Spacewatch 0.9m Mosaic Camera Survey, v1.0
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Details of the Spacewatch 0.9m Mosaic Camera Used for the Survey
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MOSAIC CAMERA

The mosaic camera used in the Spacewatch 0.9m Mosaic Camera Survey was designed and constructed by Spacewatch personnel in 2002. It contains four grade-one back-illuminated, broad-band red antireflection-coated 4608x2048 CCDs (CCD42-90BI) from Marconi Applied Technologies (later EEV, then e2V) of Chelmsford, Essex, UK. Spacewatch received six CCDs and selected the best four for the mosaic system. The CCDs are arranged such that three are stacked vertically with their longest sides horizontal. The fourth chip is to the right (west) with its longest side vertical. Each CCD is read with two amplifiers (Fig. 1, 2, 3). The chips were tested before delivery by Marconi technicians (Fig. 4); however, the test data for CCD 4 is not available. After installation, the inverse gain (electrons per analog-to-digital unit) was measured for each amplifier (Table 1).

The mosaic camera is filtered with a Schott OG-515 filter that transmits from 515nm to the long-wavelength cutoff of the CCDs (Fig. 5). The effective wavelength on typical asteroids is about 700nm. The yellow-orange filter was chosen primarily for the simplicity of the optical prescription and ease of fabrication of the field correction lenses. This allowed the use of flint glass for achromatism and all spherical surfaces in the lens designs. The filtering also provides cleaner images at high airmass without the need for atmospheric dispersion compensation, suppresses the mostly-blue twilight and scattered moonlight, and suppresses the color equation between stars and asteroids in astrometric field modeling at high airmass. Given the typical reddish or grey of asteroid colors, the filtering shortward of 515nm does not lose much light from asteroids, especially when atmospheric dispersion of the shorter wavelengths of light is taken into account. Lastly, glass colloidal filters are more stable and less expensive than interference filters and are better suited to fast f/numbers.

The first light for the mosaic camera at the 0.9-m telescope was on October 10, 2002. On October 23, 2002, the mosaic's first detection of a near-Earth asteroid was made (Potentially Hazardous Asteroid 2002 TD66 (179806)).

The field-of-view covers a solid angle of 2.9 square degrees. The image scale is 1.00 arcsecond per pixel. The pixel size is 13.5 microns.

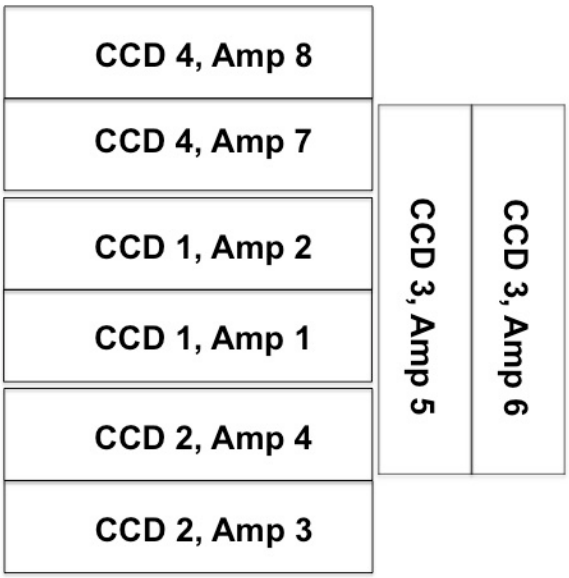

Figure 1. Arrangement of chips and their respective amplifiers in the mosaic camera. CCD1 is #9131-4-4. CCD2 is #8434-11-3. CCD3 is #9054-17-4. CCD4 is #8434-20-3.

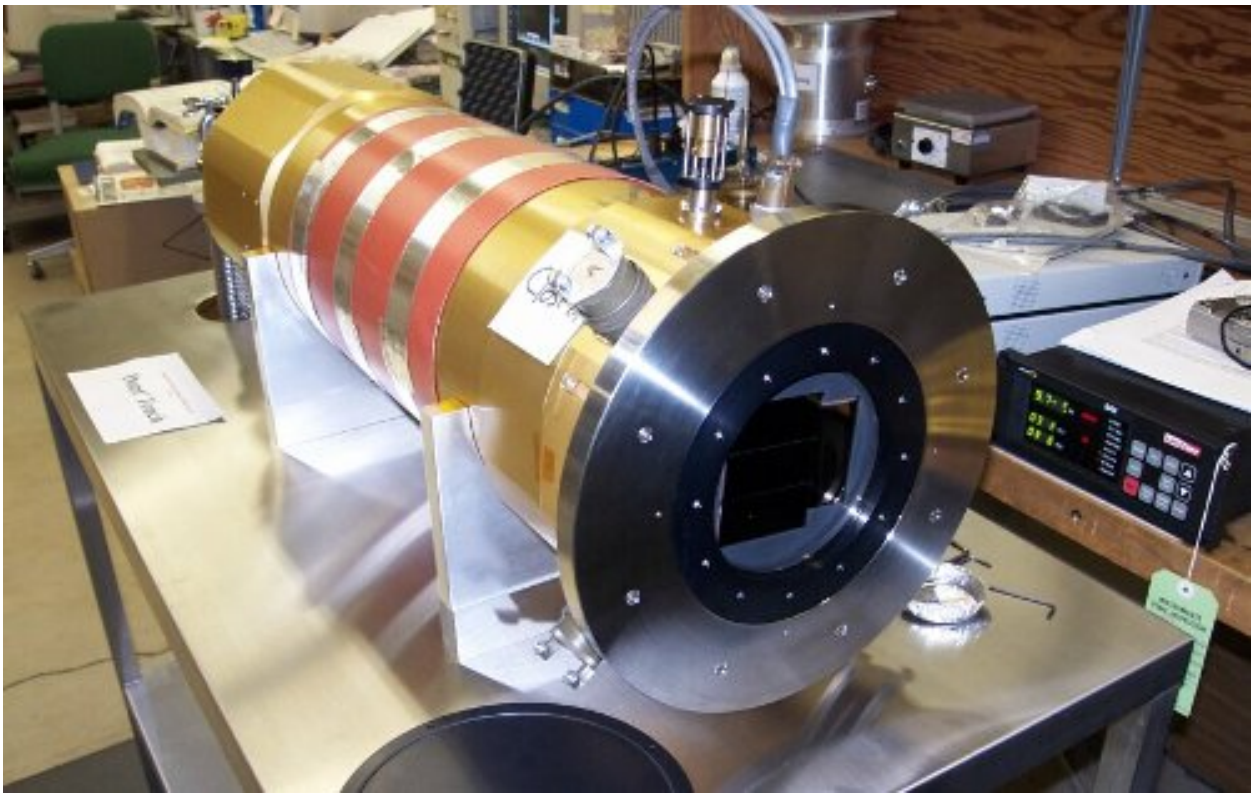

Figure 2. Mosaic camera during construction with CCDs installed.
Credit: Mike Read

0.9-m Mosaic CCD/Amplifier Map
24 September 2018 - T. Bressi

Marconi/EEV/e2 **CCD42-90BI #9131-4-4** **CCD 1/Amp 0:** BAD 0 4611 0 51 BAD 0 4611 1073 1099 ROW 0 4611 984 986 ROW 3453 4611 699 702	**Marconi/EEV/e2v** **CCD42-90BI #9131-4-4** **CCD 1/Amp 1:** BAD 0 4611 0 26 BAD 0 4611 1048 1099 ROW 0 4611 455 457 ROW 2164 4611 1038 1040 ROW 3752 4611 764 768 ROW 4377 4612 926 930
Marconi/EEV/e2 **CCD42-90BI #8434-11-3** **CCD 2/Amp 2:** BAD 0 4611 0 51 BAD 0 4611 1073 1099 ROW 3752 4611 764 768 ROW 4377 4612 926 930 ROW 2164 4611 1038 1040	**Marconi/EEV/e2** **CCD42-90BI #8434-11-3** **CCD 2/Amp 3:** BAD 0 4611 0 26 BAD 0 4611 1048 1099
Marconi/EEV/e2 **CCD42-90BI #9054-17-4** **CCD 3/Amp 4:** BAD 0 51 0 4610 BAD 1074 1099 0 4611	**Marconi/EEV/e2** **CCD42-90BI #9054-17-4** **CCD 3/Amp 5:** BAD 0 26 0 4611 BAD 1048 1099 0 4611 COL 333 335 0 4452 COL 640 642 0 4291
Marconi/EEV/e2 **CCD42-90BI #8434-20-03** **CCD 4/Amp 6:** BAD 0 4611 0 51 BAD 0 4611 1073 1099 BAD 4540 4611 79 166	**Marconi/EEV/e2** **CCD42-90BI #8434-20-03** **CCD 4/Amp 7:** BAD 0 4611 0 26 BAD 0 4611 1048 1099 BAD 504 512 674 682 ROW 508 4611 674 678

Bad region -- "BAD xlo xhi ylo yhi" (mark as BAD_DATA_VALUE)
Fix column -- "COL xlo xhi ylo yhi" (Linearly interpolate over columns in row)
Fix row -- "ROW xlo xhi ylo yhi" (Linearly interpolate over rows in column)
Fix bad pixel "PIX x y" (Bilinear Interpolation of four nearby pixels)
Fix cluster "IRR x y x1 y1 x2 y2 x3 y3 x4 y4" (replace x,y with mean of 1-4)

Figure 3. Serial numbers of the CCD chips used in the mosaic and bad pixels that have been masked or interpolated over. In Fig. 3, the amplifiers are numbered 0 through 7 instead of 1 through 8.

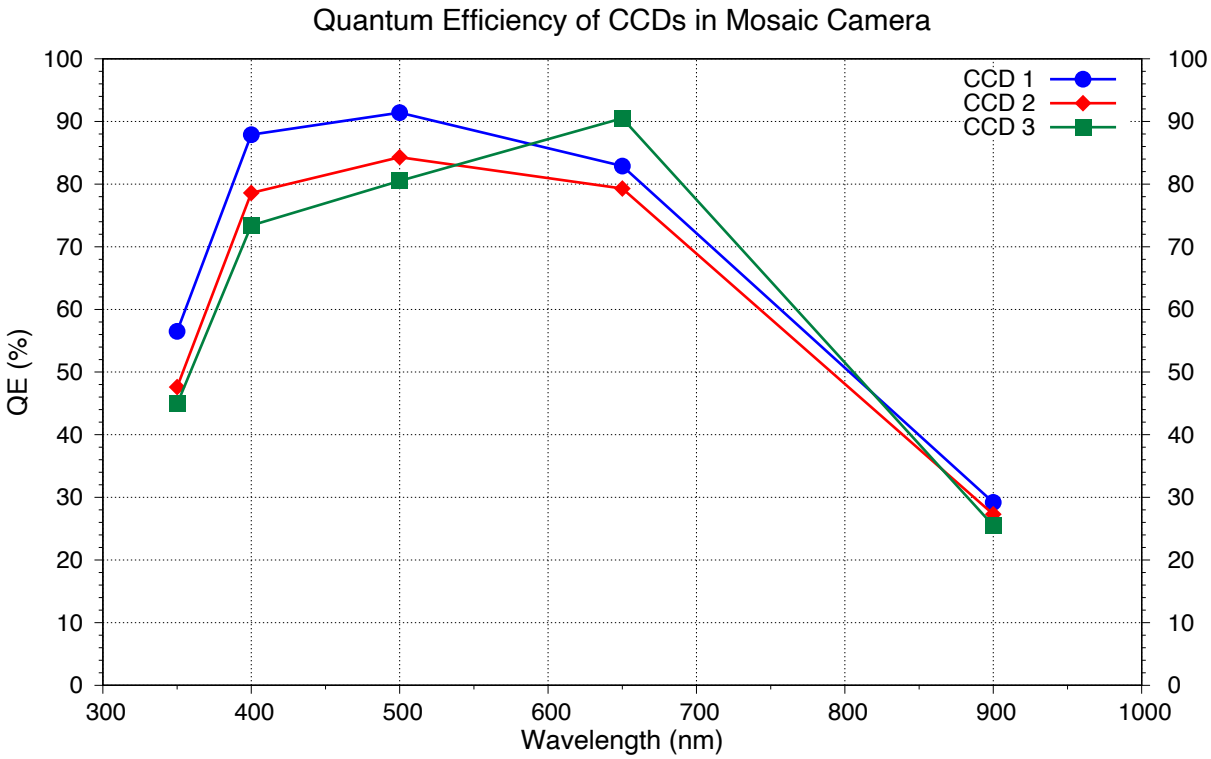

Figure 4. CCD test data from Marconi Applied Technologies Inc.
The test data for CCD 4 is not available.

Table 1. Inverse gain values for Amplifiers 1 through 8

Amplifier	Gain ($\mu V/e^-$)	Inverse Gain (e^-/ADU)
1	4.28	2.88
2	4.24	2.90
3	4.74	2.60
4	4.81	2.56
5	4.65	2.65
6	4.6	2.68
7	5.3	2.32
8	5.14	2.39

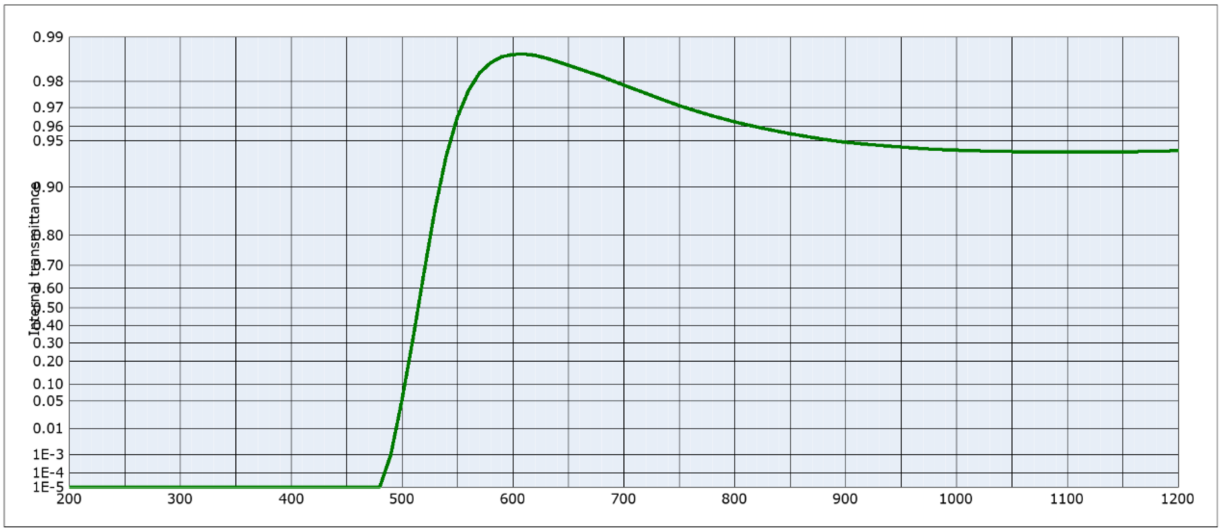

Figure 5. Transmission curve from the OG515 filter data sheet from Schott Advanced Optics.