



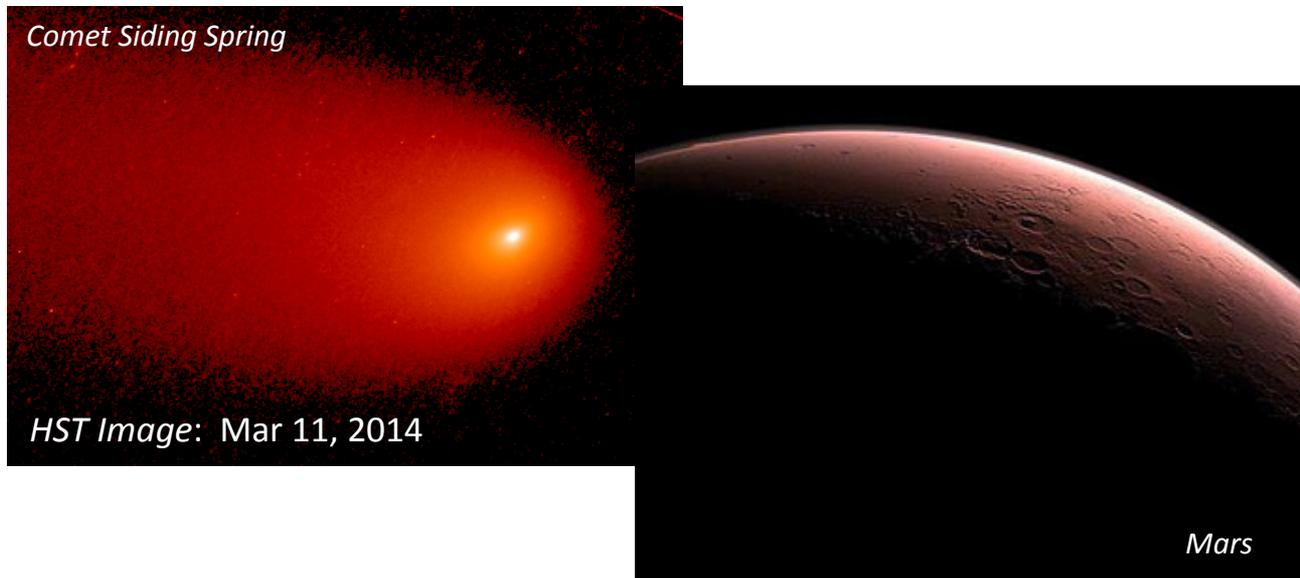
National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

Mars Exploration Program Office

Comet Siding Spring (C/SS) at Mars: Mars Mission Mitigation Status

*by R. Zurek, Mars Program Office (JPL)
19 September, 2014*



Mars Exploration

Operational

2001 - 2014

2016

2018

2020

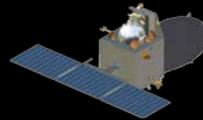
2022



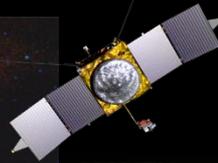
Odyssey

MRO

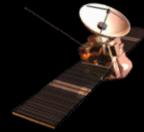
Mars Express
Collaboration



ISRO – MOM
Mangalyaan



MAVEN



ESA Trace Gas
Orbiter
(Electra)

Opportunity



Curiosity –
Mars Science
Laboratory



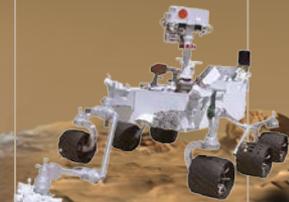
InSIGHT
(Discovery Program)



ESA ExoMars
Rover (MOMA)



2020
Science Rover



Future
Planning

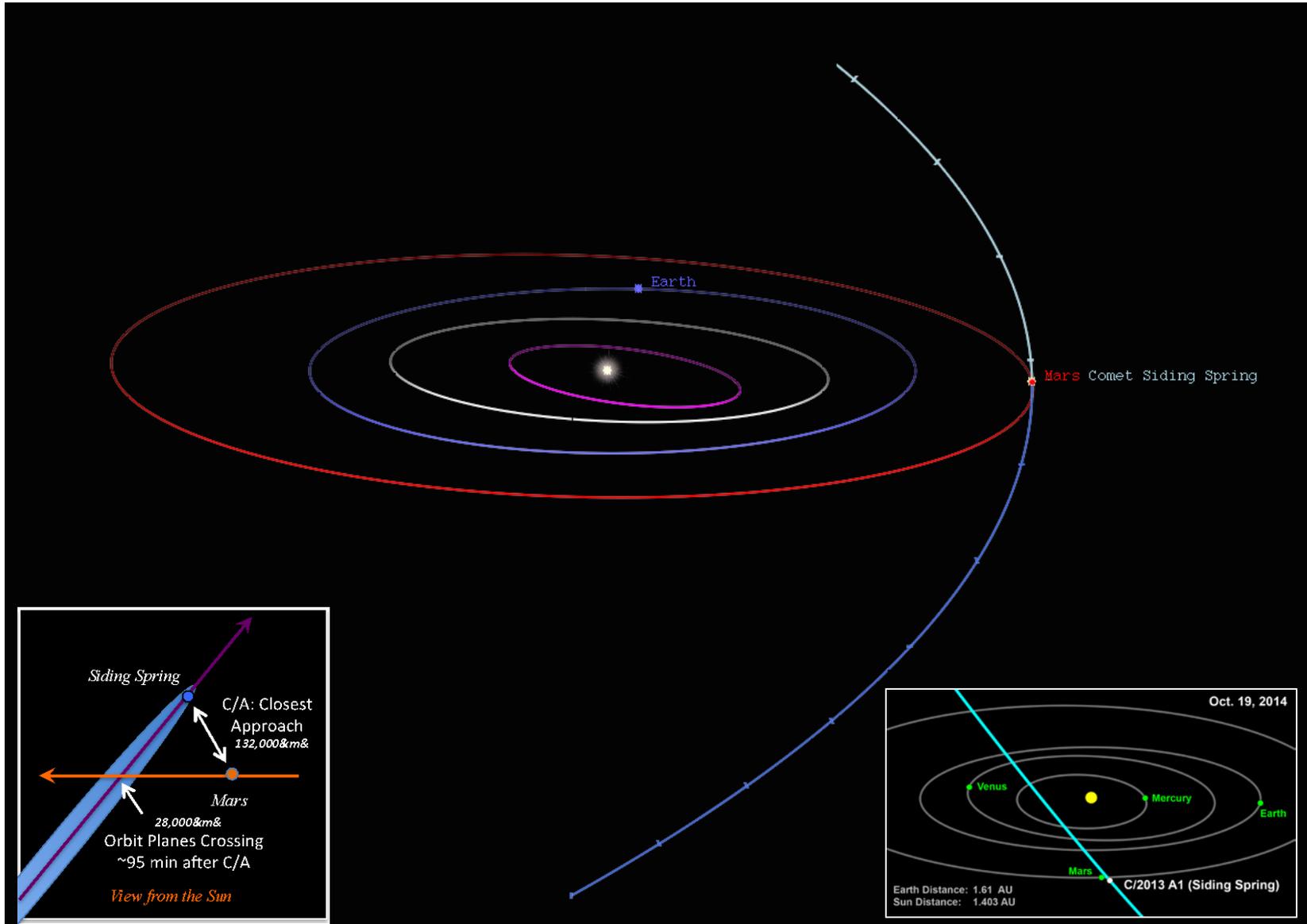


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Comet /2013 A1 Siding Spring

Mars Exploration Program Office



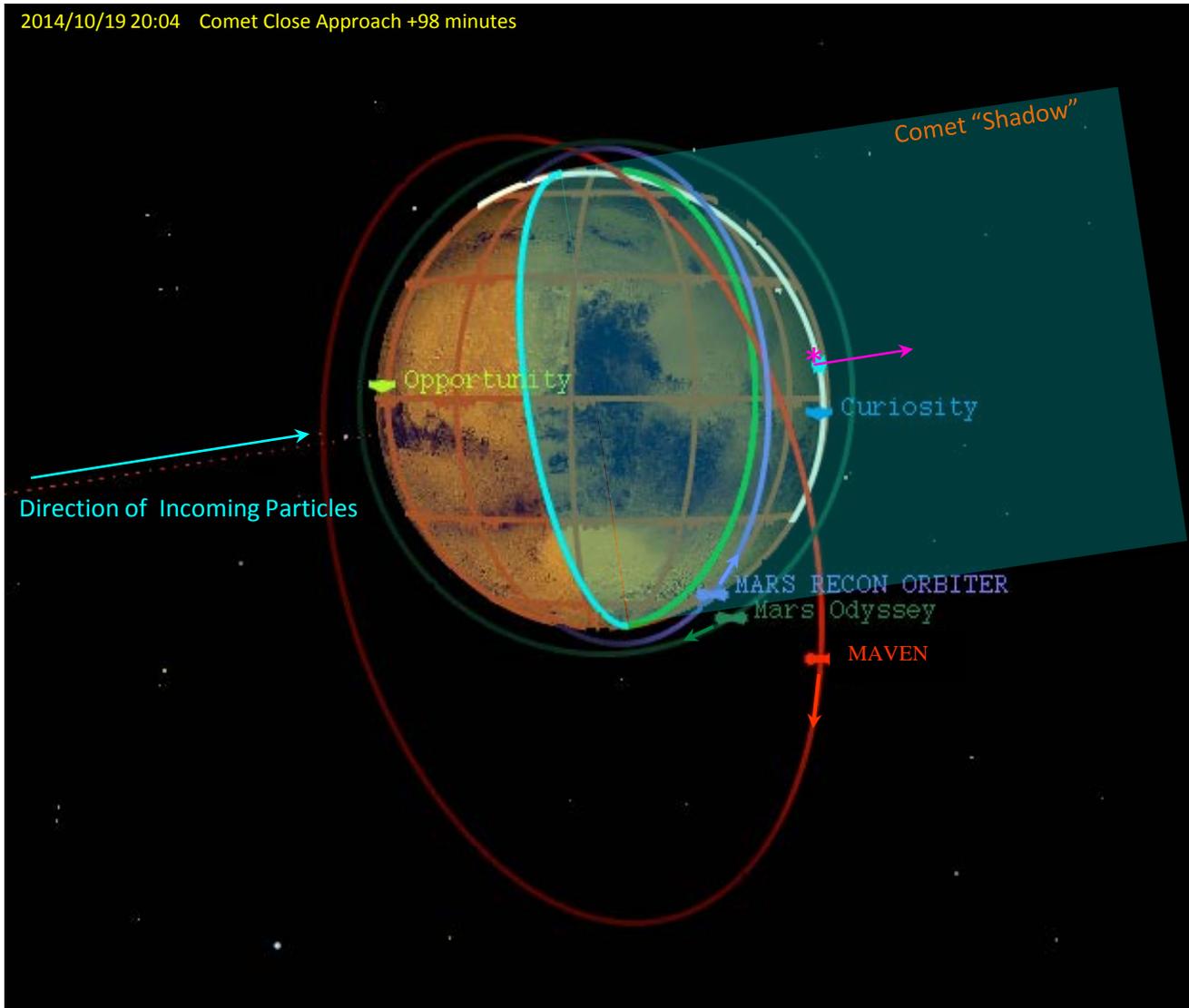


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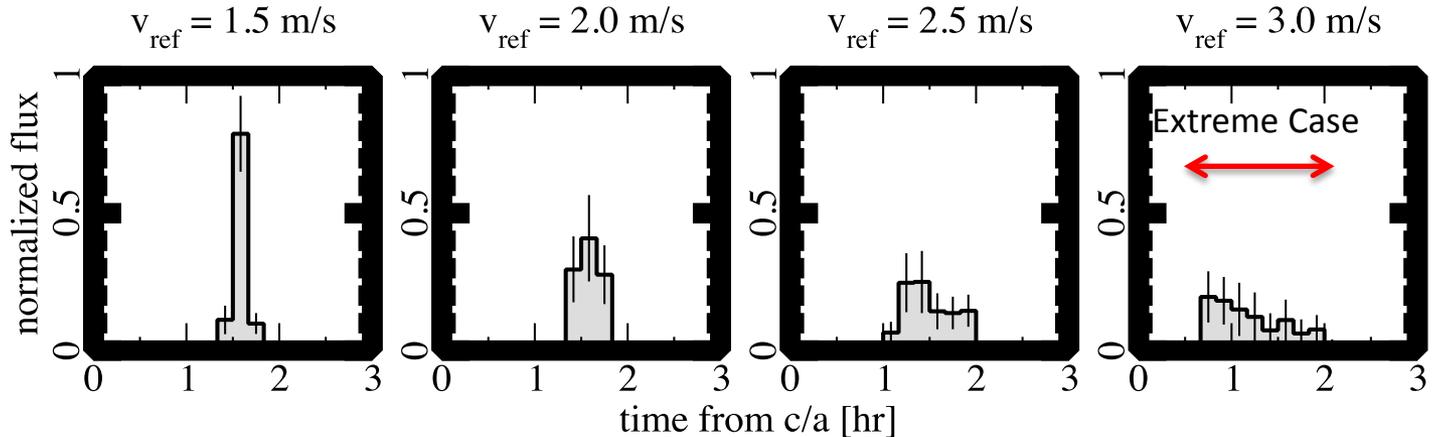
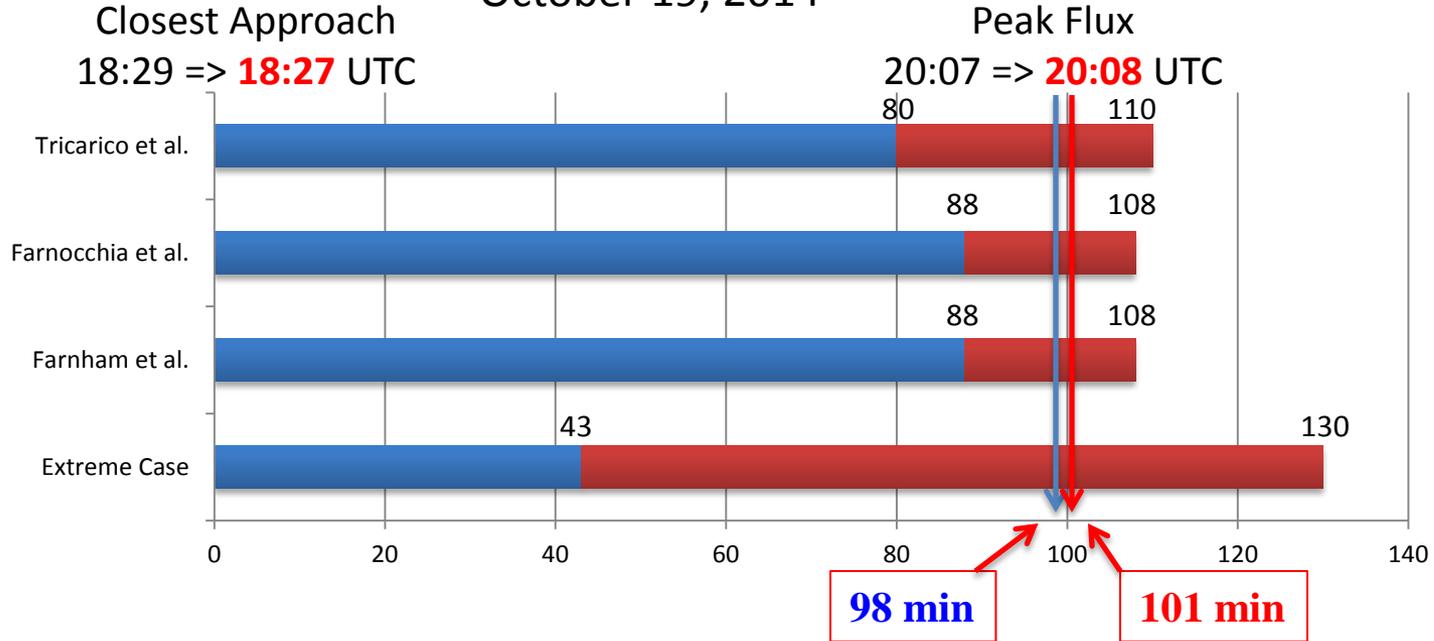
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Time of Maximum Flux

October 19, 2014





Science Observations - *Preliminary*

**Conducted only if safe, posing no spacecraft or instrument issues*

Mars Exploration Program Office

NASA Missions

Target	Observation Objective	MRO						ODY		ROVERS		MAVEN ¹		
		HiRISE	CTX	CRISM	MCS	MARCI	SHARAD	THEMIS VIS & IR	HEND/NS	PAN/CAM	MastCAM/CHEM/CAM?	IUVS	LPW/MAG, SEP	NGIMS, STATIC SWEA, SWIA
Comet	Comet General Features					❖		❖		◆	◆	◆	◆	
	<u>Comet Nucleus</u> : Size, Shape & Rotation	◆												
	Comet Activity: Jets & Variable Brightness	◆	◆	❖				❖				◆		
	<u>Comet Coma</u> : Variability, particle size, gas composition	◆	❖	◆	◆	◆		◆				◆		
	<u>Comet Tail</u> : Particle Size		◆	❖	❖	❖		❖				◆	◆	
Mars Response	Mars Upper Atmosphere Composition: Neutrals, ions & electrons; meteor trails						❖		❖	◆	◆	◆	◆	◆
	Mars Lower Atmosphere: Temperature and Clouds			❖		❖		❖		❖	❖	❖		

Key: major contribution ◆ contribution ❖

¹*Conducted only if transition to science orbit is nominal*



Phasing Maneuver Status

- **Phasing Maneuvers**

- ✓ July 2 MRO 1st of 2 phasing maneuvers (OTM 37)
- ✓ August 5 ODY phasing maneuver
- September 25 MRO 2nd maneuvers (OTM 38 delayed from Aug 29 due to safing event)
- October 9 MAVEN will combine with 3rd period reduction maneuver (PRM-3) during transition to science orbit

- **Comet Encounter Observation Sequences are designed & being verified**

- **Interactions with Comet Science Community**

- ✓ Ongoing: Participation in Coordinated Investigations of Comets (CIOC) forum
- ✓ August 11: Workshop involving Mars Projects and other Comet Observers
- September 19: Virtual Meeting between Mars Projects and Comet Scientists
 - Give status on final science observing plans by Mars Projects.
 - Review latest observations.



- **September 19: Provide update on mitigation status and observation planning**

- **October 19: Closest Approach of Comet Siding Spring to Mars**

- *Prime observing campaign ± 2.5 days around nucleus closest approach*



Status of Contingency Re-Orientation

Mars Exploration Program Office

- **Opportunity and Curiosity rovers are protected by the Mars atmosphere**
- **MAVEN is already planning to be at its “least vulnerable” orientation during closest approach period**
 - This orientation was already close to their nominal attitude during transition
 - Orientation for remote sensing of the comet occurs before closest approach
- **ODY & MRO have chosen to optimize for comet observations**
 - Contingency attitude only marginally better than comet observing attitudes
 - Some of the best science to be gained should come from observations during closest approach period and the risk is low, as Mars will shield the spacecraft during the predicted period of cometary dust flux
- **Criteria for moving to contingency orientations was:**
 - Non-gravitational forces move the comet nucleus significantly closer to Mars; i.e., within 125,000 km of Mars (3 sigma). Current: 138,000 ±1600 km ✓
 - Observations and/or calculations indicate a dust particle flux at Mars that will occur outside the present 30 minute window, ~80-110 minutes after closest approach of the comet nucleus. ***TBC-this meeting***