

On the shoulders of Dawn & Rosetta: Operation of the Asteroid Framing Camera (AFC)

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Dawn-FC and Rosetta/OSIRIS



Dawn Framing Camera Operated on NASA Dawn Spacecraft from Sep 2007 to Nov 2018

> OSIRIS Narrow Angle (top) and Wide Angle (bottom) Camera Operated on ESA Rosetta Spacecraft from Mar 2004 to Sep 2016







Dawn Framing Camera





Item	Specification						
Focal Length	150 mm						
F-Number	7.5						
Encircled Energy	$>80\%$ inside a pixel of 14 μ m sq.						
BFL	19 mm						
Focal Shift	$<\!20 \mu m$ wrt. channel 4						
Field of View	$5.5^{\circ} \times 5.5^{\circ}$						
IFOV	93.7 µrad						
Field Curvature	<10 µm						
Distortion	< 0.1%						
Spectral Range	400–1050 nm						
Spectral Transmission	>75%						



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Sierks et al. (2011)







Dawn-FC Planning Scheme

- High Level Observation Plan
- Time Ordered Listing (TOL)
 - Sequence Name
 - Start time, Cadence, Repetitions
- Command Snippets
 - Short command sequences, used for one "station"
 - One to a few images (e.g. colour stack)
- Damocles
 - Input: TOL & Command Snippets
 - Output: integrated commanding file

Start Time (SCET)	End Time (SCET)	MTP Name	Activity Name	Observation Name	Images/Ob	s #	0	oservation	Observation	Image	Filter Wheel	Actual
(year-day)	(year-day)				ervation	Observa	tio Du	iration	Cadence (mins)	Cadence	Movements	Images
						ns				(min)		
2014-107T12:00:00	2014-107T12:01:00	STP002	OSI_RECOMM_SWITCHON_003	PowerBothOn)	1	00T00:01:00	00T00:00:00	C) (
2014-107T23:56:00	2014-107T23:57:00	STP002	OSI_RECOMM_OPEN_NAC_003	OpenNACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-107T23:58:00	2014-107T23:59:00	STP002	OSI_RECOMM_OPEN_WAC_003	OpenWACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-107T23:59:00	2014-107T23:59:42	STP002	OSI_RECOMM_LC_003_SETUP	001a_continuous_se	t ()	1	00T00:00:42	00T00:00:00	C) (
2014-108T00:00:00	2014-109T01:12:00	STP002	OSI_RECOMM_LC_003	001a_continuous	:	2	72	00T00:07:00	00T00:21:00	C		J 144
2014-109T01:13:00	2014-109T01:14:00	STP002	OSI_RECOMM_CLOSE_WAC_003	CloseWACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-109T01:15:00	2014-109T01:16:00	STP002	OSI_RECOMM_CLOSE_NAC_003	CloseNACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-109T01:17:00	2014-109T01:18:00	STP002	OSI_RECOMM_SWITCHOFF_003	PowerBothOff	()	1	00T00:01:00	00T00:00:00	C) (
2014-113T16:00:00	2014-113T16:01:00	STP002	OSI_RECOMM_SWITCHON_004	PowerBothOn	()	1	00T00:01:00	00T00:00:00	C	. () (
2014-114T03:56:00	2014-114T03:57:00	STP002	OSI_RECOMM_OPEN_NAC_004	OpenNACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-114T03:58:00	2014-114T03:59:00	STP002	OSI_RECOMM_OPEN_WAC_004	OpenWACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-114T03:59:00	2014-114T03:59:42	STP002	OSI_RECOMM_LC_004_SETUP	001a_continuous_se	t ()	1	00T00:00:42	00T00:00:00	C) (
2014-114T04:00:00	2014-114T16:36:00	STP002	OSI_RECOMM_LC_004	001a_continuous	:	2	36	00T00:07:00	00T00:21:00	C) 72
2014-114T16:37:00	2014-114T16:38:00	STP002	OSI_RECOMM_CLOSE_WAC_004	CloseWACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-114T16:39:00	2014-114T16:40:00	STP002	OSI_RECOMM_CLOSE_NAC_004	CloseNACdoor	()	1	00T00:01:00	00T00:00:00	C) (
2014-114T16:41:00	2014-114T16:42:00	STP002	OSI_RECOMM_SWITCHOFF_004	PowerBothOff)	1	00T00:01:00	00T00:00:00	C) (

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Dawn-FC Planning Scheme







Rosetta/OSIRIS Planning Scheme

- Initially derived from Dawn
- Difference:
 - Pointing considered a valuable resource PTRM determines timeline (OSIRIS metadata)
- Developments:
 - Complex memory model (compression)
 - Dynamic change of exposure times (surface: phase angle; coma: activity level, gas species, etc.)





Static vs. Dynamic Pointing

Static pointing:

Dynamic pointing (ellipse):

Dynamic pointing (two ellipses):









Static vs. Dynamic Pointing

2016-06-06T07:18:52 WAC Distance S/C - target center: 27.12 km



The so called illuminatedPoint might not be illuminated.





Static vs. Dynamic Pointing

SHAP5: nucleus mapping in 2014

SHAP8: nucleus mapping in 2016







Additional OSIRIS Metadata

<block ref="OBS"> <startTime> 2016-06-06T07:17:22 </startTime> <endTime> 2016-06-06T11:38:57 </endTime> <attitude ref="illuminatedPoint" > <boresight ref="OsirisNAC" /> <surface ref="CG EllipseJorda" /> <offsetRefAxis ref='CG2Sun'/> <offsetAngles ref='custom'> <startTime>2016-06-06T07:18:52</startTime> <deltaTimes units='min'> 0.0 117.5 1.0 59 1.0 28.0 2.0 50.00 </deltaTimes> <xAngles units='deg'> 0.0 0.0 0.5 0.5 1.0 1.0 2.0 2.0 </xAngles> <xRates units='deg/min'> 0. 0. 0. 0. 0. 0. 0. 0. </xRates> <yAngles units='deg'> 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 </yAngles> <yRates units='deg/min'> 0. 0. 0. 0. 0. 0. 0. 0. </yRates> </offsetAngles> </attitude> <metadata> <comment> OSIRIS SHAP8 004e9N N </comment> <comment> SR.ASPEN ID=SHAP8 004e9N N,SR.SNIPPET VERSION=001 </comment> <comment> 004e9N,NAC orange frame </comment> <comment> SR.OWNER=TRUE </comment> <comment> SR.PROCESSED=FALSE </comment> <comment> SR.DURATION=2.0min,SR.DATA VOLUME=3.01MB,SR.CADENCE=30.0min,SR.REPETITIONS=24 </comment> <comment> SR.OBS000.START=BLOCK_START_TIME+00:01:30 </comment> <comment> SR.OBS001.START=BLOCK_START_TIME+00:15:00 </comment> <comment> SR.OBS002.START=BLOCK START TIME+00:30:00 </comment> <comment> SR.OBS003.START=BLOCK START TIME+00:45:00 </comment> . . . <comment> SR.OBS015.START=BLOCK START TIME+03:45:00 </comment> <comment> SR.OBS016.START=BLOCK START TIME+04:00:00 </comment> <comment> SR_OBS017_START=BLOCK_START_TIME+04.15.00 </comment>

- Introduced metadata in pointing file
- Event timing intimately linked to pointing
- If pointing changes, timing remains synchronized

steroid Framing Camera (AFC)



Compression Planning









Instrument MMB and Spacecraft SSMM



Optimisation of instrument MMB and spacecraft SSM: Interaction between MPS Damocles and ESA MAPPS.





Rosetta/OSIRIS Planning Scheme





Coverage Studies





Dawn-FC Occator; XM2 orbits



Rosetta/OSIRIS SHAP8





Hera / Didymos image simulation

- Spice kernels from Marc Costa
- Fixed nadir attitude kernel
- Morpheus image simulator
- 2022-08-01 to 2022-08-04
- Image rate synchronized with rotation

