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REPORT ON THE GEOPHYSICAL DESCRIPTION AND AVAILABLE DATA ASSOCI--ETC(U)

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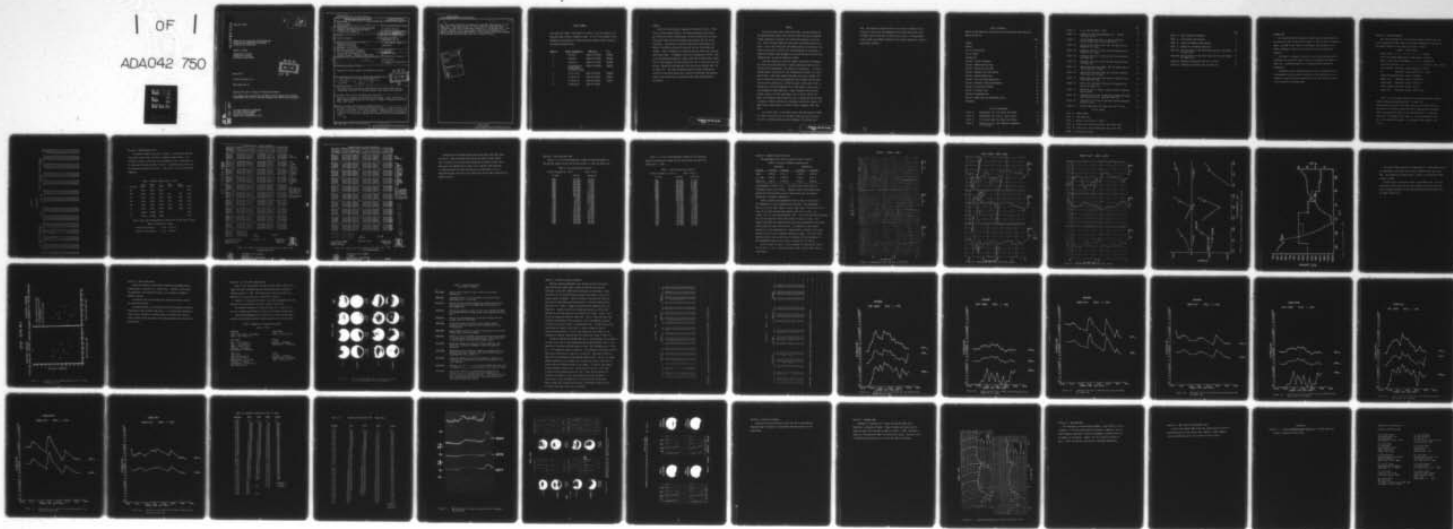
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REPORT ON THE GEOPHYSICAL DESCRIPTION AND
AVAILABLE DATA ASSOCIATED WITH ROCKET
PF-SGT-116 (IC 630.02-1A)

Gerald J. Romick

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University of Alaska
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March 1977

Scientific Report No. 8

HAES Report No. 63

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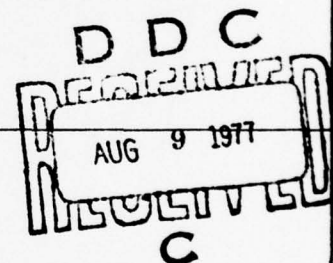
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A Sargent rocket was launched at 08:05:20 UT on April 1, 1976 from Poker Flat Research Rocket Range. This rocket reached an apogee altitude of 125 km with a total flight time greater than 390 seconds. The payload was successfully recovered. The rocket was launched into intense auroral activity propagating south.		



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20. The launch occurred at the onset of a broad 800 γ negative bay in ΔH at Poker Flat. Peak intensities of OI (5577A) emission along the rocket trajectory on the order of 250kR were reached at T + 24 seconds and T + 194 seconds. Because of the rapid changes in position and intensity of the aurora during this launch determination of the detailed relationship between the aurora and on-board rocket data will be very difficult.

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REPORT SUMMARY

This Scientific Report, the eighth in a series, is the last report to be published under Contract F19628-74-C-0188. A list of the complete series documenting the geophysical conditions during selected rocket launches of the ICECAP Program follows:

<u>Report #</u>	<u>Rocket Experiment #</u>	<u>AFGL Doc #</u>	<u>AD #</u>
1	A10.312-3	AFCRL-TR-74-0540	A008496
2	A18.006-2	AFCRL-TR-75-0040	A008500
3	EX531.43-1	AFCRL-TR-75-0327	A018055
4	Aurora/Particle Precipitation Correlation Study	AFCRL-TR-75-0508	A032730
5	IC 511.21-1A	AFGL-TR-76-0632	A033093
6	IC 507.11-2A	AFGL-TR-76-0010	A034731
7	IC 519.07-1B	AFGL-TR-76-0007	A034381
8	IC 630.02-1A	AFGL-TR-77-0073	

Summary

The PF-SGT-116 rocket was launched at 08:05:20 UT, April 1, 1976 into an active auroral display. The region traversed by the rocket was filled with auroral precipitation for many minutes prior to launch. During the flight the activity moved south and away from the rocket trajectory. Intensities at the 100 km entry point were greater than 200 kR in OI(5577A) emission at launch but fell to 14 kR within two minutes. Large fluctuations in intensity occurred within the trajectory during the flight. The magnetic activity at College was initially -300γ in ΔH and became more negative, -800γ , within the 5 minutes after launch. The Ft. Yukon magnetic activity varied from -750γ to -600γ over the same period. Absorption associated with this activity was greater than 2 db at Poker Flat. The large variations observed in both intensity and position of the aurora during this launch will complicate the detailed study of the rocket data in association with those data obtained on the ground.

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PREFACE

The High Altitude Effects Simulation (HAES) Program sponsored by the Defense Nuclear Agency since the early 1970 time period, comprises several groupings of separate, but interrelated technical activities, e.g., ICECAP (Infrared Chemistry Experiments--Coordinated Auroral Program). Each of the latter have the common objective of providing information ascertained as essential for the development and validation of predictive computer codes designed for use with high priority DoD radar, communications, and optical defensive systems.

Since the inception of the HAES Program, significant achievements and results have been described in reports published by DNA, participating service laboratories, and supportive organizations. In order to provide greater visibility for such information and enhance its timely applications, significant reports published since early calendar 1974 shall be identified with an assigned HAES serial number and the appropriate activity acronym (e.g., ICECAP) as part of the report title. A complete and current bibliography of all HAES reports issued prior to and subsequent to HAES Report No. 1 dated 5 February 1974 entitled, "Rocket Launch of an SWIR Spectrometer into an Aurora (ICECAP 72)," AFCL Environmental Research Paper No. 466, is maintained and available on request at DASIIAC, DoD Nuclear Information and Analysis Center, 816 State Street, Santa Barbara, California 93102, Telephone: (805) 965-0551.

This report, which is the eighth report under DNA Contract F19628-74-C-0188 is the 63rd report in the HAES series and covers technical activities performed during the period November 1975 through April

1976. The purpose of the work herein is to provide a geophysical description of the auroral and geomagnetic environment during the launch of ICECAP rocket PF-SGT-116 (IC 630.02-1A) to assist in interpretation of the primary measurements obtained by the sensors onboard this specific experimental payload.

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Rocket PF-SGT-116.

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INTRODUCTION

This report describes the general auroral activity associated with the launch of rocket PF-SGT-116 on UT April 1, 1976 at Poker Flat Research Range. Included in this report are peripheral data pertinent to the launch, atmospheric meteorology and ground station instrumentation operation.

The format is arranged in sections to facilitate locating specific information on the various types of data and instruments that were in operation. Explanatory material is included with each section for completeness.

The summary that is presented pertains only to the description of the geomagnetic activity and our evaluation of the usefulness in proceeding to detailed absolute intensity and high time resolution studies of the available ground based data.

Section 1 - Launch Parameters

This section reviews all of the pertinent details known at the time of the preparation of this report on the launch parameters of the vehicle. The specific details of the launch are listed in Table 1.

TABLE 1 Launch Resume

Vehicle Type-----	Sargent
Poker Flat Research Range Vehicle Code Number---	PF-SGT-116
NASA or other Vehicle Code Number-----	IC 630.02-1A
Launch Date and Time-----	UT April 1, 1976 08:05:20
Launch Azimuth	predicted, (actual setting) 47, (40.3)
QE	predicted, (actual setting) 81.8, (86.0)
Apogee Altitude	predicted, (actual) (125.6km)
Apogee Time	predicted, (actual) (08:08:14.4)
Impact Range	predicted, (actual) (128.6 km)
Impact Azimuth	predicted, (actual) (37.3)
Impact Time	predicted, (actual) (08:11:52.8)

Table 2 lists the rocket and field line observation angles obtained from the trajectory supplied by AFGL. Listed in 10 second steps in time after the launch (T+0) are the Azimuth and Elevation angles to the vehicle and to the 100 km intercept point along the field line through the rocket as seen from Poker Flat, Ft. Yukon and Ester Dome. The magnetic field model used in this calculation is the Pogo 10-65 internal field model. The altitude of the rocket is also listed.

Table 2.

(SEC)	ROCKET OBSERVATION ANGLES				LOOK ANGLE DATA				100 KM FIELD LINE INTERCEPT OBSERVATION ANGLES				(KM)
	ESTER DOME		POKER FLAT		FT. YUKON		ESTER DOME		POKER FLAT		FT. YUKON		
	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	
T+													ALT
50	41.672	40.326	30.652	71.556	-146.283	13.869	45.535	66.962	37.790	88.113	-146.470	26.951	46.34
60	41.254	44.643	31.945	71.215	-146.404	17.805	43.762	63.669	34.929	84.095	-146.551	27.877	58.12
70	40.895	47.507	32.771	70.746	-146.531	21.465	42.486	60.646	34.452	80.279	-146.640	28.819	68.93
80	40.590	49.424	33.359	70.189	-146.667	24.841	41.540	57.883	34.311	76.685	-146.740	29.776	78.78
90	40.336	50.699	33.813	69.576	-146.813	27.931	40.826	55.373	34.293	73.336	-146.855	30.743	87.68
100	40.108	51.498	34.157	68.891	-146.965	30.745	40.265	53.068	34.309	70.220	-146.980	31.723	95.64
110	39.903	51.939	34.424	68.145	-147.123	33.292	39.817	51.009	34.342	67.341	-147.114	32.711	102.65
120	39.720	52.094	34.641	67.334	-147.289	35.586	39.458	49.123	34.392	64.690	-147.261	33.705	108.71
130	39.558	52.009	34.825	66.452	-147.465	37.638	39.172	47.408	34.459	62.254	-147.423	34.702	113.83
140	39.417	51.719	34.987	65.498	-147.653	39.461	38.947	45.852	34.541	60.027	-147.602	35.698	118.01
150	39.291	51.241	35.130	64.457	-147.853	41.068	38.770	44.437	34.635	57.991	-147.797	36.691	121.25
160	39.180	50.585	35.261	63.321	-148.067	42.471	38.634	43.150	34.740	56.129	-148.012	37.677	123.54
170	39.081	49.758	35.379	62.078	-148.296	43.675	38.533	41.978	34.854	54.430	-148.245	38.653	124.89
180	38.995	48.761	35.490	60.714	-148.542	44.688	38.462	40.911	34.978	52.881	-148.500	39.615	125.31
190	38.916	47.588	35.589	59.210	-148.804	45.514	38.416	39.937	35.107	51.467	-148.774	40.561	124.79
200	38.844	46.233	35.682	57.548	-149.086	46.153	38.392	39.048	35.244	50.176	-149.070	41.497	123.33
210	38.779	44.685	35.767	55.704	-149.387	46.596	38.388	38.238	35.386	49.000	-149.385	42.389	120.93
220	38.722	42.929	35.850	53.650	-149.715	46.833	38.404	37.500	35.539	47.929	-149.726	43.263	117.58
230	38.667	40.948	35.924	51.356	-150.067	46.847	38.435	36.826	35.695	46.953	-150.085	44.107	113.28
240	38.617	38.723	35.993	48.785	-150.447	46.612	38.480	36.213	35.858	46.066	-150.465	44.917	108.04
250	38.575	36.237	36.063	45.900	-150.865	46.086	38.544	35.656	36.033	45.263	-150.871	45.686	101.84
260	38.534	33.466	36.127	42.657	-151.317	45.214	38.620	35.153	36.213	44.537	-151.294	46.412	94.69
270	38.501	30.389	36.193	39.008	-151.817	43.909	38.713	34.701	36.406	43.887	-151.741	47.089	86.58
280	38.472	26.988	36.257	34.908	-152.367	42.056	38.820	34.294	36.608	43.304	-152.205	47.716	77.51
290	38.450	23.248	36.325	30.318	-152.981	39.476	38.944	33.933	36.826	42.788	-152.692	48.285	67.46

Section 2 - Meteorological Data

The weather summaries are given in Table 3. The data are obtained from either station logs, ASC data, or weather bureau records. Also included in Table 4 (next page) are the complete 3 hour climatology data for the months of March and April at the U. S. Weather Bureau Station at the Fairbanks International Airport. Local time is used in these weather summaries.

TABLE 3 Weather Summary April 1, 1976

Time (UT)	Ester Dome	Poker Flat	Ft. Yukon	Mould Bay	Sachs Harbor	Inuvik
05	Clear	Clear	Clear			Clear
06	Clear	Clear	Clear	NO	NO	Clear
07	Clear	Clear	Clear	DATA	DATA	Clear
08	Clear	Clear	Clear	FOR	FOR	Clear
09	Clear	Clear	Clear	THIS	THIS	Clear
10	Clear	Clear	Clear	TIME	TIME	Clear
11	Cloudy	Cloudy	Clear			Clear
12	Cloudy	Cloudy	Clear			Clear

Table 5 gives the wind parameters at Poker Flat at the time of launch.

TABLE 5 Wind Data at Launch

Surface Wind Velocity	3.1 m/s	Az 25.4°
Ballistic Wind Velocity	5.9 m/s	Az 64.6°

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NOTES
CEILING
UNL INDICATES UNLIMITED

WEATHER

T TORNADO
* THUNDERSTORM
Q SQUALL
R RAIN
RW RAIN SHOWERS
ZR FREEZING RAIN
L DRIZZLE
ZL FREEZING DRIZZLE
S SNOW
SP SNOW PELLETS
IC ICE CRYSTALS
SN SNOW SHOWERS
SG SNOW GRAINS
IP ICE PELLETS
R HAIL
F FOG
IF ICE FOG
GF GROUND FOG
BD BLOWING DUST
BN BLOWING SAND
BS BLOWING SNOW
BY BLOWING SPRAY
R SMOKE
M HAZE
Q DUST

HIND

DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS. INDICATED IN TENS OF DEGREES FROM TRUE NORTH: I.E., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST. ENTRY OF 00 IN THE DIRECTION COLUMN INDICATES CALM.

SPEED IS EXPRESSED IN KNOTS;
MULTIPLY BY 1.15 TO CONVERT
TO MILES PER HOUR.

COM-210



FIRST CLASS

LCD-50-26411-FR

99701



OBSERVATIONS AT 3-HOUR INTERVALS

OBSERVATIONS AT 3-HOUR INTERVALS																																				
HOUR	WIND DIRECTION	WIND SPEED	WIND GUSTS	WIND SHEAR	WIND SHEAR	TEMPERATURE					WIND					TEMPERATURE					WIND					TEMPERATURE					WIND					
						AIR	SEA	WIND	WIND	WIND	WIND	WIND	WIND	AIR	SEA	WIND	WIND	WIND	WIND	AIR	SEA	WIND	WIND	WIND	WIND	AIR	SEA	WIND	WIND	WIND	WIND					
DAY 01																																				
02	10	70	10			23	18	08	52	34	10	5	UNL	20		22	20	19	74	02	5	8	80	20		18	17	13	81	31	3					
05	10	200	10			22	18	08	55	01	8	2	UNL	80		15	14	10	80	36	3	2	UNL	80		19	17	12	74	02	8					
08	10	UNL	80			21	20	10	53	05	3	2	UNL	80		24	21	11	58	11	5	4	UNL	80		31	28	14	48	07	3					
11	10	UNL	80			32	27	15	48	00	0	0	UNL	80		38	31	16	39	07	7	7	UNL	80		43	34	17	35	10	7					
14	10	110	80			40	31	15	36	00	0	4	UNL	80		44	34	18	35	10	8	10	UNL	80		44	34	18	35	11	7					
17	10	80	80			36	30	20	52	00	0	4	UNL	80		43	33	16	34	18	3	8	40	80		44	34	18	37	11	12					
20	10	100	20			28	26	18	66	21	4	7	UNL	20		36	30	17	46	04	6	8	200	20		36	30	20	54	18	9					
23	7	UNL	15			27	24	17	66	38	4	4	UNL	15		28	24	15	58	34	4	5	UNL	20		30	27	20	56	02	8					
DAY 02																																				
02	3	UNL	20			22	21	17	81	03	6	0	UNL	20		18	18	14	81	02	4	0	UNL	20		21	21	19	92	00	0					
05	2	UNL	80			17	16	13	84	01	5	1	UNL	80		15	14	10	80	00	0	10	1	1		16	16	13	88	05	4					
08	1	UNL	80			31	26	17	94	08	3	0	UNL	80		25	22	14	83	04	4	10	7	4		22	22	21	96	15	3					
11	1	UNL	80			30	32	20	46	00	0	0	UNL	80		36	29	16	44	22	4	3	UNL	10		27	26	24	98	19	4					
14	1	UNL	80			45	34	12	26	00	0	4	UNL	80		41	34	21	45	22	8	5	UNL	40		35	31	23	62	25	3					
17	5	UNL	80			45	34	12	26	00	0	5	UNL	80		40	33	20	45	22	8	5	UNL	40		36	30	20	52	32	8					
20	2	UNL	20			31	27	18	58	00	0	1	UNL	40		35	28	18	52	26	8	7	180	20		30	26	19	64	28	5					
23	0	UNL	10			24	27	18	68	38	8	0	UNL	10		24	23	20	85	00	0	3	UNL	20		28	26	19	58	35	6					
DAY 03																																				
02	10	70	10			23	18	08	52	34	10	5	UNL	20		22	20	19	74	02	5	8	80	20		18	17	13	81	31	3					
05	10	200	10			22	18	08	55	01	8	2	UNL	80		15	14	10	80	36	3	2	UNL	80		19	17	12	74	02	8					
08	10	UNL	80			21	20	10	53	05	3	2	UNL	80		24	21	11	58	11	5	4	UNL	80		31	28	14	48	07	3					
11	10	UNL	80			32	27	15	48	00	0	0	UNL	80		38	31	16	39	07	7	7	UNL	80		43	34	17	35	10	7					
14	10	110	80			40	31	15	36	00	0	4	UNL	80		44	34	18	35	10	8	10	UNL	80		44	34	18	35	11	7					
17	10	80	80			36	30	20	52	00	0	4	UNL	80		43	33	16	34	18	3	8	40	80		44	34	18	37	11	12					
20	10	100	20			28	26	18	66	21	4	7	UNL	20		36	30	17	46	04	6	8	200	20		36	30	20	54	18	9					
23	7	UNL	15			27	24	17	66	38	4	4	UNL	15		28	24	15	58	34	4	5	UNL	20		30	27	20	56	02	8					
DAY 04																																				
02	3	UNL	20			22	21	17	81	03	6	0	UNL	20		18	18	14	81	02	4	0	UNL	20		21	21	19	92	00	0					
05	2	UNL	80			17	16	13	84	01	5	1	UNL	80		15	14	10	80	00	0	10	1	1		16	16	13	88	05	4					
08	1	UNL	80			31	26	17	94	08	3	0	UNL	80		25	22	14	83	04	4	10	7	4		22	22	21	96	15	3					
11	1	UNL	80			30	32	20	46	00	0	0	UNL	80		36	29	16	44	22	4	3	UNL	10		27	26	24	98	19	4					
14	1	UNL	80			45	34	12	26	00	0	4	UNL	80		41	34	21	45	22	8	5	UNL	40		35	31	23	62	25	3					
17	5	UNL	80			45	34	12	26	00	0	5	UNL	80		40	33	20	45	22	8	5	UNL	40		36	30	20	52	32	8					
20	2	UNL	20			31	27	18	58	00	0	1	UNL	40		35	28	18	52	26	8	7	180	20		30	26	19	64	28	5					
23	0	UNL	10			24	27	18	68	38	8	0	UNL	10		24	23	20	85	00	0	3	UNL	20		28	26	19	58	35	6					
DAY 05																																				
02	18	18	14			18	18	14	81	02	4	0	UNL	20		18	18	14	81	02	4	0	UNL	20		21	21	19	92	00	0					
05	15	14	10			15	14	10	80	00	0	10	1	1		15	14	10	80	00	0	10	1	1		16	16	13	88	05	4					
08	22	14	83			22	14	83	04	4	10	7	4		22	14	83	04	4	10	7	4			22	22	21	96	15	3						
11	36	29	16			36	29	16	44	22	4	3	UNL	10		36	29	16	44	22	4	3	UNL	10		27	26	24	98	19	4					
14	41	34	21			41	34	21	45	22	8	5	UNL	40		41	34	21	45	22	8	5	UNL	40		35	31	23	62	25	3					
17	40	33	20			40	33	20	45	22	8	5	UNL	40		40	33	20	45	22	8	5	UNL	40		36	30	20	52	32	8					
20	35	28	18			35	28	18	52	26	8	7	180	20		35	28	18	52	26	8	7	180	20		30	26	19	64	28	5					
23	24	23	20			24	23	20	85	00	0	3	UNL	20		24	23	20	85	00	0	3	UNL	20		28	26	19	58	35	6					
DAY 06																																				
02	18	18	14			18	18	14	81	02	4	0	UNL	20		18	18	14	81	02	4	0	UNL	20		21	21	19	92	00	0					
05	15	14	10			15	14	10	80	00	0	10	1	1		15	14	10	80	00	0	10	1	1		16	16	13	88	05	4					
08	22	14	83			22	14	83	04	4	10	7	4		22	14	83	04	4	10	7	4			22	22	21	96	15	3						
11	36	29	16			36	29	16	44	22	4	3	UNL	10		36	29	16	44	22	4	3	UNL	10		27	26	24	98	19	4					
14	41	34	21			41	34	21	45	22	8	5	UNL	40		41	34	21	45	22	8	5	UNL	40		35	31	23	62	25	3					
17	40	33	20			40	33	20	45	22	8	5	UNL	40		40	33	20	45	22	8	5	UNL	40		36	30	20	52	32	8					
20	35	28	18			35	28	18	52	26	8	7	180	20		35	28	18	52	26	8	7	180	20		30	26	19	64	28	5					
23	24	23	20			24	23	20	85	00	0	3	UNL	20		24	23	20	85	00	0	3	UNL	20		28	26	19	58	35	6					
DAY 07																																				
02	10	37	10			28	27	23	82	03	6	4	UNL	10		24	21	13	63	04	5	7	UNL	10		37	24	17	86	04	5					
05	2	UNL	80			28	27	23	82	03	6	4	UNL	10		24	21	13	63	04	5	7	UNL	10		37	24	17	86	04	5					
08	10	80	80			28	26	22	78	05	4	10	150	80		27	24	12	61	07	8	10	13	2		37	24	17	86	04	5					
11	1	UNL	80			34	30	23	84	10	5	10	220	80		36	29	13	38	05	7	10	80													

Examination of the ground station data shows that Ester Dome, Poker Flat and Ft. Yukon skies were clear during the launch of this rocket, thus corrections for extinction and scattering for these stations can be used, which are appropriate for clear skies. Good MSP data from both Ft. Yukon and Poker Flat were obtained and the combination of all of these observations with the all-sky camera data can be used to describe the auroral activity.

Section 3 - Solar and Lunar Data

Table 6 is a list of the geographic azimuth and elevation angles of the sun with respect to the true horizon on April 1, 1976, for Poker Flat.

TABLE 6 Solar Azimuth and Elevation

Station Location Lat = 65.13

Long = 147.48

UT Time	Azimuth	Elevation
0000	215.1851	25.1844
0100	230.8094	20.8778
0200	245.5641	15.5133
0300	259.6430	9.4907
0400	273.3459	3.1918
0500	287.0043	- 3.0199
0600	300.9298	- 8.7875
0700	315.3674	-13.7524
0800	330.4397	-17.5615
0900	346.0897	-19.9008
1000	2.0651	-20.5528
1100	17.9897	-19.4527
1200	33.5075	-16.7086
1300	48.4136	-12.5690
1400	62.7015	- 7.3628
1500	76.5310	- 1.4465
1600	90.1696	4.8218
1700	103.9380	11.0849
1800	118.1651	16.9753
1900	133.1319	22.1055
2000	148.9890	26.0750
2100	165.6569	28.5109
2200	182.7769	29.1477
2300	199.8050	27.9104
2400	216.2368	24.9424

Table 7 is a list of the geographic azimuth and the elevation angles of the moon with respect to the true horizon for Poker Flat during April 1, 1976.

TABLE 7 Lunar Azimuth and Elevation

Station Location Lat = 65.13

Long = 147.48

UT Time	Azimuth	Elevation
0000	202.9519	34.4130
0100	219.5760	31.3186
0200	235.1339	26.9040
0300	249.6634	21.5647
0400	263.3995	15.6977
0500	276.6547	9.6624
0600	289.9041	4.1594
0700	303.0856	- 1.2344
0800	316.5709	- 5.8504
0900	330.4703	- 9.4072
1000	344.7508	-11.6566
1100	359.2635	-12.4273
1200	13.7719	-11.6583
1300	28.0375	- 9.3994
1400	41.7842	- 5.4388
1500	55.1960	- 0.7896
1600	68.2830	4.6575
1700	81.2479	10.6192
1800	94.3713	16.7860
1900	107.9763	22.8456
2000	122.4064	28.4382
2100	137.8019	33.5607
2200	154.5841	37.0304
2300	172.3535	38.8414
2400	190.4758	38.7616

Section 4 - Magnetic Data and Indices

The magnetometer data from the stations listed in Table 8

TABLE 8 Location of Magnetic Observatories

Location	Geographic		Geomagnetic	
	Latitude	Longitude	Latitude	Longitude
Inuvik	N 68.25	W 133.3	N 70.59	W 93.59
Ft. Yukon	N 66.57	W 145.25	N 66.9	W 95.3
Poker Flat	N 65.13	W 147.48	N 65.11	W102.46

are presented in Figure 1a, b, c. The time of the rocket launch is indicated on each set of records. Separate records are presented here because the scaling machine used to convert these data for computer processing is currently inoperative.

Figure 2 presents the magnetometer data in terms of variations of the magnitude of Z and H components with latitude. The magnetometer data at T-5 min at Poker shows an initial -500γ value in ΔH similar to the level at Ft. Yukon but much more negative than Inuvik (-100γ). At launch, ΔH at Ft. Yukon had changed to -750γ . At T+5 min the Poker deflection was much more negative (-800γ) than either Ft. Yukon or Inuvik. This change illustrates the intensification and southern movement of the current sheet during the rocket launch period. The magnitude of the current density to a first approximation ($\propto$ sheet current) in Amp/km is the same numerical value as the H component magnitude in gamma. The actual value may be as much as two or more times that deduced from the magnitude of the magnetometer data but the temporal variation will be similar.

Figure 3 shows the total K index, planetary K_p index and DST values for UT, April 1, 1976. During the rocket flight, K_p and K were 8 and 7, respectively.

INUVIK APRIL 1, 1976

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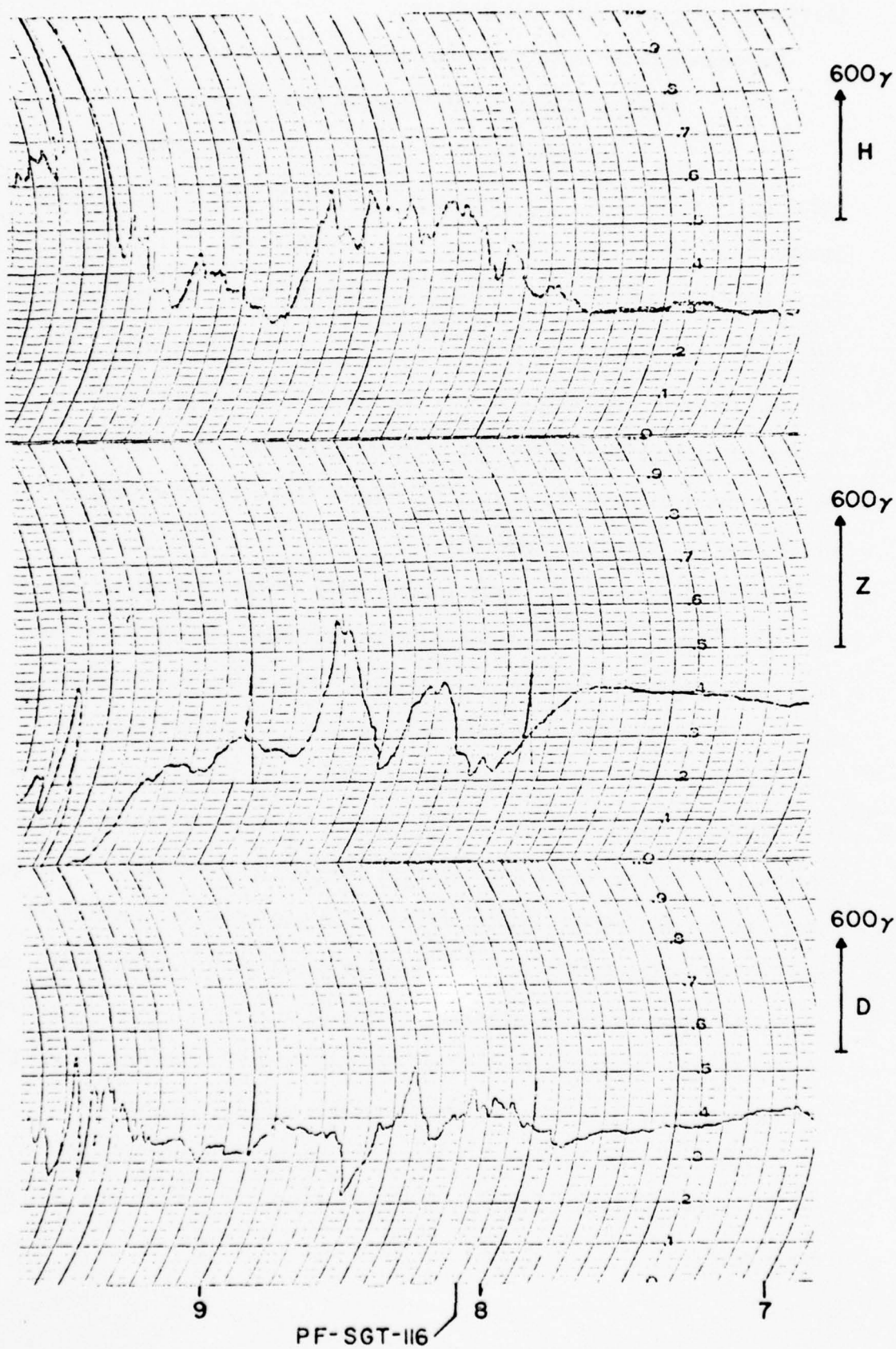


Figure 1a. Magnetometer Data from Inuvik, NWT Canada

FORT YUKON APRIL 1, 1976

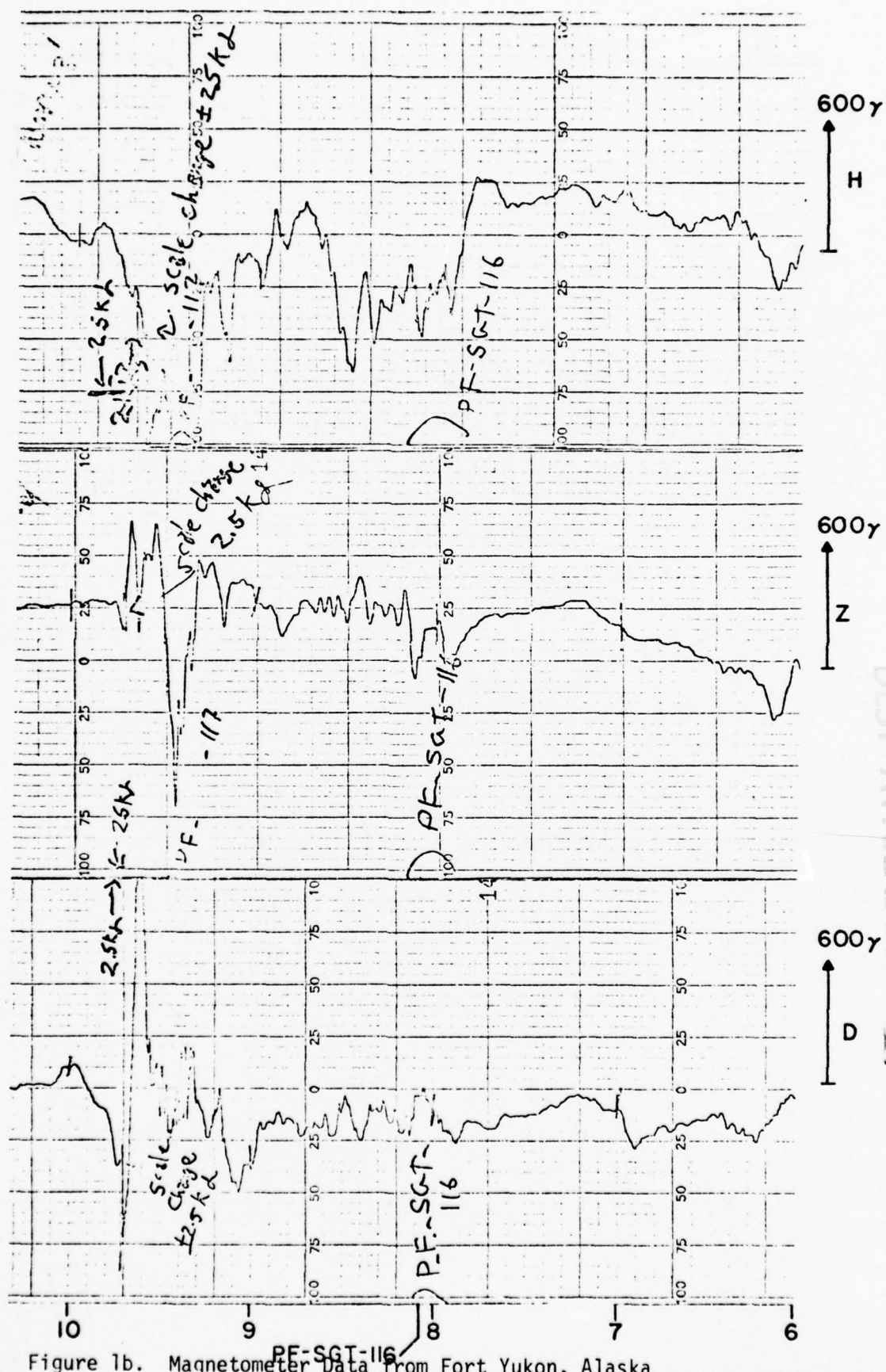


Figure 1b. Magnetometer Data from Fort Yukon, Alaska

POKER FLAT APRIL 1, 1976



Figure 1c. Magnetometer Data from Poker Flat, Alaska

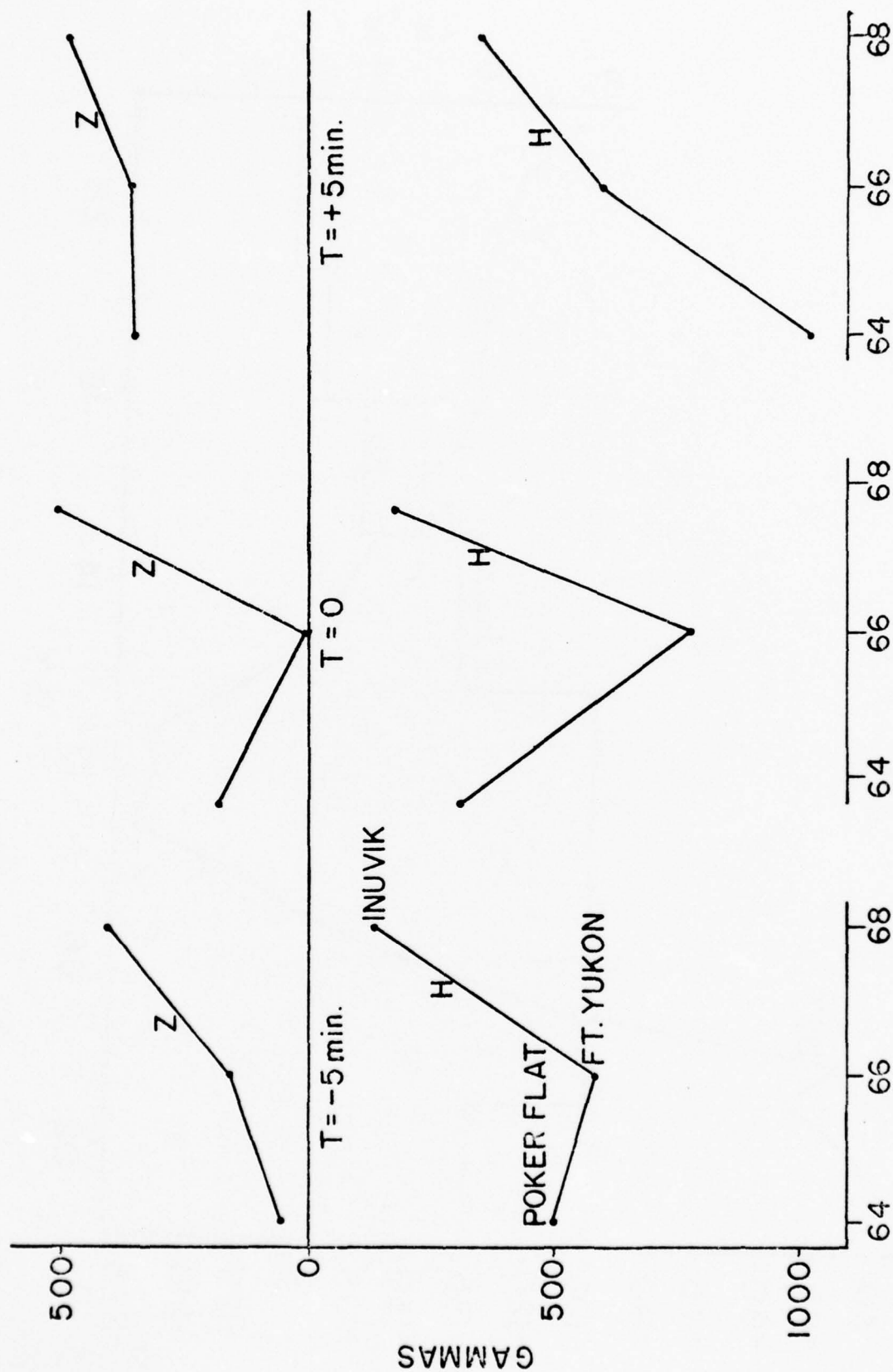


Figure 2. Variation of the Z and H Magnetic Components with Latitude.

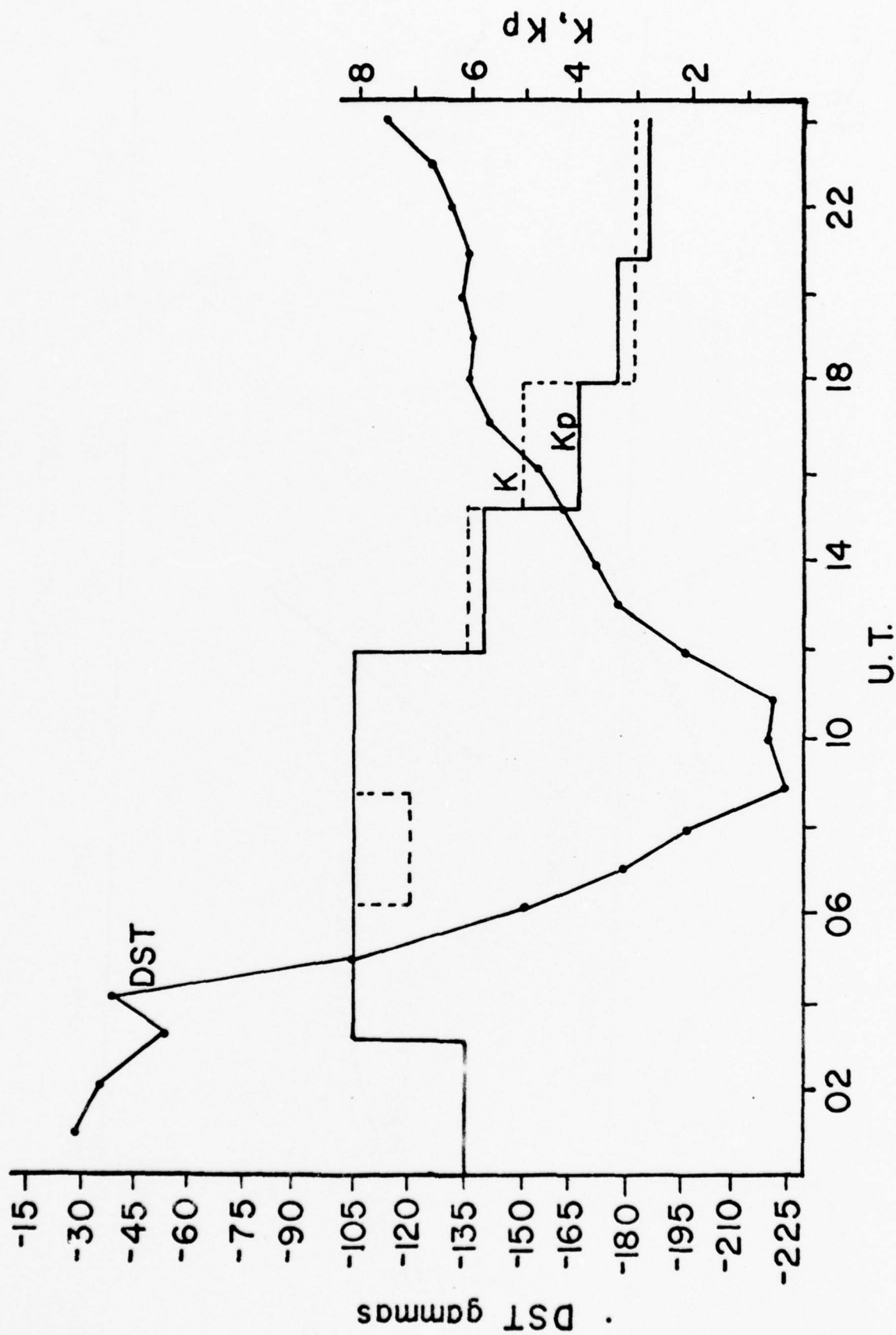


Figure 3. K, K_p, DST for April 1, 1976

The rocket flight occurred at the beginning of a large negative bay in ΔH associated with the onset of an auroral substorm nearly over Poker Flat. The maximum of the negative bay $>(-1000\gamma)$ in ΔH occurred at 0930 UT April 1, 1976.

The DST value, as seen from Figure 3, was between -195γ and -221γ during this launch, which implies using the data in Figure 4 that the cut-off trapping boundary for high energy electrons must have been very far south of Poker Flat.

2030 - 2230 MLT

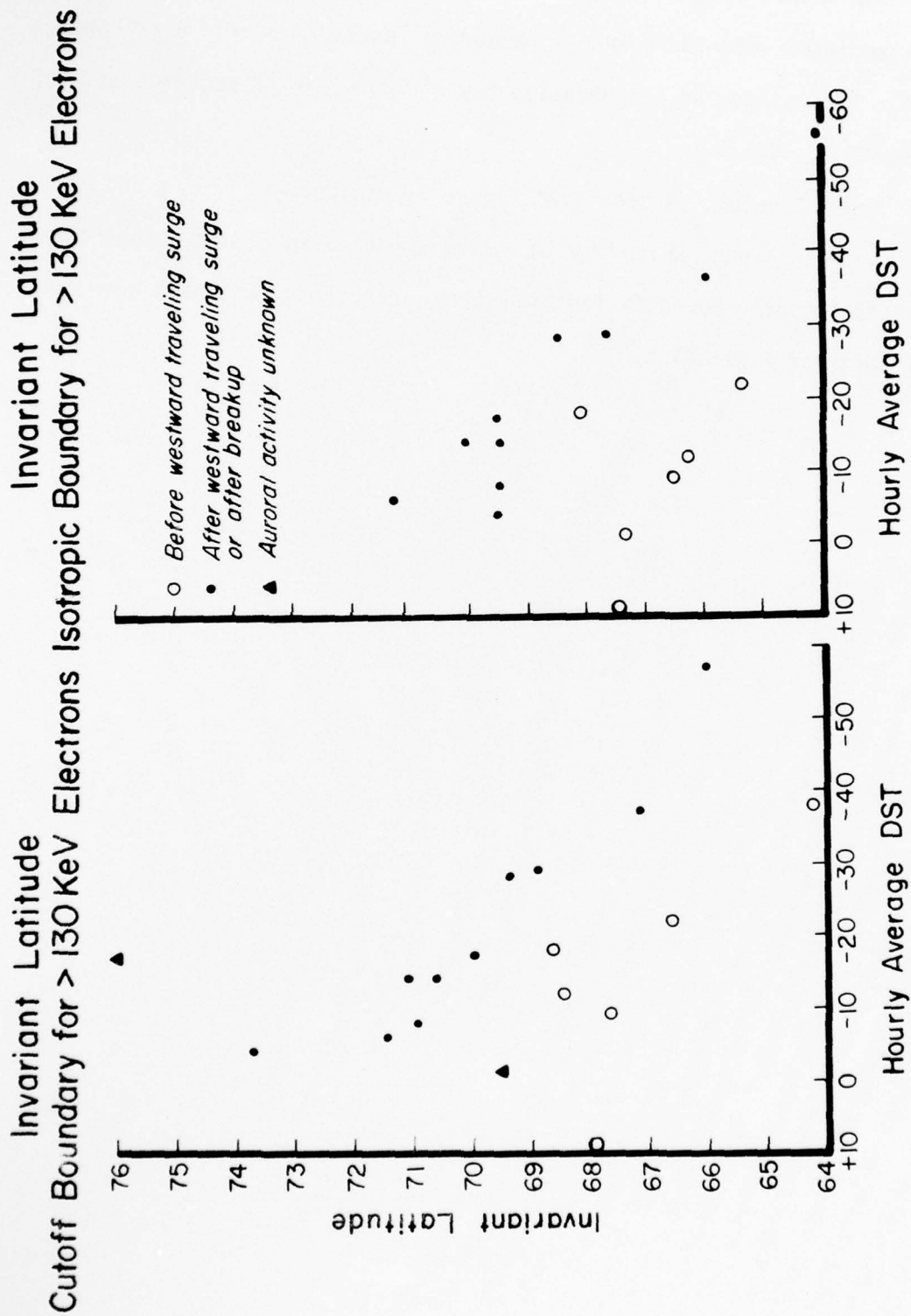


Figure 4. Position of the Trapping Boundary for > 130 keV Electrons vs. Dst.

Section 5 - Radar Observations

During this period in the spring of 1976 the 50 MHz NOAA radar at Anchorage was in operation on a routine basis. Resumes of their data, instrumentation, and operational details are available from NOAA in Boulder, Colorado.

In addition, data from the Chatanika Incoherent Scatter radar are also available from SRI.

Any detailed study of the rocket data should incorporate a detailed examination of the available radar data. It is particularly applicable to the spatial structure of electron density irregularities, electric fields, neutral winds, and spatial and temporal dynamics of the particle precipitation.

Section 6 - All Sky Camera Observations

Table 9 lists the stations from which either 16mm or 35mm all sky camera and other instrument data are available during the period of interest on April 1, 1976. The auroral data quality from each site depends on the cloud coverage as indicated in Section 2.

Figure 5 is a composite of 35mm all sky camera photographs for the period prior to, during and after the launch of PF-SGT-116.

The stations used were Ft. Yukon and Poker Flat. Time in UT as well as in seconds with respect to launch are indicated on each print.

From these photographs and a review of all of the data available, we describe the general auroral situation covering this rocket launch.

TABLE 9 Geophysical Instruments Operating

April 1, 1976

Chatanika

Incoh. Scat. Radar - continuous
35ACS - 06:31-13:37 UT

Fort Yukon

MSP - 08:01-09:36 UT
35ASC - 07:22-09:39 UT
16ASC - 05:15-14:15 UT
Riometer - Continuous
Magnetometer - Continuous

Poker Flat

35ASC 08:01-09:49 UT
16ASC 05:15-14:45 UT
Magnetometer - Continuous
Riometer - Continuous
Spectrometer - 05:15-10:21 UT
MSP 08:00-09:50 UT

Murphy Dome

16ASC - 05:15-14:45 UT

College

Riometer - Continuous
Magnetometer - Continuous

Inuvik

Riometer - Continuous
Magnetometer - Continuous
16ASC - 04:30-13:30 UT

GMN

人上三

POKER

8:05
T+0:00

8:04
T-0:01

8:03
T-0:02

8:02
T-0:03

8:27
T+0:21

8:17
T+O:12

8:09
T+0:04

8:07
T+0:02

Figure 5. All Sky Camera Data Prior To, During, and After Launch (Bright Aurora are Printed Black).

April 1, Auroral Description
(from Poker Flat Data)

UT	
0627-0648	Zenith auroral rayed arcs were visible in the bright twilight sky
0649-0656	Decreased auroral activity overhead as the aurora moved equatorward still in twilight
0657-0707	Auroral activity appeared between the southern horizon and 30° elevation angle in the south with little activity in the northern sky
0708-0757	Activity increased with many arcs and ray structures between the southern horizon and the zenith, later covering the north too.
0758-0802	Auroral arcs brightened and a large spiral moved from east to west, north of the zenith.
0802-0804	Bright aurora from the zenith to the northern horizon gradually filled the whole sky with intense auroral arcs and structures
0804-0808	Rapid changes occurred in intensity and position as the main auroral region moved equatorward
0809-0813	Bright arc and arc segments were associated with the movement of a large surge across the southern sky. The northern part of the sky had no structure only a general glow
0814-0823	Zenith to southern horizon was filled with multiple arcs while only a single arc remained in the north about 20° elevation
0824-0828	Decreased activity where only simple arcs remained both in the north and south. However, more activity was occurring equatorward of the southern arc
0829-0839	Increased southern activity was followed by a lowering of intensity over the whole sky in which only broken arcs and glows remained.
0840-0854	Activity in north increased arcs moved through the zenith and re-formed into two main arc structures in the south and north.
0855-0946	Arcs at 20° elevation in both the north and south and across the zenith brightened and were followed by more extensive activity over the whole sky. Very intense activity over the whole sky continued until the sky became overcast after which observations ceased.

Section 7 - Meridian Scanning Photometer

Meridian scanning photometers were operated at Poker Flat and Ft. Yukon during this rocket launch. Tables 10a and 10b give the time variations of the 4278, 6300 and 5577 emissions as seen from Ft. Yukon and Poker Flat for the 100 km entry and exit look angles as well as for auroral maxima in between. Figures 6a and 6b illustrate the intensity-time plots of the maximum and minimum values of the 4278, 6300 and 5577 emissions at Ft. Yukon. Figures 6c and 6d are the respective plots for Poker Flat. Figures 7a and 7b are intensity-time plots of 4278, 6300 and 5577 for the entry and exit look angles at Ft. Yukon. Figure 7c and 7d are the respective plots for Poker Flat. The Ft. Yukon and Poker Flat intensity calibrations in kilo rayleighs in all 4 wavelengths are given in Table 11a and 11b in terms of voltage deflection. The MSP frame at one time during the launch as seen from Ft. Yukon is shown in Figure 8 along with the ordinate in -5 to +5 volt deflection units which can be converted to absolute intensity with the calibration curves in Table 11a.

Figures 9a and 9b have the MSP data at Ft. Yukon and Poker Flat scaled to the same size as the all sky camera data for the period during launch. Poor operation of the data recording camera at Poker Flat precluded using it prior to T + 119 seconds as shown in Figure 9a. Illustration of the events prior to that time as seen from Ft. Yukon are in Figure 9b. Good chart records at Poker Flat are available for the complete launch period. The all sky camera and MSP comparison is only useful to illustrate the actual intensities of some of the main features on the all sky camera. In reality, the angular scale on the MSP is truly linear whereas that on the ASC is not linear in angle versus distance across the image. Thus, the two records may agree near the zenith but will not agree as the aurora increases in zenith angle. Also, the 35mm ASC is limited to an 80° zenith angle where the MSP data includes the horizons, so additional peaks may occur on the MSP data that do not occur on the ASC.

FORT YUKON APRIL 1, 1976

UT TIME T(SEC)	ELV	100KM ENTRY		ELV	MAXIMUM		ELV	6300		ELV	100KM EXIT		ELV	MINIMUM		ELV	6300	
		5577	4278		5577	4278		5577	4278		5577	4278		5577	4278		5577	4278
2-2-58	-142	31	7.9	1.8	59	7.9	1.8	0.0	0.0	59	7.9	1.8	31	7.9	1.8	0.0	0.0	
2-3-19	-121	31	7.9	1.8	59	7.9	1.8	0.0	0.0	59	7.9	1.8	31	7.9	1.8	0.0	0.0	
2-3-40	-100	31	7.9	1.8	59	16.4	2.7	0.2	0.2	59	16.4	2.7	31	7.9	1.8	0.0	0.0	
2-4-2	-78	31	7.9	1.8	51	25.1	3.4	0.3	0.3	59	21.7	3.1	31	7.9	1.8	0.0	0.0	
2-4-23	-57	31	10.6	2.3	52	61.4	8.3	1.0	1.0	59	35.0	5.4	31	10.6	2.3	0.2	0.2	
2-4-44	-36	31	12.2	2.7	55	91.7	8.3	1.1	1.1	59	37.9	5.4	31	12.2	2.7	0.2	0.2	
2-5-6	-14	31	12.2	2.7	59	44.5	6.2	0.7	0.7	59	44.5	6.2	31	12.2	2.7	0.3	0.3	
2-5-27	7	31	12.2	2.7	50	37.9	5.4	1.4	1.4	59	35.0	4.7	31	12.2	2.7	0.7	0.7	
2-5-49	29	31	10.6	2.7	46	35.0	4.7	0.7	0.7	59	21.7	4.0	31	10.6	2.7	0.2	0.2	
2-6-10	50	31	14.2	3.4	59	91.7	9.6	1.9	1.9	59	91.7	9.6	31	14.2	3.4	0.4	0.4	
2-6-31	71	31	14.2	3.1	52	66.5	8.3	1.5	1.5	59	52.3	6.2	31	14.2	3.1	0.3	0.3	
2-6-53	93	31	12.2	2.7	54	66.5	7.2	1.4	1.4	59	52.3	5.4	31	12.2	2.7	0.2	0.2	
2-7-14	114	31	14.2	3.1	49	61.4	8.3	1.1	1.1	59	44.5	7.2	31	14.2	3.1	0.4	0.4	
2-7-35	136	31	10.6	2.3	59	29.8	4.7	0.7	0.7	59	29.8	4.7	31	10.6	2.3	0.2	0.2	
2-7-57	157	31	7.9	1.8	48	35.0	4.7	0.7	0.7	59	21.7	3.4	31	7.9	1.8	0.0	0.0	
2-8-18	178	31	7.9	1.9	55	21.7	3.1	1.0	1.0	59	18.9	3.1	31	7.9	1.9	0.3	0.3	
2-8-40	200	31	5.9	1.5	46	21.7	3.1	0.4	0.4	59	10.6	2.3	31	5.9	1.5	0.0	0.0	
2-9-1	221	31	6.8	1.8	52	18.9	2.7	0.3	0.3	59	12.2	2.3	31	6.8	1.8	0.2	0.2	
2-9-22	242	31	7.9	1.8	59	18.9	3.1	0.8	0.8	59	18.9	3.1	31	7.9	1.8	0.2	0.2	
2-9-44	264	31	6.8	2.3	59	12.2	2.7	0.6	0.6	59	12.2	2.7	31	6.8	2.3	0.6	0.6	
2-10-5	285	31	7.9	1.8	59	10.6	1.8	0.4	0.4	59	10.6	1.8	31	7.9	1.8	0.4	0.4	
2-10-27	307	31	6.8	1.8	59	10.6	5.4	0.6	0.6	59	10.6	5.4	31	6.8	1.8	0.6	0.6	

Table 10a. Time Variations at the 100 km Entry and Exit Look Angles for Poker Flat

POKER FLAT APRIL 1, 1976

JT TIME T(SEC)	100KM ENTRY		MAXIMUM		100KM EXIT		MINIMUM	
	ELV	5577	ELV	5577	ELV	5577	ELV	5577
3-1-20	72	71.2	55	135.1	27	71.2	27	71.2
3-1-30	72	71.2	50	135.1	27	31.9	27	31.9
3-1-50	72	77.2	50	124.7	27	31.9	27	31.9
3-2-17	72	77.2	55	135.1	27	37.5	27	37.5
3-2-35	72	135.1	60	158.6	27	40.6	27	40.6
3-2-55	72	135.1	55	135.1	27	44.0	27	44.0
3-3-51	72	71.2	64	77.2	27	31.9	50	23.2
3-5-7	72	37.5	30	60.7	27	60.7	55	23.2
3-5-25	72	236.6	65	256.3	27	60.7	50	31.9
3-5-44	72	277.7	67	277.7	27	51.7	60	29.5
3-6-4	72	146.4	72	146.4	27	71.2	58	31.9
3-7-57	72	14.3	27	34.6	27	34.6	72	14.3
3-8-16	72	18.2	27	37.5	27	37.5	72	18.2
3-8-34	72	44.0	54	236.6	27	56.0	40	44.0
3-10-9	72	16.8	37	27.2	27	23.2	55	15.5
3-10-23	72	15.5	45	60.7	27	25.1	72	15.5
3-10-47	72	16.8	55	31.9	27	23.2	72	16.8
3-11-6	72	14.3	30	25.1	27	21.4	72	14.3

Table 10b. Time variations at the 100 km Entry and Exit Look Angles for Poker Flat

MAXIMUM

FORT YUKON

APRIL 1, 1976

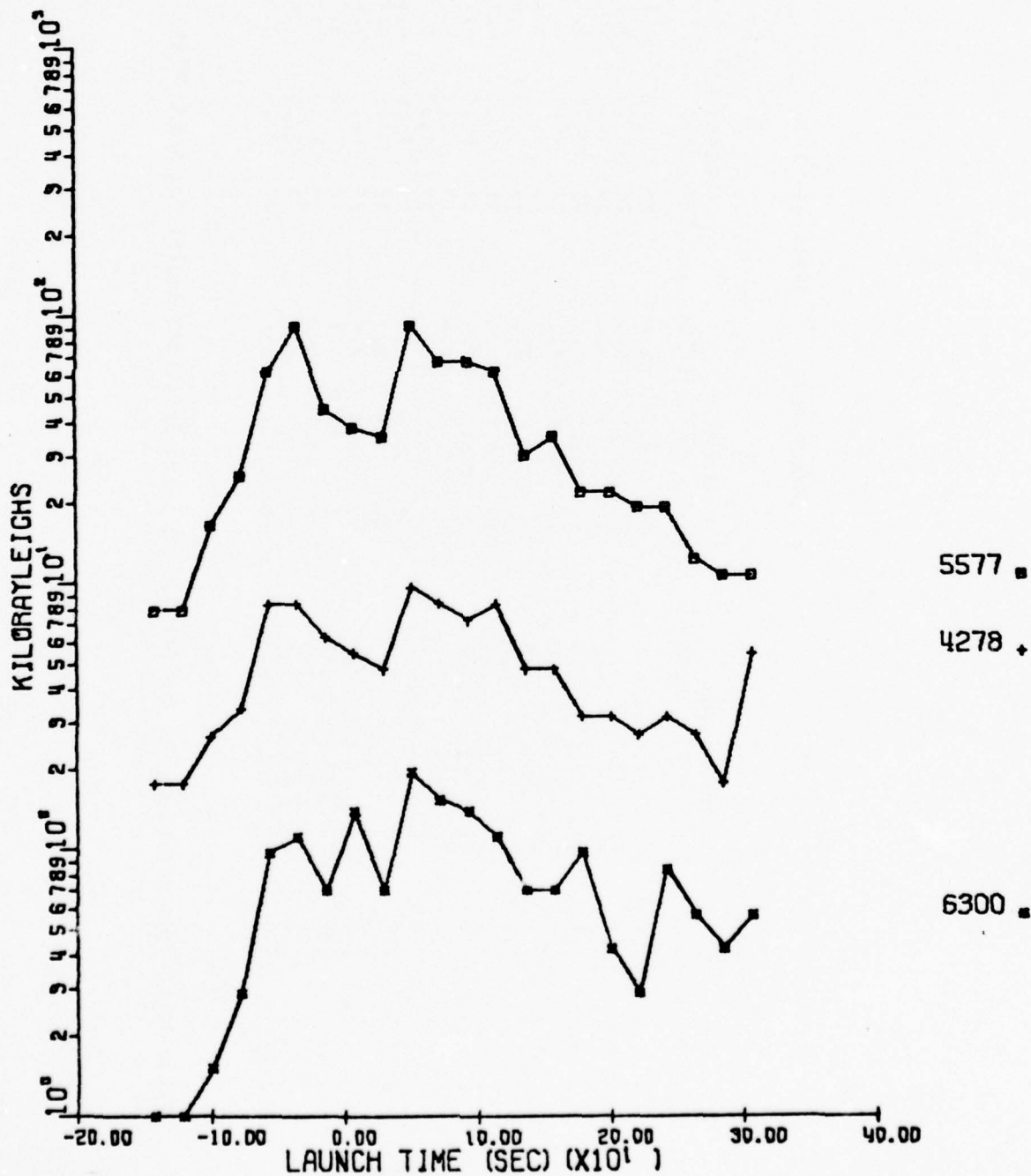


Figure 6a. Intensity Time Plot of 4278, 5577 and 6300 Emission Maxima for Ft. Yukon.

MINIMUM

FORT YUKON APRIL 1, 1976

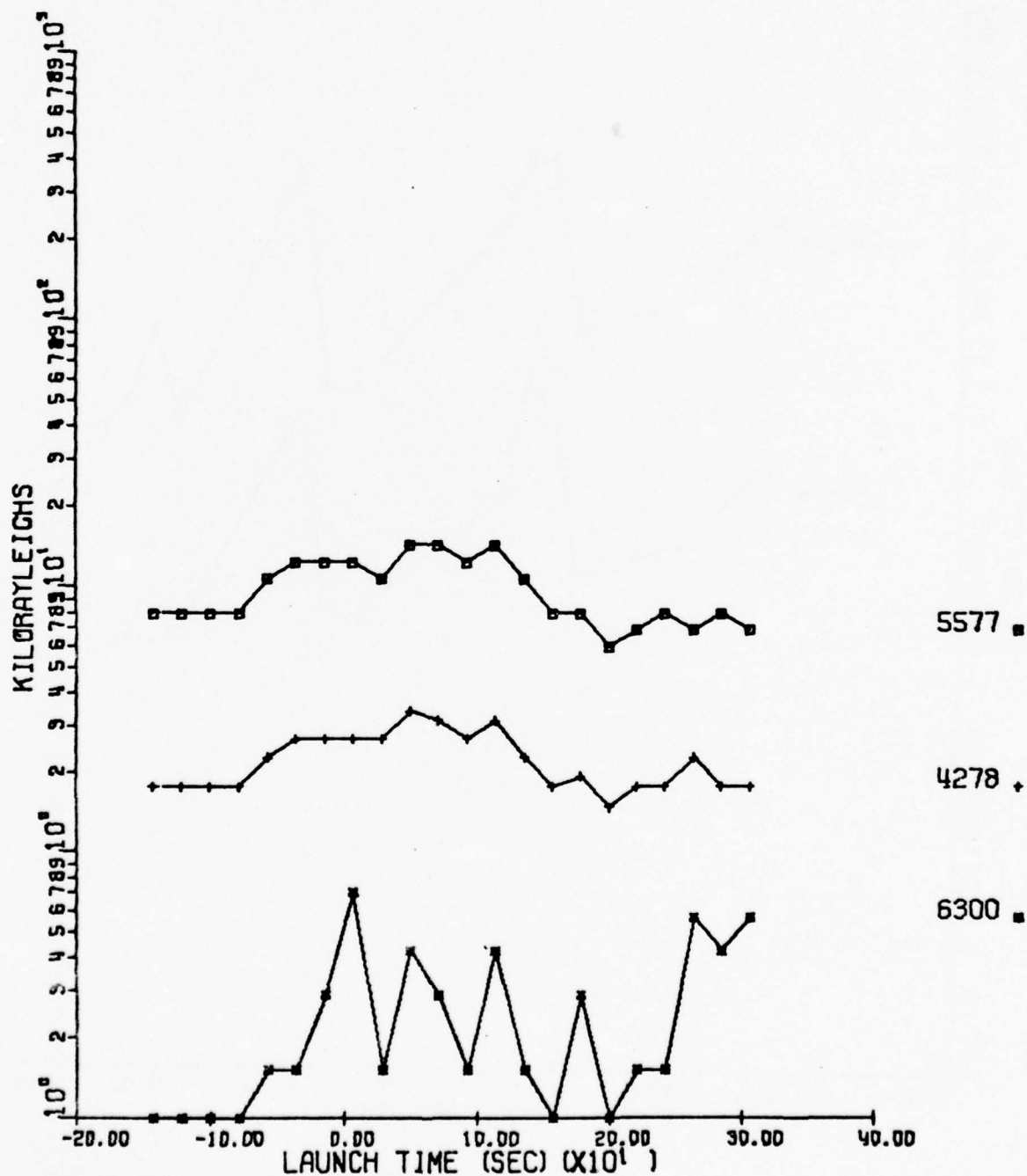


Figure 6b. Intensity Time Plot of 4278, 5577 and 6300 Emission Minima for Ft. Yukon.

MAXIMUM

POKER FLAT APRIL 1, 1976

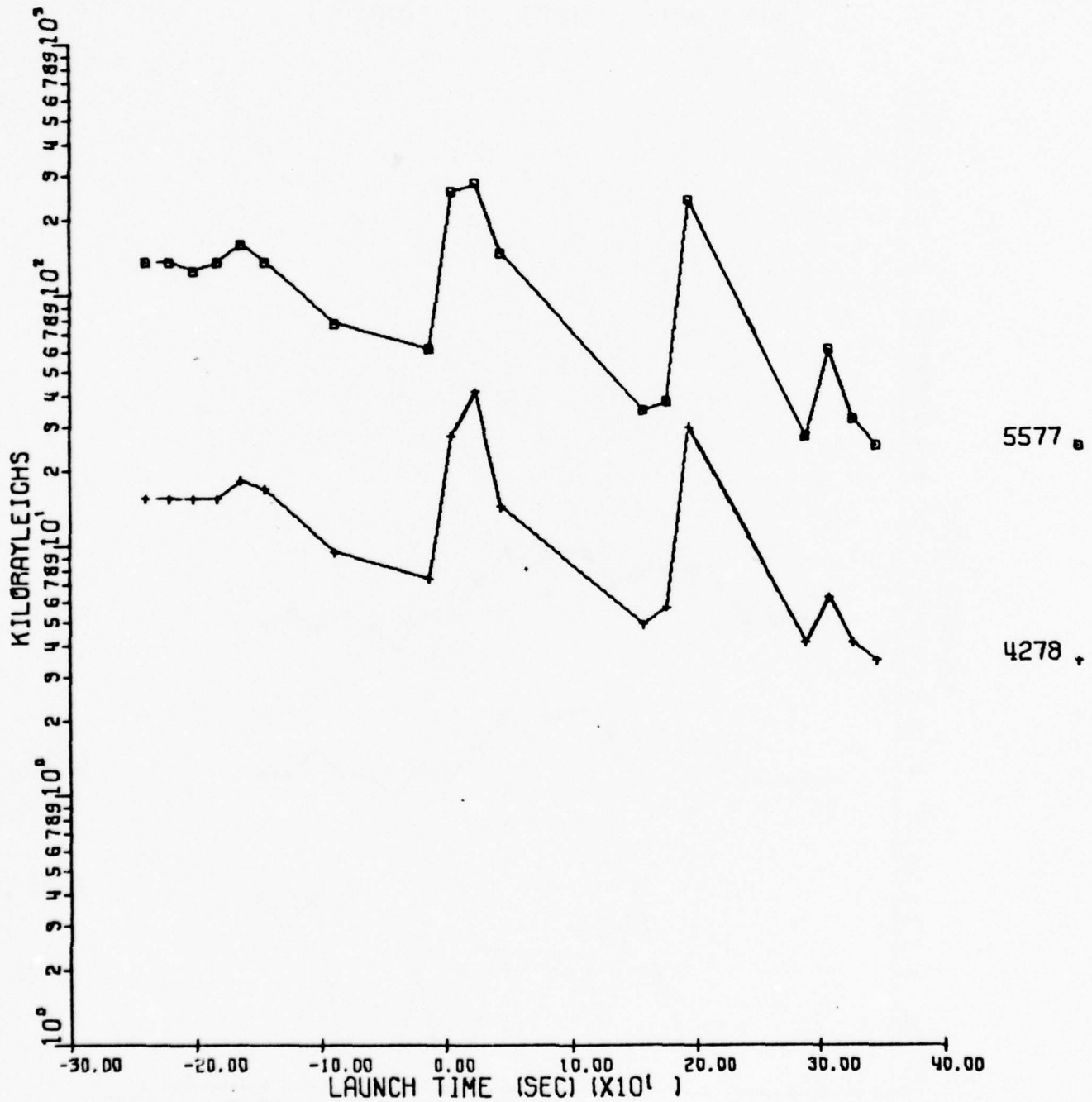


Figure 6c. Intensity Time Plot of 4278 and 5577 Emission Maxima for Poker Flat.

MINIMUM

POKER FLAT APRIL 1, 1976

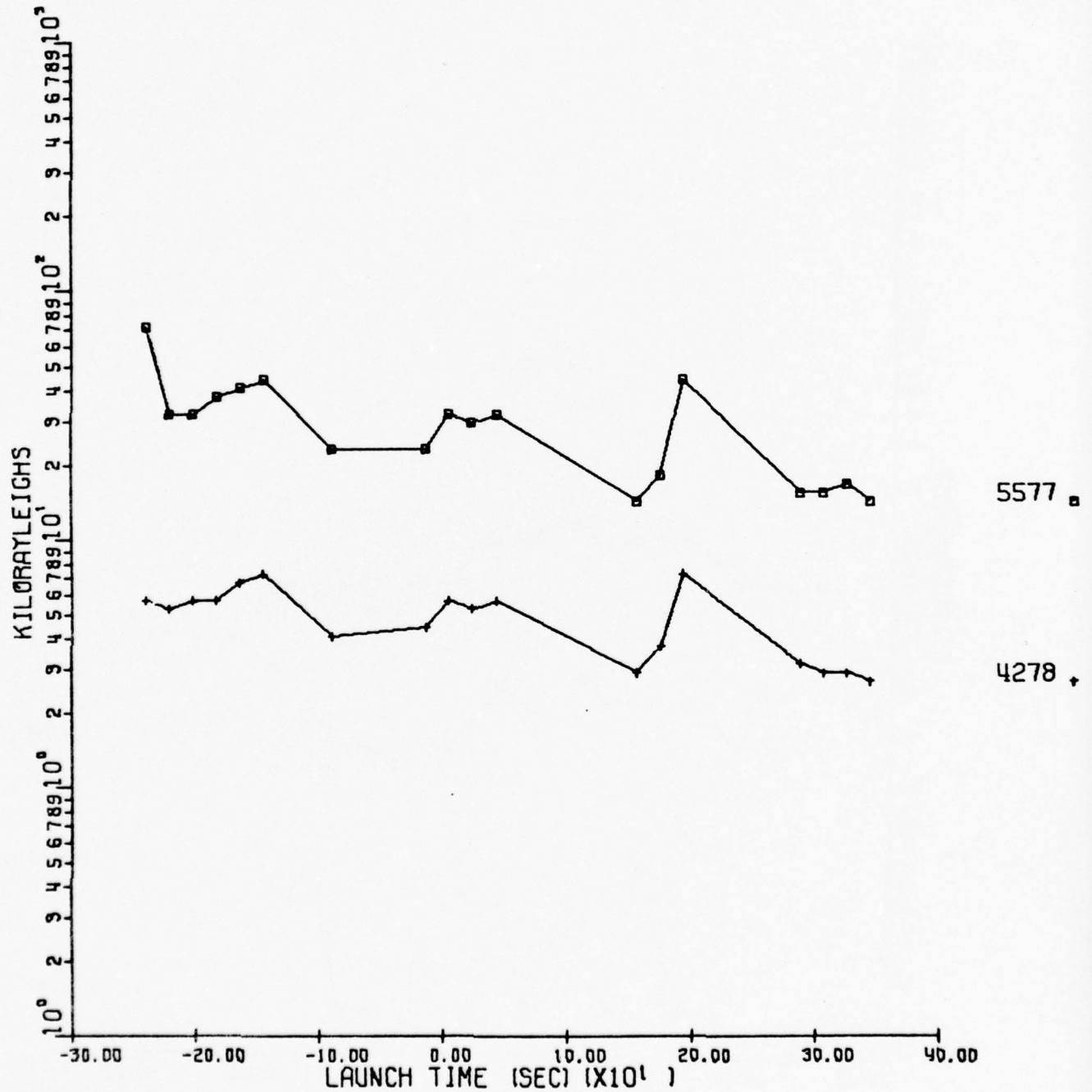


Figure 6d. Intensity Time Plot of 4278 and 5577 Emission Minima for Poker Flat.

100KM ENTRY

FORT YUKON APRIL 1, 1976

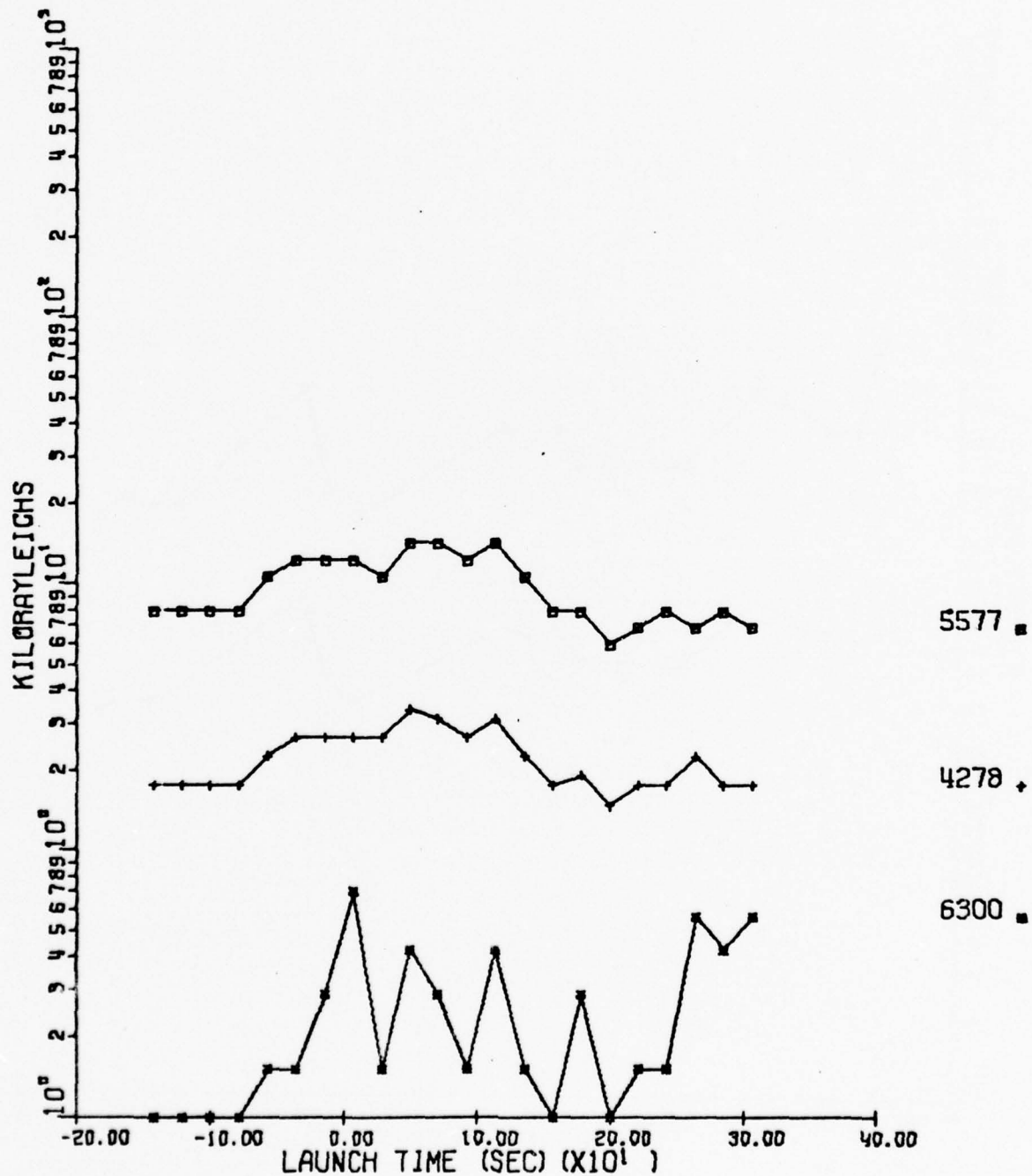


Figure 7a. 100 km Entry Look Angle 4278, 5577 and 6300 Intensity Time Curves for Ft. Yukon.

100KM EXIT

FORT YUKON APRIL 1, 1976

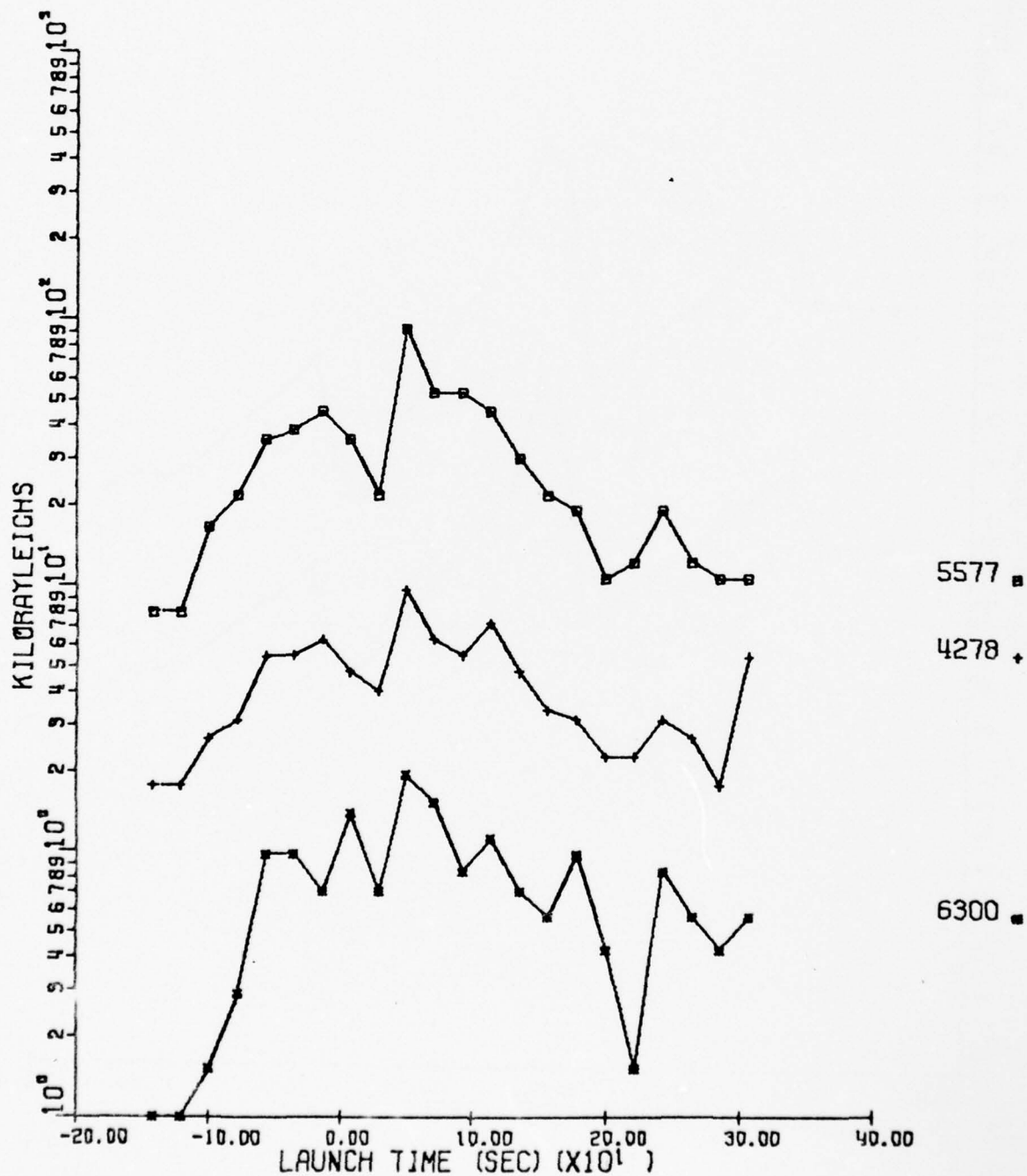


Figure 7b. 100 km Exit Look Angle 4278, 5577 and 6300 Intensity Time Curves for Ft. Yukon.

100KM ENTRY

POKER FLAT APRIL 1, 1976

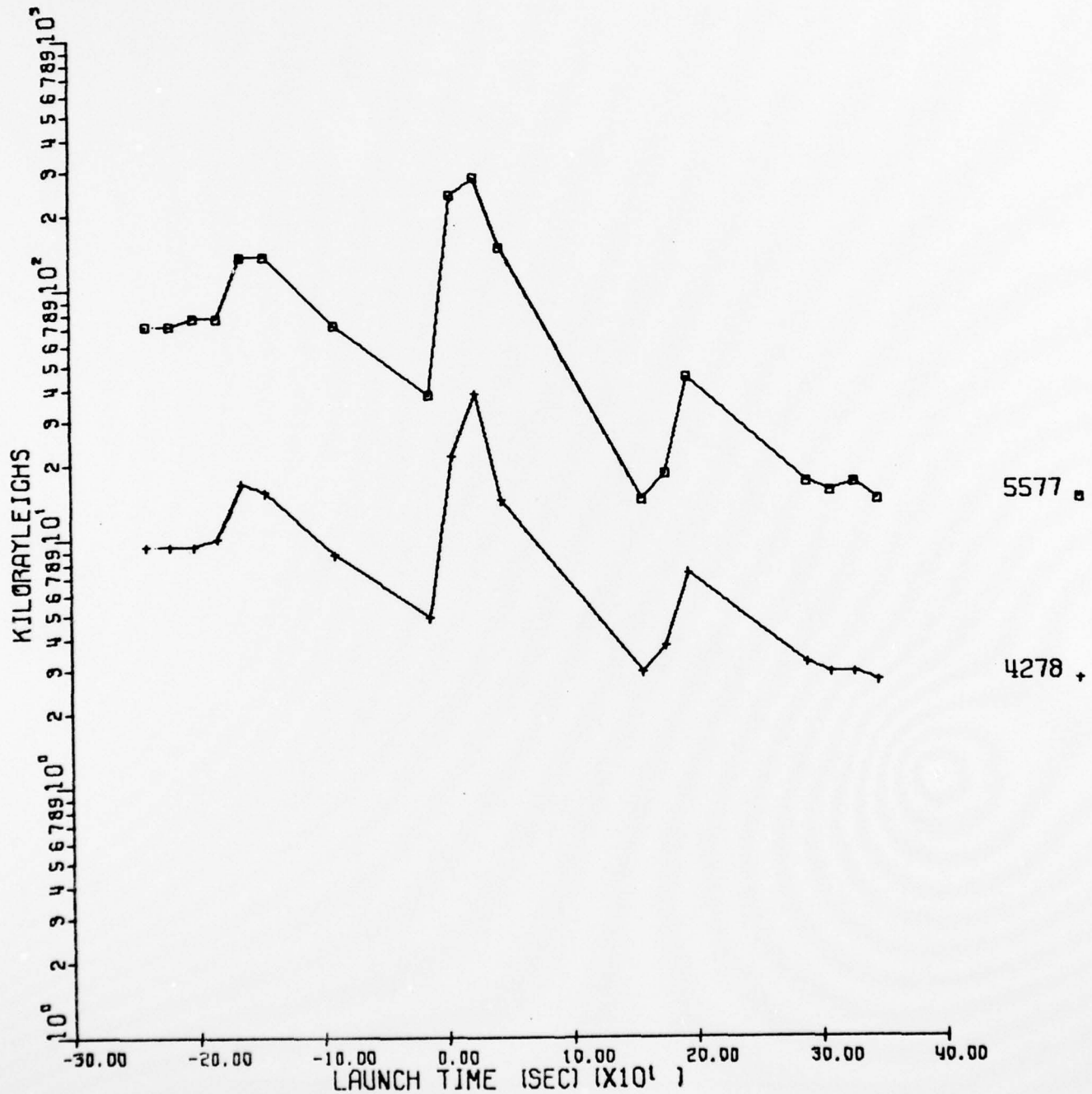


Figure 7c. 100 km Entry Look Angle 4278 and 5577 Intensity Time Curves for Poker Flat.

100KM EXIT

POKER FLAT APRIL 1, 1976

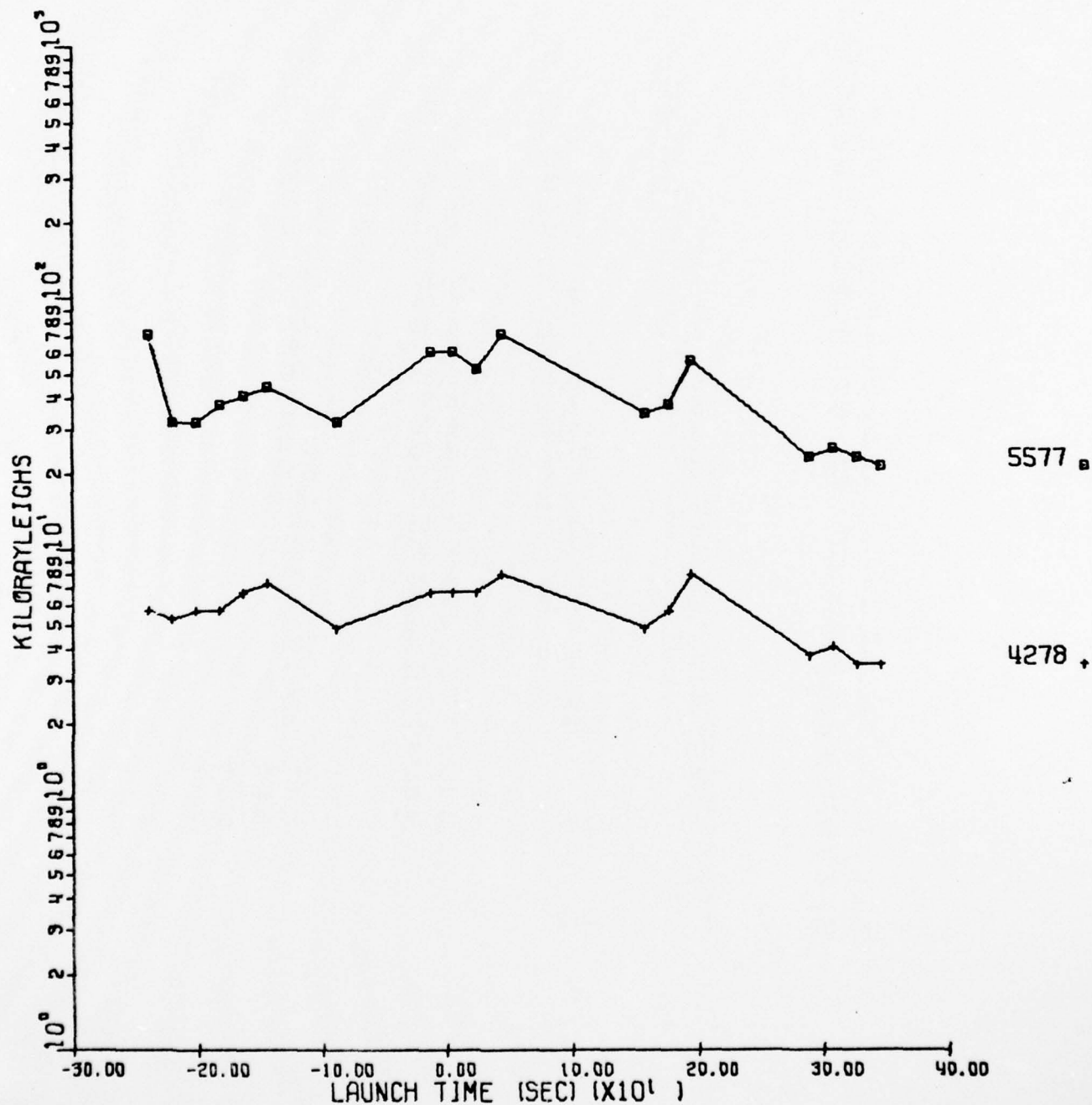


Figure 7d. 100 km Exit Look Angle 4278 and 5577 Intensity Time Curves for Poker Flat.

TABLE 11a Intensity Calibrations (kR) Ft. Yukon

<u>Voltage</u>	<u>5577</u>	<u>4278</u>	<u>6300</u>	<u>H Beta</u>
-5.00	0	0	0	0
4.75	.128	.051	.33	.011
4.50	.160	.112	.66	.022
4.25	.199	.164	1.00	.035
-4.00	.251	.234	1.33	.047
3.75	.318	.318	1.67	.058
3.50	.397	.42	2.00	.070
3.25	.488	.49	2.35	.082
-3.00	.613	.772	2.67	.094
2.75	.774	.98	3.00	.106
2.50	.978	1.26	3.34	.118
2.25	1.22	1.54	3.68	.127
-2.00	1.53	1.92	4.01	.141
1.75	1.94	2.34	4.35	.151
1.50	2.40	2.91	4.70	.165
1.25	2.96	3.51	5.04	.174
-1.00	3.67	4.35	5.36	.188
0.75	4.54	5.38	5.71	.198
0.50	5.61	6.46	6.03	.212
0.25	6.95	7.81	6.38	.224
0	8.6	9.60	6.70	.235
+0.25	10.6	11.7	7.05	.247
0.50	13.2	14.5	7.37	.258
0.75	16.3	17.8	7.71	.270
+1.00	20.2	21.5	8.06	.282
1.25	25.0	26.2	8.38	.291
1.50	30.9	32.3	8.73	.306
1.75	38.2	38.8	9.05	.317
+2.00	47.3	47.7	9.39	.329
2.25	58.5	58.5	9.74	.341
2.50	72.4	71.1	10.08	.353
2.75	89.7	86.6	10.40	.364
+3.00	111	108	10.73	.376
3.25	137		11.10	
3.50	190		11.42	
3.75	210		11.76	
+4.00	260	236	12.06	(Average of H and V profiles)
4.25	322			
4.50	399			
4.75	493			
+5.00	611	468		

TABLE 11 b Intensity Calibrations (kR) Poker Flat

<u>Voltage</u>	<u>5577</u>	<u>4278</u>	<u>6300</u>	<u>H Beta</u>
-5.00	0	0	0	0
4.75	.030	.035	.37	.013
4.50	.065	.080	.74	.025
4.25	.104	.140	1.10	.038
-4.00	.146	.214	1.47	.050
3.75	.201	.313	1.84	.062
3.50	.281	.425	2.20	.074
3.25	.373	.534	2.57	.086
-3.00	.500	.689	2.91	.099
2.75	.654	.867	3.28	.111
2.50	.827	1.067	3.64	.123
2.25	1.04	1.335	4.01	.135
-2.00	1.29	1.65	4.36	.147
1.75	1.70	2.00	4.73	.159
1.50	1.96	2.51	5.08	.171
1.25	2.48	3.11	5.45	.183
-1.00	3.19	3.87	5.82	.195
0.75	4.04	4.67	6.18	.208
0.50	5.0	5.78	6.54	.220
0.25	6.15	7.12	6.90	.232
0	7.50	8.67	7.27	.244
0.25	9.23	10.45	7.64	.256
0.50	11.15	12.90	7.99	.268
0.75	13.47	15.57	8.36	.280
+1.00	16.54	19.12	8.73	.292
1.25	20.19	23.35	9.09	.304
1.25	24.61	28.47	9.46	.316
1.75	30.57	35.59	9.81	.329
+2.00	36.92	43.37	10.18	.341
2.25	44.22	53.38	10.55	.353
2.50	53.84	64.50	10.91	.365
2.75	65.38	80.07	11.28	.377
+3.00	84.60	95.64	11.65	.389
3.25	96.14	115.77	12.01	.401
3.50	121.1	137.90	12.38	.414
3.75	146.1	157.9	12.75	.426
+4.00	155.7	211.3	13.10	.438
4.25	211.5		13.47	.450
4.50	259.6		13.84	.463
4.75	321.1		14.20	.475
+5.00	385		14.57	.487

(Average of
H and V
profiles)

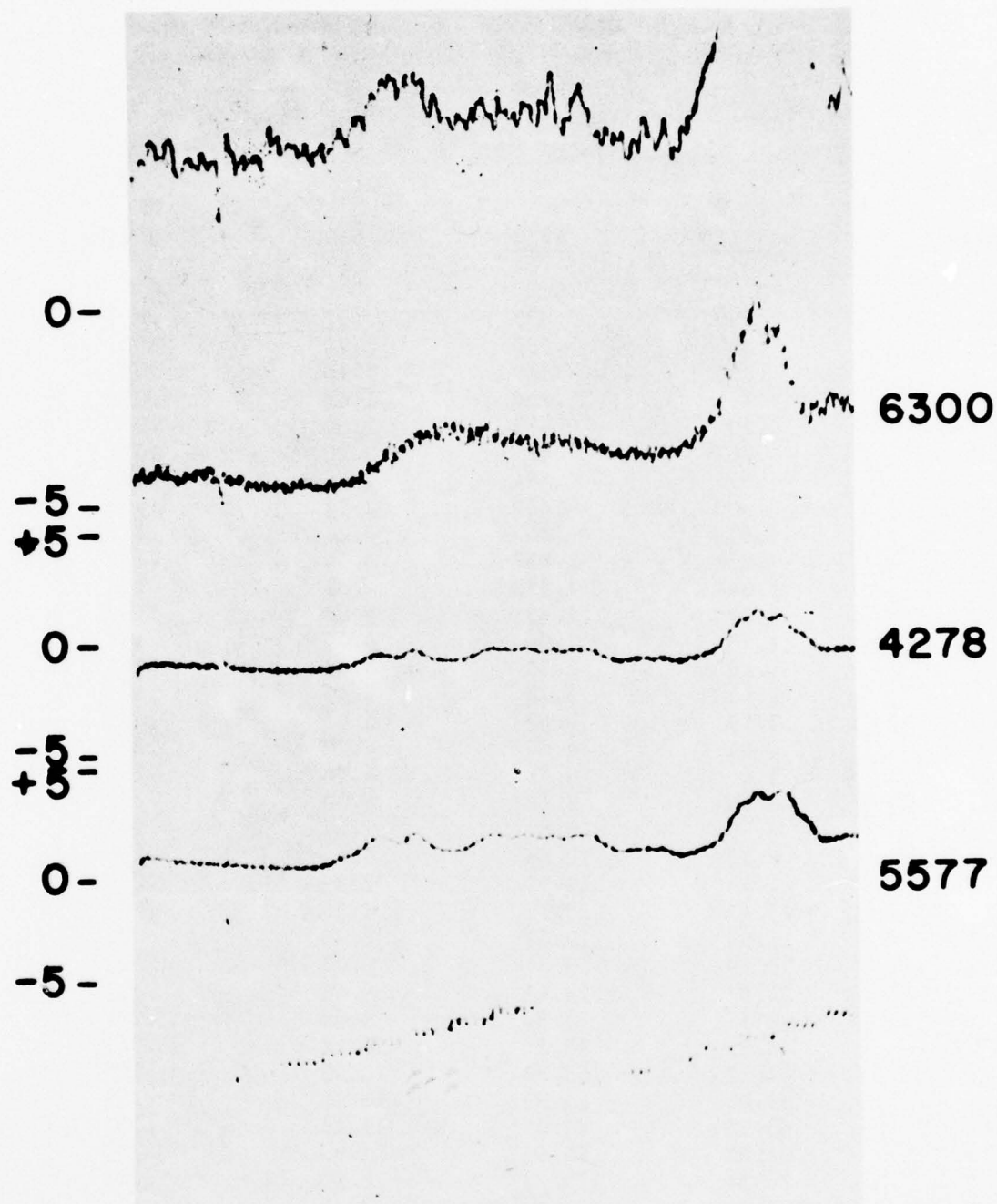


Figure 8. MSP Frame from Ft. Yukon at Typical Auroral Brightness During Launch.

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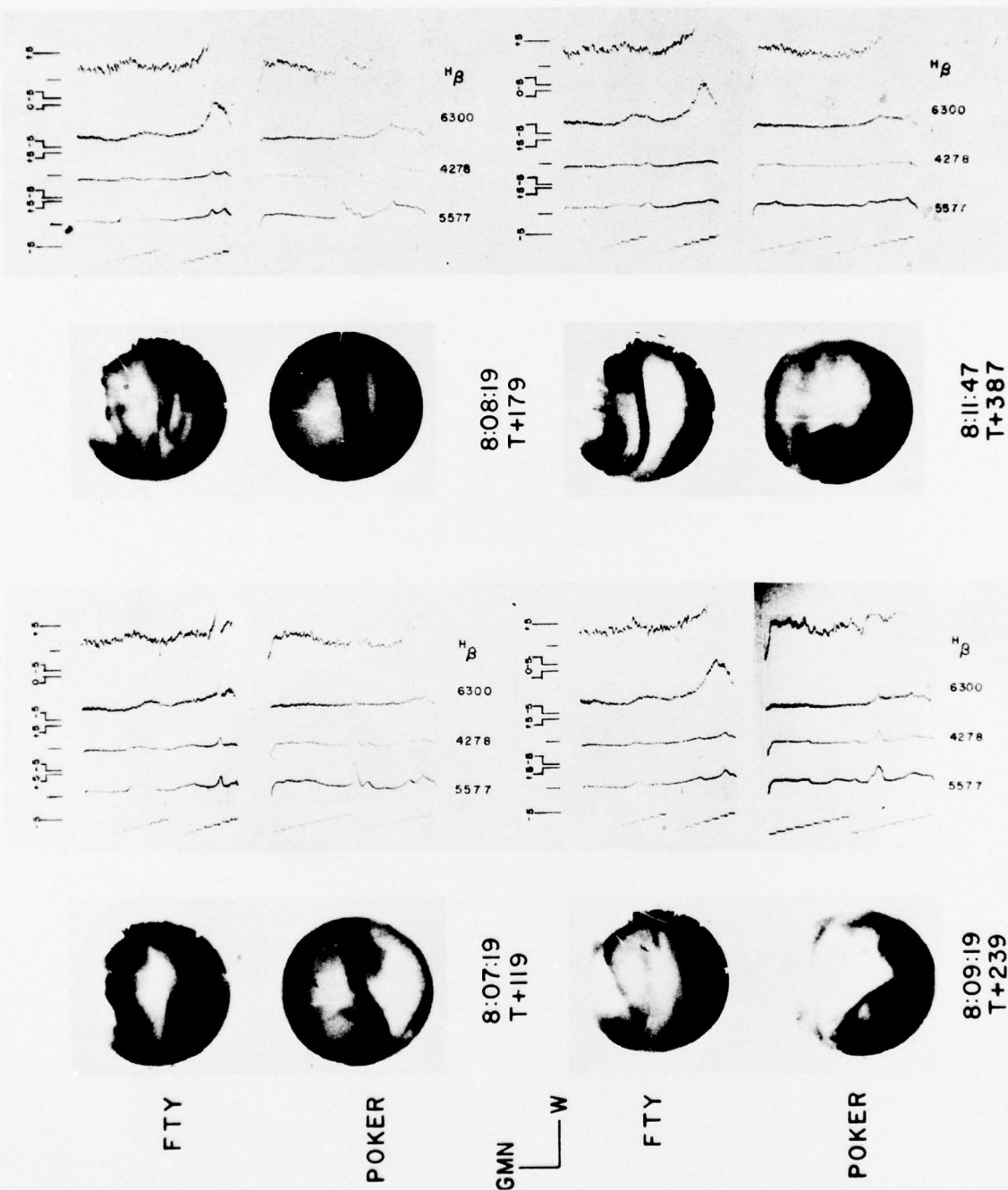


Figure 9a. Composite of 35 mm ASC and Meridian Scanning Photometer Data Recorded from Ft. Yukon and Poker Flat.

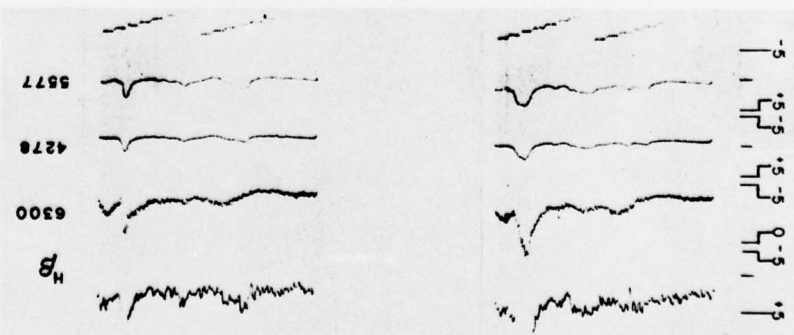
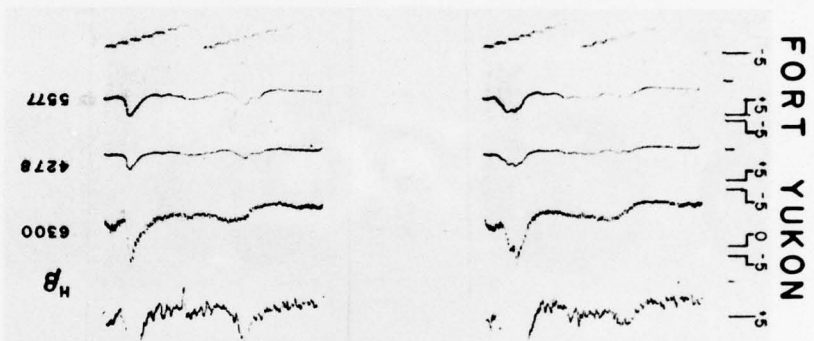
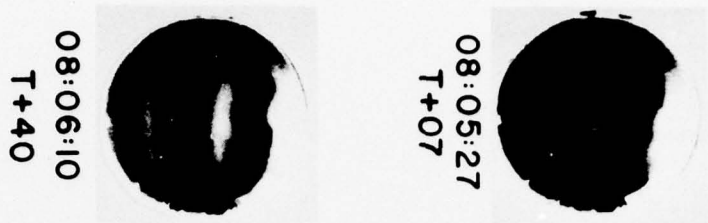


Figure 9b. Composite of 35 mm ASC and Meridian Scanning Photometer from Fort Yukon.

Section 8 - Television Coverage

Television data was obtained at Poker Flat and is available for detailed study if necessary in conjunction with the analysis of the rocket data.

Section 9 - Riometer Data

Riometers are operated at Ft. Yukon, College and Poker Flat.

Absorption is measured at 30 MHz. Figure 10 shows the records from Ft. Yukon and Poker Flat from 0700 to 1000 UT on April 1, 1976. Absorption values of 2 db occurred at Poker Flat during this launch. The exact values of absorption are accurate to ± 1 db for this level of activity.

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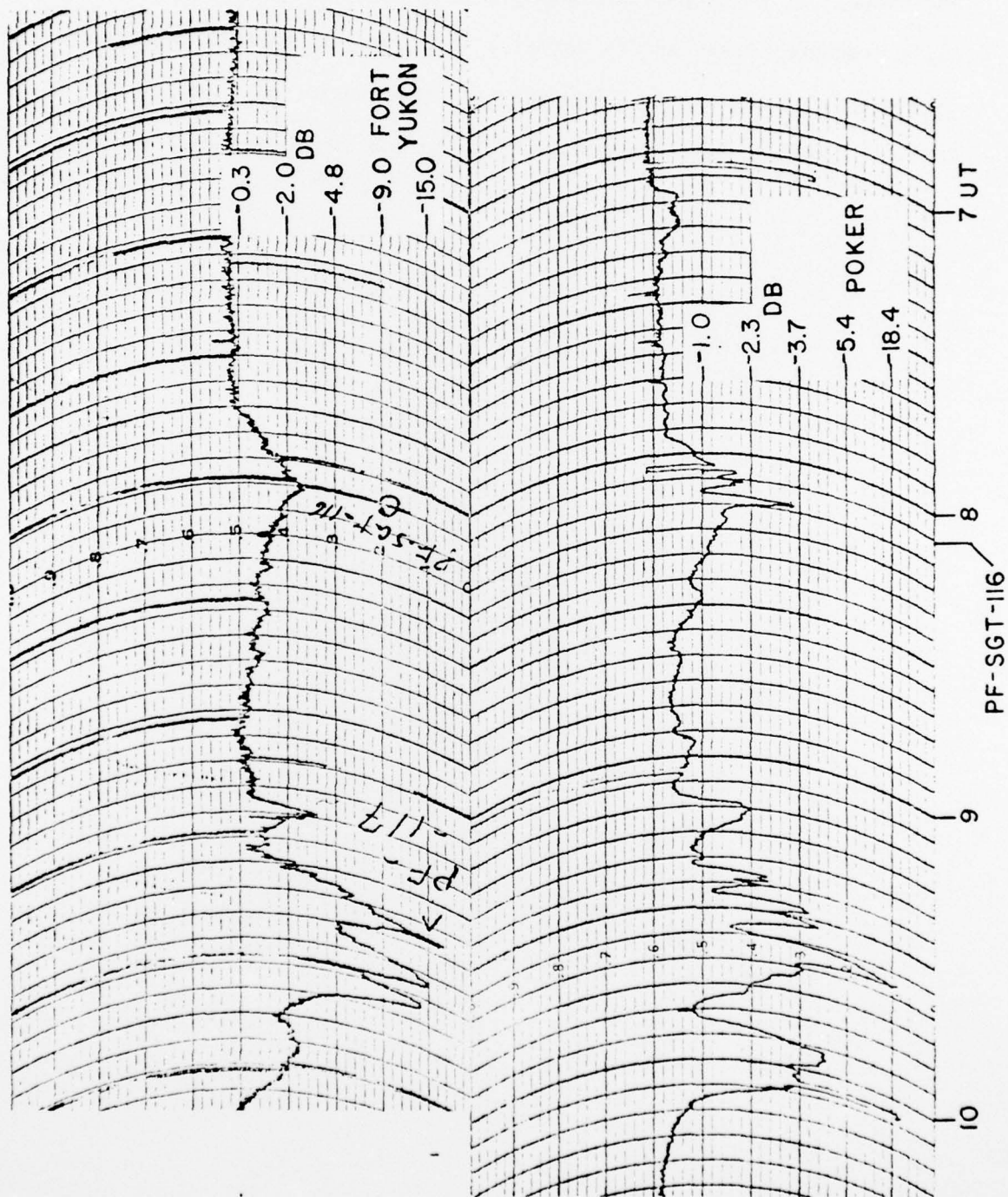


Figure 10. Riometer Absorption from Poker Flat and Ft. Yukon.

Section 10 - Ionosonde Data

The ionosonde at College operates between .5 and 20 MHz at vertical incidence. It requires approximately 30 seconds to sweep over the complete frequency range and is normally programmed to operate once every 15 minutes, on the minute. However, for this period of interest on April 1, 1976, no data was acquired due to equipment malfunction.

Section 11 - DMSP Satellite Photographic Data

The Air Force weather DMSP satellites record auroral activity on nighttime passes over the auroral zone. However, no data anywhere close to the Alaskan sector are available for this launch.

References

Akasofu, S.-I., Polar and Magnetospheric Substorms, D. Reidel Publishing Company, Dordrecht, Holland, 1968.

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