Apollo 16 Orbital Mass Spectrometer Data Output Scans Collection: Microfilm Scans

Collection Overview

This collection contains microfilm scans of formatted outputs of the full set of data acquired by the Apollo 16 Orbital Mass Spectrometer (OMS) from lunar orbit during 20-24 April 1972. The mass ranges covered are 12-28 and 28-67 atomic mass units (amu). The scans are provided as multipage PDF/A files. Please note there is concern that much of the data are dominated by contamination from spacecraft and instrument outgassing (Hoffman, et al. 1972).

The four PDF/A files, a16_oms_mp*.pdf, contain high-resolution, 400 dots-per-inch scans of formatted outputs of data that were imaged on five rolls of 16-millimeter microfilm. The microfilms are held at the NASA Space Science Data Coordinated Archive (NSSDCA) as data set PSPA-00139.

This collection includes copies of these public publications:

- "Chapter 21. Lunar Orbital Mass Spectrometer Experiment", from the Apollo 16 Preliminary Science Report, which describes the instrument and science goals and provides an early analysis of returned data, and
- "Chapter 29. Lunar Orbital Mass Spectrometer (NASA Experiment S-165)", from the Apollo Scientific Experiments Data Handbook, which provides the basic information necessary to decode the data in formatted outputs such as the description of the fields and the parsing technique of that data set.

Description of the OMS Formatted Data Outputs

The Orbital Mass Spectrometer Experiment on Apollo 16 consisted of a dual collector, single-focusing, sector-field spectrometer mounted at the end of a retractable boom that measured 7.3 meters when fully extended deployed from the Scientific Instrument Module on the Service Module. The two collectors simultaneously scanned two mass ranges, 12 to 28 amu (low-mass channel) and 28 to 67 amu (high-mass channel). This flight neutral mass spectrometer was designed to measure gas concentrations to study the sources, sinks, and transport mechanisms of the lunar ambient atmosphere from orbit. Pre-flight absolute calibration was performed at the Langley Research Center Molecular Beam Facility.

The original data set on 16-mm microfilm was supplied by the principal investigator, Dr. John H. Hoffman, and researcher C. Peters in late 1972. The microfilm records are formatted outputs of the data on magnetic tape. The format presents sequential pairs of mass spectra (low- and high-mass channels) along with background, housekeeping, and calibration data as shown in Figures 1 and 2. Each sequential pair spans about one minute and two seconds. The next section of this document explain the contents of the low- and high-mass tables in more detail.

In addition, there are tabulated summaries of peak amplitudes from 12 to 67 amu at steps of 1 amu (Figure 3), trajectory data (Figure 4), and housekeeping measurements (Figure 5) as a function of ground elapsed time (GET). Each summary chart covers several hours of experiment operation. These tabulated summaries are printed after the corresponding set of sequential pairs of mass spectra output. The headings of these tables are explained in the Apollo Scientific Experiments Data Handbook, pages 29-7 to 29-11 and 29-16 to 29-18.

The GET time spans covered the PDF/A files are:

a16_oms_mp20072.pdf: GET 148-158, 161-167 hours
a16_oms_mp20073.pdf: GET 124-148 hours
a16_oms_mp20074.pdf: GET 159, 167, 180-185, 187-193 hours
a16_oms_mp20075.pdf: GET 106-108, 110-124 hours
a16_oms_mp20076.pdf: GET 80-92 hours

Some sets of sequential pairs of mass spectra output within a PDF/A file may not be in time order because the order of the microfilm records is preserved.

A Fortran program, which appears to have been used to format and output the spectrometer data, is captured on pages 3-6 in the file a16_oms_mp20074.pdf.

GET TIME APOLLO 16 A0 A1 B0 B1 REV SUN HR LONG LAT SUN A SUN B TEMP ALT VEL ALPHA VEL
167 34 8 LOW MASS -505.83 34703.50 -53.49 17373.73 48.42 -29.65 28.61 -6.64 120.98 182.57 2.33 119.14 .73 1.62

********** PEAK ERROR CODE 1

1	911	247	56	47	151	233	65535	43007	10623	67	46	911	3616
2	991	263	58	89	175	209	65535	43007	10751	52	55	1087	508
3	983	279	57	112	165	245	65535	43519	10751	59	100	1167	162
4	927	295	60	116	217	319	65023	43519	10623	64	165	1183	2
5	879	287	56	131	231	479	65023	43519	10367	55	209	1215	1
6	791	283	55	127	247	583	64511	43519	10239	53	209	1183	2
7	599	283	49	119	249	631	64511	43519	9983	64	207	1167	1
8	455	275	50	137	259	687	64511	43519	9727	48	193	1167	2
9	399	283	57	131	291	639	64511	43519	9343	71	191	1151	1
10	975	275	45	127	283	655	65023	44031	9087	59	193	1151	1
11	3327	267	38	129	279	639	65535	43519	7551	65	201	1251	0
12	5887	287	48	127	291	647	65023	43519	4479	109	191	1151	1
13	6783	271	37	127	295	663	64511	43007	2175	259	197	1135	1
14	6719	237	31	131	299	647	63487	43007	815	583	217	1103	2
15	6847	225	33	116	311	639	62975	43007	319	735	169	1119	2
16	6719	177	29	135	431	647	61951	41983	189	767	183	943	1632
17	6527	112	34	124	663	639	60415	38911	153	791	193	671	1632
18	6463	99	29	120	799	623	58367	32767	145	767	161	451	1632
19	6399	76	33	114	871	655	53247	24063	131	767	99	271	1632
20	6335	63	32	84	863	687	44031	16383	137	759	83	175	1632
21	6207	72	24	70	847	631	31999	9983	123	751	60	133	1632
22	6079	89	30	61	823	663	19711	5567	122	743	57	121	1632
23	6079	107	28	55	831	591	10623	2815	113	727	46	112	1632
24	5631	114	26	52	815	631	5055	1519	122	711	41	124	1632
25	4607	113	22	50	783	551	2591	863	125	695	43	122	1632
26	2847	118	34	57	759	495	1535	599	119	687	47	118	1632
27	1311	111	26	58	759	399	1015	475	147	583	46	125	1632
28	479	108	26	59	727	371	743	399	355	327	43	107	1632
29	299	102	18	58	767	363	599	363	863	171	45	101	1632
30	395	110	25	54	735	359	487	307	1055	105	46	99	1632
31	559	111	21	69	695	355	443	315	1103	64	56	112	
32	559	106	26	52	695	359	395	311	1087	59	50	108	
33	559	110	26	56	687	375	355	307	1119	64	45	100	
34	527	113	26	61	695	395	331	267	1087	50	46	100	HOUSE
35	543	112	23	61	679	427	327	275	1087	46	47	90	KEEPING
36	559	118	28	59	567	471	307	319	1015	55	62	91	3.86+12
37	567	104	26	48	391	511	287	291	1055	53	56	94	2.43+ 5
38	535	90	26	56	251	535	307	343	1039	48	50	97	2.96-12
39	519	93	32	57	167	615	351	395	1015	54	74	88	4.67-15
40	519	81	34	67	141	703	419	475	1015	57	54	88	2.04 EM
41	519	66	25	62	137	775	623	679	863	51	63		3.10 F1
42	507	67	32	68	137	983	1535	919	559	60	67		.16 F2
43	471	57	39	63	145	1631	5119	1135	267	50	65		2.59 LM
44	367	56	26	67	155	4799	15871	1311	141	52	77		2.71 HM
45	275	61	36	60	193	14975	31487	1551	87	52	75		1.98 SW
46	169	56	36	58	271	38911	39423	1935	66	50	75		3.02 T1
47	103	51	27	65	423	58879	41471	3007	70	55	90		2.33 T2
48	76	58	33	73	447	63487	42495	5183	70	49	121		.02 MF
49	106	68	31	93	379	65023	43007	7679	67	40	223		2.45 DF
50	167	74	40	112	291	65023	43007	9343	62	46	559		1.73 IC

28 6468 25 77 23 0 22 86 20 633 19 363 17 43266 16 9803 15 973 14 689 13 143
27 505 24 23 21 0 18 64377 12 1094 PBKG BKG N
26 247 1 1 10

Figure 1 – Low-mass channel data of the sequential pair starting at GET 167:34:08 (hour:minute:second). This sample is page 44 of a16_oms_mp20074.pdf.

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GET  TIME  APOLLO 16          4 OCTOBER 1972 / 22 NOVEMBER 1972 SPEC.                              DATA C FLAG 00000000   PBKG    BKG  N
167 34  8  HIGH MASS     A0     -505.83   A1    34703.50   B0      -53.49    B1    17373.73   DATA C SYNC 11000011     83      78 10
**********  PEAK ERROR CODE     1
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1	45	4	286	52	34	59	800	27	21	33	47	154	268
2	31	14	370	42	35	46	728	26	70	34	46	134	108
3	51	24	338	39	38	37	592	37	92	26	48	158	92
4	57	24	258	27	34	22	356	39	102	20	119	222	81
5	61	13	168	23	28	28	232	14	58	35	185	242	75
6	41	15	70	30	28	24	112	47	46	45	261	270	76
7	23	17	46	31	10	27	60	54	21	49	277	294	75
8	25	9	40	22	23	31	48	74	29	59	213	258	74
9	28	8	33	48	6	38	58	120	10	51	177	234	82
10	59	12	56	50	13	69	39	142	32	35	95	210	79
11	95	20	112	45	26	135	39	138	22	35	61	214	75
12	101	26	186	44	12	283	46	150	24	19	57	206	81
13	95	26	234	48	6	399	45	142	38	23	57	490	83
14	81	20	222	29	14	551	37	122	39	28	49	1954	78
15	30	36	172	29	37	527	94	68	40	28	48	5874	78
16	17	10	110	24	26	479	154	44	65	15	51	10418	1696
17	24	14	50	13	18	347	256	47	49	36	45	12210	1712
18	28	3	29	15	20	223	348	28	34	20	47	11058	1696
19	38	15	35	27	18	139	356	21	31	27	53	7730	1712
20	33	33	42	25	41	57	352	25	19	20	51	4338	1712
21	30	54	90	29	21	47	328	23	14	44	63	1922	1712
22	9	82	214	71	22	57	244	22	31	63	115	650	1696
23	17	54	334	93	17	55	168	22	35	59	317	242	1712
24	4	60	426	99	21	57	112	27	31	41	657	134	1696
25	25	38	418	89	8	49	70	27	17	49	945	136	1696
26	29	15	338	75	9	79	56	33	23	43	865	110	1712
27	39	15	254	53	15	183	18	47	37	30	641	122	1696
28	40	20	140	43	17	495	19	76	79	44	381	108	1712
29	41	18	80	25	25	1391	25	124	123	47	177	108	1696
30	35	43	36	25	46	3087	18	180	69	45	99	104	1712
31	9	52	18	25	41	4911	30	220	65	29	51	106	
32	31	72	20	26	51	6127	36	312	34	41	53	94	
33	8	60	42	18	39	6255	44	308	28	46	51	100	
34	12	48	34	35	34	5167	86	324	22	35	57	110	
35	7	25	56	39	23	3727	154	280	20	55	51	112	
36	37	9	58	59	11	2319	264	248	25	169	51	178	
37	27	17	60	65	17	1199	456	176	29	1025	67	370	
38	17	19	46	77	13	559	568	134	21	3057	58	650	
39	15	27	33	55	25	199	632	100	18	4593	66	818	
40	5	44	24	46	9	128	680	48	19	4401	76	822	
41	0	114	30	44	24	88	608	35	30	2993	96		
42	7	124	27	31	8	70	520	33	31	1505	254		
43	13	116	16	24	23	64	400	10	44	553	594		
44	36	90	31	22	32	78	288	27	43	145	1074		
45	30	74	37	18	47	120	146	23	36	67	1458		
46	26	38	56	26	103	220	76	26	31	55	1458		
47	33	30	66	13	107	388	46	32	36	49	1218		
48	24	54	90	10	105	616	25	34	19	55	786		
49	4	76	82	24	97	760	30	29	32	37	442		
50	2	158	78	18	87	872	35	27	14	40	234		
67	77 61	20*56	199 52	30 48	23 45	522 42	321 39	282*37	38 33	34 30	909 28	12037	
66	24 60	72*55	405 51	80 47	24*44	6282 41	655 38	84 36	94 32	4682 29	1345 27	0*	
65	30 59	55 54	37 50	54 46	84 43	809 40	117*	35	21 31	233			
64	25*58	101 53	67 49	20				34	35				
63	28 57	336											
62	14												

Figure 2 – High-mass channel data of the sequential pair starting at GET 167:34:08. This sample is page 45 of a16_oms_mp20074.pdf.

APOLLO 16 PEAK SUMMARY

GET	TIME	SUN HR	C	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	L	H
-159	22 40	18.4	0	619	64	330	456	5016	31396	60225	236	358	0	64	0	16	47	154	3	129
-159	23 42	15.3	1	842	94	461	652	6792	36177	62857	200	307	0	48	0	14	42	130	5	122
**********																				
+167	22 47	4.2	0	819	106	491	647	6899	36295	61431	215	358	0	52	0	20	55	153	1	11
+167	23 49	1.2	0	918	113	533	719	7737	39115	60952	255	422	0	60	0	19	56	190	0	21
+167	24 51	-1.9	0	858	109	533	702	7493	39472	60103	304	506	0	64	0	18	64	203	1	33
+167	25 53	-5.0	0	768	99	462	621	6984	39552	63098	293	498	0	74	0	21	67	205	0	48
+167	26 54	-8.0	0	757	97	461	634	7032	38299	62154	268	426	0	67	0	18	59	184	1	65
+167	27 56	-11.1	3	944	117	566	785	8506	38496	63703	273	435	0	70	0	22	63	191	1	82
+167	28 58	-14.2	0	882	117	551	775	8133	41258	64174	313	560	0	76	2	28	77	224	1	86
+167	30 0	-17.3	3	855	106	540	740	7873	38945	63618	308	537	0	75	0	24	68	227	1	89
+167	31 2	-20.4	0	941	132	606	857	9255	44325	65090	343	564	0	73	0	23	72	237	1	95
+167	32 4	-23.5	0	963	128	607	861	9224	43737	62925	338	589	0	84	0	20	79	241	1	85
+167	33 6	-26.6	0	982	143	616	892	9330	46334	63912	360	630	0	78	0	22	83	250	1	83
+167	34 8	-29.7	1	1094	143	689	973	9803	43266	64377	363	633	0	86	0	23	77	247	1	78
+167	35 10	-32.8	0	873	120	574	840	8996	44024	65250	399	728	0	94	0	28	88	[illegible]	1	78
+167	36 12	-35.9	0	1116	168	712	1018	10306	44888	63669	322	554	0	79	0	17	80	228	1	75
+167	37 14	-39.0	0	1084	155	719	1030	10702	46842	64225	392	731	0	86	0	28	98	288	0	7
+167	38 16	-42.1	0	1150	165	757	1075	11113	48217	64900	403	710	0	95	0	30	93	300	1	10
+167	39 18	-45.2	0	1031	145	656	952	9240	45161	64272	409	740	0	92	0	30	95	318	1	12
+167	40 20	-48.3	0	1122	162	740	1093	10921	46892	65202	402	717	0	97	0	33	98	297	1	11
+167	41 22	-51.5	0	1155	172	748	1062	9763	41584	64796	411	720	0	97	0	27	96	309	1	15
+167	42 24	-54.6	0	1227	183	826	1191	11402	47860	64834	426	767	0	104	0	30	100	313	1	11
+167	43 26	-57.7	0	892	139	620	937	9508	46563	64843	441	774	0	105	1	31	116	343	1	11
+167	44 28	-60.8	0	1231	184	822	1237	11309	48716	64761	314	522	0	77	0	23	83	250	1	8
+167	45 30	-64.0	0	1247	195	833	1235	11061	48961	63884	430	766	0	103	0	27	101	344	1	4
+167	46 32	-67.1	0	1233	195	867	1284	11231	49388	63218	425	777	0	111	0	36	110	344	0	4
+167	47 33	-70.3	0	1405	223	948	1424	12012	48105	64222	419	763	0	113	0	39	111	346	1	4
+167	48 35	-73.4	0	1235	195	828	1278	10525	45668	64750	486	839	0	120	0	35	120	388	1	5
+167	49 37	-76.5	0	1275	213	889	1351	10890	48755	64446	414	733	0	105	0	29	114	353	1	39
+167	50 39	-79.7	0	1414	232	941	1400	11084	47481	63355	408	702	0	120	1	35	116	366	1	65
+167	51 41	-82.8	0	1436	236	970	1456	10928	46623	64381	422	733	0	131	0	34	115	367	2	97
+167	52 43	-86.0	0	1563	260	1018	1557	11156	45285	61859	399	727	0	138	0	33	122	384	2	133
+167	53 45	-89.1	0	1313	214	849	1336	9554	44239	63500	437	751	0	151	0	35	120	[illegible]	1	227
+167	54 47	-92.3	0	1465	238	978	1496	10808	46586	64029	350	611	0	135	0	33	108	337	1	59

APOLLO 16 PEAK SUMMARY

GET	TIME	SUN HR	C	55	56	57	58	59	60	61	62	63	64	65	66	67		
-159	22 40	18.4	0	181	67*	155	43*	36*	31*	18*	14*	21*	26*	23	15	46	3	129
-159	23 42	15.3	1	212	95	170	49	32	26*	15*	26	12*	12*	15*	4*	48*	5	122
**********																		
+167	22 47	4.2	0	308	121	258	71	35*	37	10*	9*	12*	11	15*	7*	62	1	11
+167	23 49	1.2	0	299	143	244	70	42	28*	12	5	16	0*	15*	13	72	0	21
+167	24 51	-1.9	0	293	134	237	75	36*	31*	8*	4*	13*	20*	27	4*	59*	1	33
+167	25 53	-5.0	0	291	141	262	74	34*	35	10*	9*	12*	9	28*	17	78	0	48
+167	26 54	-8.0	0	327	142	260	82*	29*	37	10*	11*	10*	0*	24*	10*	59	1	65
+167	27 56	-11.1	3	315	169	259	76	42*	48*	10*	9	12*	14*	27	19*	59	1	82
+167	28 58	-14.2	0	324	147	260	67	46	58	24	14*	18*	12*	20*	19*	57	1	86
+167	30 0	-17.3	3	342	143	249	88	53*	44	26	17*	35*	26*	21*	14*	59	1	89
+167	31 2	-20.4	0	356	169	287	102	58*	49	25*	15*	20*	7	18*	11*	74	1	95
+167	32 4	-23.5	0	378	160	298	106	48*	67	18*	0*	13*	18	44	17	73	1	85
+167	33 6	-26.6	0	396	181	286	106	73	61*	17*	20*	33*	22*	36	4	58	1	83
+167	34 8	-29.7	1	405	199	336	101	55	72*	20*	14	28	25*	30	24	77	1	78
+167	35 10	-32.8	0	430	202	333	113	58	67	11	0*	20*	23*	17*	15*	90	1	78
+167	36 12	-35.9	0	480	223	343	123	66*	84	31*	18*	20	14*	23	16*	100	1	75
+167	37 14	-39.0	0	461	225	360	91	72	69	30	10*	21	30*	27	18*	107	0	7
+167	38 16	-42.1	0	480	234	385	96*	62	81	24*	19*	31	34	37	22	99	1	10
+167	39 18	-45.2	0	552	228	396	130	69	64	23	9*	14*	23	34	16*	99	1	12
+167	40 20	-48.3	0	529	273	418	155	69	84	17	4*	19	18*	31	16	110	1	11
+167	41 22	-51.5	0	543	296	439	139	77	88	21*	11*	30*	29	38	28*	101	1	15
+167	42 24	-54.6	0	559	270	461	137	76	99	31*	11	27	12*	24	12	89	1	11
+167	43 26	-57.7	0	576	287	477	155	81	96	22	9*	16*	18*	42*	17*	112	1	11
+167	44 28	-60.8	0	629	328	484	150	77	84	19	4*	27	27	45*	13	111	1	8
+167	45 30	-64.0	0	666	308	502	154	74	85	25*	14	28	27	38*	20*	107	1	4
+167	46 32	-67.1	0	649	292	488	150	82	79	22	12*	16*	37	44*	23	135	0	4
+167	47 33	-70.3	0	665	329	534	168	80	90	19	10*	26*	23*	43	18	120	1	4
+167	48 35	-73.4	0	670	325	489	171	84	87	16*	23	32	21	43	18*	135	1	5
+167	49 37	-76.5	0	659	327	482	175	87	96	28	18	29	12*	41*	29	119	1	39
+167	50 39	-79.7	0	641	344	535	164	86	89	25	17	27*	14*	25*	13*	129	1	65
+167	51 41	-82.8	0	666	316	518	154*	80	84	10*	6*	30*	17*	46	12*	119	2	97
+167	52 43	-86.0	0	640	365	496	194	93	74	38	2	33	39	55*	26*	113	2	133
+167	53 45	-89.1	0	613	344	514	161	75	79	19	11*	20	20*	36*	40*	117	1	227
+167	54 47	-92.3	0	573	334	468	191	78	67*	14	34*	28*	31*	16*	9*	103	1	59

Figure 3 – Top: Summary of peak amplitudes from 12 to 26 amu in 1-amu steps covering GET 159:34:08 to GET 159:24:44. This sample is page 90 of a16_oms_mp20074.pdf. Bottom: Summary of peak amplitudes from 55 to 67 amu in 1-amu steps covering GET 167:22:47 to GET 167:55:49. This sample is page 93 of a16_oms_mp20074.pdf. Pages 91 and 92 that present peak summaries for 27-39 amu and 40-54 amu are not shown here.

APOLLO 16 TRAJECTORY SUMMARY

GET TIME	REV	SUN HR	LONG	LAT	RADIUS	VELOCITY	ALTITUDE	SS LONG	SS LAT	SUN A	SUN B	VEL ALPHA	VEL BETA
159 22 40	44.28	18.36	80.78	.59	1853.09	1.6247	115.26	62.43	1.56	105.25	215.41	177.12	211.22
159 23 42	44.28	15.29	77.70	.08	1853.44	1.6244	115.61	62.42	1.56	102.41	215.14	177.38	211.85
*********													
167 22 47	48.33	4.25	62.61	-1.77	1853.81	1.6240	115.98	58.36	1.56	86.11	181.95	.08	62.13
167 23 49	48.33	1.18	59.53	-2.27	1854.20	1.6237	116.37	58.35	1.56	89.38	182.10	.25	113.09
167 24 51	48.34	-1.89	56.45	-2.76	1854.56	1.6234	116.73	58.35	1.56	92.79	181.78	.56	143.83
167 25 53	48.35	-4.97	53.37	-3.24	1854.91	1.6231	117.08	58.34	1.56	96.14	181.50	.85	146.23
167 26 54	48.36	-8.04	50.28	-3.71	1855.24	1.6228	117.41	58.33	1.56	99.35	181.67	.98	145.23
167 27 56	48.37	-11.12	47.20	-4.17	1855.55	1.6226	117.72	58.32	1.56	102.18	181.82	.69	139.77
167 28 58	48.38	-14.20	44.11	-4.62	1855.84	1.6223	118.01	58.31	1.56	105.10	181.87	.33	168.58
167 30 0	48.39	-17.29	41.02	-5.06	1856.11	1.6221	118.28	58.30	1.56	107.92	181.95	.27	265.52
167 31 2	48.39	-20.37	37.92	-5.48	1856.36	1.6219	118.53	58.29	1.56	111.07	182.12	.45	261.29
167 32 4	48.40	-23.46	34.82	-5.88	1856.59	1.6217	118.76	58.28	1.56	114.42	182.24	.37	209.15
167 33 6	48.41	-26.56	31.72	-6.27	1856.79	1.6215	118.96	58.28	1.56	117.73	181.90	.53	175.98
167 34 8	48.42	-29.65	28.61	-6.64	1856.97	1.6214	119.14	58.27	1.56	120.98	182.57	.73	160.27
167 35 10	48.43	-32.76	25.50	-6.99	1857.12	1.6213	119.29	58.26	1.56	123.82	183.08	.58	138.10
167 36 12	48.44	-35.86	22.39	-7.32	1857.25	1.6212	119.42	58.25	1.56	126.50	183.21	.47	92.70
167 37 14	48.45	-38.97	19.27	-7.63	1857.36	1.6211	119.53	58.24	1.56	129.34	182.85	.51	61.02
167 38 16	48.46	-42.09	16.15	-7.92	1857.43	1.6210	119.60	58.23	1.56	132.70	183.18	.28	96.36
167 39 18	48.46	-45.20	13.02	-8.18	1857.48	1.6210	119.65	58.22	1.56	136.15	183.54	.35	173.09
167 40 20	48.47	-48.33	9.89	-8.42	1857.51	1.6210	119.68	58.21	1.56	139.53	183.84	.66	200.92
167 41 22	48.48	-51.45	6.76	-8.63	1857.51	1.6210	119.68	58.21	1.56	142.62	183.98	.69	211.08
167 42 24	48.49	-54.58	3.62	-8.82	1857.48	1.6210	119.65	58.20	1.56	145.52	184.22	.46	204.28
167 43 26	48.50	-57.71	.48	-8.99	1857.43	1.6211	119.60	58.19	1.56	148.49	185.17	.31	187.21
167 44 28	48.51	-60.85	-2.67	-9.12	1857.35	1.6211	119.52	58.18	1.56	151.45	186.47	.24	149.79
167 45 30	48.52	-63.98	-5.81	-9.23	1857.24	1.6212	119.41	58.17	1.56	154.37	187.65	.25	106.43
167 46 32	48.52	-67.12	-8.96	-9.32	1857.11	1.6213	119.28	58.16	1.56	157.33	188.86	.38	85.24
167 47 33	48.53	-70.26	-12.11	-9.37	1856.95	1.6215	119.12	58.15	1.56	160.33	190.87	.46	82.81
167 48 35	48.54	-73.41	-15.26	-9.40	1856.77	1.6216	118.94	58.14	1.56	163.42	193.23	.32	87.31
167 49 37	48.55	-76.55	-18.41	-9.40	1856.57	1.6218	118.74	58.14	1.56	166.48	195.13	.14	216.09
167 50 39	48.56	-79.69	-21.57	-9.37	1856.34	1.6220	118.51	58.13	1.56	169.51	198.49	.28	278.76
167 51 41	48.57	-82.84	-24.72	-9.32	1856.09	1.6222	118.26	58.12	1.56	172.40	206.75	.41	270.17
167 52 43	48.58	-85.98	-27.87	-9.24	1855.81	1.6224	117.98	58.11	1.56	174.82	224.91	.34	272.90
167 53 45	48.59	-89.12	-31.02	-9.13	1855.52	1.6227	117.69	58.10	1.56	176.04	261.65	.24	273.25
167 54 47	48.59	-92.26	-34.17	-8.99	1855.20	1.6229	117.37	58.09	1.56	173.90	295.18	1.46	132.89

Figure 4 – Summary of trajectory data covering GET 159:34:08 to GET 159:24:44 and GET 167:22:47 to GET 167:55:49. This sample is page 94 of a16_oms_mp20074.pdf.

APOLLO 16 HOUSEKEEPING SUMMARY

GET TIME	+12	+ 5	-12	-15	EMISSION	FIL 1	FIL 2	LM HV	HM HV	S HV	ETEMP	STEMP	M LO/HI	D HI/LO	I
159 22 40	3.86	2.43	2.96	4.67	2.08	3.10	.18	2.59	2.69	2.31	2.80	2.35	.02	2.47	1.92
159 23 42	3.86	2.43	2.96	4.67	2.08	3.10	.18	2.57	2.69	1.76	2.80	2.35	.02	2.47	1.90
*********															
167 22 47	3.88	2.43	2.96	4.69	2.08	3.10	.18	2.59	2.71	1.75	2.90	2.35	.04	2.45	1.71
167 23 49	3.86	2.43	2.96	4.67	2.06	3.10	.16	2.59	2.71	1.82	2.92	2.35	.02	2.45	1.69
167 24 51	3.86	2.43	2.94	4.67	2.02	3.12	.16	2.61	2.71	1.92	2.92	2.33	.04	2.45	1.65
167 25 53	3.88	2.43	2.96	4.65	2.02	3.10	.18	2.59	2.71	1.98	2.94	2.33	.02	2.47	1.67
167 26 54	3.86	2.43	2.94	4.67	2.06	3.12	.16	2.59	2.71	2.06	2.96	2.35	.02	2.45	1.65
167 27 56	3.88	2.43	2.96	4.67	2.06	3.12	.18	2.61	2.69	2.16	2.96	2.35	.02	2.45	1.65
167 28 58	3.88	2.45	2.96	4.67	2.06	3.12	.16	2.59	2.71	2.24	2.98	2.35	.02	2.45	1.67
167 30 0	3.86	2.43	2.96	4.67	2.02	3.12	[illegible]	2.59	2.73	2.31	2.98	2.35	.02	2.45	1.71
167 31 2	3.86	2.45	2.96	4.67	2.02	3.12	.16	2.59	2.71	1.75	2.98	2.35	.02	2.45	1.69
167 32 4	3.86	2.43	2.96	4.67	2.06	3.12	.18	2.61	2.71	1.82	3.00	2.35	.02	2.45	1.71
167 33 6	3.86	2.43	2.96	4.67	2.00	3.12	.18	2.59	2.71	1.92	3.02	2.33	.02	2.45	1.71
167 34 8	3.86	2.43	2.96	4.67	2.04	3.10	.16	2.59	2.71	1.98	3.02	2.33	.02	2.45	1.73
167 35 10	3.86	2.45	2.96	4.67	2.02	3.10	.18	2.59	2.71	2.06	3.04	2.33	.02	2.45	1.73
167 36 12	3.88	2.41	2.96	4.67	2.00	3.10	.18	2.59	2.71	2.16	3.04	2.33	.02	2.45	1.75
167 37 14	3.86	2.45	2.96	4.67	2.02	3.12	.18	2.61	2.71	2.22	3.06	2.33	.02	2.43	1.76
167 38 16	3.86	2.41	2.96	4.67	1.96	3.12	.18	2.59	2.71	2.31	3.06	2.35	.02	2.43	1.82
167 39 18	3.88	2.43	2.96	4.67	2.00	3.10	.18	2.59	2.71	1.76	3.08	2.35	.02	2.43	1.78
167 40 20	3.88	2.45	2.94	4.67	2.02	3.10	.18	2.61	2.71	1.82	3.08	2.35	.04	2.43	1.78
167 41 22	3.88	2.45	2.96	4.67	1.98	3.12	.18	2.59	2.71	1.92	3.08	2.33	.02	2.45	1.82
167 42 24	3.88	2.43	2.96	‘.67	2.04	3.12	.16	2.61	2.71	2.00	3.08	2.33	.02	2.43	1.80
167 43 26	3.86	2.43	2.96	4.67	2.02	3.12	.18	2.59	2.71	2.08	3.10	2.35	.02	2.41	1.86
167 44 28	3.88	2.43	2.96	4.67	1.98	3.10	.18	2.59	2.71	2.16	3.10	2.35	.02	2.43	1.86
167 45 30	3.86	2.45	2.96	4.65	1.96	3.10	.18	2.61	2.71	2.24	3.12	2.35	.04	2.43	1.88
167 46 32	3.88	2.43	2.94	4.67	2.00	3.12	.16	2.61	2.71	2.29	3.12	2.35	.04	2.43	1.92
167 47 33	3.88	2.45	2.96	4.67	2.00	3.10	.18	2.59	2.71	1.75	3.12	2.35	.02	2.43	1.90
167 48 35	3.86	2.45	2.96	4.67	1.90	3.10	.18	2.59	2.71	1.82	3.12	2.35	.02	2.43	1.90
167 49 37	3.86	2.45	2.96	4.67	1.98	3.10	.16	2.59	2.71	1.90	3.14	2.35	.02	2.45	1.90
167 50 39	3.88	2.45	2.94	4.67	2.02	3.10	.20	2.61	2.71	2.00	3.12	2.35	.02	2.4'	1.94
167 51 41	3.86	2.47	2.96	4.67	2.02	3.10	.18	2.59	2.73	2.08	3.14	2.35	.02	2.43	1.94
167 52 43	3.86	2.45	2.94	4.67	1.96	3.12	.18	2.59	2.71	2.16	3.14	2.37	.02	2.43	1.94
167 53 45	3.86	2.45	2.94	4.67	2.00	3.12	.18	2.61	2.71	2.24	3.14	2.35	.02	2.41	1.94
167 54 47	3.86	2.45	2.98	4.67	1.96	3.10	.18	2.59	2.69	2.31	3.14	2.35	.02	2.43	1.96

Figure 5 – Summary of housekeeping measurements covering GET 159:34:08 to GET 159:24:44 and GET 167:22:47 to GET 167:55:49. This sample is page 95 of a16_oms_mp20074.pdf.

Explanation of the Low- and High-Mass Data Tables, Conversion Coefficients, and Calibration

The first two lines of the high-mass table shown in Figure 2 give the GET (ground elapsed time), Apollo mission number, high or low mass designation, observation date, high mass coefficients, data synchronization flags, starting background count, ending background count, and number of data points used to calculate the background data. More details on these can be found in Chapter 29 of the Apollo Scientific Experiments Data Handbook. The first two lines of the low-mass table shown in Figure 1 are slightly different. It gives the GET and Apollo mission, but the coefficients identified as low-mass are actually the high mass coefficients. These are followed by other numbers, described in more detail in Chapter 29 of the Apollo Scientific Experiments Data Handbook.

For both the high- and low-mass case, starting with the third row, the data are organized in columns. The first column simply gives the row numbers. The second column gives the counts from voltage steps 1 to 50. Column 3 gives steps from 51-100, column 4 steps 101-150, etc., until column 13, which gives the readings from steps 551-590, the last measurement in the sequence.

The 590 steps cycle through the potential voltage, step 1 at 620 V to step 590 at 1560 V. Step 1 is the count for the highest mass measured (approx. 68 amu for the high-mass and 28 amu for the low-mass). Step 590 is the count for the lowest mass measured in each range (28 amu for high-mass, 16 amu for low-mass). Step number can be converted to the mass being measured for the high-mass case using the coefficients in the second row and the conversion equation:

step# = A0 + A1/mass for steps 1-400
step# = B0 + B1/mass for steps 401-590

For example, in the case given in Figure 2, the mass at step 300 would be: 300 = -505.83 + 34703.50/mass, or mass = 43.07, so in this case the count of 872 measured at step 300 would apply to mass 43.07.

Unfortunately, an equation and coefficients are not given for the low-mass case. Assuming the low-mass conversion equation has the same form, and identifying known peaks in the data from the literature (Apollo 15 and 16 Preliminary Science Reports) we can roughly estimate the coefficients for the low-mass case as A0 = -503.33, A1 = 14,485.33, B0 = -66, and B1 = 7488. This would give for step 300 in Figure 1, equivalent to our example above:

300 = -503.33 + 14485.33/mass, or mass = 18.03

The final column has background, calibration, and housekeeping numbers, see Yeager et al. (1973) for more details.

Data Quality

Please note there is concern that much of the data is dominated by contamination from spacecraft and instrument outgassing. See Hoffman, et al. (1972) for more details.

Some frames on the microfilm were blurry which causes the corresponding pages in the PDF/A files to appear to be scans that were out of focus, which is not the case.

References

Apollo 16 Preliminary Science Report, NASA SP-315, published by NASA, Washington, D.C., 1972. (Available from the NASA Technical Reports Server (NTRS), https://ntrs.nasa.gov/)

Apollo Scientific Experiments Data Handbook, NASA Technical Memorandum X-58131, JSC-09166, published by NASA Johnson Space Center, Houston, Texas, August 1974 (revised April 1976). (Available from the NTRS, https://ntrs.nasa.gov/)

Hoffman, J. H., Lunar orbital mass spectrometer, International Journal of Mass Spectrometry and Ion Physics, Volume 8, Issue 4, pp. 403-416, 1972. (doi:10.1016/0020-7381(72)83026-2)

Hoffman, J. H., R. R. Hodges, Jr., and D. E. Evans, Lunar orbital mass spectrometer experiment, Lunar and Planetary Science Conference Proceedings, Volume 3, pp. 2205-2216, 1972. (Available from the NTRS, https://ntrs.nasa.gov/) Published Abstract: One of the Orbital Science experiments on Apollo 15 was a mass spectrometer designed to measure the composition and distribution of the lunar atmosphere. It operated for nearly 90 hours, producing spectra of an unexpectedly complex nature, indicating that many complex gas molecules exist in the vicinity of the spacecraft. The most plausible explanation is that there was continual vaporization of frozen or liquid drops of water, fuel, or other matter that had been ejected from the spacecraft with small relative velocity so that these particles remained in nearby orbits. The search for naturally occurring gases in these spectra involves a statistical analysis of the data which has not been completed to date. A theoretical prediction regarding the possibilities of detecting lunar volcanism from orbit is included.

Yeager, P. R., A. Smith, J. J. Jackson, and J. H. Hoffman, Absolute Calibration of Apollo Lunar Orbital Mass Spectrometer, Journal of Vacuum Science and Technology, Volume 10, pp. 348-354, 1973. (doi:10.1116/1.1317064) Published Abstract: Recent experiments were conducted in Langley Research Center's molecular beam system to perform an absolute calibration of the lunar orbital mass spectrometer which was flown on the Apollo 15 and 16 missions. Tests were performed with several models of the instrument using two test gases, argon and neon, in the 1 ntorr to .1 picotorr range. Sensitivity to argon at spacecraft orbital velocity was .00028 A/torr enabling partial pressures in the .01-picotorr range to be measured at the spacecraft altitude. Neon sensitivity was nearly a factor of 5 less. Test data support the feasibility of using the lunar orbital mass spectrometer as a tool to gather information about the lunar atmosphere.

Related Data Sets

The NSSDCA holds two data sets related to this collection: PSPA-00611 contains the original, high-resolution, 400 dots per inch, TIFF files (scans) of the formatted data outputs on microfilm; PSPA-00098 contains the full set of Apollo 16 Orbital Mass Spectrometer data on magnetic tape supplied by the principal investigator and used to generate the formatted outputs.

A similar orbital mass spectrometer was flown on Apollo 15. A set of scans of formatted data outputs from that experiment are archived in the NASA PDS as collection ID urn:nasa:pds:a15oms:document_data_output_scans.

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