Image comet in Mars sky.



Schematic: 3-1 days before CA **JPL**

Mars atmosphere observations



Comet observations



Around CA (before CA)



Date & Time	Activity	
<p>Oct 19, CA - 2-1hr</p>	<p>MAVEN goes into planned “minimum risk” mode ~2hrs hour prior to CA. LPW, SEP, MAG continue to operate.</p>	<p>Risk mitigation (all instruments requiring high voltage will be off). LPW may detect small particles, SEP and MAG will monitor comet effects on solar wind.</p>
	<p>MRO imaging of the comet (CRISM, HiRISE, CTX).</p>	<p>Image nucleus.</p>
	<p>MRO (MCS, MARCI, SHARAD) will monitor Mars’ atmosphere.</p>	<p>Determine nominal state of Mars’ atmosphere (pre-comet).</p>
	<p>ODY (THEMIS) imaging of the comet.</p>	<p>Thermal IR and visible imaging of the coma.</p>
<p>Oct 19 18:28 UTC/ 11:28 a.m. PT/ 2:28 p.m. ET</p>	<p>Comet Siding Spring (C/2013 A1) CA to Mars at ~86,000 miles (138,800 ± 1600 kilometers)</p> <p>MRO imaging of the comet (CRISM, HiRISE, CTX).</p>	<p>Image nucleus. HiRISE resolution will be ~150 m/pixel.</p>



The day after CA



Date & Time	Activity	Purpose
Oct 19/CA + 20 min	Mars will skirt the comet coma.	
Oct 19/CA + 90 min	ODY (THEMIS) will image the comet and tail.	Thermal IR and visible images of coma and tail.
	MRO (CRISM, HiRISE, CTX) to image comet.	Image nucleus.
	MRO (MCS, MARCI, SHARAD) will monitor Mars' atmosphere.	Identify and measure interactions between comet particles and Mars' atmosphere.
Oct 19/CA + 2.5-5 hrs	Curiosity may image comet at night using the ChemCam, Mastcam.	Image comet over Mars skyline.
Oct 19/CA + ~7.5 hrs	MAVEN will leave "minimum risk" mode.	Spacecraft and instrument status checked over the next orbit, then will resume Mars observations (~CA+7hrs).
Oct 19/CA + 5-14 hrs	MRO (HiRISE, CRISM, CTX) will image the comet.	To determine nucleus rotation rate.
Oct 19/CA + ~10 hrs	Opportunity may image the comet using the PanCam.	Image comet over Mars skyline.



The days after CA



Date	Activity	Purpose
Oct 20	Opportunity and Curiosity may image the comet.	Image comet in Mars sky.
	Orbital spacecraft will begin to report back to Earth their health and safety status.	Status checks (this schedule is still TBD and it's uncertain which spacecraft will call home first), followed by resumption of regular operations.
Oct 20-21	MRO (MCS, MARCI, SHARAD) monitors the Mars' atmosphere.	Identify and measure interactions between comet particles and Mars' atmosphere.
Oct 21	ODY (THEMIS) images the comet with planet limb	Thermal IR and visible image of coma and tail and Martian limb; will allow comparison of the coma with the known temperature, gas, and dust opacity of the Mars atmosphere.



Schematic: 0-2 days after CA



Mars atmosphere observations

MRO: to CA + 2 days: MCS, MARCI, SHARAD will make nadir observations of atmosphere to determine comet particle effect on atmosphere



CA (+ 3hrs):
19-OCT-2014
 See slide 10

MRO: +5 to +14 hours: 2 observations every other orbit using ~75% of orbit. HiRISE, CRISM observations to determine rotation rate; CTX R/A

ODY: 21 October 14:13:37-14:22:16 TDB; 1 THEMIS slew to get the comet (coma and tail) with the Mars limb. Comet will be ~8.8 million km away.

Opportunity: ~10 hours after CA: PanCam may image the comet in the Mars sky.

Curiosity: ~2.5-5 hours after CA: MastCam and ChemCam may image the comet in the Mars sky.

Comet observations



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For further updates



- <http://mars.nasa.gov/comets/sidingspring/>