Physics and Astronomy Department
4400 University Drive 3F3
Fairfax, VA 22030
Tel: +1 703 225-9080; Fax: +1 703 993-1296
tduxbury@gmu.edu

Source of the Mariner Mars 1969 Images
Thomas C. Duxbury
Physics and Astronomy Department
George Mason University
Fairfax, VA 22030 USA
07 December 2016

The author obtained a grant for the NASA Planetary Science Division Planetary Data Archive, Restoration and Technology Program (PDART) to restore the Mariner Mars 1969 Mariner 6 and 7 Far and Near Encounter images from data available at the National Space Science Data Center (NSSDC) and the Planetary Data System (PDS). Ancillary NAIF SPICE kernels were also produced to complete the archive. A CD was obtained from the NASA Planetary Data System (PDS) Imaging Node at the Caltech Jet Propulsion Laboratory (JPL) from Ms. Susan LaVoie and Ms. Amy Culver that contained the digital image archive from the Mariner Mars 1969 Mariner 6 and Mariner 7 Far and Near Encounter images of Mars. The CD contained the NSSDCA ID: PSPG-00046 archive of Mariner 6 and 7 TV reduced data records. The records were originally on 7 track tapes and were copied onto a CD-WO as part of the Science Digital Data Preservation Task (SDDPT). This is SDDPT data set code 69-030A-0019, volume ID M69_2001. See the extracts taken from the NSSDC web site, copied at the end of this document, for more details.

Edmonds and Robinson (2003) performed photometric analyses of these images and produced their own archive, including thumbnail images, as another possible source of these images:

http://ser.sese.asu.edu/M67/mar67.html

Processing of these images was not included in the scope of this PDART effort. The author did go to this web site, download and unzip image files but, due to his own limitations, could not open the files. However, a personal conversation with Prof. Mark Robinson, ASU, did provide very useable images in USGS ISIS format. These were distortion corrected images and this PDART task was to deal with restoring the original EDR data; therefore no further processing of this dataset was attempted.

Freeware to view the CD containing the original EDR data set described in the first paragraph:

http://petermasek.tripod.com/mariner67.html

was downloaded to extract 700 images from the CD that were saved as bit mapped pixel (.bmp) files, each having a 54 byte label record and an 8 bit grey scale interlaced Red, Green and Blue image within a single file. The original Far and Near Encounter images from the Mariner 6 and 7 wide and narrow angle cameras were each taken through a single filter to produce monochromatic images. These monochrome images are repeated three times in the Red, Green, Blue interlaced images within each .bmp file. Table 1 gives the details of these extracted images with:

IMAGE #:   the file order number within the CCD
PIC ID: the file name on the CD

PICNO: the Mariner Mars 1969 image name as Mariner//Encounter//Number:
               Mariner = 6 or 7; Encounter = F – far or N – Near; Number = sequence
               number.
TYP: the type of file: CAV – Composite Analog Video; DV – Digital Video; ETE –
               Every Twenty-Eigth.
PRC: Level of processing: RAW – raw / original image; DC – Distortion Corrected;
               MP – map projected; UK – unknown
SAMPLES: the number of samples in each interlaced RGB image
LINES: the number of lines in each interlaced RGB image
LABEL BYTES: number of bytes in the label record preceding the interlaced RGB images
FILE SIZE: total number of bytes in the image file including the Label Record and the 3
               RGB interlaced 8-bit/pixel images

The image types (TYP) are defined by Rindfleisch, *et. al*., 1971 as:

"The CAV pictures consist of the fully sampled raster with each picture element digitized to 6 significant bits. Prior to the digital encoding of the CAV pictures, the amplitude-modulated camera output signal was processed through an automatic-gain-control amplifier (AGC) and a cubing amplifier to emphasize low-contrast detail, and was recorded on the analog tape recorder. The dynamic amplifier gains were not recorded.

The DV pictures consist of every seventh picture element along each scan line linearly encoded to 8 significant bits but with the 2 most significant bits (MSB) truncated prior to transmission. In a separate engineering-telemetry data stream, statistical information was transmitted for every block of 32 television lines indicating independently the dominant state for each of the MSB's. Of the 134 possible DN elements per line, the central 26 were used to transmit non-video science data thus forming a 'data bar' in the middle of the DV pictures.

The ETE pictures consist of every twenty-eighth picture element along each scan line linearly encoded effectively to 6 significant bits, but with the two MSB's truncated prior to transmission. These ETE data provide coverage in the 'data bar' of the DV pictures and, together with the DV data, give information relative to the nonlinear effects of the AGC and cubing amplifiers on the CAV data. The time constants of the AGC amplifier were chosen so that the gain would change only very slowly over the every-seventh spacing of the DV samples."

NOTE: the author could not find a definition for "ETE" and refers to these as "Electronically Telemetered Elements".

As each image was extracted from the CD and displayed on the computer monitor, a best efforts attempt was made to tie the CD file name (PIC ID) to a Mariner 6 or 7 Near or Far Encounter Picture Number (PICNO). This was accomplished by looking at the hardcopy images in Collins, 1971, and visually matching the hardcopy images with PICNO's with the image displayed on the computer monitor. The reference also gives the color filter and shutter direction associated with the images. The DV and ETE image PICNOs were selected that "best" matched the CAV images. It is seen that PICNOs 7F02, 7F34 and 7F68 are not included in the CD archive and IMAGE #'s 412 – 517 were not matched. These are all Digital Video (DV) images where only

every 7th sample in each line was telemetered to Earth. There is a high probability that these images were taken and played back to Earth in real-time and the associated full frame images were not received on Earth and therefore not produced.

The Mariner 7 onboard Tape Recorders could only hold 33 full images so the last image of a stored sequence, 7F34 and 7F64, were lost. It is not known why image 7N02 was not on the CD. It is noted that Campbell, 1970 gives timetags, spacecraft positions and platform pointings for all images except 7F00. The Collins document states that 7F00 was taken about 5 hours before 7F01, therefore image timetag and spacecraft position data were produced at this approximate time.

It is seen that the raw Composite Analog Video .bmp images have 704 lines and 948 samples per line. The flight vidicons produced 945 sample x 704 line images. BMP file format conventions require the number of lines and samples per line to be divisible by 4; therefore the software that created the BMP files, from the PDS-supplied CD, added three blank samples at the end of each line to meet this constraint. Only CAV images 6F01 – 6F49, 6N01-6N31, 7F00-7F93 and 7N01-7N32 were included in the scope of the PDART task; however the additional 500 images were extracted from the CD, the DV and ETE images converted to full-frame images, and PICNO's were associated with the CD file names on a best efforts basis.

Table 1. Contents of the Mariner Mars 1969 CD image archive

```
******************************************************************************
             MARINER MARS 1969 .bmp FORMATTED IMAGE LIST
******************************************************************************
```

IMAGE #	PIC ID	PICNO	TYP	PRC	# SAMPLES	# LINES	#LABEL BYTES	FILE SIZE
609	RBL_012_001	6F01	CAV	RW	948	704	54	2002230
610	RBL_012_002	6F02	CAV	RW	948	704	54	2002230
611	RBL_012_003	6F03	CAV	RW	948	704	54	2002230
612	RBL_012_004	6F04	CAV	RW	948	704	54	2002230
613	RBL_012_005	6F05	CAV	RW	948	704	54	2002230
614	RBL_012_006	6F06	CAV	RW	948	704	54	2002230
615	RBL_012_007	6F07	CAV	RW	948	704	54	2002230
616	RBL_012_008	6F08	CAV	RW	948	704	54	2002230
617	RBL_012_009	6F09	CAV	RW	948	704	54	2002230
618	RBL_012_010	6F10	CAV	RW	948	704	54	2002230
619	RBL_012_011	6F11	CAV	RW	948	704	54	2002230
620	RBL_012_012	6F12	CAV	RW	948	704	54	2002230
621	RBL_012_013	6F13	CAV	RW	948	704	54	2002230
622	RBL_012_014	6F14	CAV	RW	948	704	54	2002230
623	RBL_012_015	6F15	CAV	RW	948	704	54	2002230
624	RBL_012_016	6F16	CAV	RW	948	704	54	2002230
593	RBL_011_001	6F17	CAV	RW	948	704	54	2002230
594	RBL_011_002	6F18	CAV	RW	948	704	54	2002230
595	RBL_011_003	6F19	CAV	RW	948	704	54	2002230
596	RBL_011_004	6F20	CAV	RW	948	704	54	2002230
597	RBL_011_005	6F21	CAV	RW	948	704	54	2002230
598	RBL_011_006	6F22	CAV	RW	948	704	54	2002230
599	RBL_011_007	6F23	CAV	RW	948	704	54	2002230
600	RBL_011_008	6F24	CAV	RW	948	704	54	2002230
601	RBL_011_009	6F25	CAV	RW	948	704	54	2002230
602	RBL_011_010	6F26	CAV	RW	948	704	54	2002230
603	RBL_011_011	6F27	CAV	RW	948	704	54	2002230
604	RBL_011_012	6F28	CAV	RW	948	704	54	2002230
605	RBL_011_013	6F29	CAV	RW	948	704	54	2002230
606	RBL_011_014	6F30	CAV	RW	948	704	54	2002230
607	RBL_011_015	6F31	CAV	RW	948	704	54	2002230
608	RBL_011_016	6F32	CAV	RW	948	704	54	2002230
669	RBL_022_001	6F33	CAV	RW	948	704	54	2002230
670	RBL_022_002	6F34	CAV	RW	948	704	54	2002230

```
671    RBL_022_003    6F35    CAV    RW    948    704    54    2002230
672    RBL_022_004    6F36    CAV    RW    948    704    54    2002230
673    RBL_022_005    6F37    CAV    RW    948    704    54    2002230
674    RBL_022_006    6F38    CAV    RW    948    704    54    2002230
675    RBL_022_007    6F39    CAV    RW    948    704    54    2002230
676    RBL_022_008    6F40    CAV    RW    948    704    54    2002230
677    RBL_022_009    6F41    CAV    RW    948    704    54    2002230
678    RBL_022_010    6F42    CAV    RW    948    704    54    2002230
679    RBL_022_011    6F43    CAV    RW    948    704    54    2002230
680    RBL_022_012    6F44    CAV    RW    948    704    54    2002230
681    RBL_022_013    6F45    CAV    RW    948    704    54    2002230
682    RBL_022_014    6F46    CAV    RW    948    704    54    2002230
683    RBL_022_015    6F47    CAV    RW    948    704    54    2002230
684    RBL_022_016    6F48    CAV    RW    948    704    54    2002230
592    RBL_010_001    6F49    CAV    RW    948    704    54    2002230
561    RBL_006_001    7F00    CAV    RW    948    704    54    2002230
562    RBL_006_002    7F01    CAV    RW    948    704    54    2002230
563    RBL_006_003    7F03    CAV    RW    948    704    54    2002230
564    RBL_006_004    7F04    CAV    RW    948    704    54    2002230
565    RBL_006_005    7F05    CAV    RW    948    704    54    2002230
566    RBL_006_006    7F06    CAV    RW    948    704    54    2002230
567    RBL_006_007    7F07    CAV    RW    948    704    54    2002230
568    RBL_006_008    7F08    CAV    RW    948    704    54    2002230
569    RBL_006_009    7F09    CAV    RW    948    704    54    2002230
570    RBL_006_010    7F10    CAV    RW    948    704    54    2002230
571    RBL_006_011    7F11    CAV    RW    948    704    54    2002230
572    RBL_006_012    7F12    CAV    RW    948    704    54    2002230
573    RBL_006_013    7F13    CAV    RW    948    704    54    2002230
574    RBL_006_014    7F14    CAV    RW    948    704    54    2002230
575    RBL_006_015    7F15    CAV    RW    948    704    54    2002230
576    RBL_006_016    7F16    CAV    RW    948    704    54    2002230
638    RBL_020_001    7F17    CAV    RW    948    704    54    2002230
639    RBL_020_002    7F18    CAV    RW    948    704    54    2002230
640    RBL_020_003    7F19    CAV    RW    948    704    54    2002230
641    RBL_020_004    7F20    CAV    RW    948    704    54    2002230
642    RBL_020_005    7F21    CAV    RW    948    704    54    2002230
643    RBL_020_006    7F22    CAV    RW    948    704    54    2002230
644    RBL_020_007    7F23    CAV    RW    948    704    54    2002230
645    RBL_020_008    7F24    CAV    RW    948    704    54    2002230
646    RBL_020_009    7F25    CAV    RW    948    704    54    2002230
647    RBL_020_010    7F26    CAV    RW    948    704    54    2002230
648    RBL_020_011    7F27    CAV    RW    948    704    54    2002230
649    RBL_020_012    7F28    CAV    RW    948    704    54    2002230
650    RBL_020_013    7F29    CAV    RW    948    704    54    2002230
651    RBL_020_014    7F30    CAV    RW    948    704    54    2002230
652    RBL_020_015    7F31    CAV    RW    948    704    54    2002230
653    RBL_020_016    7F32    CAV    RW    948    704    54    2002230
625    RBL_019_001    7F33    CAV    RW    948    704    54    2002230
626    RBL_019_002    7F35    CAV    RW    948    704    54    2002230
627    RBL_019_003    7F36    CAV    RW    948    704    54    2002230
628    RBL_019_004    7F37    CAV    RW    948    704    54    2002230
629    RBL_019_005    7F38    CAV    RW    948    704    54    2002230
630    RBL_019_006    7F39    CAV    RW    948    704    54    2002230
631    RBL_019_007    7F40    CAV    RW    948    704    54    2002230
632    RBL_019_008    7F41    CAV    RW    948    704    54    2002230
633    RBL_019_009    7F42    CAV    RW    948    704    54    2002230
634    RBL_019_010    7F43    CAV    RW    948    704    54    2002230
635    RBL_019_011    7F44    CAV    RW    948    704    54    2002230
636    RBL_019_012    7F45    CAV    RW    948    704    54    2002230
637    RBL_019_013    7F46    CAV    RW    948    704    54    2002230
685    RBL_026_001    7F47    CAV    RW    948    704    54    2002230
686    RBL_026_002    7F48    CAV    RW    948    704    54    2002230
687    RBL_026_003    7F49    CAV    RW    948    704    54    2002230
688    RBL_026_004    7F50    CAV    RW    948    704    54    2002230
689    RBL_026_005    7F51    CAV    RW    948    704    54    2002230
690    RBL_026_006    7F52    CAV    RW    948    704    54    2002230
691    RBL_026_007    7F53    CAV    RW    948    704    54    2002230
692    RBL_026_008    7F54    CAV    RW    948    704    54    2002230
693    RBL_026_009    7F55    CAV    RW    948    704    54    2002230
694    RBL_026_010    7F56    CAV    RW    948    704    54    2002230
695    RBL_026_011    7F57    CAV    RW    948    704    54    2002230
696    RBL_026_012    7F58    CAV    RW    948    704    54    2002230
```

```
697    RBL_026_013    7F59    CAV    RW    948    704    54    2002230
698    RBL_026_014    7F60    CAV    RW    948    704    54    2002230
699    RBL_026_015    7F61    CAV    RW    948    704    54    2002230
700    RBL_026_016    7F62    CAV    RW    948    704    54    2002230
577    RBL_009_001    7F63    CAV    RW    948    704    54    2002230
578    RBL_009_002    7F64    CAV    RW    948    704    54    2002230
579    RBL_009_003    7F65    CAV    RW    948    704    54    2002230
580    RBL_009_004    7F66    CAV    RW    948    704    54    2002230
581    RBL_009_005    7F67    CAV    RW    948    704    54    2002230
582    RBL_009_006    7F69    CAV    RW    948    704    54    2002230
583    RBL_009_007    7F70    CAV    RW    948    704    54    2002230
584    RBL_009_008    7F71    CAV    RW    948    704    54    2002230
585    RBL_009_009    7F72    CAV    RW    948    704    54    2002230
586    RBL_009_010    7F73    CAV    RW    948    704    54    2002230
587    RBL_009_011    7F74    CAV    RW    948    704    54    2002230
588    RBL_009_012    7F75    CAV    RW    948    704    54    2002230
589    RBL_009_013    7F76    CAV    RW    948    704    54    2002230
590    RBL_009_014    7F77    CAV    RW    948    704    54    2002230
591    RBL_009_015    7F78    CAV    RW    948    704    54    2002230
654    RBL_021_001    7F79    CAV    RW    948    704    54    2002230
655    RBL_021_002    7F80    CAV    RW    948    704    54    2002230
656    RBL_021_003    7F81    CAV    RW    948    704    54    2002230
657    RBL_021_004    7F82    CAV    RW    948    704    54    2002230
658    RBL_021_005    7F83    CAV    RW    948    704    54    2002230
659    RBL_021_006    7F84    CAV    RW    948    704    54    2002230
660    RBL_021_007    7F85    CAV    RW    948    704    54    2002230
661    RBL_021_008    7F86    CAV    RW    948    704    54    2002230
662    RBL_021_009    7F87    CAV    RW    948    704    54    2002230
663    RBL_021_010    7F88    CAV    RW    948    704    54    2002230
664    RBL_021_011    7F89    CAV    RW    948    704    54    2002230
665    RBL_021_012    7F90    CAV    RW    948    704    54    2002230
666    RBL_021_013    7F91    CAV    RW    948    704    54    2002230
667    RBL_021_014    7F92    CAV    RW    948    704    54    2002230
668    RBL_021_015    7F93    CAV    RW    948    704    54    2002230
  1    69_011_001     6N01    DV     RW    816    704    54    1723446
  2    69_011_002     6N02    DV     RW    816    704    54    1723446
  3    69_011_003     6N03    DV     RW    816    704    54    1723446
  4    69_011_004     6N04    DV     RW    816    704    54    1723446
  5    69_011_005     6N05    DV     RW    816    704    54    1723446
  6    69_011_006     6N06    DV     RW    816    704    54    1723446
  7    69_011_007     6N07    DV     RW    816    704    54    1723446
  8    69_011_008     6N08    DV     RW    816    704    54    1723446
  9    69_011_009     6N09    DV     RW    816    704    54    1723446
 10    69_011_010     6N10    DV     RW    816    704    54    1723446
 11    69_011_011     6N11    DV     RW    816    704    54    1723446
 12    69_011_012     6N12    DV     RW    816    704    54    1723446
 13    69_011_013     6N13    DV     RW    816    704    54    1723446
 14    69_011_014     6N14    DV     RW    816    704    54    1723446
 15    69_011_015     6N15    DV     RW    816    704    54    1723446
 16    69_011_016     6N16    DV     RW    816    704    54    1723446
 17    69_011_017     6N17    DV     RW    816    704    54    1723446
 18    69_011_018     6N18    DV     RW    816    704    54    1723446
 19    69_011_019     6N19    DV     RW    816    704    54    1723446
 20    69_011_020     6N20    DV     RW    816    704    54    1723446
 21    69_011_021     6N21    DV     RW    816    704    54    1723446
 22    69_011_022     6N22    DV     RW    816    704    54    1723446
 23    69_011_023     6N23    DV     RW    816    704    54    1723446
 24    69_011_024     6N24    DV     RW    816    704    54    1723446
 25    69_011_025     6N25    DV     RW    816    704    54    1723446
 26    69_021_001     7N01    DV     RW    816    704    54    1723446
 27    69_021_002     7N02    DV     RW    816    704    54    1723446
 28    69_021_003     7N03    DV     RW    816    704    54    1723446
 29    69_021_004     7N04    DV     RW    816    704    54    1723446
 30    69_021_005     7N05    DV     RW    816    704    54    1723446
 31    69_021_006     7N06    DV     RW    816    704    54    1723446
 32    69_021_007     7N07    DV     RW    816    704    54    1723446
 33    69_021_008     7N08    DV     RW    816    704    54    1723446
 34    69_021_009     7N09    DV     RW    816    704    54    1723446
 35    69_021_010     7N10    DV     RW    816    704    54    1723446
 36    69_021_011     7N11    DV     RW    816    704    54    1723446
 37    69_021_012     7N12    DV     RW    816    704    54    1723446
 38    69_021_013     7N13    DV     RW    816    704    54    1723446
```

7-Dec-16   mr69_image_source

Physics and Astronomy Department
4400 University Drive 3F3
Fairfax, VA 22030
Tel: +1 703 225-9080; Fax: +1 703 993-1296
tduxbury@gmu.edu

39	69_021_014	7N14	DV	RW	816	704	54	1723446
40	69_021_015	7N15	DV	RW	816	704	54	1723446
41	69_021_016	7N16	DV	RW	816	704	54	1723446
42	69_021_017	7N17	DV	RW	816	704	54	1723446
43	69_021_018	7N18	DV	RW	816	704	54	1723446
44	69_021_019	7N19	DV	RW	816	704	54	1723446
45	69_021_020	7N20	DV	RW	816	704	54	1723446
46	69_031_001	7N21	DV	RW	816	704	54	1723446
47	69_031_002	7N22	DV	RW	816	704	54	1723446
48	69_031_003	7N23	DV	RW	816	704	54	1723446
49	69_031_004	7N24	DV	RW	816	704	54	1723446
50	69_031_005	7N25	DV	RW	816	704	54	1723446
51	69_031_006	7N26	DV	RW	816	704	54	1723446
52	69_031_007	7N27	DV	RW	816	704	54	1723446
53	69_031_008	7N28	DV	RW	816	704	54	1723446
54	69_031_009	7N29	DV	RW	816	704	54	1723446
55	69_031_010	7N30	DV	RW	816	704	54	1723446
56	69_031_011	7N31	DV	RW	816	704	54	1723446
57	69_041_001	6N01	CAV	DC	1000	772	54	2316054
58	69_041_002	6N02	CAV	DC	1000	772	54	2316054
59	69_041_003	6N03	CAV	DC	1000	772	54	2316054
60	69_041_004	6N04	CAV	DC	1000	772	54	2316054
61	69_041_005	6N05	CAV	DC	1000	772	54	2316054
62	69_041_006	6N06	CAV	DC	1000	772	54	2316054
63	69_041_007	6N07	CAV	DC	1000	772	54	2316054
64	69_041_008	6N08	CAV	DC	1000	772	54	2316054
65	69_041_009	6N09	CAV	DC	1000	772	54	2316054
66	69_041_010	6N10	CAV	DC	1000	772	54	2316054
67	69_041_011	6N11	CAV	DC	1000	772	54	2316054
68	69_041_012	6N12	CAV	DC	1000	772	54	2316054
69	69_041_013	6N13	CAV	DC	1000	772	54	2316054
70	69_051_001	6N14	CAV	DC	1000	772	54	2316054
71	69_051_002	6N15	CAV	DC	1000	772	54	2316054
72	69_051_003	6N16	CAV	DC	1000	772	54	2316054
73	69_051_004	6N17	CAV	DC	1000	772	54	2316054
74	69_051_005	6N18	CAV	DC	1000	772	54	2316054
75	69_051_006	6N19	CAV	DC	1000	772	54	2316054
76	69_051_007	6N20	CAV	DC	1000	772	54	2316054
77	69_051_008	6N21	CAV	DC	1000	772	54	2316054
78	69_051_009	6N22	CAV	DC	1000	772	54	2316054
79	69_051_010	6N23	CAV	DC	1000	772	54	2316054
80	69_051_011	6N24	CAV	DC	1000	772	54	2316054
81	69_051_012	6N25	CAV	DC	1000	772	54	2316054
82	69_061_001	7N01	CAV	DC	1000	772	54	2316054
83	69_061_002	7N02	CAV	DC	1000	772	54	2316054
84	69_061_003	7N03	CAV	DC	1000	772	54	2316054
85	69_061_004	7N04	CAV	DC	1000	772	54	2316054
86	69_061_005	7N05	CAV	DC	1000	772	54	2316054
87	69_061_006	7N06	CAV	DC	1000	772	54	2316054
88	69_061_007	7N07	CAV	DC	1000	772	54	2316054
89	69_061_008	7N08	CAV	DC	1000	772	54	2316054
90	69_061_009	7N09	CAV	DC	1000	772	54	2316054
91	69_061_010	7N10	CAV	DC	1000	772	54	2316054
92	69_061_011	7N11	CAV	DC	1000	772	54	2316054
93	69_061_012	7N12	CAV	DC	1000	772	54	2316054
94	69_061_013	7N13	CAV	DC	1000	772	54	2316054
95	69_071_001	7N14	CAV	DC	1000	772	54	2316054
96	69_071_002	7N15	CAV	DC	1000	772	54	2316054
97	69_071_003	7N16	CAV	DC	1000	772	54	2316054
98	69_071_004	7N17	CAV	DC	1000	772	54	2316054
99	69_071_005	7N18	CAV	DC	1000	772	54	2316054
100	69_071_006	7N19	CAV	DC	1000	772	54	2316054
101	69_071_007	7N20	CAV	DC	1000	772	54	2316054
102	69_071_008	7N21	CAV	DC	1000	772	54	2316054
103	69_071_009	7N22	CAV	DC	1000	772	54	2316054
104	69_071_010	7N23	CAV	DC	1000	772	54	2316054
105	69_071_011	7N24	CAV	DC	1000	772	54	2316054
106	69_071_012	7N25	CAV	DC	1000	772	54	2316054
107	69_071_013	7N26	CAV	DC	1000	772	54	2316054
108	69_081_001	7N27	CAV	DC	1000	772	54	2316054
109	69_081_002	7N28	CAV	DC	1000	772	54	2316054
110	69_081_003	7N29	CAV	DC	1000	772	54	2316054

```
111   69_081_004   7N30   CAV   DC   1000   772   54   2316054
112   69_081_005   7N31   CAV   DC   1000   772   54   2316054
113   69_081_006   7N32   CAV   DC   1000   772   54   2316054
114   69_091_001   7N01   CAV   RW    948   704   54   2002230
115   69_091_002   7N02   CAV   RW    948   704   54   2002230
116   69_091_003   7N03   CAV   RW    948   704   54   2002230
117   69_091_004   7N04   CAV   RW    948   704   54   2002230
118   69_091_005   7N05   CAV   RW    948   704   54   2002230
119   69_091_006   7N06   CAV   RW    948   704   54   2002230
120   69_091_007   7N07   CAV   RW    948   704   54   2002230
121   69_091_008   7N08   CAV   RW    948   704   54   2002230
122   69_091_009   7N09   CAV   RW    948   704   54   2002230
123   69_091_010   7N10   CAV   RW    948   704   54   2002230
124   69_091_011   7N11   CAV   RW    948   704   54   2002230
125   69_091_012   7N12   CAV   RW    948   704   54   2002230
126   69_091_013   7N13   CAV   RW    948   704   54   2002230
127   69_091_014   7N14   CAV   RW    948   704   54   2002230
128   69_091_015   7N15   CAV   RW    948   704   54   2002230
129   69_091_016   7N16   CAV   RW    948   704   54   2002230
130   69_101_001   7N17   CAV   DC    948   704   54   2002230
131   69_101_002   7N18   CAV   DC    948   704   54   2002230
132   69_101_003   7N19   CAV   DC    948   704   54   2002230
133   69_101_004   7N20   CAV   DC    948   704   54   2002230
134   69_101_005   7N21   CAV   DC    948   704   54   2002230
135   69_101_006   7N22   CAV   DC    948   704   54   2002230
136   69_101_007   7N23   CAV   DC    948   704   54   2002230
137   69_101_008   7N24   CAV   DC    948   704   54   2002230
138   69_101_009   7N25   CAV   DC    948   704   54   2002230
139   69_101_010   7N26   CAV   DC    948   704   54   2002230
140   69_101_011   7N27   CAV   DC    948   704   54   2002230
141   69_101_012   7N28   CAV   DC    948   704   54   2002230
142   69_101_013   7N29   CAV   DC    948   704   54   2002230
143   69_101_014   7N30   CAV   DC    948   704   54   2002230
144   69_101_015   7N31   CAV   DC    948   704   54   2002230
145   69_111_001   6N01   CAV   DC    948   704   54   2002230
146   69_111_002   6N02   CAV   DC    948   704   54   2002230
147   69_111_003   6N03   CAV   DC    948   704   54   2002230
148   69_111_004   6N04   CAV   DC    948   704   54   2002230
149   69_111_005   6N05   CAV   DC    948   704   54   2002230
150   69_111_006   6N06   CAV   DC    948   704   54   2002230
151   69_111_007   6N07   CAV   DC    948   704   54   2002230
152   69_111_008   6N06   CAV   DC    948   704   54   2002230
153   69_111_009   6N09   CAV   DC    948   704   54   2002230
154   69_111_010   6N10   CAV   DC    948   704   54   2002230
155   69_111_011   6N11   CAV   DC    948   704   54   2002230
156   69_111_012   6N12   CAV   DC    948   704   54   2002230
157   69_111_013   6N13   CAV   DC    948   704   54   2002230
158   69_121_001   6N14   CAV   DC    948   704   54   2002230
159   69_121_002   6N15   CAV   DC    948   704   54   2002230
160   69_121_003   6N16   CAV   DC    948   704   54   2002230
161   69_121_004   6N17   CAV   DC    948   704   54   2002230
162   69_121_005   6N18   CAV   DC    948   704   54   2002230
163   69_121_006   6N19   CAV   DC    948   704   54   2002230
164   69_121_007   6N20   CAV   DC    948   704   54   2002230
165   69_121_008   6N21   CAV   DC    948   704   54   2002230
166   69_121_009   6N22   CAV   DC    948   704   54   2002230
167   69_121_010   6N23   CAV   DC    948   704   54   2002230
168   69_121_011   6N24   CAV   DC    948   704   54   2002230
169   69_121_012   6N24   CAV   DC    948   704   54   2002230
170   69_131_001   6N01   ETE   RW    816   704   54   1723446
171   69_131_002   6N02   ETE   RW    816   704   54   1723446
172   69_131_003   6N03   ETE   RW    816   704   54   1723446
173   69_131_004   6N04   ETE   RW    816   704   54   1723446
174   69_131_005   6N05   ETE   RW    816   704   54   1723446
175   69_131_006   6N06   ETE   RW    816   704   54   1723446
176   69_131_007   6N07   ETE   RW    816   704   54   1723446
177   69_131_008   6N08   ETE   RW    816   704   54   1723446
178   69_131_009   6N09   ETE   RW    816   704   54   1723446
179   69_131_010   6N10   ETE   RW    816   704   54   1723446
180   69_131_011   6N11   ETE   RW    816   704   54   1723446
181   69_131_012   6N12   ETE   RW    816   704   54   1723446
182   69_131_013   6N13   ETE   RW    816   704   54   1723446
```

```
183   69_131_014   6N14   ETE   RW   816   704    54   1723446
184   69_131_015   6N15   ETE   RW   816   704    54   1723446
185   69_131_016   6N16   ETE   RW   816   704    54   1723446
186   69_131_017   6N17   ETE   RW   816   704    54   1723446
187   69_131_018   6N18   ETE   RW   816   704    54   1723446
188   69_131_019   6N19   ETE   RW   816   704    54   1723446
189   69_131_020   6N20   ETE   RW   816   704    54   1723446
190   69_131_021   6N21   ETE   RW   816   704    54   1723446
191   69_131_022   6N22   ETE   RW   816   704    54   1723446
192   69_131_023   6N23   ETE   RW   816   704    54   1723446
193   69_131_024   6N24   ETE   RW   816   704    54   1723446
194   69_131_025   6N25   ETE   RW   816   704    54   1723446
195   69_141_001   7N01   ETE   RW   816   704    54   1723446
196   69_141_002   7N02   ETE   RW   816   704    54   1723446
197   69_141_003   7N03   ETE   RW   816   704    54   1723446
198   69_141_004   7N04   ETE   RW   816   704    54   1723446
199   69_141_005   7N05   ETE   RW   816   704    54   1723446
200   69_141_006   7N06   ETE   RW   816   704    54   1723446
201   69_141_007   7N07   ETE   RW   816   704    54   1723446
202   69_141_008   7N08   ETE   RW   816   704    54   1723446
203   69_141_009   7N09   ETE   RW   816   704    54   1723446
204   69_141_010   7N10   ETE   RW   816   704    54   1723446
205   69_141_011   7N11   ETE   RW   816   704    54   1723446
206   69_141_012   7N12   ETE   RW   816   704    54   1723446
207   69_141_013   7N13   ETE   RW   816   704    54   1723446
208   69_141_014   7N14   ETE   RW   816   704    54   1723446
209   69_141_015   7N15   ETE   RW   816   704    54   1723446
210   69_141_016   7N16   ETE   RW   816   704    54   1723446
211   69_141_017   7N17   ETE   RW   816   704    54   1723446
212   69_141_018   7N18   ETE   RW   816   704    54   1723446
213   69_141_019   7N19   ETE   RW   816   704    54   1723446
214   69_141_020   7N20   ETE   RW   816   704    54   1723446
215   69_141_021   7N21   ETE   RW   816   704    54   1723446
216   69_141_022   7N22   ETE   RW   816   704    54   1723446
217   69_141_023   7N23   ETE   RW   816   704    54   1723446
218   69_141_024   7N24   ETE   RW   816   704    54   1723446
219   69_141_025   7N25   ETE   RW   816   704    54   1723446
220   69_141_026   7N26   ETE   RW   816   704    54   1723446
221   69_141_027   7N27   ETE   RW   816   704    54   1723446
222   69_141_028   7N28   ETE   RW   816   704    54   1723446
223   69_141_029   7N29   ETE   RW   816   704    54   1723446
224   69_141_030   7N30   ETE   RW   816   704    54   1723446
225   69_141_031   7N31   ETE   RW   816   704    54   1723446
233   69_191_004   7N04   CAV   DC   956   776    54   2234934
234   69_191_005   7N05   CAV   DC   960   776    54   2234934
235   69_191_006   7N06   CAV   DC   956   776    54   2234934
236   69_191_007   7N07   CAV   DC   960   776    54   2234934
237   69_191_008   7N08   CAV   DC   956   776    54   2234934
238   69_191_009   7N09   CAV   DC   960   776    54   2234934
239   69_191_010   7N10   CAV   DC   956   776    54   2234934
240   69_191_011   7N11   CAV   DC   960   776    54   2234934
241   69_191_012   7N12   CAV   DC   956   776    54   2234934
242   69_191_013   7N13   CAV   DC   960   776    54   2234934
243   69_201_001   7N14   CAV   DC   956   704    54   2019126
244   69_201_002   7N15   CAV   DC   960   776    54   2234934
245   69_201_003   7N16   CAV   DC   956   776    54   2234934
246   69_201_004   7N17   CAV   DC   960   776    54   2234934
247   69_201_005   7N18   CAV   DC   956   776    54   2234934
248   69_201_006   7N19   CAV   DC   960   776    54   2234934
249   69_201_007   7N20   CAV   DC   956   776    54   2234934
250   69_201_008   7N21   CAV   DC   960   776    54   2234934
251   69_201_009   7N22   CAV   DC   956   776    54   2234934
252   69_201_010   7N23   CAV   DC   960   776    54   2234934
253   69_201_011   7N24   CAV   DC   956   776    54   2234934
254   69_201_012   7N25   CAV   DC   960   776    54   2234934
255   69_201_013   7N26   CAV   DC   956   776    54   2234934
256   69_211_001   7N27   CAV   DC   960   776    54   2234934
257   69_211_002   7N28   CAV   DC   948   704    54   2002230
258   69_211_003   7N29   UNK   UK   970   704    54   2002230
259   69_211_004   7N29   UNK   UK   952   1300   54   3712854
260   69_211_005   7N30   UNK   UK   976   704    54   2002230
261   69_221_001   6N01   CAV   DC   976   776    54   2272182
```

262	69_221_002	6N02	CAV	DC	960	776	54	2234934
263	69_221_003	6N03	CAV	DC	976	776	54	2272182
264	69_221_004	6N04	CAV	DC	960	776	54	2272182
265	69_221_005	6N05	CAV	DC	976	776	54	2272182
266	69_221_006	6N06	CAV	DC	960	776	54	2272182
267	69_221_007	6N07	CAV	DC	976	776	54	2272182
268	69_221_008	6N08	CAV	DC	960	776	54	2272182
269	69_221_009	6N09	CAV	DC	976	776	54	2272182
270	69_221_010	6N10	CAV	DC	960	776	54	2272182
271	69_221_011	6N11	CAV	DC	976	776	54	2272182
271	69_221_012	6N12	CAV	DC	960	776	54	2272182
273	69_221_013	6N13	CAV	DC	976	776	54	2272182
274	69_231_001	6N14	CAV	DC	960	776	54	2234934
275	69_231_002	6N15	CAV	DC	976	776	54	2234934
276	69_231_003	6N16	CAV	DC	960	776	54	2234934
277	69_231_004	6N17	CAV	DC	976	776	54	2234934
278	69_231_005	6N18	CAV	DC	960	776	54	2234934
279	69_231_006	6N19	CAV	DC	976	776	54	2234934
280	69_231_007	6N20	CAV	DC	960	776	54	2234934
281	69_231_008	6N21	CAV	DC	976	776	54	2234934
282	69_231_009	6N22	CAV	DC	960	776	54	2234934
283	69_231_010	6N23	CAV	DC	976	776	54	2234934
284	69_231_011	6N24	CAV	DC	960	776	54	2234934
285	69_231_012	6N25	CAV	DC	976	776	54	2234934
286	69_261_001	6N01	CAV	DC	976	776	54	2272182
287	69_261_002	6N02	CAV	DC	960	776	54	2234934
288	69_261_003	6N03	CAV	DC	976	776	54	2234934
289	69_261_004	6N04	CAV	DC	960	776	54	2234934
290	69_261_005	6N05	CAV	DC	976	776	54	2234934
291	69_261_006	6N06	CAV	DC	960	776	54	2234934
292	69_261_007	6N07	CAV	DC	976	776	54	2234934
293	69_261_008	6N08	CAV	DC	960	776	54	2234934
294	69_261_009	6N09	CAV	DC	976	776	54	2234934
295	69_261_010	6N10	CAV	DC	960	776	54	2234934
296	69_261_011	6N11	CAV	DC	976	776	54	2234934
297	69_261_012	6N12	CAV	DC	960	776	54	2234934
298	69_261_013	6N13	CAV	DC	976	776	54	2234934
299	69_271_001	6N14	CAV	DC	960	776	54	2234934
300	69_271_002	6N15	CAV	DC	976	776	54	2272182
301	69_271_003	6N16	CAV	DC	960	776	54	2272182
302	69_271_004	6N17	CAV	DC	976	776	54	2272182
303	69_271_005	6N18	CAV	DC	960	776	54	2272182
304	69_271_006	6N19	CAV	DC	976	776	54	2272182
305	69_271_007	6N20	CAV	DC	960	776	54	2272182
306	69_271_008	6N21	CAV	DC	976	776	54	2272182
307	69_271_009	6N22	CAV	DC	960	776	54	2272182
308	69_271_010	6N23	CAV	DC	976	776	54	2272182
309	69_271_011	6N24	CAV	DC	960	776	54	2272182
310	69_271_012	6N25	CAV	DC	976	776	54	2272182
311	69_291_001	6N01	CAV	MP	1000	772	54	2316054
312	69_291_002	6N03	CAV	MP	1000	772	54	2316054
313	69_291_003	6N05	CAV	MP	752	776	54	1750710
314	69_291_004	6N07	CAV	MP	1000	772	54	2316054
315	69_291_005	6N09	CAV	MP	700	952	54	1999254
316	69_291_006	6N11	CAV	MP	804	1028	54	2479590
317	69_291_007	6N13	CAV	MP	876	912	54	2396790
318	69_291_008	6N15	CAV	MP	1000	772	54	2316054
319	69_291_009	6N17	CAV	MP	852	852	54	2177766
320	69_291_010	6N19	CAV	MP	864	752	54	1949238
321	69_291_011	6N21	CAV	MP	952	1300	54	3712854
322	69_291_012	6N23	CAV	MP	1000	772	54	2316054
323	69_301_001	7N01	CAV	MP	804	1028	54	2479590
324	69_301_002	7N03	CAV	MP	700	952	54	1999254
325	69_301_003	7N05	CAV	MP	600	800	54	1440054
326	69_301_004	7N07	CAV	MP	600	800	54	1440054
327	69_301_005	7N09	CAV	MP	804	1028	54	2479590
328	69_301_006	7N11	CAV	MP	1000	772	54	2316054
329	69_301_007	7N12	CAV	MP	876	912	54	2396790
330	69_301_008	7N13	CAV	MP	952	1300	54	3712854
331	69_301_009	7N19	CAV	MP	1024	1504	54	4620342
332	69_311_001	7N17	CAV	MP	1000	1328	54	3984054
333	69_311_002	7N19	CAV	MP	1000	1352	54	4056054

Physics and Astronomy Department
4400 University Drive 3F3
Fairfax, VA 22030
Tel: +1 703 225-9080; Fax: +1 703 993-1296
tduxbury@gmu.edu

```
334   69_311_003   7N21   CAV   MP   1000   1000   54   3000054
335   69_311_004   7N23   CAV   MP   1000   1000   54   3000054
340   69_321_001   7N01   CAV   MP    804   1028   54   2479590
341   69_321_002   7N03   CAV   MP    700    952   54   1999254
342   69_321_003   7N05   CAV   MP    600    800   54   1440054
343   69_321_004   7N07   CAV   MP    600    800   54   1440054
344   69_321_005   7N09   CAV   MP    804   1028   54   2479590
345   69_321_006   7N11   CAV   MP   1000    900   54   2700054
346   69_321_007   7N13   CAV   MP    876    912   54   2396790
347   69_321_008   7N15   CAV   MP    952   1300   54   3712854
348   69_331_001   7N17   CAV   MP   1000   1328   54   3984054
349   69_331_002   7N19   CAV   MP   1000   1352   54   4056054
350   69_331_003   7N21   CAV   MP   1000   1000   54   3000054
351   69_331_004   7N23   CAV   MP    852    852   54   2177766
352   69_331_005   7N25   CAV   MP    952   1300   54   3712854
353   69_331_006   7N27   CAV   MP    752    776   54   1750710
354   69_331_007   7N29   CAV   MP    804   1028   54   2479590
355   69_331_008   7N31   CAV   MP    700    952   54   1999254
356   69_341_001   6N01   CAV   DC   1000    772   54   2316054
357   69_341_002   6N02   CAV   DC   1000    772   54   2316054
358   69_341_003   6N03   CAV   DC   1000    772   54   2316054
359   69_341_004   6N04   CAV   DC   1000    772   54   2316054
360   69_341_005   6N05   CAV   DC   1000    772   54   2316054
361   69_341_006   6N06   CAV   DC   1000    772   54   2316054
362   69_341_007   6N07   CAV   DC   1000    772   54   2316054
363   69_341_008   6N08   CAV   DC   1000    772   54   2316054
364   69_341_009   6N09   CAV   DC   1000    772   54   2316054
365   69_341_010   6N10   CAV   DC   1000    772   54   2316054
366   69_341_011   6N11   CAV   DC   1000    772   54   2316054
367   69_341_012   6N12   CAV   DC   1000    772   54   2316054
368   69_341_013   6N13   CAV   DC   1000    772   54   2316054
369   69_351_001   6N14   CAV   DC   1000    772   54   2316054
370   69_351_002   6N15   CAV   DC   1000    772   54   2316054
371   69_351_003   6N16   CAV   DC   1000    772   54   2316054
372   69_351_004   6N17   CAV   DC   1000    772   54   2316054
373   69_351_005   6N18   CAV   DC   1000    772   54   2316054
374   69_351_006   6N19   CAV   DC   1000    772   54   2316054
375   69_351_007   6N20   CAV   DC   1000    772   54   2316054
376   69_351_008   6N21   CAV   DC   1000    772   54   2316054
377   69_351_009   6N22   CAV   DC   1000    772   54   2316054
378   69_351_010   6N23   CAV   DC   1000    772   54   2316054
379   69_351_011   6N24   CAV   DC   1000    772   54   2316054
380   69_351_012   6N25   CAV   DC   1000    772   54   2316054
381   69_361_001   7N01   CAV   DC   1000    772   54   2316054
382   69_361_002   7N02   CAV   DC   1000    772   54   2316054
383   69_361_003   7N03   CAV   DC   1000    772   54   2316054
384   69_361_004   7N04   CAV   DC   1000    772   54   2316054
385   69_361_005   7N05   CAV   DC   1000    772   54   2316054
386   69_361_006   7N06   CAV   DC   1000    772   54   2316054
387   69_361_007   7N07   CAV   DC   1000    772   54   2316054
388   69_361_008   7N08   CAV   DC   1000    772   54   2316054
389   69_361_009   7N09   CAV   DC   1000    772   54   2316054
390   69_361_010   7N10   CAV   DC   1000    772   54   2316054
391   69_361_011   7N11   CAV   DC   1000    772   54   2316054
392   69_361_012   7N12   CAV   DC   1000    772   54   2316054
393   69_361_013   7N13   CAV   DC   1000    772   54   2316054
394   69_371_001   7N14   CAV   DC   1000    772   54   2316054
395   69_371_002   7N15   CAV   DC   1000    772   54   2316054
396   69_371_003   7N16   CAV   DC   1000    772   54   2316054
397   69_371_004   7N17   CAV   DC   1000    772   54   2316054
398   69_371_005   7N18   CAV   DC   1000    772   54   2316054
399   69_371_006   7N19   CAV   DC   1000    772   54   2316054
400   69_371_007   7N20   CAV   DC   1000    772   54   2316054
401   69_371_008   7N21   CAV   DC   1000    772   54   2316054
402   69_371_009   7N22   CAV   DC   1000    772   54   2316054
403   69_371_010   7N23   CAV   DC   1000    772   54   2316054
404   69_371_011   7N24   CAV   DC   1000    772   54   2316054
405   69_371_012   7N25   CAV   DC   1000    772   54   2316054
406   69_371_013   7N26   CAV   DC   1000    772   54   2316054
407   69_381_001   7N27   CAV   DC   1000    772   54   2316054
408   69_381_002   7N28   CAV   DC   1000    772   54   2316054
409   69_381_003   7N29   CAV   DC   1000    772   54   2316054
```

```
410   69_381_004   7N30   CAV   DC   1000   772   54   2316054
411   69_381_005   7N31   CAV   DC   1000   772   54   2316054
412   ED_006_001   7FXX   DV    RW    816   704   54   1723446
413   ED_006_002   7FXX   DV    RW    816   704   54   1723446
414   ED_006_003   7FXX   DV    RW    816   704   54   1723446
415   ED_006_004   7FXX   DV    RW    816   704   54   1723446
416   ED_006_005   7FXX   DV    RW    816   704   54   1723446
417   ED_006_006   7FXX   DV    RW    816   704   54   1723446
418   ED_006_007   7FXX   DV    RW    816   704   54   1723446
419   ED_006_008   7FXX   DV    RW    816   704   54   1723446
420   ED_006_009   7FXX   DV    RW    816   704   54   1723446
421   ED_006_010   7FXX   DV    RW    816   704   54   1723446
422   ED_006_011   7FXX   DV    RW    816   704   54   1723446
423   ED_006_012   7FXX   DV    RW    816   704   54   1723446
424   ED_006_013   7FXX   DV    RW    816   704   54   1723446
425   ED_006_014   7FXX   DV    RW    816   704   54   1723446
426   ED_006_015   7FXX   DV    RW    816   704   54   1723446
427   ED_006_016   7FXX   DV    RW    816   704   54   1723446
428   ED_006_017   7FXX   DV    RW    816   704   54   1723446
429   ED_006_018   7FXX   DV    RW    816   704   54   1723446
430   ED_006_019   7FXX   DV    RW    816   704   54   1723446
431   ED_006_020   7FXX   DV    RW    816   704   54   1723446
432   ED_006_021   7FXX   DV    RW    816   704   54   1723446
433   ED_006_022   7FXX   DV    RW    816   704   54   1723446
434   ED_006_023   7FXX   DV    RW    816   704   54   1723446
435   ED_006_024   7FXX   DV    RW    816   704   54   1723446
436   ED_006_025   7FXX   DV    RW    816   704   54   1723446
437   ED_012_001   7NXX   DV    RW    816   704   54   1723446
438   ED_012_002   7NXX   DV    RW    816   704   54   1723446
439   ED_012_003   7NXX   DV    RW    816   704   54   1723446
440   ED_012_004   7NXX   DV    RW    816   704   54   1723446
441   ED_012_005   7NXX   DV    RW    816   704   54   1723446
442   ED_012_006   7NXX   DV    RW    816   704   54   1723446
443   ED_012_007   7NXX   DV    RW    816   704   54   1723446
444   ED_012_008   7NXX   DV    RW    816   704   54   1723446
445   ED_012_009   7NXX   DV    RW    816   704   54   1723446
446   ED_014_001   7N35   DV    RW    816   704   54   1723446
447   ED_014_002   7N35   DV    RW    816   704   54   1723446
448   ED_014_003   7N35   DV    RW    816   704   54   1723446
449   ED_014_004   7N35   DV    RW    816   704   54   1723446
450   ED_014_005   7N35   DV    RW    816   704   54   1723446
451   ED_014_006   7N35   DV    RW    816   704   54   1723446
452   ED_014_007   7N35   DV    RW    816   704   54   1723446
453   ED_014_008   7N35   DV    RW    816   704   54   1723446
454   ED_014_009   7N35   DV    RW    816   704   54   1723446
455   ED_014_010   7N35   DV    RW    816   704   54   1723446
456   ED_014_011   7N35   DV    RW    816   704   54   1723446
457   ED_014_012   7N35   DV    RW    816   704   54   1723446
458   ED_014_013   7N35   DV    RW    816   704   54   1723446
459   ED_014_014   7N35   DV    RW    816   704   54   1723446
460   ED_014_015   7N35   DV    RW    816   704   54   1723446
461   ED_014_016   7N35   DV    RW    816   704   54   1723446
462   ED_014_017   7N35   DV    RW    816   704   54   1723446
463   ED_014_018   7N35   DV    RW    816   704   54   1723446
464   ED_014_019   7N35   DV    RW    816   704   54   1723446
465   ED_014_020   7N35   DV    RW    816   704   54   1723446
466   ED_014_021   7N35   DV    RW    816   704   54   1723446
467   ED_014_022   7N35   DV    RW    816   704   54   1723446
468   ED_014_023   7N35   DV    RW    816   704   54   1723446
469   ED_014_024   7N35   DV    RW    816   704   54   1723446
470   ED_014_025   7N35   DV    RW    816   704   54   1723446
471   ED_016_001   7F35   DV    RW    816   704   54   1723446
472   ED_016_002   7F35   DV    RW    816   704   54   1723446
473   ED_016_003   7F35   DV    RW    816   704   54   1723446
474   ED_016_004   7F35   DV    RW    816   704   54   1723446
475   ED_016_005   7F35   DV    RW    816   704   54   1723446
476   ED_016_006   7F35   DV    RW    816   704   54   1723446
477   ED_016_007   7F35   DV    RW    816   704   54   1723446
478   ED_016_008   7F35   DV    RW    816   704   54   1723446
479   ED_016_009   7F35   DV    RW    816   704   54   1723446
480   ED_016_010   7F35   DV    RW    816   704   54   1723446
482   ED_016_011   7F35   DV    RW    816   704   54   1723446
```

```
483   ED_016_012   7F35   DV   RW   816   704   54   1723446
484   ED_016_013   7F35   DV   RW   816   704   54   1723446
485   ED_016_014   7F35   DV   RW   816   704   54   1723446
486   ED_016_016   7F35   DV   RW   816   704   54   1723446
487   ED_016_017   7F35   DV   RW   816   704   54   1723446
488   ED_016_018   7F35   DV   RW   816   704   54   1723446
489   ED_016_019   7F35   DV   RW   816   704   54   1723446
490   ED_016_020   7F35   DV   RW   816   704   54   1723446
491   ED_016_021   7F35   DV   RW   816   704   54   1723446
492   ED_016_022   7F35   DV   RW   816   704   54   1723446
493   ED_016_023   7F35   DV   RW   816   704   54   1723446
494   ED_016_024   7F35   DV   RW   816   704   54   1723446
495   ED_016_025   7F36   DV   RW   816   704   54   1723446
496   ED_018_001   7F36   DV   RW   816   704   54   1723446
497   ED_018_002   7F36   DV   RW   816   704   54   1723446
498   ED_018_003   7F36   DV   RW   816   704   54   1723446
499   ED_018_004   7F36   DV   RW   816   704   54   1723446
500   ED_018_005   7F36   DV   RW   816   704   54   1723446
501   ED_018_006   7F36   DV   RW   816   704   54   1723446
502   ED_018_007   7F36   DV   RW   816   704   54   1723446
503   ED_022_001   UNKN   DV   RW   816   704   54   1723446
504   ED_022_002   UNKN   DV   RW   816   704   54   1723446
505   ED_022_003   UNKN   DV   RW   816   704   54   1723446
506   ED_022_004   UNKN   DV   RW   816   704   54   1723446
507   ED_022_005   UNKN   DV   RW   816   704   54   1723446
508   ED_022_006   UNKN   DV   RW   816   704   54   1723446
509   ED_022_007   BLNK   DV   RW   816   704   54   1723446
510   ED_022_008   7F35   DV   RW   816   704   54   1723446
511   ED_022_009   7F35   DV   RW   816   704   54   1723446
512   ED_022_010   7F35   DV   RW   816   704   54   1723446
513   ED_022_011   7F35   DV   RW   816   704   54   1723446
514   ED_022_012   7F35   DV   RW   816   704   54   1723446
515   ED_022_013   7F35   DV   RW   816   704   54   1723446
516   ED_022_014   7F35   DV   RW   816   704   54   1723446
517   ED_022_015   7F35   DV   RW   816   704   54   1723446
518   JAC_138_001  7F68   DV   RW   816   704   54   1723446
519   JAC_138_002  7F68   DV   RW   816   704   54   1723446
520   JAC_138_003  7F68   DV   RW   816   704   54   1723446
521   JAC_138_004  7F68   DV   RW   816   704   54   1723446
522   JAC_138_005  7F68   DV   RW   816   704   54   1723446
523   JAC_138_006  7F68   DV   RW   816   704   54   1723446
524   JAC_138_007  7F68   DV   RW   816   704   54   1723446
525   JAC_138_008  7F68   DV   RW   816   704   54   1723446
526   JAC_138_009  7F68   DV   RW   816   704   54   1723446
527   JAC_170_001  7F68   DV   RW   816   704   54   1723446
528   JAC_170_002  7F68   DV   RW   816   704   54   1723446
529   JAC_170_003  7F68   DV   RW   816   704   54   1723446
530   JAC_191_001  6F29   DV   RW   816   704   54   1723446
531   JAC_191_002  6F29   DV   RW   816   704   54   1723446
532   JAC_191_003  6F29   DV   RW   816   704   54   1723446
533   JAC_191_004  6F29   DV   RW   816   704   54   1723446
534   JAC_191_005  6F29   DV   RW   816   704   54   1723446
535   JAC_191_006  6F29   DV   RW   816   704   54   1723446
536   JAC_191_007  6F29   DV   RW   816   704   54   1723446
537   JAC_191_008  6F29   DV   RW   816   704   54   1723446
538   JAC_191_009  6F29   DV   RW   816   704   54   1723446
539   JAC_191_010  6F20   DV   RW   816   704   54   1723446
540   JAC_224_001  6F2Q   DV   RW   816   704   54   1723446
541   JAC_224_002  6F2R   DV   RW   816   704   54   1723446
542   JAC_224_003  6F2S   DV   RW   816   704   54   1723446
543   JAC_224_004  6F2T   DV   RW   816   704   54   1723446
544   JAC_224_005  6F2U   DV   RW   816   704   54   1723446
545   JAC_224_006  6F2V   DV   RW   816   704   54   1723446
546   JAC_224_007  6F2W   DV   RW   816   704   54   1723446
547   JAC_224_008  6F2X   DV   RW   816   704   54   1723446
548   JAC_224_009  6F2Y   DV   RW   816   704   54   1723446
549   JAC_224_010  6F2Z   DV   RW   816   704   54   1723446
550   JAC_372_001  6F29   DV   RW   816   704   54   1723446
551   JAC_372_002  6N29   DV   RW   816   704   54   1723446
552   JAC_372_003  6F29   DV   RW   816   704   54   1723446
553   JAC_372_004  6F29   DV   RW   816   704   54   1723446
554   JAC_372_005  6F29   DV   RW   816   704   54   1723446
```

```
555   JAC_372_006   6F29   DV    RW     816    704    54    1723446
556   JAC_372_007   6F29   DV    RW     816    704    54    1723446
557   JAC_372_008   6F30   DV    RW     816    704    54    1723446
558   JAC_372_009   6F30   DV    RW     816    704    54    1723446
559   JAC_372_010   6F30   DV    RW     816    704    54    1723446
560   JAC_372_011   6F30   DV    RW     816    704    54    1723446
226   69_151_001    UNKN   UNK   UK     948    704    54    2002230
227   69_151_002    UNKN   UNK   UK     948    704    54    2002230
228   69_151_003    UNKN   UNK   UK     816    704    54    1723446
229   69_151_004    UNKN   UNK   UK     948    704    54    2002230
336   69_311_005    7N19   CAV   MP    1000   1352    54    4056054
337   69_311_006    7N19   CAV   MP    1000   1352    54    4056054
338   69_311_007    7N19   CAV   MP    1000   1352    54    4056054
339   69_311_008    UNKN   CAV   MP     700    952    54    1999254
```

For completeness, the following information was taken and repeated verbatim from the NSSDC website:

1) http://nssdc.gsfc.nasa.gov/nmc/spacecraftDisplay.do?id=1969-014A
"NSSDCA/COSPAR ID: 1969-014A, NSSDC ID: 1969-014A-01, Mission Name: Mariner 6, Principal Investigator: Dr. Robert B. Leighton

Two television cameras, one of medium resolution (wide angle) and the other of high resolution (narrow angle), were part of the Mariner 6 scientific instrumentation. The wide-angle camera, which had a field of view of 11 deg by 14 deg and a focal length of 50 mm, encompassed 100 times more surface area than the narrow-angle camera and was used only for near-encounter pictures. The narrow-angle camera, which was used for both near- and far-encounter pictures, had a focal length of 508 mm and provided 10 times the linear resolution of the wide-angle camera. Camera shutters were alternated and timed to provide overlapping of the wide-angle and narrow-angle pictures, providing 75 pictures from the two systems (26 near-encounter and 49 far-encounter, plus a 50th fractional far-encounter image). The near-encounter pictures were taken between 13 min 59 s before encounter and 2 min 55 s after encounter along a track that crossed the equatorial zones of the planet and included many known light and dark features of the Martian surface. The far-encounter pictures were obtained in two series of operations. In the first series, 33 pictures were obtained between 48 h and 28 h before encounter. In the second series, 17 pictures were obtained between 22 h and 7 h from closest approach. The picture data were encoded and recorded within the onboard television and data storage subsystems. For each picture produced by the cameras, three separate encoded versions were transmitted to earth -- a composite analog video (CAV) picture, a digital video (DV) picture, and an every twenty-eighth (ETE) digital picture. Video reconstruction consisted of combining the three data streams (CAV, DV, and ETE). This generated video data as they existed coming out of the camera heads. The telemetered video magnetic tapes were displayed on a CRT and photographed on 70-mm film to produce the raw images. They were also digitally processed by an IBM 360/44 computer for enhancement and by an IBM 360/75 for noise removal to obtain the versions contained in data sets -01C through -01H. Detailed information on the digital processing procedures can be found in "Digital Processing of the Mariner 6 and 7 pictures," T. C. Rindfleish et al, J. Geophys. Res. , v. 76, p. 394-417, January 1971. Accurate trajectory and related geometrical data can be found in Mariner Mars 1969 Simulated TV Pictures (Final), J. K. Campbell, 1970, which was issued by JPL."

2) http://nssdc.gsfc.nasa.gov/nmc/datasetDisplay.do?id=PSPG-00046

"NSSDCA ID: PSPG-00046 Availability: At NSSDC, Ready for Offline Distribution (or Staging if Digital) Ancillary data are not needed for the proper use of these data Description

This data set contains Mariner 6 and 7 TV reduced data records. The records were originally on 7 track tapes and were copied onto CD-WO as part of the Science Digital Data Preservation Task (SDDPT). The original 7-bit data were padded to 8 bits by removing first (parity) bit and padding the resulting 6-bit characters to 8-bits by placing zeroes into the 2 highest order bits. The 7-track tape data was originally written in "SNAKED" format with attached EBCDIC VICAR labels in front of the data. The files on this CD are organized in one top-level directory with several subdirectories.

To display images originally archived on 7-track tapes use the VICAR program LABEL-CREATE, with inputs of NL = xxx (number of lines) and NS = xxx (number of samples). More information on these data is contained in the AAREADME.TXT and M69_INFO.TXT files on the CD.

The magnetic tapes in most cases, were at least 20-27 years old. Accompanying each tape on the disc, there is a log file which documents SDDPT processing history and copy errors. Each CD-WO has been formatted according to the ISO 9660 Interchange Standard so that a variety of computer systems may access the data. File attributes are specified by Extended Attribute Records which comprise the first 512 bytes of the file.

This data set was created at JPL as part of its Science Digital Data Preservation Task (SDDPT), and a copy was provided to NSSDC for safekeeping. Numerous SDDPT data sets are not readily usable, as they represent bit copies of old data tapes and do not contain user documentation. Persons interested in ordering these data should contact the NSSDC person listed for this data set. Freeware to view this particular data set is available at:

http://members.tripod.com/petermasek/mariner67.html

This is SDDPT data set code 69-030A-0019, volume ID M69_2001."

REFERENCES

- Campbell, J. K., Mariner Mars 1969 Simulated TV Pictures, JPL Document 605-237, 1970.

- Collins, S. A., The Mariner 6 and 7 Pictures of Mars, NASA SP-263, Washington, D.C., 1971.

- Danielson, G. E., and D. R. Montgomery, Calibration of the Mariner Mars 1969 television

Physics and Astronomy Department
4400 University Drive 3F3
Fairfax, VA 22030
Tel: +1 703 225-9080; Fax: +1 703 993-1296
tduxbury@gmu.edu

cameras, *J. Geophys. Res*., **76**, 2, 1971.

- Dunne, J. A., W. D. Stromberg, R. M. Ruiz, S. A. Collins, and T. E. Thorpe, Maximum discriminability versions of the near-encounter Mariner pictures, *J. Geophys. Res*., **76**, 2, 1971.

- Edmonds, J. L. and M. S. Robinson, New Mariner 6 and 7 mosaics of Mars: clues about time variable surface features, Lunar and Planetary Science XXXIV (2003), 1436.pdf

- Leighton, R. B., and B. C. Murray, One year's processing and interpretation--an overview, *J. Geophys. Res*., **76,** 2, 1971.

- Rindfleisch, T. C., J. A. Dunne, H. J. Frieden, W. D. Stromberg, and R. M. Ruiz, Digital Processing of the Mariner6 and 7 Pictures, *J. Geophys. Res*., **76**, 2, 1971

- http://nssdc.gsfc.nasa.gov/nmc/spacecraftDisplay.do?id=1969-014A

- http://nssdc.gsfc.nasa.gov/nmc/datasetDisplay.do?id=PSPG-00046
-
- http://ser.sese.asu.edu/M67/mar67.html