HiRISE observations of Comet Siding Springs

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and the HiRISE targeting team

Objectives for observation of a new comet

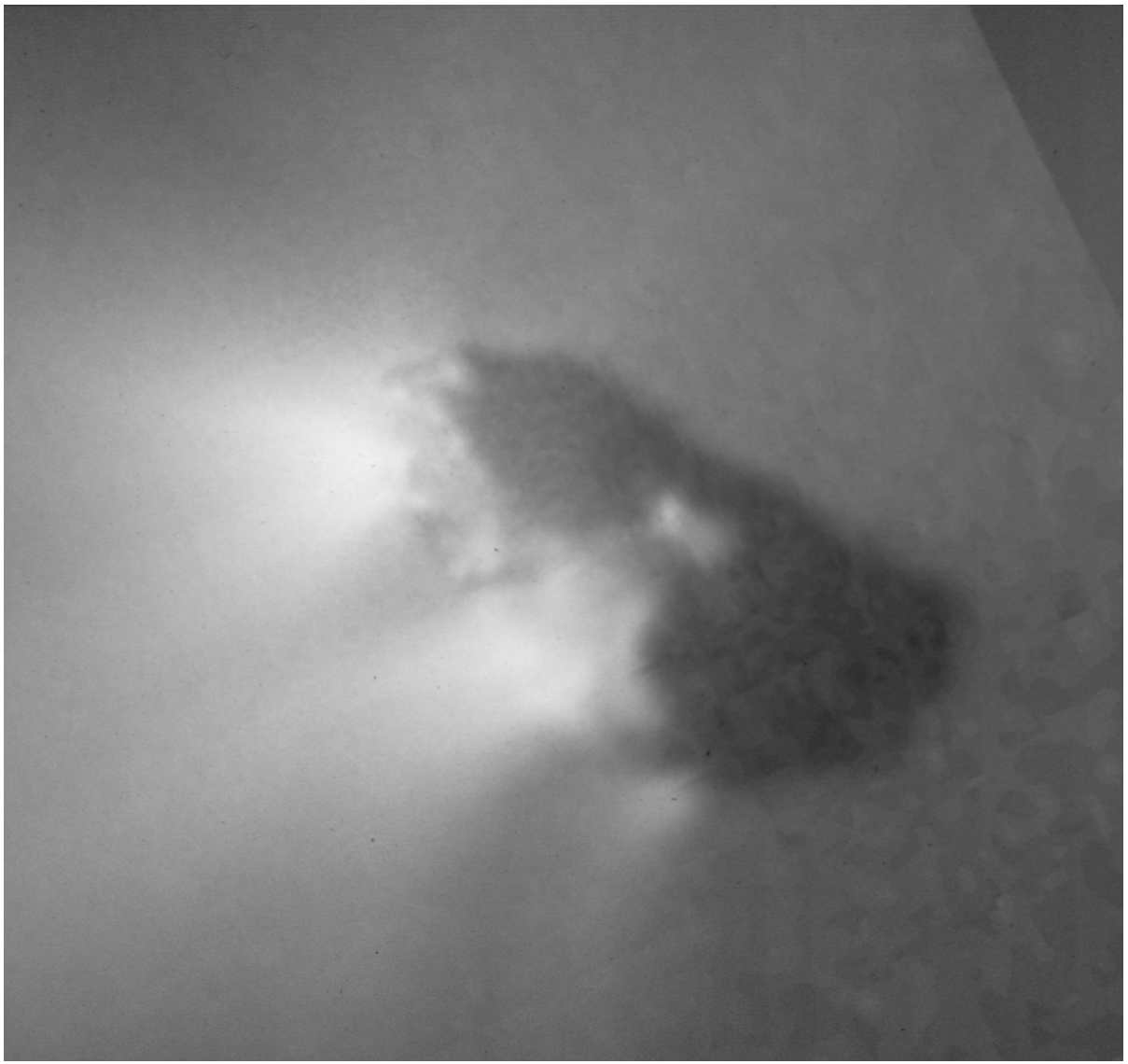
- Measure the shape and dimensions of the nucleus
- Determine the surface albedo of the nucleus
- Provide information to help determine the rotation period, mode and axis
- Observe the inner coma for jets and outbursts

Nucleus dimensions

- Solar phase angle varies from 88 to 108 degrees
  - If there is a strong background coma, the nucleus will be silhouetted. (See Halley pic.)
  - In the absence of a strong coma, only the illuminated portion of the nucleus can be seen
    - Determining the shape relies on frequent measurements during flyby. Nucleus rotation may aid or confuse these measurements

    How big is the nucleus? 1 to 2km dia?

Comet Halley Solar Phase angle 107 degrees



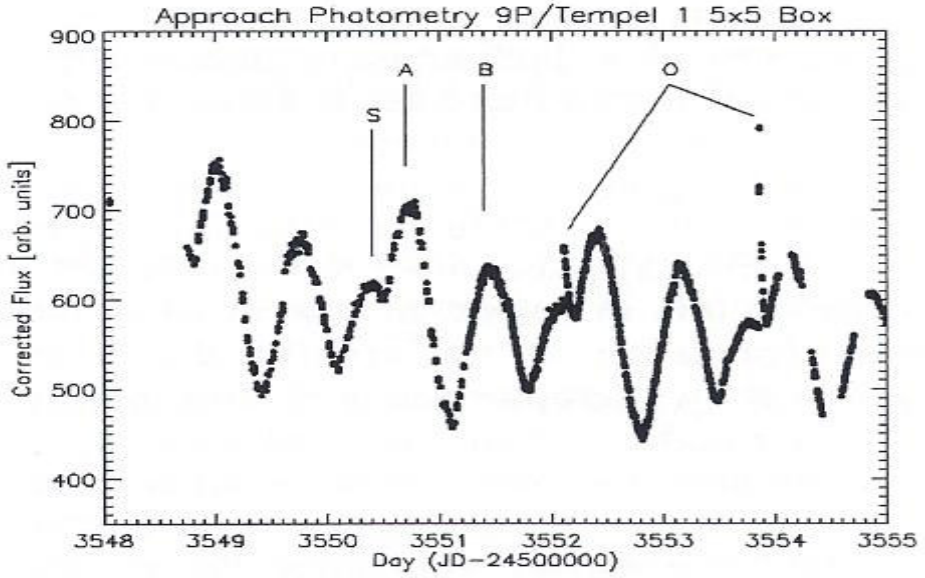
Albedo of a new comet

- Are comets formed black?
- Do they become black in the Oort Cloud because of exposure to galactic cosmic rays?
- Do frequent visits to the inner solar system create the low albedo?

This could be the most significant finding of the MRO comet campaign.

Rotation state

- A light curve over several revolutions is the normal method of obtaining the rotation parameters
- The nucleus is greater than one pixel for about 10 hours for a 1km dia. nucleus.
- Will have good ground based observations to use with MRO data



Rotation rate for a new comet is unknown!

5 hours to 70 hours?

Inner Coma, Jets and Outbursts

- Inner coma and jets are most detectable at the limb –strong for Halley but weak for Tempel 1
- Outbursts need many observations or luck
  - Frequent or rare?
- Useful to tie together the large scale observation by HST, etc with inner coma structure

Encounter parameters Ephemeris solution #67

Date	10/19/2014	
Time of CA	18:29	
Distance	136,000	km
RA	33.1	Degrees
DEC	75.6	Degrees
Solar Phase angle	109	Degrees
T-mag	-5.7	
Flyby velocity	55.5	Km/sec

-12 day Observation

Orbit	Scan #	Image Duration (sec)	Time on target (UC)	HiRISE pixel scale m	HiRISE line time millisec	HiRISE FOV milli-rad	Lines	Columns	# colors	CCDs
-12 days Oct 7th	1	160	15:03:25	58km	20	6x6	6,000	6,000	2	12,13,4,5,6
	2	160	15:28:25	58km	20	6x6	6,000	6,000	2	12,13,4,5,6
	3	160	15:53:25	58km	20	6x6	6,000	6,000	2	12,13,4,5,6

Using a large FOV, 6x6miili-radians, to obtain many stars.

Can we measure the Center of Brightness (COB) to a pixel?

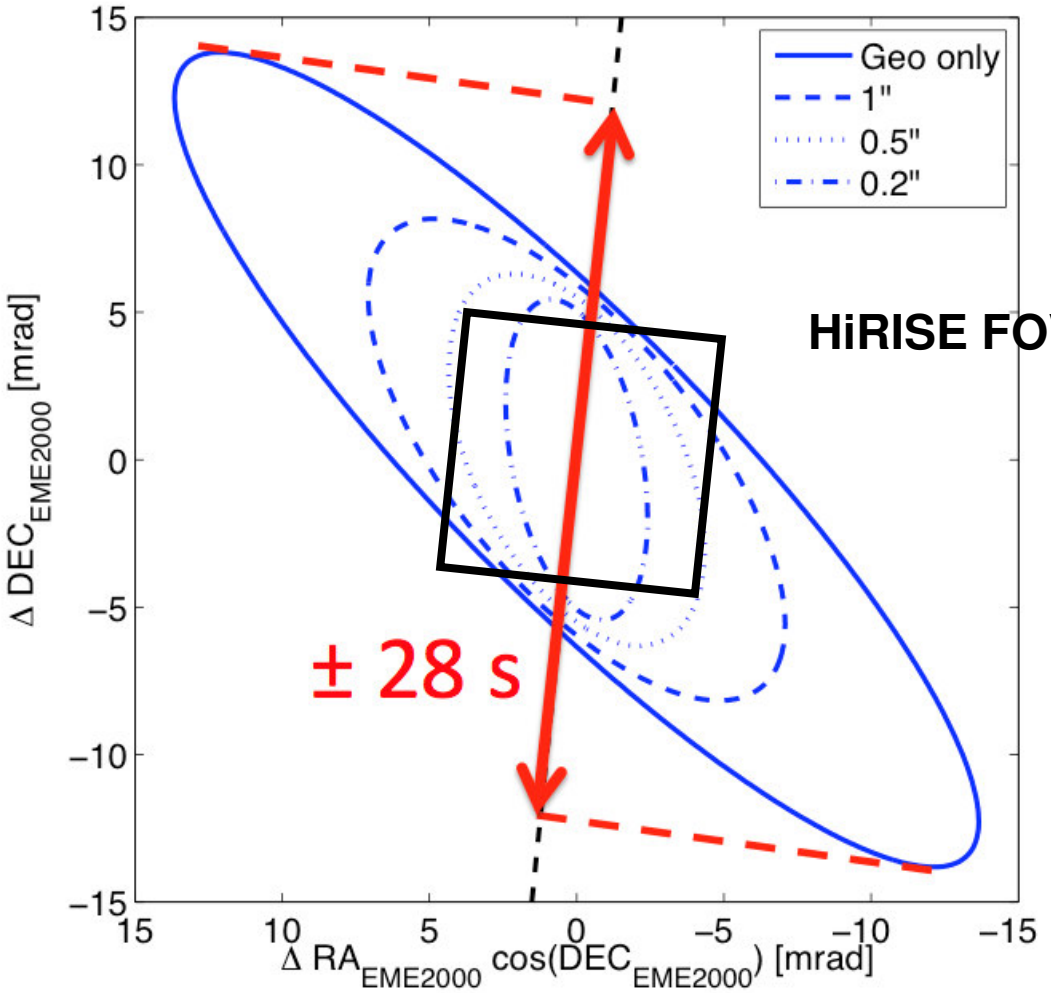
Is the nucleus at the COB?

Can we take out spacecraft jitter using 3 observations?

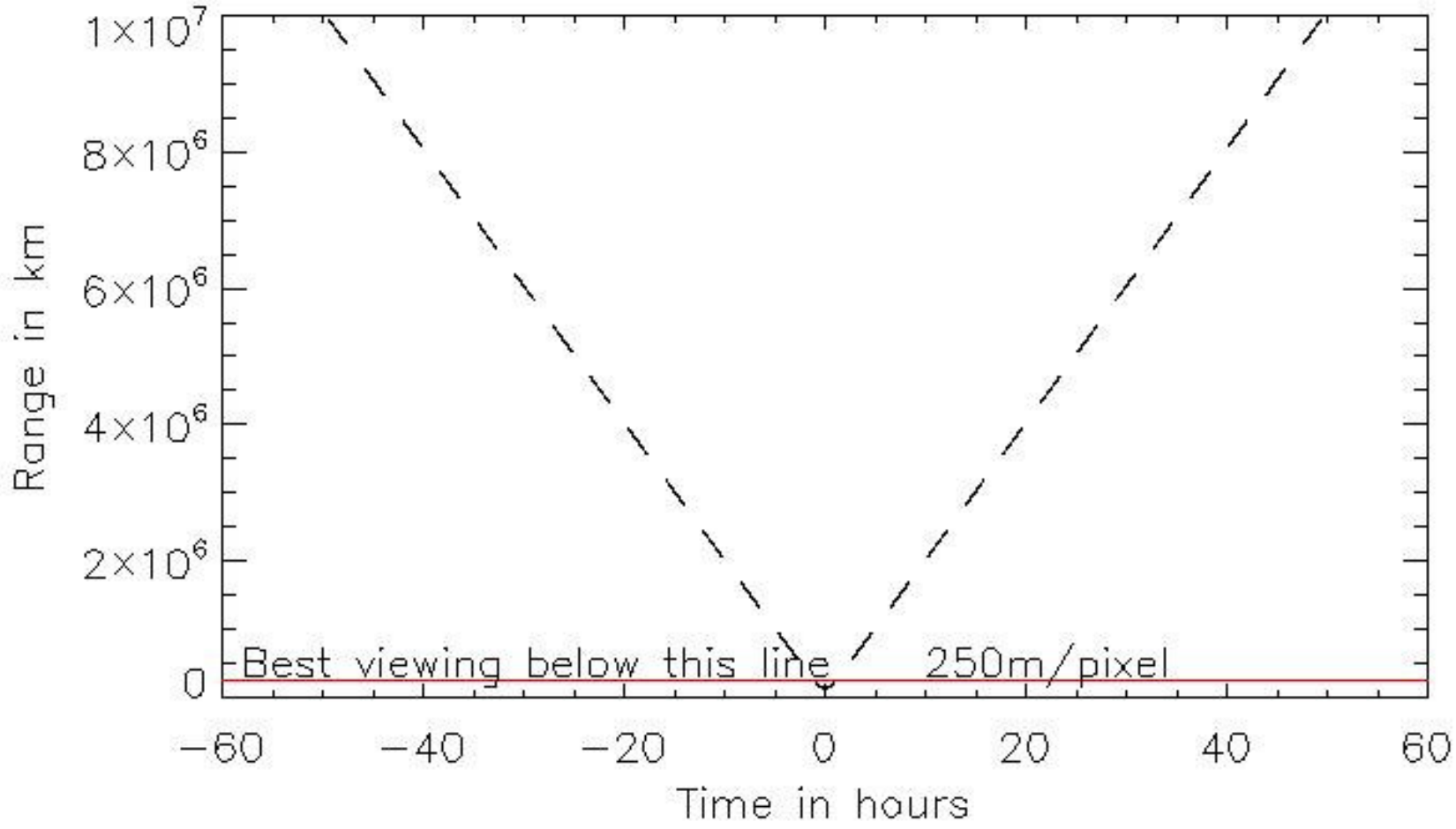
How long will it take to get good data to update the ephemeris?

3 sigma error ellipses at closest approach

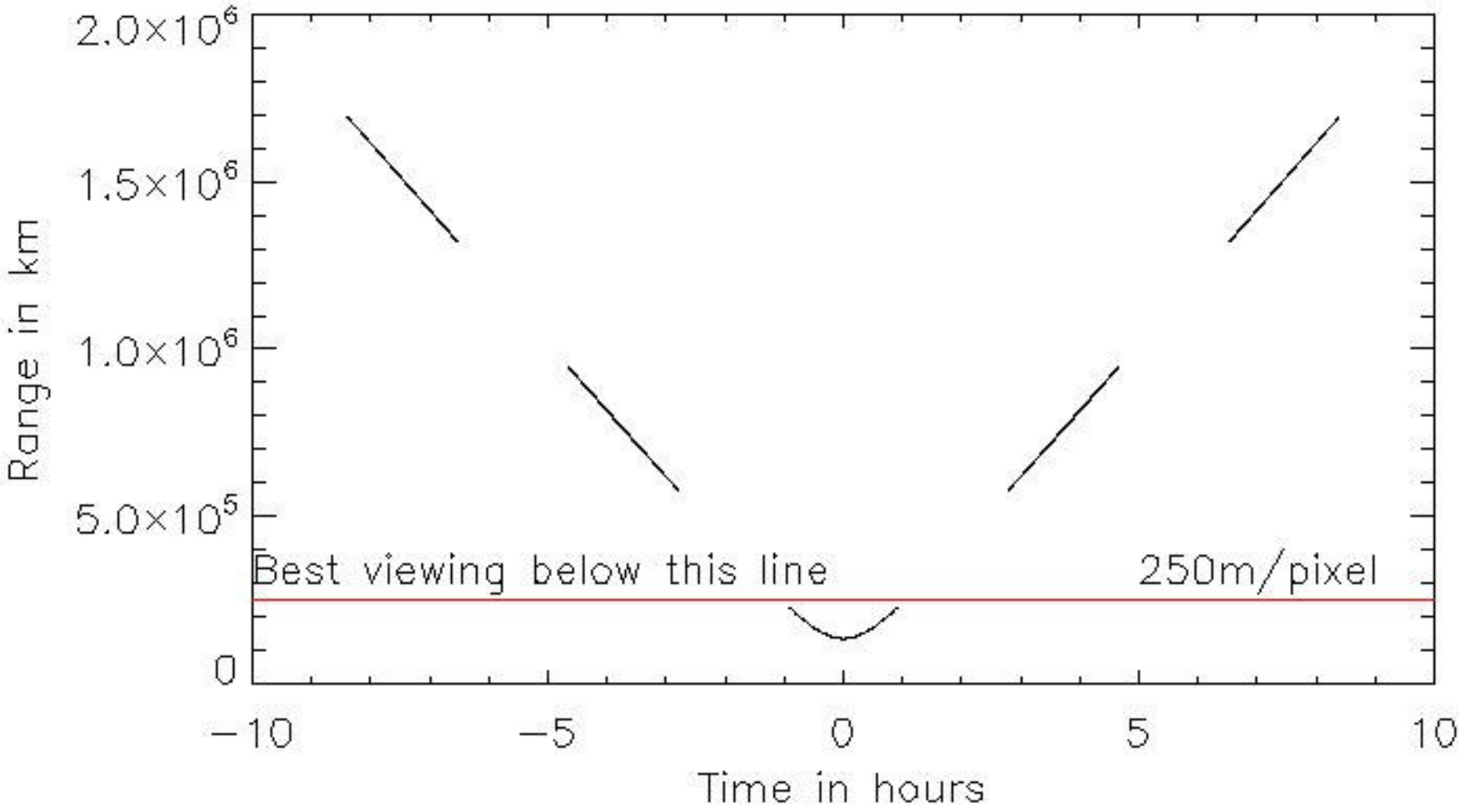
Data from Davide Farnocchia JPL



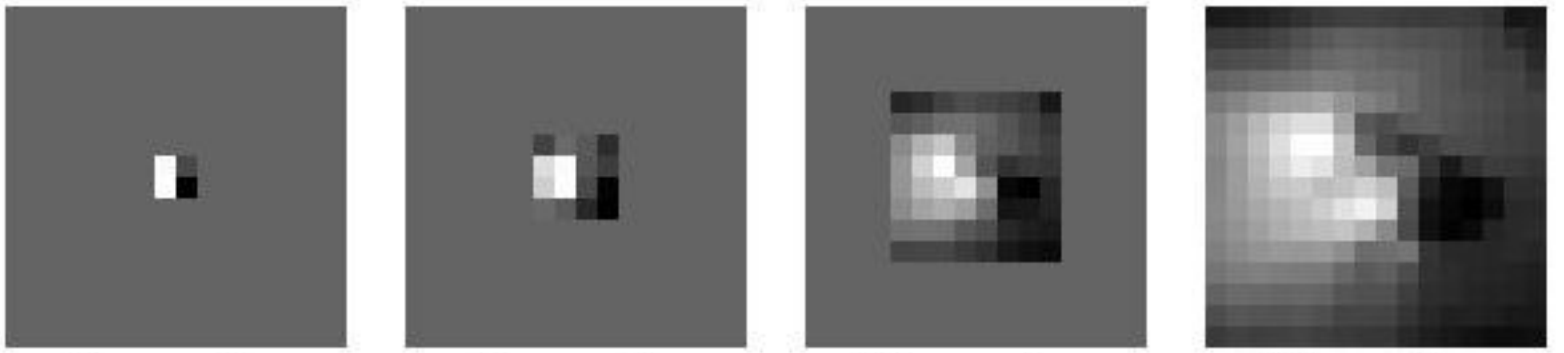
Viewing windows near closest approach



3 orbits at CA will give good resolution on Nucleus



Simulation using Halley image
16 by 16 pixel box



PSF not applied to simulated images

Sequence 1

	Orbit	Scan #	Image Duration (sec)	Time on target (UC)	HiRISE pixel scale m	HiRISE line time millisec	HiRISE FOV milli-rad	Lines	Columns	# colors	CCDs
Seq 1 Oct 17-18	CA-32	1	130	6:52:27	12048	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-32	2	130	7:22:27	11908	20	4x6		4,000	2	12,13,4,5,6
	CA-30	1	130	10:36:43	11250	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-30	2	130	11:06:43	11136	20	4x6		4,000	2	12,13,4,5,6
	CA-28	1	130	14:21:02	10502	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-28	2	130	14:51:02	10398	20	4x6		4,000	2	12,13,4,5,6
	CA-26	1	130	18:05:26	9750	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-26	2	130	18:35:26	9640	20	4x6		4,000	2	12,13,4,5,6
	CA-24	1	130	21:49:40	8790	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-24	2	130	22:19:40	8887	20	4x6		4,000	2	12,13,4,5,6
	CA-22	1	130	1:33:59	8250	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-22	2	130	2:03:59	8140	20	4x6		4,000	2	12,13,4,5,6
	CA-20	1	130	5:18:22	7480	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-20	2	130	5:48:22	7380	20	4x6		4,000	2	12,13,4,5,6
	CA-18	1	130	9:02:37	6740	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-18	2	130	9:32:37	6638	20	4x6		4,000	2	12,13,4,5,6
	CA-16	1	130	12:46:50	5990	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-16	2	130	13:16:50	5880	20	4x6		4,000	2	12,13,4,5,6

CRISM obs in scan 2 not 1. CRISM pixel scale is HiRISE*60

Sequences 2 & 5

	Orbit	Scan #	Image Duration (sec)	Time on target (UC)	HiRISE pixel scale m	HiRISE line time millisec	HiRISE FOV milli-rad	Lines	Columns	# colors	CCDs
Seq 5 oct 18-19	CA-14	1	130	16:40:00	5196	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-14	2	130	17:10:00	5094	20	4x6		4,000	2	12,13,4,5,6
	CA-12	1	130	20:25:00	4440	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-12	2	130	20:55:00	4340	20	4x6		4,000	2	12,13,4,5,6
	CA-10	1	130	0:10:00	3868	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-10	2	130	0:40:00	3584	20	4x6		4,000	2	12,13,4,5,6
Seq 2 Oct 19	CA-8	1	130	3:50:00	2949	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-8	2	60	4:20:00	2846	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA-6	1	130	7:35:00	2200	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-6	2	60	8:05:00	2100	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA-4	1	130	11:20:00	1243	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-4	2	60	11:50:00	1339	5	4x6		4,000	3	12,13,4,5,6,10,11

CRISM pixel scale is HiRISE*60

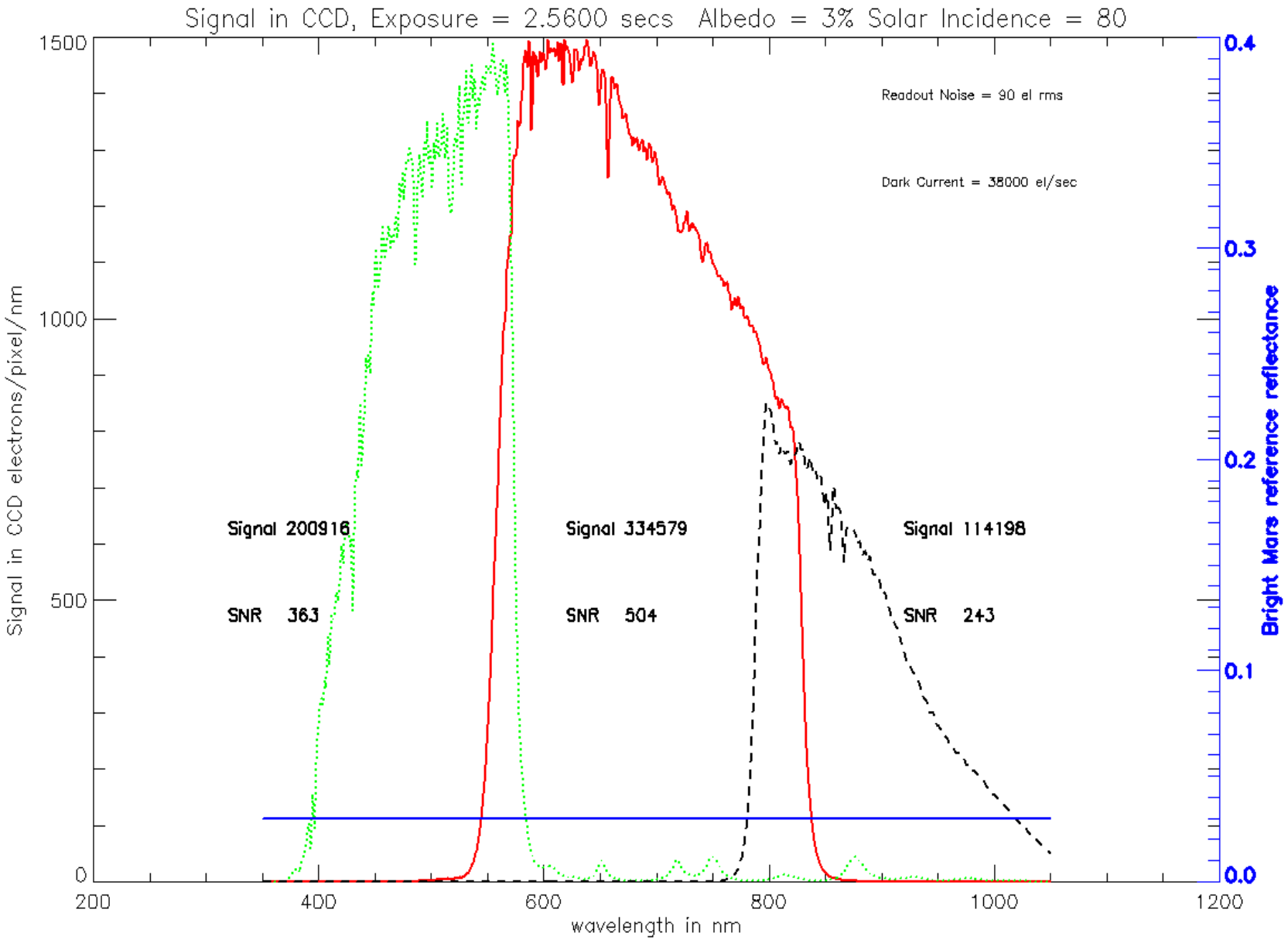
Sequence 3 Closest approach orbits

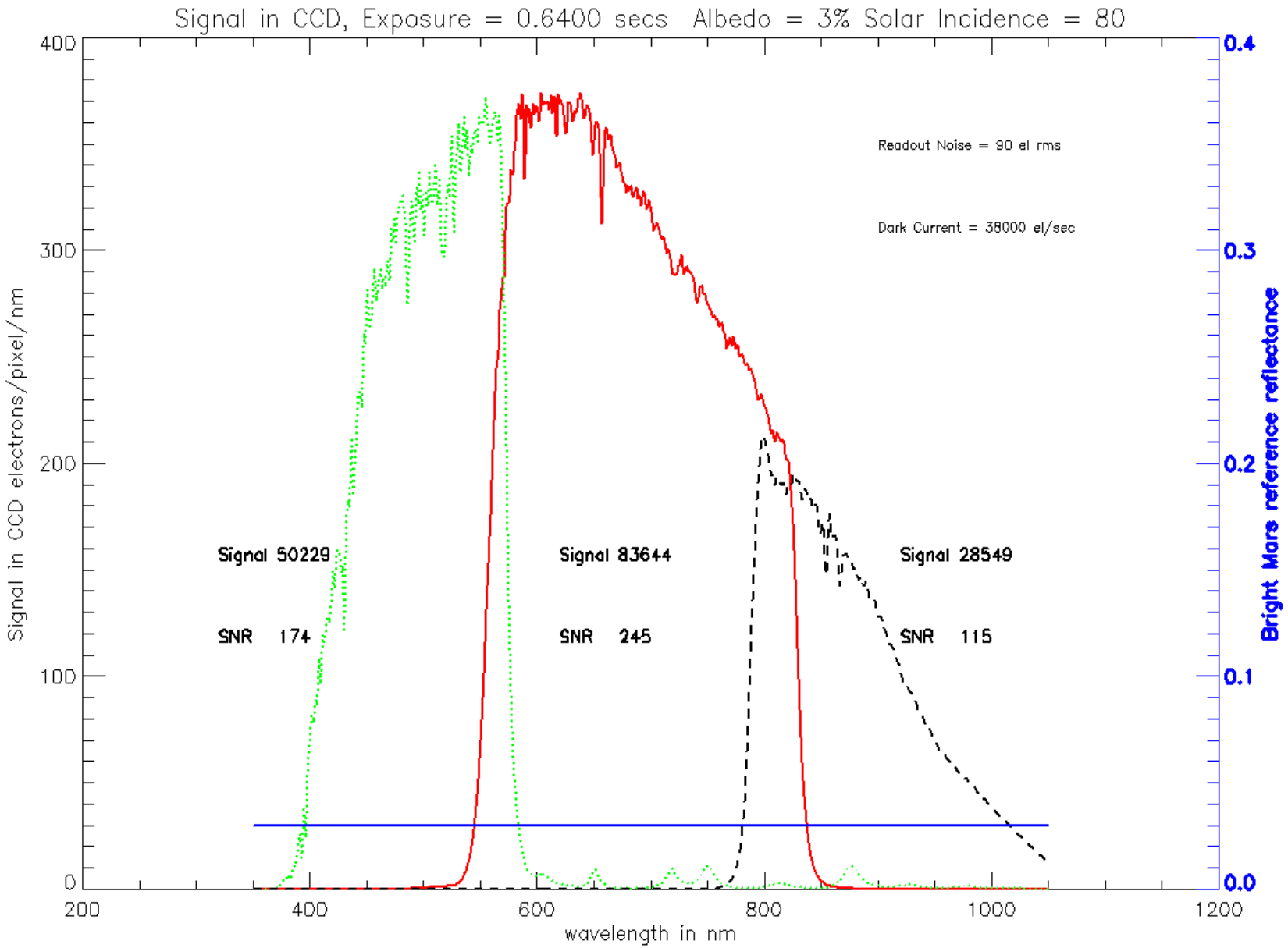
	Orbit	Scan #	Image Duration (sec)	Time on target (UC)	HiRISE pixel scale m	HiRISE line time millisec	HiRISE FOV milli-rad	Lines	Columns	# colors	CCDs
Seq 3 Oct 19	CA-2	1	130	15:00:00	709	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA-2	2	60	15:30:00	609	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA-1	1	350	16:44:00				7x35			
	CA-1	2	130	16:51:11	360	20	4x6	4x35	4,000	2	12,13,4,5,6
	CA-1	3	40	16:55:22	350	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA-1	4	10	17:00:11	322	1	4x6		4,000	3	12,13,4,5,6,10,11
	CA-1	5	40	17:04:43	320	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA-1	6	350	17:11:10				7x35			
	CA	1	350	18:15:50		33.33	8x8	10x35			
	CA	2	210	18:24:38	140	20	8x8	8x35	8,000	2	12,13,3,4,5,6
	CA	3	60	18:30:57	136	5	8x8		8,000	3	12,13,3,4,5,6,10,11
	CA	4	60	18:36:16	140	5	8x8		8,000	3	12,13,3,4,5,6,10,11
	CA	5	14	18:41:03	141	1	8x8		8,000	3	12,13,3,4,5,6,10,11
	CA	6	60	18:45:35	149	5	8x8		8,000	3	12,13,3,4,5,6,10,11
	CA	7	350	18:52:55	160			10x35			
	CA	8	60	18:59:50	176	5	8x8		8,000	3	12,13,3,4,5,6,10,11
	CA+1	1	350	19:49:00				7x35			
	CA+1	2	130	19:56:16	325	20	4x6	4x35	4,000	2	12,13,4,5,6
	CA+1	3	40	20:00:26	338	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA+1	4	10	20:05:13	353	1	4x6		4,000	3	12,13,4,5,6,10,11
	CA+1	5	40	20:09:42	368	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA+1	6	350	20:15:40				7x35			
	CA+2	1	130	22:00:00	724	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA+2	2	130	22:30:00	826	5	4x6	8x35	4,000	3	12,13,4,5,6,10,11

Sequence 4

	Orbit	Scan #	Image Duration (sec)	Time on target (UC)	HiRISE pixel scale m	HiRISE line time millisec	HiRISE FOV milli-rad	Lines	Columns	# colors	CCDs
Seq 4 Oct 20	CA+4	1	130	1:20:00	1392	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA+4	2	60	1:50:00	1489	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA+6	1	130	5:10:00	2160	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA+6	2	60	5:40:00	2260	5	4x6		4,000	3	12,13,4,5,6,10,11
	CA+8	1	130	8:55:00	2912	20	4x6	8x35	4,000	2	12,13,4,5,6
	CA+8	2	60	9:25:00	3014	5	4x6		4,000	3	12,13,4,5,6,10,11

Backup


Signal in CCD, Exposure = 2.5600 secs Albedo = 3% Solar Incidence = 80
Readout Noise = 90 el rms
Dark Current = 38000 el/sec
Signal 200916
SNR 363
Signal 334579
SNR 504
Signal 114198
SNR 243
Signal in CCD electrons/pixel/nm
Bright Mars reference reflectance
wavelength in nm
0
500
1000
1500
200
400
600
800
1000
1200
0.0
0.1
0.2
0.3
0.4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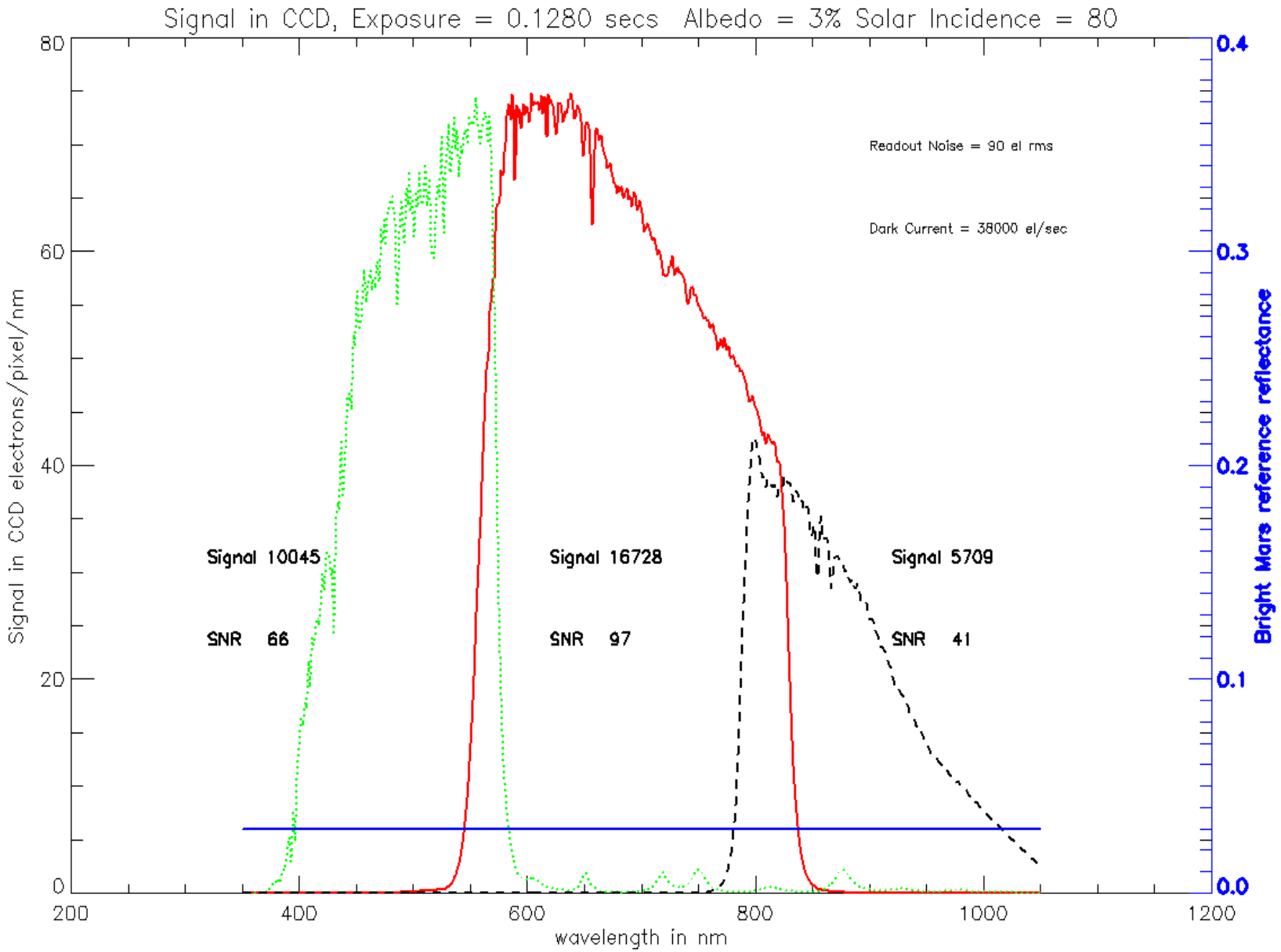
Readout Noise = 90 el rms
Dark Current = 38000 el/sec
Signal 50229
SNR 174
Signal 83644
SNR 245
Signal 28549
SNR 115
Signal in CCD electrons/pixel/nm
Bright Mars reference reflectance
wavelength in nm
0
100
200
300
400
0.0
0.1
0.2
0.3
0.4
200
400
600
800
1000
1200


Signal in CCD, Exposure = 0.1280 secs Albedo = 3% Solar Incidence = 80
Signal in CCD electrons/pixel/nm
Bright Mars reference reflectance
wavelength in nm
Readout Noise = 90 el rms
Dark Current = 38000 el/sec
Signal 10045
SNR 66
Signal 16728
SNR 97
Signal 5709
SNR 41
0
20
40
60
80
0.0
0.1
0.2
0.3
0.4
200
400
600
800
1000
1200

5 CA Orbits Temperature profile