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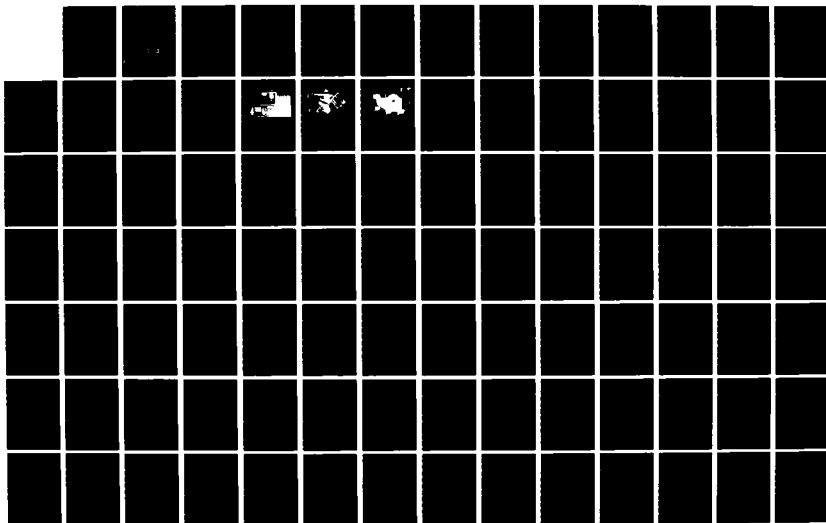
INVESTIGATION F THE PROPERTIES OF RADAR BACKSCATTER
FROM SEA ICE(U) KANSAS UNIV/CENTER FOR RESEARCH INC
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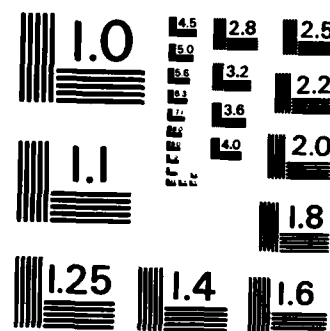
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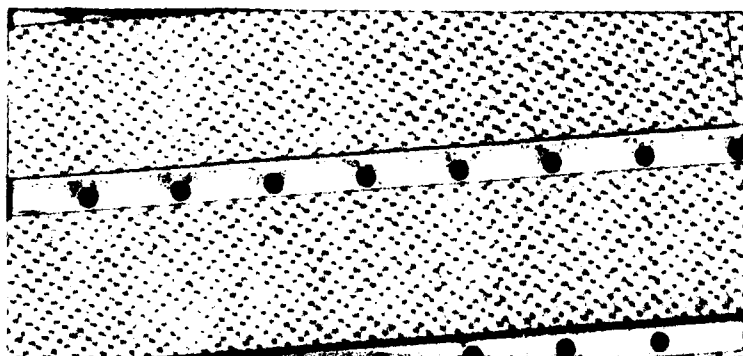


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**FINAL REPORT ON
INVESTIGATION OF THE PROPERTIES OF RADAR
BACKSCATTER FROM SEA ICE**

**R.K. Moore
T.H. Lee Williams
R.G. Onstott**

**Remote Sensing Laboratory
University of Kansas Center for Research, Inc.
Lawrence, Kansas 66045-2969**

**Remote Sensing Laboratory Technical Report
RSL TR 3311-5**

August 1985

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ABSTRACT

Included in this final report are a list of all publications produced under support by ONR Contract N00014-76-C-1105 and NASA Contract NAGW-334 and the preliminary data report for the laboratory-grown sea ice experiment at CRREL.



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Measurements of the radar backscatter from sea ice have been made and interpreted over the period from 1976 to 1985 using systems developed for the purpose. The systems include the first helicopter-transportable surface-based radar spectrometer, the first helicopter-mounted radar spectrometer (now copied in several countries), and several specialized systems for sled, ship, and CRREL laboratory operation.

A great deal of knowledge has been gained about the radar response of various types of ice in late winter, spring, and summer; only one measurement has been conducted in the fall. The results of this research have been extensively documented in reports, oral presentations, and published papers. A list of reports and papers is appended.

The most recent experiment for which the data have been in part analyzed involved measurements of sea ice grown in the laboratory at CRREL. The preliminary data report is included as part of this final report. Other work that is reasonably complete has already been reported.

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AND NASA CONTRACT NAGW-334

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LABORATORY-BASED EXPERIMENT TO STUDY THE
ACTIVE MICROWAVE RESPONSE
OF ARTIFICIALLY GROWN SEA ICE

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ABSTRACT

Active microwave measurements have been made in conjunction with passive microwave measurements of saline ice. Simulated Arctic sea ice was grown in an approximately 5 m x 15 m tank at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL), thereby simplifying experimentation and control of the physical and chemical properties of the ice sheets. Radar backscatter measurements were made at 5.2, 9.6, 13.6 and 16.6 GHz. Antenna polarizations include vertical, horizontal and cross. Angles of incidence range from 0° from vertical to 50°.

Scenes investigated include water, grease ice, dark nilas, grey ice, grey ice with a roughened surface, grey ice with a 5-cm snow cover and ice which had grown to 30 cm. In addition, the influence of small-scale surface roughness and snow were examined. Conducting screens were implanted at three depths and observed by a vertical-viewing radar to investigate the lossy nature of the ice sheet. 

Preliminary results are as follows: (1) At vertical incidence the strongest signal was from water. (2) At angles greater than 15° off vertical, returns separate into two groups: snow-covered and rough grey ice and the remaining categories. The second group of scenes has rapid fall-off with angle; for the first group, volume scattering (from snow) and rough surface scatter produce similar angular responses. (3) the depolarization is very weak for grease ice, dark nilas and grey ice; is moderate for water; and is strong for roughened or snow-covered grey ice.

This report contains a brief description of the experiment and a complete set of radar data. Analysis will be reported separately.

INTRODUCTION

A laboratory experiment was conducted at the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) to grow saline ice (which simulates Arctic sea ice). Objectives were to measure sea-ice electrical properties; to simultaneously characterize the structure of the ice, especially the parameters that influence the electrical properties, such as brine inclusion sizes and geometric shapes, ice salinity and temperature; to correlate, through modeling appropriate to the frequency range, the relationships between structural parameters and measured electrical characteristics; and to make in-situ active and passive microwave measurements. This experiment simplified experimentation and allowed control of the physical and chemical properties of the ice sheet in a way not possible in the field. Development of the CRREL facility began during the 1982/1983 winter. The measurements were made during the winters of 1984 and 1985.

The University of Kansas made backscatter measurements at 5.2, 9.6, 13.6 and 16.6 GHz. Antenna polarizations included vertical transmit and receive (VV), horizontal transmit and receive (HH), and cross. Angles of incidence ranged from 0° (vertical) to 50°. These measurements were made from a moving platform about 3 m from the surface of the ice sheet whose movement allowed spatial averaging.

The purpose of this work is to improve our understanding of the relationship between the physical, chemical and electrical properties of sea ice and its microwave response. This is important for development of future optimum ice-sensing systems and for improvement of our ability to interpret sensor outputs. Our previous study of the radar-ice interaction process has indicated that the most critical influences on the backscatter process are ice-surface roughness, the permittivity of the ice sheet, and, for multiyear ice, the size of the air bubbles in the uppermost layers. In addition, the presence of a snow layer may have an impact, ranging from significant to insignificant, on the microwave response.

Ice categories studied during the 1984 and 1985 experiments included open water, grease ice, dark nilas, light nilas, grey and grey-white ice. An additional category was encountered which may be across between multiyear and first-year ice since its upper layer contained ice which was low salinity, had bubbles of a significant size, but not in large populations. A roughened ice surface was also observed. Naturally fallen snow was allowed to accumulate

and mechanically blown snow was placed on the sheet and observed again. The saline ice sheets studied represented, both physically and electrically, the ice encountered in the more harsh Arctic environment.

DESCRIPTION OF THE EXPERIMENT

1984 Investigation

Measurements were made from an I-beam structure, provided by the University of Massachusetts, using a mount that allowed measurements from 0° to 50° . Measurements were made at 5° intervals to characterize accurately the near-vertical angular response of the scattering cross-sections and further reduce the effects of fading by increasing the number of degrees of freedom in the data. Data were acquired at 12 frequencies in each of the bands from 4-6, 8-12 and 12-18 GHz. The large number of frequencies provided a very detailed frequency response and also permitted further reducing the effects of fading.

Sheets of ice were investigated on two occasions. From January 14-21, 1984, the ice sheet grew from open water (the reference point). Air temperatures were around -17° C, allowing seeding which produced crystal growth very similar to that found naturally in the Arctic. Grease ice formed, then grew to over 4 cm during the experiment period. Several sets of active and passive measurements were made (by Tom Grenfell, University of Washington) to monitor changes in the backscatter properties as the ice grew in thickness.

A second investigation was carried out during February 16-20, 1984. This ice sheet was composed of a 6-cm layer of fresh water ice (due to flooding in the early part of the month caused by torrential rains) on top of 25 cm of young sea ice. The fresh-water ice contained 1-3 mm bubbles which are expected to provide a volume scattering contribution. Air temperatures during the measurements ranged from 0° to -2° C.

The plan for this stage of the experiment was to grow multiyear ice. Because high ambient air temperatures during the day and low temperatures at night are required so that the flooding and flushing action can be initiated without the water immediately freezing to the top of the ice sheet, the experiment was scheduled in the late winter. During this time temperatures were higher than expected, so the multiyear ice could not be grown. The fresh-water ice which capped the saline ice prevented the transformation of the young sea ice into the equivalent of multiyear ice. Since ambient air

temperatures were not expected to dip low enough at this late date to allow the seeding necessary to grow a new simulated sheet of Arctic sea ice, the decision was made to examine the existing ice sheet as a special case, and plan to remove part of it if the weather pattern brought in the needed colder air.

1985 Investigation

Three sheets of ice were grown during this investigation. The first, grown during 4-8 January, was seeded on one end, whereas the other half was not. Since the radar was positioned at the center of the ice tank to avoid any effects related to the tank edges, it could observe equal areas of each half. Differences in radar response between seeded and non-seeded ice were not detected. This sheet was observed at depths which ranged from 3.5 to 8.5 cm. Observations were made of a smooth-surfaced ice sheet, the same ice sheet with a roughened surface, and the roughened ice sheet with a 4.5 cm natural snow layer.

On 8 January the first ice sheet was removed and radar measurements of water were made. Water measurements serve as a baseline with which the sea ice measurements may be compared. An unseeded ice sheet was then allowed to form. Observations were made at thicknesses of 0.1 - 0.5, 0.8 - 1.0, 2.0 - 2.2, 5, 6, 6.5, 7, 7.5, 11, 13, 14.5 and 16 cm. Air temperature ranged from -8 to -15° C.

On 14 January this ice was removed and more water data were obtained. Due to a high air temperature, the water was motionless since continual sweeping was not required to prevent ice growth.

A third and final ice sheet which began growing 14 January was completely seeded and left in place until it rotted in March. This sheet was observed at thicknesses of 1.1, 3.5, 4.1, 12.5, 13.5, 15.8, 18.4, 19.1, 32 and 36 cm.

DESCRIPTION OF ACTIVE MICROWAVE SENSOR

The University of Kansas surface-based scatterometer, SURSCAT, was used during both the 1984 and 1985 laboratory-based experiments. The SURSCAT is a frequency-modulated continuous-wave radar that operates from 4-18 GHz, over angles of incidence from vertical to 50° and with like- and cross-antenna polarizations. System specifications are given in Table 1. This radar uses a

horn antenna (4-18 GHz) and a dual-ridge-horn-fed parabolic dish (8-18 GHz).

Absolute calibration is conducted by measuring the signal passed through a delay line of known attenuation and by measuring the return power from a Luneberg lens retrograde of known radar cross-section.

The geometry of the radar antenna platform is shown in Figure 1-4. The radar was positioned at a vertical height of 2.8 m off the ice sheet. The antenna cluster center was offset from the torque tube about which the antenna assembly rotated a horizontal distance designated by arm-H and a vertical distance arm-V when the antenna look direction is vertically downward. Two-way 3-dB antenna beamwidths are given in Table 2, effective two-way integrated beamwidths which describe beamwidths for an idealized cylindrical radiation pattern in Table 3, radar footprint sizes based upon an effective beamwidth in Table 4, and the number of independent samples acquired by sweeping the radar with a bandwidth in excess of that required by resolution requirements in Table 5.

DESCRIPTION OF THE ICE SCENES AND DATA SET

Information describing the ice scenes is available from many sources; e.g., CRREL, University of Massachusetts, University of Washington and University of Kansas. These data have not been compiled jointly. What is included in this report (in Table 5 for the 1984 experiment and Table 6 for the 1985 experiment) are general scene descriptions which include date, time, ice sheet identifier, air/ice temperatures, surface conditions and ice thickness. Radar cross-section data are included here in both tables and angular response plots.

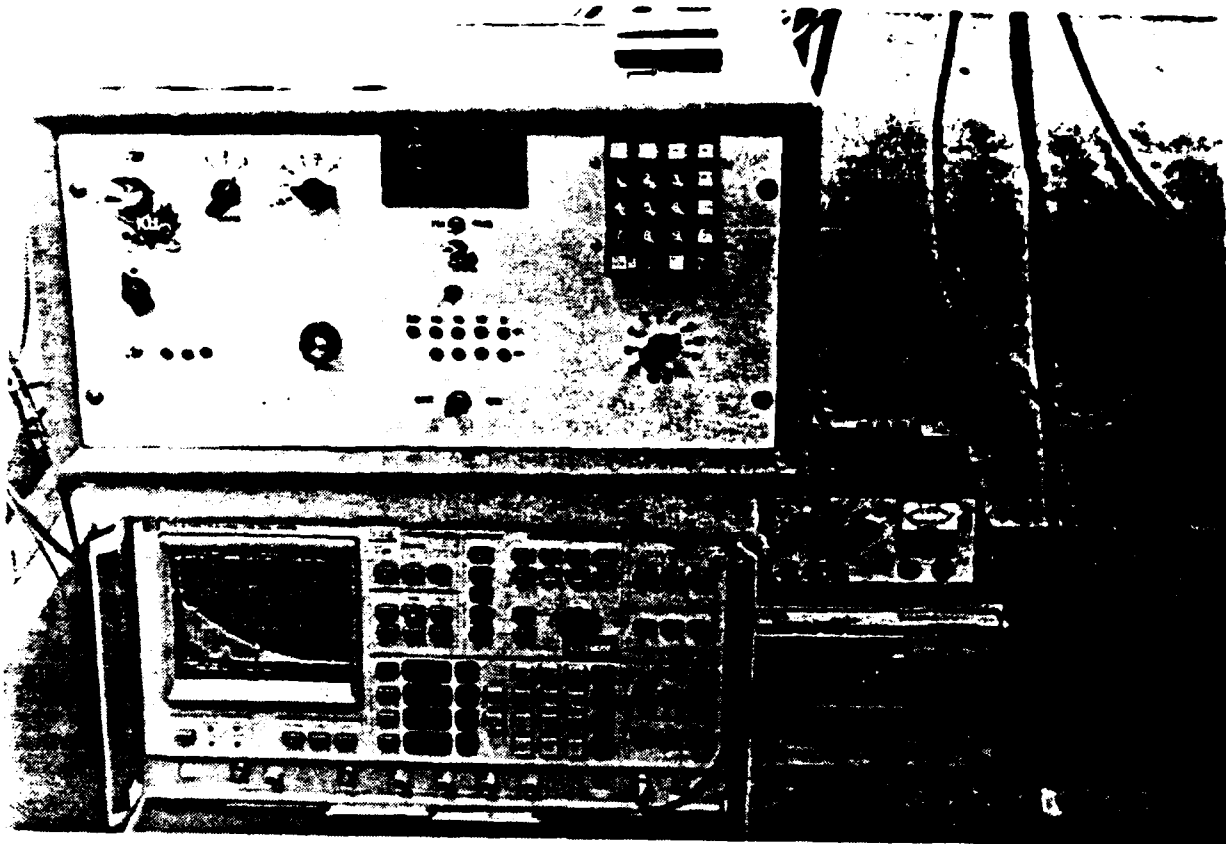


FIGURE 1: The University of Kansas surface-fased radar (SURSCAT) and spectrum analyzer were used during the laboratory investigation at CRREL during the 1984 and 1985 winters.

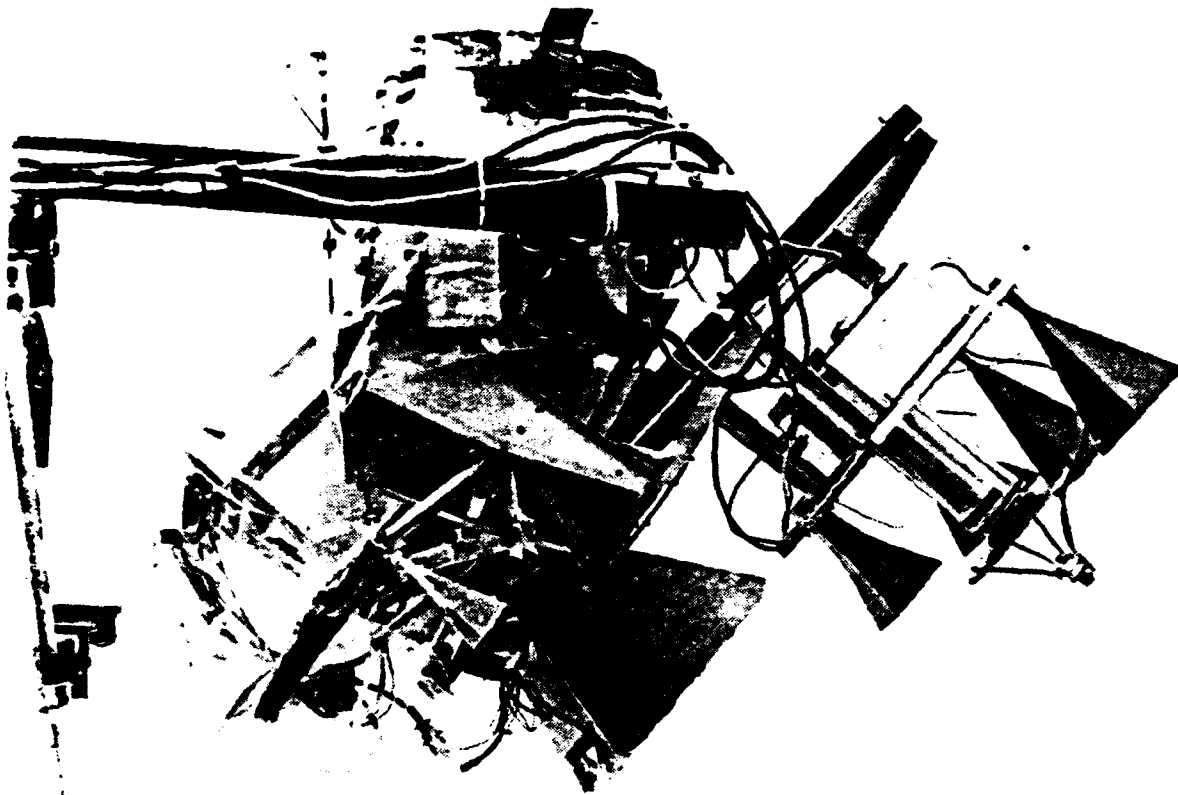


FIGURE 2: University of Kansas surface-based radar (SURSCAT) uses four standard gain horns and one parabolic dish. Other sensors shown include a 33 GHz radar (ERIM/KU) and a step-frequency C-band radiometer (U. Mass).

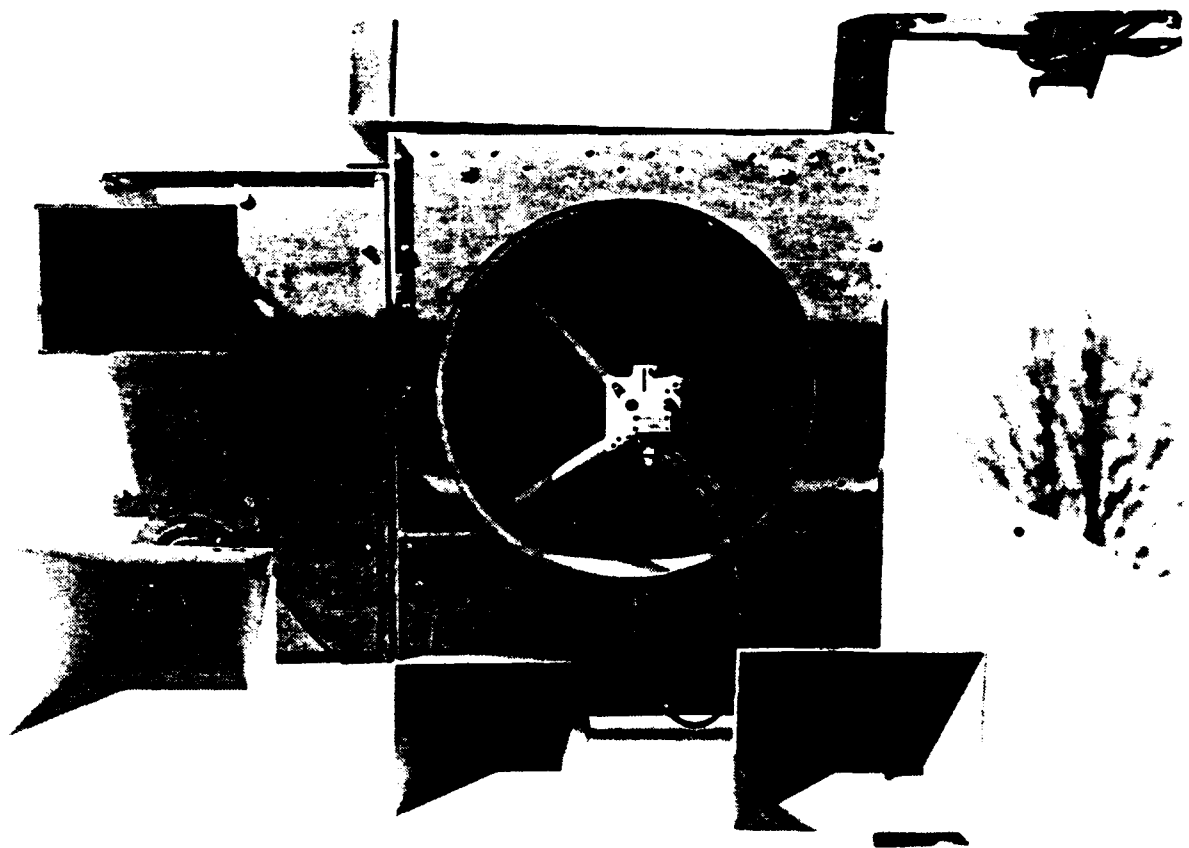


FIGURE 3: University of Kansas surface-based radar (SURSCAT) antenna mount supports five antennas which may be manually rotated. The left two antennas operate from 4-6 GHz, the center from 12-18 GHz, the right horn from 8-12 GHz, and the horn-fed parabolic dish from 8-18 GHz.



TABLE 1
SYSTEM SPECIFICATIONS

Type	FM-CW
Frequency Range	4-18 GHz
Frequencies Selected	5.0, 5.9, 9.6, 13.6 and 16.6 GHz
FM Sweep	1.9 GHz
Intermediate Frequency	15 kHz
IF Bandwidth	3.5 kHz
Antennas:	
Receive Type	Standard Gain 4-6 GHz horn 8-18 GHz horn-fed parabolic dish
Transmit Type	Standard Gain 4-6, 8-12 and 12-18 GHz horns
Polarizations	VV, HH and Cross
Beamwidths	See Tables 2 and 3.
Geometry:	
Height	2.7 m (1985)
Horizontal Arm	52.6 cm (406 GHz: 1985) 44.3 cm (8-18 GHz: 1985)
Vertical Arm	0 cm (4-6 GHz: 1984) 0 cm (8-18 GHz: 1984)
Incidence Angle Range	Vertical to 50°
Calibration:	
Internal	Signal injection (delay line)
External	Luneberg lens - 30-cm dia.

TABLE 2
TWO-WAY 3-dB ANTENNA BEAMWIDTHS

Azimuthal Beamwidths in Degrees					
Pol./ Freq.	5 GHz	5.9 GHz	9.6 GHz	13.6 GHz	16.6 GHz
HH	15.0	12.9	5.1	4.7	3.6
VV	15.0	12.9	6.3	5.6	4.3
X	15.7	13.8	5.2	4.8	3.7

Elevational Beamwidths in Degrees					
HH	15.0	12.9	6.3	5.1	4.3
VV	15.0	12.9	5.1	4.7	3.6
X	15.7	13.8	6.1	5.0	4.1

TABLE 3
EFFECTIVE TWO-WAY ANTENNA BEAMWIDTHS

Azimuthal Beamwidths in Degrees					
Pol. Freq.	5 GHz	5.9 GHz	9.6 GHz	13.6 GHz	16.6 GHz
HH	18	15.5	6.2	5.7	4.3
VV	18	15.5	7.6	6.7	5.2
X	18.9	16.6	6.3	5.8	4.5

Elevational Beamwidths in Degrees					
HH	18	15.5	7.6	6.2	5.2
VV	18	15.5	6.2	5.7	4.3
X	18.9	16.6	7.4	6.0	4.9

TABLE 4
RADAR FOOTPRINT SIZES IN SQUARE METERS

Angle Freq.	5	5.9	9.6	13.6	16.6
0	0.57	0.42	0.08	0.06	0.04
5	0.59	0.44	0.09	0.06	0.04
10	0.64	-.47	-.09	0.07	0.04
15	0.70	0.52	0.10	0.08	0.05
20	0.79	0.58	0.12	0.09	0.05
25	0.92	0.68	0.13	0.10	0.06
30	1.11	0.82	0.16	0.13	0.08
35	1.37	1.01	0.20	0.16	0.10
40	1.72	1.3	0.26	0.19	0.13
45	2.13	1.68	0.34	0.28	0.16

N.B. The areas above are based on the data of HH-polarization, CRREL-85. For VV- and X-polarizations, the corresponding areas are nearly the same. For CRREL-84, the footprint sizes have the same order of magnitude as listed above.

TABLE 5
NUMBERS OF INDEPENDENT SAMPLES PER FOOTPRINT

Angle Freq.	5	5.9	9.6	13.6	16.6
0	1	1	1	1	1
5	1	1	1	1	1
10	2	1	1	1	1
15	3	2	1	1	1
20	4	3	1	1	1
25	6	5	2	2	1
30	8	7	3	2	2
35	10	9	4	3	3
40	12	12	5	4	4
45	14	13	7	6	5

TABLE 6
SCENE DESCRIPTION FOR CRREL-84

Date	Time	Temperature (°C)		Depth cm	Comments
		Air	Ice		
1/17					Open water; HH, X
	1004				Initial ice growth; HH, X
1/18	1405	-6	-2	3.4	It started snowing, few mm wet snow on top layer; HH, X
1/19	1345- 1643	-3.4- -6.6	-4- -5.2	3.9	Scene #1, HH
	2039	-10.4	-5.5	4.2	Scene #2; Hh, VV, X
1/20	1315	-10.1	-8.8		HH
2/22	2100	0			6 cm fresh water on ice top with 1 - 3 mm bubbles, 1 mm dominant; VV

TABLE 7
SCENE DESCRIPTION FOR CRREL-85

Date	Time	Temperature (°C)		Depth cm	Ice Sheet	Comments
		Air	Ice			
1/4		- 6.8			1	Ice sheet #1 is 1/2 seeded and 1/2 non-seeded; HH
1/5	2140	-12.0		4.5	1	VV, HH, X
1/6	1426 1717	- 7.0 - 8.0		6.5	1	VV HH, X
1/7	1030 1406 1450	-12.5 -13.0 -13.0	-10.5		1S 1R 1R	Smooth ice sheet, Tslush = -3.25 C; X, HH, VV Rough ice sheet; VV HH, X
1/8	0911 1055	-10.1 -13.5	- 3.0	8.5	1R	HH, X; 4.5 cm of snow; 1-2 cm of slush, Tslush = -3.0 C; snow density = 0.10 Gm/Cubic cm VV; Tslush = -6 C; Photo roll #1, F = 27 - 31; Salinity #79 = slush layer, #22 = right at snow layer, #180 = snow 1/2 cm above slush layer S' 1/2 cm thick.
1629 1743 1815				0.1	W 2	Water data at VV Grease ice: $\theta = 10$ VV $\theta = 25$ $\theta = 35$ $\theta = 45$
1822 1506 2004 2032 2300 2335		-14.0 -15.0 -14.7		0.5 0.3 0.5 0.8 0.1 2.0 2.0		VV HH VV $\theta = 45$ VV HH

1/9	1111 1242 1843					2 2	Ice sheet with snow, HH VV Snow surface - natural, VV Snow surface - natural, VH Snow surface - natural, HH Roughened, unseeded ice, HH Roughened, unseeded ice, VH Roughened, unseeded ice, VV Finished smooth ice, VV Finished smooth ice, VH Finished smooth ice, HH
	1932 2006 2036 2040 2326 2350	-15.0	7.0				
		-15.0					
1/11	1426 1404	-10.0 -2.5	11.0 11.4	2			Sunny day; Photo R#2 - F17 & 18; Bare ice sheet
1/12	1118	-10.0					Morning run; no sun on ice; W
1/13	1247	-7.7	14.5				Sunny but no sun on ice sheet
1/14	1850			W			Water data taken rippleless
1/16	1648 1742 1757 2245	-4.0 -17 -20	1.1 3.5	3			Ice sheet #3 completely seeded; Salinity: #180 is 11 mm of ice X HH HH; Salinity: #79 is 3.5 cm ice at 0600 a.m.; #104 is top 1/2 cm
1/17	0010	-21	4.1	3			
1/19	1137						VH
1/21	1145	-14.6	-9.8				VV, mostly sunny, blowing snow
1/23	0740	-4.6	-4.9				VV, full overcast, snowing lightly, calm air
1/25	0844	-11.1	-5.4				VV, snowing, rapid fall rate, fine snow, calm air, snow was brushed off ice just before test
1/26	1350	-6.7	-6.0				VV, rough ice, snow was stuck on ice like sandpaper, ice was swept
1/28	0830	-11.1	-6.1	15.8			VV, overcast, calm air, 0.5" layer of light, fresh snow was shoveled off ice
2/1	1000	-3.8	-3.8	18.4			VV, shoveled off 2" of powder snow on surface, snow continues to fall lightly
2/2	1040	-2.5	-2.8	7.5			VV, light overcast, about 1" light, dry snow covering surface

2/4	0818	-24.1	-7.9	17.4	Clear, sunny; 1" powder snow on ice, shadows from trailer across ice
2/8	0755	-16.8	-10.9		Breezy, high, thin clouds becoming thicker; shoveled 1/8-1/4" fine windblown snow off ice
2/9	1148	-11.0			W, 19 cm thick bare ice sheet
	1210				VH
	1319		-11.0		HH
2/11					HH, ice sheet wet looking on surface, very smooth
	1155	-8.0	-4.5		VH
	1246				W, warm/sunny, sheet shaded, surface appears slightly moist
	2145	-8.0	-5.5		W, smooth ice case, roughened ice/smooth ice (each 1/2 of tank)
	2332				VV, rough ice case
2/12	0246	-8.0			W, 2 dm thick snow, rough side
	0345				W, snow covered scene, smooth side, T _{snow} = -5
	1345	2.0			VV, wet snow on middle of tank
	1638				W, wet snow
					VV, bare
2/15	0819	-7.5			W, simulated MV ice sheet
	0907	-6.0	-3.2		VH
	0940	-3.0	-1.9		HH
3/4	2435	-4.0	-5.5	32	Ice has been under tent during past 2 weeks of warm weather, runoff left a 6 cm layer of fresh water ice on top
3/8		3.9	0	32	W, ice thickness including 6 cm fresh, no snow layer; VV with a layer of snow on top of ice (14 cm), smooth surface; VV, show surface has been roughened
3/18	2245		-2.0	36	W, fresh water/sea ice composite, no snow; VH; HH

DATE : JAN. 04, 1985

SCENE: ICE SHEET #1

POLARIZATION: HH

TIME: --:--

ANGLE	FREQUENCY (GH)				
DEGREES	5.8	5.9	9.6	13.6	16.6
0.0	6.6		18.4	19.4	23.6
2.5	6.3		18.4	18.5	23.1
5.0	4.7		14.4	11.5	9.1
7.5	2.8		8.0	1.5	0.0
10.0	2.7		-1.6	-3.8	-0.2
15.0	-1.3		-8.2	-19.6	-13.4
20.0	-7.9		-19.7	-18.6	-13.7
30.0	-21.3		-28.4	-32.2	-19.8
40.0	-30.6		-29.7	-44.9	-13.8
50.0	-33.6		-38.4		-28.2

DATE : JAN. 05, 1985

SCENE: ICE SHEET #1

POLARIZATION: VV TIME: 21:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.4		16.8	20.8	25.8
2.5	3.0		15.9	19.0	21.7
5.0	3.1		11.9	10.2	7.7
7.5	1.9		2.8	-6.2	1.9
10.0	-0.1		-4.7	-1.2	0.2
15.0	-4.1		-5.2	-12.1	-10.7
20.0	-8.1		-9.9	-17.5	-10.7
25.0	-13.4		-19.0	-18.4	-12.5
30.0	-17.5		-18.4	-23.8	-12.6
35.0	-20.6		-20.5	-24.0	
40.0	-20.2		-24.9	-26.2	
45.0	-20.3		-25.4	-30.7	-19.2
50.0	-21.5				
55.0	-23.2				
60.0	-26.0				

POLARIZATION: HH TIME: 21:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.9		18.2	18.7	23.7
2.5	4.6		17.9	18.2	21.5
5.0	2.7		13.8	10.3	7.5
7.5	2.6		4.1	-3.4	-3.0
10.0	1.4		-1.4	-4.3	-4.2
15.0	-4.4		-14.4	-18.2	-13.4
20.0	-9.3		-15.9	-21.3	-10.5
25.0	-16.1		-21.7	-20.3	-14.1
30.0	-25.6		-26.8		
35.0	-29.2		-31.9		
40.0	-36.6		-28.5		
45.0	-35.7				
50.0	-38.3				

POLARIZATION: VH TIME: 21:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-32.5		-1.7	-5.1	4.7
5.0	-29.8		-8.3	-7.0	-1.2
10.0	-34.9		-10.2	-17.3	-11.5
15.0	-32.8		-20.2		-13.6
20.0	-35.8		-27.8		-17.7
25.0	-37.7		-31.7	-38.2	

DATE : JAN. 06, 1985

SCENE: ICE SHEET #1

POLARIZATION: VV TIME: 14:26

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.0		16.6	18.6	20.9
1.0	2.1		14.9	14.3	15.8
3.0	2.5		14.9	19.3	22.0
4.5	2.2		12.8	16.0	18.2
6.0	1.6		7.8	10.0	12.4
7.0	1.1		6.2	4.1	5.5
10.5	-1.2		-5.6	-0.1	3.3
12.5	-2.0		-1.4	-3.1	-3.3
15.0	-5.7		-5.2	-13.4	-12.6
19.0	-9.8		-10.9	-17.7	-18.7
25.0	-16.0		-21.2	-18.6	
30.0	-21.5		-20.5	-24.1	
35.0	-23.8		-25.3	-25.6	
40.0	-23.6		-24.7	-36.8	
45.0	-23.1		-25.9	-31.2	
50.0	-23.1				
55.0	-22.8				
60.0	-27.1				
70.0	-27.5				

POLARIZATION: HH TIME: 17:17

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.2		19.1	18.2	22.1
2.5	2.8		18.9	17.6	20.2
5.0	2.6		16.8	14.1	14.3
7.5	2.0		11.0	3.7	0.1
10.0	0.3		-0.4	-4.1	-2.9
15.0	-5.5		-10.6	-15.5	-13.2
20.0	-11.5		-18.3	-18.8	
25.0	-19.4		-20.5	-28.2	
30.0	-25.0		-23.5		
35.0	-29.8		-28.4		
40.0	-32.8				
45.0	-43.6				
50.0	-41.0				

POLARIZATION: VH TIME: 17:17

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-29.6		-1.0	-4.4	5.6
5.0	-34.2		-6.3	-3.6	0.9
10.0	-53.4		-7.9	-13.6	-8.2
15.0	-35.1		-16.6	-19.8	-20.1
20.0	-40.8		-34.7		
30.0	-43.6		-38.0		
40.0	-42.7		-33.3	-42.9	

DATE : JAN. 07, 1985

SCENE: ICE SHEET #1

POLARIZATION: VV

TIME: 10:30

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.9		18.9	20.4	25.6
2.5	1.8		17.1	15.9	18.9
5.0	1.0		9.3	2.4	5.3
7.5	0.2		-5.5	-1.3	5.3
10.0	-2.0				
12.5			-0.9	-12.8	-12.0
15.0	-6.7				
17.5			-8.2	-19.2	-11.4
20.0	-10.1				
22.5			-19.3	-15.7	-13.3
25.0	-15.0				
27.5			-19.4	-26.8	-12.4
30.0	-20.7				
32.5			-20.9	-24.4	-20.5
35.0	-25.3				
37.5			-25.9	-29.5	-14.7
40.0	-23.2				
45.0	-22.8				
50.0	-23.4				

POLARIZATION: HH

TIME: 10:30

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.0		19.1	18.9	23.9
2.5	2.7		19.2	19.3	23.6
5.0	2.1		17.5	15.3	16.5
7.5	1.3		12.1	3.4	3.7
10.0	-0.8		0.1	-3.9	-1.9
15.0	-5.7		-8.5	-17.0	-10.4
20.0	-12.0		-18.3	-21.1	-13.0
25.0	-19.2		-18.2	-20.4	-18.4
30.0	-26.4		-23.6	-25.9	-19.0
35.0	-32.0		-23.3	-25.4	-21.2
40.0	-32.5		-30.8	-30.4	-16.3
45.0	-38.8				
50.0	-42.2				

POLARIZATION: VH

TIME: 10:30

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-29.0		-1.3	-4.6	4.3
5.0	-34.3		-8.6	-2.4	4.6
10.0	-37.0		-8.4	-14.6	-9.9
15.0	-34.1		-16.8	-23.4	
20.0	-44.0		-32.8	-30.9	
30.0	-38.9		-32.5		
40.0			-32.3	-33.8	

DATE : JAN. 07, 1985

SCENE: ICE SHEET #1

POLARIZATION: VV			TIME: 14:06		
ANGLE	-----FREQUENCY (GH)-----				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.7		19.6	19.7	23.2
2.5	6.6		17.8	14.4	17.0
5.0	4.9		11.0	2.5	9.4
7.5	2.8		1.2	0.2	6.8
10.0	1.7				
12.5			-0.7	-7.9	0.7
15.0	-1.6				
17.5			-1.4	-5.8	2.7
20.0	-4.6				
22.5			-3.5	-4.8	-3.5
25.0	-9.6				
27.5			-4.9	-7.1	-1.1
30.0	-13.9				
32.5			-0.9	-2.0	-5.5
35.0	-17.0				
37.5			-4.7	-3.1	-0.1
40.0	-16.7				
42.5			-10.4	-9.4	-2.8
45.0	-17.4				

POLARIZATION: HH		TIME: 14:50			
ANGLE	-----FREQUENCY (GH)-----				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.7		18.4	17.8	19.3
2.5	6.6		18.5	18.5	19.9
5.0	6.4		15.8	15.5	15.4
7.5	5.0		10.4	8.8	3.7
10.0	3.2		-1.9	0.9	-0.2
15.0	0.3		1.3	-4.6	-3.0
20.0	-5.2		-2.2	-4.5	-0.4
25.0	-11.8		-5.2	-4.2	-0.4
30.0	-16.8		-7.0	-4.4	-0.8
35.0	-20.9			-7.4	-4.0
40.0	-24.8		-4.6	-4.7	-2.4
45.0	-30.2		-13.6	-14.9	-9.0

POLARIZATION: VH		TIME: 14:50			
ANGLE	-----FREQUENCY (GH)-----				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-29.0		-0.7	-4.1	5.1
5.0	-23.4		-5.9	-4.6	-0.5
10.0	-25.4		-6.1	-7.3	-6.3
15.0	-28.8		-8.2	-12.8	-6.2
21.0	-28.7		-11.8	-17.7	-8.5
30.0	-32.9		-15.0	-13.9	-6.7
40.0	-39.3		-17.8	-16.2	-14.3

DATE : JAN. 08, 1985

SCENE: ICE SHEET #1

POLARIZATION: VV

TIME: 10:55

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.8		17.3	16.4	11.5
2.5	6.9		16.0	16.1	15.2
5.0	6.3		9.9	7.9	11.4
7.5	4.7		2.7	5.2	9.5
10.0	3.3		-5.3	6.5	9.2
15.0	-2.5		-0.1	0.4	-4.3
21.0	-4.2		-7.8	-3.0	-3.0
25.0	-7.5		-7.2	-1.9	-9.3
30.0	-10.9		-2.1	-5.6	-3.8
35.0	-11.0		-6.9	-3.4	-8.1
40.0	-10.7		-5.9	-5.7	-12.3
45.0	-12.4		-9.9	-3.6	-6.0
51.0	-14.6		-11.9	-6.6	-6.6
55.0	-14.7		-11.4	-10.9	-7.0
60.0	-16.4		-12.1	-11.6	-10.1

POLARIZATION: HH

TIME: 09:11

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.7		18.4	19.5	23.6
3.0	6.7		19.2	19.5	22.1
4.0	6.7		19.1	20.5	25.4
8.0	4.5		8.4	4.8	11.4
10.0	2.7		4.0	6.4	14.5
13.0	-0.7		-5.7	1.6	3.4
13.5	0.0		-1.8	0.9	6.6
21.0	-3.0		-5.7	0.7	15.9
25.5	-11.8		-5.2	-5.4	-1.0
30.0	-14.1		-6.1	-4.3	-1.2
36.0	-13.5		-7.0	-3.2	-4.6
40.0	-14.6		-11.0	-8.7	-5.9
45.0	-17.5		-15.3	-12.6	-6.8
51.0	-19.9		-15.5	-13.1	-12.1
60.0	-20.9		-15.5	-19.6	-11.3

POLARIZATION: VH

TIME: 09:11

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-23.6		-3.9	-8.7	5.2
2.5	-23.7		-7.1	-13.5	0.7
5.5	-23.0		-6.6	-6.3	-2.0
11.0	-27.6		-10.3	-8.6	-5.8
15.0	-26.6		-8.2	-10.5	-6.5
19.5	-26.3		-13.9	-15.1	-6.6
30.0	-23.2		-16.6	-13.7	-9.4
40.0	-25.7		-16.6	-14.2	-13.0
50.0	-29.3		-17.5	-19.4	-16.8

DATE : JAN. 08, 1985

SCENE: OPEN WATER BETWEEN ICE SHEETS #1 & #2

POLARIZATION: VV

TIME: 16:29

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.7		19.7	21.5	27.1
2.5	6.6		18.1	21.3	18.4
5.0	6.4		14.7	14.1	
7.5					10.3
10.0	3.2		3.0	4.8	-4.4
12.5	1.3		1.9	-1.4	
13.5					-3.1
15.0					-11.2
16.0	0.4		1.1	-3.5	
17.5	-1.2		-3.0	-18.1	-11.6
20.0	-2.2		-8.3	-18.4	
23.5					-14.0
26.0	-7.4		-19.7	-16.5	
28.5					-17.1
31.0	-13.2		-15.7	-20.4	
33.5					-16.7
36.0	-15.7		-19.0	-21.0	
37.5					-15.9
40.0	-15.7		-20.8	-22.5	
44.0	-15.5		-19.6	-27.4	

DATE : JAN. 08, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV TIME: 17:43

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	6.9		19.2	21.9	26.8
2.1	6.8		18.7		
3.1				14.9	18.8
5.1	6.3		14.8		
5.6				-1.0	6.5
7.6	3.0		3.9		
8.1				2.1	1.8
10.1	2.0		-1.1		
13.1				-13.4	-8.5
15.1	-1.0		-3.1		
18.1				-18.0	-11.0
20.1	-3.8		-10.3		
23.1				-11.7	-11.3
25.1	-9.0		-19.9		
28.1				-17.6	-14.9
30.1	-12.7		-17.0		
33.1				-24.5	-15.9
35.1	-16.4		-21.2		
38.1				-34.4	-15.9
40.1	-17.7		-20.3		
45.1	-15.6		-20.7		

POLARIZATION: VV TIME: 18:22

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	6.7		19.1	22.3	26.9
2.6	6.6		18.4	18.3	21.6
5.1	6.4		16.1	-1.5	3.8
6.6				0.8	6.7
7.6	3.0		5.2	2.6	3.1
9.1	3.3		1.2		
10.1	2.0		-1.2		
13.6				-9.4	-8.7
16.1	-0.4		-2.3		
18.6				-16.8	-10.6
21.1	-3.6		-9.9		
23.1				-13.0	-10.9
25.6	-9.6		-20.8		
30.6				-17.7	-12.1
33.1	-14.0		-19.6		
33.6				-23.7	-14.4
36.1	-17.1		-21.0		
37.6				-24.8	-15.5
40.1	-16.7		-22.4		
45.1	-16.8		-24.1		
50.6	-18.5		-24.5		
56.4	-35.3				

POLARIZATION: VV TIME: 20:04

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	7.2		19.2	22.7	28.2
2.0	7.3				
3.0			17.8	19.7	21.6
5.0	7.1				
5.5			9.6	-1.1	4.0
7.5	3.8				
8.5			-6.7	2.5	5.5
10.5	3.1				
12.5			-1.3	-6.7	-11.5
14.5	-0.5				
17.0			-5.8	-19.0	-11.3
19.0	-3.0				
23.0			-19.3	-15.3	-7.8
25.0	-6.8				
27.0			-21.7	-16.5	-12.2
29.0	-13.1				
33.0			-19.7	-18.0	-17.0
35.0	-16.0				
38.0			-23.2	-26.2	
40.0	-17.2				
43.0			-26.2		-20.6
45.0	-17.0				

POLARIZATION: HH TIME: 15:06

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	7.1		19.7	21.0	26.4
3.0	7.0		19.6	20.7	26.0
6.0	6.8		16.3	14.2	13.3
8.0	5.3		9.6	1.0	2.1
11.0	3.6		-0.8	-3.4	-0.6
15.0	0.7		-7.2	-14.7	-13.3
21.0	-5.1		-18.1	-20.2	-13.0
26.0	-12.2		-20.4	-19.5	-18.4
31.0	-20.9		-27.4	-30.1	-20.3
36.0	-26.9		-30.1	-31.3	-19.5
40.0	-28.4		-29.2	-34.8	
45.0	-42.1				

DATE : JAN. 08, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV TIME: 23:00

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.4		18.9	21.0	24.5
2.5	6.3				
3.5			12.3	7.1	6.3
5.0			12.4	-4.3	1.4
7.5	2.3		-7.6	-1.3	1.2
6.0					
10.0	1.7				
12.5			3.6	-9.4	-10.6
15.0	-1.7				
18.5			-9.0	-21.9	-8.6
21.0	-5.7				
23.5			-26.6	-16.4	-12.3
26.0	-11.5				
26.5			-19.9	-24.5	
29.0	-15.2				
32.5			-20.2	-21.0	
35.0	-18.8				
37.5			-25.4		
40.0	-18.6				
45.0	-19.8				

POLARIZATION: HH TIME: 23:35

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.6		18.4	18.4	30.7
4.0	6.4		17.4	16.2	26.7
7.0	5.1		14.1	9.7	17.5
10.0	3.0		-2.3	-4.1	4.7
16.0	-2.2		-18.8	-17.5	-2.6
20.0	-5.8		-20.0	-20.0	-2.4
26.0	-14.7		-22.3	-22.5	
31.0	-23.6		-26.7	-26.7	
35.0	-27.3		-27.5	-30.0	
39.0	-29.3		-29.1		
44.0	-34.3		-30.0		

DATE : JAN. 09, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV		TIME: 12:42			
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.7		16.4	21.5	25.8
2.5	2.3		15.0	19.5	22.2
4.5			10.7	22.7	11.7
5.0	1.6				
7.0	0.5				
7.5			-0.9	-1.0	3.2
10.0	-0.8				
12.5			-5.3	-10.2	-1.5
15.0	-6.3				
16.5			-9.3	-13.7	-8.1
19.0	-7.7				
23.5			-24.9	-16.9	-6.8
26.0	-16.1				
28.5			-22.8	-18.1	-10.4
31.0	-21.1				
31.5			-19.7	-16.3	-12.8
34.0	-22.4				
37.5			-24.0	-15.0	-10.1
40.0	-23.5				
42.5			-21.3	-19.3	-12.9
45.0	-23.2				
48.5			-25.2	-17.8	-14.2
51.0	-32.6				

POLARIZATION: HH			TIME: 11:11		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.9		16.7	19.7	24.5
2.5	3.3		16.3	17.8	20.6
5.0	2.9				
9.0			-3.2	-2.4	-0.7
11.5	-0.2				
12.5			-11.0	-10.8	-5.3
15.0	-3.9				
17.5			-15.0	-18.7	-12.8
20.0	-9.9				
22.5			-23.5	-22.1	-10.6
25.0	-17.0				
27.5			-21.8	-21.2	-13.1
30.0	-23.6				
32.5			-19.5	-21.9	-12.2
35.0	-29.2				
38.5			-27.9	-20.7	-13.7
41.0	-30.3				
42.5			-26.4	-27.4	-14.3
45.0	-31.0				
47.5			-28.1	-43.1	-16.0
50.0	-34.6				

DATE : JAN. 09, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV TIME: 18:43

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.6		17.3	20.3	20.8
2.5	2.2		14.0	12.9	10.4
5.0	1.2		5.0	-4.8	-2.6
7.5	-0.3		-5.7	-2.4	0.9
10.0	-1.6				
12.5			-5.5	-12.2	-5.7
15.0	-6.2				
17.5			-10.0	-9.2	-10.6
20.0	-11.7				
22.5			-18.2	-10.3	-8.6
25.0	-16.0				
27.5			-18.6	-11.3	-11.2
30.0	-21.5				
32.5			-20.5	-12.9	-12.6
35.0	-24.2				
37.5			-19.4	-11.6	-13.0
40.0	-27.3				
42.5			-20.9	-14.6	-11.5
45.0	-29.5				
50.0	-30.3				

POLARIZATION: HH TIME: 19:32

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.5		17.3	17.9	19.4
2.5	2.2		14.7	12.3	25.9
5.0	2.4		8.4	-1.9	
7.5	1.6		-3.6	-5.0	1.7
10.0	0.3				
12.5			-9.2	-7.6	-5.9
15.0	-5.6				
17.5			-15.2	-12.2	-7.3
20.0	-10.3				
22.5			-19.4	-15.2	-14.0
25.0	-17.2				
27.5			-22.4	-13.9	-12.2
30.0	-24.7				
32.5			-22.1	-14.5	-9.6
35.0	-27.0				
37.5			-21.4	-15.6	-14.5
40.0	-31.7				
42.5			-26.9	-22.4	-21.1
45.0	-31.9				

POLARIZATION: VH TIME: --:--

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-29.9		-8.8	1.0	-0.7
2.5	-28.6		-1.5	-5.5	0.5
5.0	-32.3		-0.6	-5.6	-1.9
10.0	-35.8		-9.8	-15.3	-8.3
20.0	-38.8		-25.3	-29.2	-13.1
30.0	-39.8		-30.8	-27.7	-17.2
40.0			-29.4	-32.7	-14.6

DATE : JAN. 09, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV

TIME: 20:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.9		16.6	18.8	21.3
2.5	1.8		15.2	15.2	17.0
5.0	2.2		10.6	8.1	9.5
7.5	1.2		-1.4	-4.3	-1.2
10.0	-0.9				
12.5			-6.6	-9.8	-4.5
15.0	-7.3				
17.5			-8.2	-6.4	1.0
20.0	-11.7				
22.5			-11.5	-2.8	-5.9
25.0	-15.9				
27.5			-7.5	-8.1	-5.9
30.0	-20.0				
32.5			-8.7	-15.3	-5.8
35.0	-24.4				
37.5			-16.3	-7.4	-1.8
40.0	-21.6				
42.5			-14.8	-10.9	-8.9
45.0	-15.9				

POLARIZATION: HH

TIME: 20:06

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.9		14.9	17.2	19.9
2.5	2.7		14.7	13.9	13.6
5.0	2.3		11.9	9.1	6.4
7.5	1.9		-1.7	-4.0	-2.9
10.0	-0.3				
12.5			-8.5	-9.4	-7.5
15.0	-6.2				
17.5			-10.2	-6.7	-0.6
20.0	-11.8				
22.5			-11.5	-3.8	-7.3
25.0	-17.6				
27.5			-6.6	-11.1	-7.6
30.0	-24.4				
32.5			-10.1	-13.5	-6.6
35.0	-26.5				
37.5			-16.3	-9.2	-5.6
40.0	-29.4				
42.5			-16.4	-11.0	-7.4
45.0	-23.1				

POLARIZATION: VH

TIME: 20:36

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-24.0		2.2	-5.7	0.7
10.0	-35.1		-13.8	-12.9	-8.9
20.0	-40.7		-29.0	-22.4	-8.8
30.0	-36.6		-23.7	-21.7	-12.3
40.0			-27.6	-23.0	-13.2

DATE : JAN. 09, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV TIME: 23:26

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.0		16.7	20.7	25.1
2.5	2.8		14.9	16.6	19.9
5.0	3.0		9.7	7.9	10.4
7.5	1.9		-5.3	-1.7	5.2
10.0	-0.4				
12.5			-6.3	-9.3	-14.0
15.0	-5.3				
17.5			-9.8	-18.6	-20.5
20.0	-8.2				
22.5			-16.0	-14.7	-18.0
25.0	-13.4				
27.5			-17.3	-31.5	
30.0	-19.5				
32.5			-15.7		
35.0	-21.3				
37.5			-19.5		
40.0	-23.1				
45.0	-32.9				
50.0	-33.0				

POLARIZATION: HH TIME: --:--

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.4		17.1	19.0	24.3
2.5	3.1		13.8	14.9	16.7
5.0	3.2		7.5	4.4	5.1
7.5	2.3		-1.7	-4.1	-0.6
10.0	0.6				
12.5			-14.8	-14.2	-12.9
15.0	-4.3				
17.5			-18.4	-18.7	-14.9
20.0	-9.8				
22.5			-18.4	-17.7	-10.1
27.5			-21.2	-35.7	-10.5
30.0	-22.4				
32.5			-17.6	-23.1	-15.1
35.0	-27.2				
37.5			-23.9	-27.1	-15.6
40.0	-34.1				
42.5			-26.1	-19.5	-17.7
45.0	-37.5				

POLARIZATION: VH TIME: 23:50

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-19.2		-5.2	4.4	8.9
10.0	-25.8		-10.3	-12.9	-4.2
20.0	-34.1		-22.9	-24.2	-15.8
30.0			-36.5		
40.0			-33.0	-34.4	

DATE : JAN. 11, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV TIME: 14:26

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.1		16.8	21.8	25.6
2.5	2.4		16.6	21.1	24.3
5.0	2.2		1.8	-1.2	5.4
7.5	0.3		-7.0	0.8	4.1
10.0	-0.6				
12.5			-4.6	-8.0	-15.7
15.0	-5.3				
17.5			-9.7	-18.0	-11.6
20.0	-7.8				
22.5			-11.3	-17.9	-14.6
25.0	-9.2				
27.5			-18.2	-16.7	
30.0	-20.6				
32.5			-20.6	-23.8	
35.0	-21.4				
37.5			-23.5	-19.8	
40.0	-32.4				
42.5			-27.8	-49.9	
45.0	-32.3				

POLARIZATION: HH TIME: 14:04

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.7		16.6	20.0	24.9
2.5	2.1		16.5	19.4	23.3
5.0	2.6		14.7	16.1	16.7
7.5	1.8		9.2	6.4	4.7
10.0	0.1		-5.5	-3.8	-1.9
15.0	-4.4		-6.3	-18.7	-10.4
20.0	-11.9		-21.8	-18.4	-15.8
25.0	-17.7		-24.6	-26.0	-14.3
30.0	-25.8		-26.7	-20.0	
35.0	-32.4		-26.4	-23.4	-17.0
40.0	-34.9		-25.9	-23.8	-19.8
45.0	-30.1		-27.4	-27.9	

POLARIZATION: VH TIME: 14:26

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-28.7		-1.0	-6.0	5.9
10.0	-34.9		-8.5	-16.7	-8.7
20.0	-34.7		-33.8	-36.2	
40.0			-34.7		

DATE : JAN. 12, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV

TIME: 11:18

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.2	3.9	17.7	22.4	26.1
2.5	3.0	3.6	14.6	17.2	18.2
5.0	2.3	3.5	1.6	-2.1	3.7
7.5	0.8	1.2	-8.7	-1.5	3.2
10.0	-0.1	-0.0			
12.5			-5.7	-7.7	-12.3
15.0	-4.7	-4.7			
17.5			-9.4	-18.0	-8.1
20.0	-8.6	-8.2			
22.5			-21.3	-16.4	-11.2
25.0	-12.2	-13.0			
27.5			-19.7	-17.6	-16.7
30.0	-16.8	-18.1			
32.5			-20.8	-25.3	-23.7
35.0	-21.4	-20.9			
37.5			-27.1	-20.8	
40.0	-23.9	-21.6			
42.5			-25.5	-33.6	
45.0	-24.6	-22.7			
47.5			-26.1	-17.7	-26.2
50.0	-24.0	-23.3			

DATE : JAN. 13, 1985

SCENE: ICE SHEET #2

POLARIZATION: VV		TIME: 12:47				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	3.8		18.2	22.1	26.1	
2.5	3.7		16.6	20.1	20.5	
5.0	3.4		9.9	7.4	2.3	
7.5	2.4		-5.4	-1.6	2.5	
10.0	-0.6					
12.5			-5.7	-7.8	-8.7	
15.0	-4.7					
17.5			-10.9	-18.8	-14.5	
20.0	-10.5					
22.5			-20.2	-13.3	-14.3	
25.0	-14.2					
27.5			-19.2	-21.6		
30.0	-20.3					
32.5			-18.7	-24.6		
35.0	-25.6					
37.5			-24.8	-23.2		
40.0	-25.5					
42.5			-25.9	-31.6		
45.0	-28.8					

POLARIZATION: VH		TIME: 12:47				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	-21.7		-6.7	1.8	4.7	
10.0	-30.8		-11.7	-13.6	-5.4	
20.0	-32.3		-17.5	-18.4		
30.0			-34.7			
40.0			-34.7			

DATE : JAN. 14, 1985

SCENE: OPEN WATER BETWEEN ICE SHEETS #1 & #2

POLARIZATION: VV TIME: 18:50

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	6.2	8.1	21.5	23.9	33.0
2.5	5.3	7.2	18.9	19.2	20.9
5.0	5.4	7.0	15.2	6.6	8.8
7.5	5.1	6.6	-0.8	4.4	8.3
10.0	3.7	4.5			
12.5			2.0	-4.5	-4.6
15.0	0.9	1.9			
17.5			-5.1	-18.1	-7.4
20.0	-2.8	-1.3			
22.5			-18.3	-13.2	-16.5
25.0	-5.9	-6.0			
27.5			-16.3	-17.7	-15.1
30.0	-11.6	-12.2			
32.5			-15.9	-23.7	
35.0	-14.8	-14.3			
37.5			-21.0	-25.6	
40.0	-16.6	-13.6			
45.0	-16.0	-14.5			

POLARIZATION: HH TIME: 18:50

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	5.4	6.6	21.4	21.6	29.3
1.0			20.8	21.5	27.1
2.5	5.5	6.7			
3.5			19.2	18.6	21.6
5.0	5.6	6.8			
6.0			14.7	7.8	6.0
7.5	5.5	6.7			
8.5			3.3	0.5	1.9
10.0	4.9	5.6			
13.5			-6.6	-13.6	-9.9
15.0	1.8	1.9			
18.5			-18.6	-25.0	-12.0
20.0	-7.4	-3.4			
23.5			-18.6		-7.2
25.0	-7.7	-10.2			
28.5			-29.2		-12.8
30.0	-13.7	-17.1			
33.5					-15.4
35.0	-21.2	-24.3			
38.5					-23.0
40.0	-26.3	-26.2			
45.0	-32.4	-32.9			

POLARIZATION: VH TIME: 18:50

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-23.8	-24.6	2.9	1.9	10.6
2.5	-25.4	-23.0	-1.9	-0.1	9.9
5.0	-27.1	-23.3	-6.1	1.6	8.3
7.5	-25.6	-25.0	-3.4	-2.5	5.2
10.0	-27.0	-28.0	-1.5	-9.6	-3.9
20.0	-36.6	-34.3	-22.3		-14.1
30.0	-54.5	-49.1			
40.0		-40.6			

DATE : JAN. 16, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV TIME: 16:48

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	5.9	7.5	19.3	21.5	26.0
2.6	5.9	7.6	17.3	17.8	17.4
5.1	5.3	6.9	9.6	2.0	0.4
7.6	1.9	3.9	-6.1	2.0	3.1
5.1					
10.1	0.1	0.5	-0.8	0.6	0.9
11.6			-3.8	-5.4	-13.3
12.6	0.2	0.5			
14.1	-0.9	-0.6			
15.1			-5.3	-15.9	
17.6	-3.7	-2.3	-7.1	-19.0	-10.1
20.1	-5.9	-4.6			
22.6			-19.5	-17.4	-12.3
25.1	-8.5	-9.2			
27.6			-19.1	-19.2	-12.8
30.1	-14.0	-15.2			
32.6			-19.5	-23.2	-14.4
35.1	-17.5	-17.8			
37.6			-23.1	-24.6	-17.4
40.1	-21.1	-17.4			
42.6			-25.5	-30.9	-14.6
45.1	-20.8	-17.6			

POLARIZATION: HH TIME: 17:57

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	5.7	6.9	18.5	18.6	22.3
2.6	5.6	6.7	17.8	16.4	18.1
5.1	5.4	6.3	14.7	11.9	8.9
7.6	3.7	4.5	7.5	0.9	-2.3
10.1	1.4	2.8	-3.2	-3.2	-3.4
15.1	-0.6	-1.1	-11.9	-18.0	-11.2
20.1	-6.1	-7.6	-21.9	-24.7	-11.7
25.1	-11.4	-13.7	-23.8	-23.5	-19.2
30.1	-18.3	-22.1	-26.0	-29.1	-17.2
35.1	-24.3	-26.8	-32.0	-29.9	-17.2
40.1	-28.3	-30.9	-27.9	-31.4	-16.1
45.1			-31.7	-51.7	-12.8

POLARIZATION: HH TIME: 22:45

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.5	5.2	18.7	18.2	20.8
3.0	4.4	5.1	18.4	17.5	18.6
6.0	4.1	4.6	15.3	11.2	8.1
7.5	3.3	3.6	7.5	-0.7	-5.0
10.0	2.1	2.1	-2.9	-6.6	-6.2
15.0	-1.2	-1.9	-11.4	-15.1	-18.2
20.0	-8.1	-9.4	-17.3	-19.1	-16.3
25.0	-12.5	-15.1	-18.4	-19.5	-22.8
30.0	-17.4	-21.5	-22.9	-24.8	
35.0	-25.4	-29.4	-27.8	-29.4	
40.0	-36.3	-37.4	-26.1	-29.7	
45.0		-45.6	-29.3	-31.2	

POLARIZATION: VH TIME: 17:42

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-21.9	-19.6	-4.0	-4.2	5.1
5.0	-22.7	-23.1	-1.8	-4.9	-1.0
10.0	-24.1	-25.9	-6.5	-13.1	-4.6
20.0	-32.5	-30.0	-20.1	-23.4	-13.7
30.0	-42.5	-40.8	-26.6	-27.5	-14.9
40.0			-30.7		-14.2

SCENE: ICE SHEET #3

POLARIZATION: VH		TIME: 00:10			
ANGLE	-----FREQUENCY (GH)-----				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0			-8.5	-1.3	2.1
5.0			-3.0	-5.3	-3.9
10.0			-7.4	-12.6	-8.3
20.0			-25.3	-25.5	-14.1
30.0			-28.5	-30.3	-18.0
40.0			-31.6	-40.9	-13.6

DATE : JAN. 19, 1985

SCENE: ICE SHEET #3

POLARIZATION: VH

TIME: 11:37

ANGLE	-----FREQUENCY (GH)-----				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-18.1		3.6	-1.7	4.9
2.5	-17.1		1.4	-8.5	1.3
5.0	-18.9		0.2	5.4	7.3
9.0	-22.9		-9.6	-5.4	7.7
15.0	-27.3		-18.2	-20.9	-12.2
20.0	-28.4		-24.0	-26.3	-14.9
30.0	-44.3			-34.9	
40.0	-42.0		-34.2		-13.3

DATE : JAN. 21, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 11:45

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.7		17.4	20.8	23.9
2.5	3.3		15.5	17.1	19.2
2.5	3.3		15.5	17.1	19.2
5.0	2.9		6.7		3.4
7.5	1.7		-6.4	-2.1	3.6
10.0	0.7				
12.5			-3.6	-9.4	-9.6
15.0	-4.3				
17.5			-9.2	-15.3	-8.3
20.0	-8.4				
22.5			-19.4	-9.4	-7.9
25.0	-12.0				
27.5			-17.0	-11.8	-5.4
30.0	-25.6				
32.5			-13.3	-9.1	-4.5
35.0	-32.0				
37.5			-12.5	-13.9	-7.9
40.0	-42.6				
42.5			-15.1	-10.2	
45.0	-27.6				

DATE : JAN. 23, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 07:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	5.9		20.1	23.1	28.8
2.5	5.9		15.0	13.0	15.0
5.0	4.2		8.9	-0.7	6.8
7.5	3.6		-1.4	1.2	7.4
10.0	2.3				
12.5			-1.5	-9.6	-8.4
15.0	-2.0				
17.5			-6.5	-10.9	-8.6
20.0	-5.5				
22.5			-17.0	-16.2	-12.4
25.0	-9.2				
27.5			-14.9	-13.4	-7.4
30.0	-13.1				
32.5			-15.7	-14.7	-12.0
35.0	-17.7				
37.5			-21.4	-21.7	-11.5
40.0	-24.8				
42.5			-17.4	-18.5	-6.3
45.0	-25.5				

DATE : JAN. 25, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV		TIME: 08:44				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	2.4		16.8	20.9	24.0	
2.5	2.9		16.0	19.5	21.9	
5.0	2.0		9.9	9.1	10.8	
7.5	1.0		-0.6	-5.5	3.1	
10.0	-0.8		-3.5	-1.7	-1.8	
15.0	-6.3		-6.2	-13.4	-12.3	
20.0	-9.6		-10.1	-16.0	-14.2	
25.0	-14.0		-20.3	-10.7		
30.0	-17.4		-16.0	-18.1		
35.0	-22.2		-22.9	-20.9		
40.0	-25.2		-20.9	-21.9		
45.0	-26.9		-22.0	-20.2		

DATE : JAN. 26, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 13:50

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.6		17.9	22.4	30.3
2.5	3.3		16.5	19.1	22.3
5.0	1.9		13.7	13.9	15.9
7.5	2.0		4.7	-0.3	4.8
10.0	0.3		-7.2	1.6	4.6
15.0	-5.3		-3.1	-13.1	-2.7
20.0	-8.7		-7.8	-13.3	-7.7
25.0	-12.4		-16.7	-16.7	-5.8
30.0	-17.4		-17.1	-19.4	-8.3
35.0	-20.8		-18.4	-18.2	-6.0
40.0	-23.6		-18.1	-17.4	-7.2
45.0	-24.1		-17.6	-18.6	-7.1

DATE : JAN. 28, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 08:30

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.5		17.7	21.3	36.7
2.0	3.1				
2.5			16.8	20.0	22.1
4.5	2.9				
5.0			11.1	8.9	11.2
7.0	2.1				
7.5			-1.1	-1.0	7.8
9.5	1.0				
10.0			-3.2	0.1	0.1
12.0	-0.5				
15.0			-3.8	-21.4	-7.9
17.0	-6.0				
20.0			-13.6	-18.9	-15.5
22.0	-10.3				
25.0			-21.9	-16.0	
27.0	-13.9				
30.0			-22.2		
32.0	-19.0				
35.0			-22.8	-19.5	
37.0	-23.0				
40.0			-21.3	-19.4	
42.0	-27.6				
45.0			-23.2	-21.8	
47.0	-30.5				

DATE : FEB. 01, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 10:00

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	5.1		19.8	23.0	27.8
2.5	4.8		16.7	18.5	20.3
5.0	4.1		9.6	2.7	6.6
7.5	3.7		2.9	-0.4	6.4
10.0	2.7		-2.3	1.6	4.5
15.0	-2.7		-2.7	-9.3	-4.6
20.0	-6.1		-10.2	-20.8	-5.2
25.0	-10.2		-17.8	-19.3	-6.8
30.0	-14.5		-18.4	-30.0	-6.8
35.0	-18.5		-20.0	-21.0	-5.2
40.0	-26.5		-22.6	-21.5	-10.1
45.0	-28.0		-19.2	-17.9	-7.4

DATE : FEB. 02, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV			TIME: 10:40		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.5		8.5	2.7	6.2
2.0	1.5				
2.5			4.6	-3.5	3.1
4.5	0.4				
5.0			-0.9	0.5	6.2
7.0	-0.7				
7.5			-5.5	-9.5	3.6
9.5	-1.4				
10.0			-2.8		
12.0	-4.3				
12.5				-19.3	-10.4
15.0			-6.6		
17.0	-9.8				
17.5				-12.6	-5.2
20.0			-10.8		
22.0	-12.3				
22.5				-12.0	-8.2
25.0			-14.9		
27.0	-15.0				
27.5				-17.8	-7.5
30.0			-13.4		
32.0	-17.7				
32.5				-12.1	-9.1
35.0			-14.3		
37.0	-19.6				
37.5				-12.0	-6.6
40.0			-13.6		
42.0	-19.0				
42.5				-18.6	-6.4
47.0	-21.3				

DATE : FEB. 04, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 08:18

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.4		18.3	20.6	24.5
2.0	4.2				
2.5			18.2	19.2	22.5
4.5	3.9				
5.0			12.8	8.6	10.2
7.0	3.3				
7.5			2.6	-4.6	6.0
9.5	2.1				
10.0			-3.4	0.4	-6.4
12.0	0.7				
15.0			-3.4	-9.5	-9.0
17.0	-3.1				
20.0			-10.8	-18.0	-3.1
22.0	-7.5				
25.0			-19.2	-10.4	-6.9
27.0	-10.6				
30.0			-16.4	-15.7	-9.4
32.0	-15.9				
35.0			-19.5	-11.4	-4.5
37.0	-19.9				
40.0			-16.6	-17.8	-7.7
42.0	-27.6				
45.0			-22.0	-14.0	-10.6
47.0	-30.2				

DATE : FEB. 08, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV			TIME: 07:55		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.0		17.3	20.4	24.4
2.0	3.8				
2.5			16.5	18.8	21.0
4.5	3.2				
5.0			13.5	10.7	11.1
7.0	2.6				
7.5			0.8	-1.5	3.8
9.5	1.2				
10.0			-2.6	-3.2	-0.5
12.0	0.0				
15.0			-6.0	-21.2	-11.2
17.0	-5.2				
20.0			-22.2	-19.8	-12.8
22.0	-12.4				
25.0			-17.8	-21.5	-14.0
27.0	-17.9				
30.0			-22.8	-23.4	-13.1
32.0	-21.4				
35.0			-23.2	-20.4	-11.7
37.0	-21.3				
40.0			-24.1	-24.1	-11.2
42.0	-23.3				
45.0			-25.2	-25.0	-13.6
47.0	-34.1				

DATE : FEB. 09, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV			TIME: 11:48		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.6	5.8	16.6	20.0	22.7
2.0	3.4	5.4			
3.0			12.2	10.0	11.0
5.0	2.5	4.1			
5.5			5.3	-4.5	3.5
7.5	1.8	3.1			
8.0			-3.2	-1.1	3.4
10.0	0.5	1.6			
10.5			-0.8	-7.2	-3.5
12.5	-1.5	-0.5			
13.0					-10.3
13.5			-5.9	-11.3	
15.0	-3.5	-2.1			
18.0			-14.6	-27.0	-12.5
20.0	-8.5	-6.3			
23.0			-21.9	-21.6	
25.0	-12.8	-12.3			
28.0			-19.9	-30.6	
30.0	-16.6	-16.0			
33.0			-23.8	-27.1	
35.0	-21.2	-19.9			
38.0			-27.0	-30.1	
40.0	-23.6	-20.2			
43.0			-27.0	-28.4	
45.0	-30.9	-28.7			
40.0					

POLARIZATION: HH			TIME: 13:19		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.7	5.0	16.8	19.3	24.2
2.0	3.5	4.8	16.7	19.0	24.4
5.0	2.9	3.0	13.8	14.0	14.0
7.5	2.5	3.5	8.9	2.1	3.8
10.0	1.4	2.2	0.2	-3.4	2.5
15.0	-2.4	-2.0	-14.3	-14.2	-13.0
20.0	-10.1	-11.6	-21.5	-27.4	-19.6
25.0	-14.7	-16.2	-22.1	-23.5	-33.9
30.0	-20.4	-23.1	-21.8	-28.0	
35.0	-28.7	-30.0	-21.1	-29.5	
40.0	-33.9	-31.3	-29.9	-27.4	-20.7
45.0	-32.8	-30.8	-31.4	-29.1	

POLARIZATION: VH		TIME: 12:10				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	-20.1	-18.3	-8.8	-2.1	5.8	
2.5	-20.1	-20.6	-5.2	-5.9	2.9	
5.0	-22.1	-22.4	-5.0	-8.6	-5.7	
10.0	-26.3	-24.4	-8.7	-14.6	-7.9	
20.0	-31.6	-30.6	-16.6	-19.1	-15.2	
30.0		-50.0	-33.7		-20.9	
35.0	-38.4	-35.8	-23.9	-24.4	-21.5	
40.0	-53.3	-45.4	-35.0			

DATE : FEB. 11, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV		TIME: 12:46				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	3.8	6.1	17.8	19.6	23.0	
2.5	3.3	5.3	16.3	16.1	18.9	
5.0	1.3	3.8	7.9	1.0	1.3	
7.5	1.3	2.8	-1.2	-4.9	-0.7	
10.0	0.2	1.0	-3.2	-3.9	-1.3	
12.5	-2.4	-1.6	-1.4	-7.9	-9.1	
15.0	-4.7	-3.4	-5.4	-18.6	-11.3	
17.5	-7.1	-5.0	-8.4	-29.2	-8.2	
20.0	-9.4	-6.6	-11.6	-18.0	-9.4	
25.0	-13.3	-12.8	-21.7	-17.8	-17.2	
30.0	-18.4	-18.2	-18.9	-19.4	-18.5	
35.0	-22.6	-17.9	-23.5	-24.3	-23.4	
40.0	-23.9	-19.2	-24.8	-24.0	-16.4	

POLARIZATION: VV			TIME: 21:45		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	3.3	5.6	17.2	20.9	24.8
2.5	2.7	4.9	15.5	19.1	21.3
5.0	1.8	3.8	10.1	10.0	11.2
7.5	0.6	1.9	-5.6	-2.3	2.5
10.0	-0.4	0.4	-5.1	-2.3	2.5
15.0	-5.9	-4.1	-9.6	-8.3	-14.6
20.0	-9.4	-7.0	-16.0	-19.4	-9.8
25.0	-12.8	-13.1	-22.0	-15.4	-17.5
30.0	-17.4	-18.1	-18.9	-25.8	-24.4
35.0	-17.6	-20.0	-25.1	-19.2	-18.4
40.0	-23.2	-19.5	-25.7	-25.1	-20.2
45.0	-22.8	-41.7	-25.0	-26.4	

POLARIZATION: VV			TIME: 23:32		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.7	5.0	15.5	17.0	18.9
2.0	2.4	4.7	14.6	15.6	16.8
5.0	1.4	3.3	8.6	4.1	0.4
7.5	-0.1	1.3	-5.5	-0.3	-0.6
10.0	-1.4	0.2	-5.4	-3.7	2.8
15.0	-6.3	-4.0	-7.1	-10.5	-1.0
20.0	-8.9	-7.1	-9.8	-5.6	-5.7
25.0	-13.4	-13.0	-6.6	-4.7	-4.4
30.0	-15.9	-16.3	-8.8	-6.8	-2.8
35.0	-17.9	-16.7	-5.4	-7.7	-3.0
40.0	-20.0	-15.8	-10.5	-11.9	-5.5
45.0	-19.0	-14.2	-10.1	-10.8	-12.1
50.0	-18.0	-12.4	-9.6	-8.5	-8.6
55.0			-13.8	-9.6	

DATE : FEB. 11, 1985

SCENE: ICE SHEET #3

POLARIZATION: HH		TIME: --:--				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	3.4	4.8	17.9	21.0	26.8	
2.0	3.1	4.7	17.1	20.8	26.7	
5.0	1.3	3.0	12.7	14.2	17.3	
7.5	1.9	3.5	8.1	6.3	9.7	
10.0	0.3	1.4	-4.4	-3.6	-0.6	
15.0	-4.7	-4.5	-18.8	-15.5	-12.1	
20.0	-9.4	-9.4	-20.1	-19.0	-22.7	
25.0	-16.5	-17.1	-22.9	-17.0	-18.3	
30.0	-21.7	-23.1	-22.4	-19.9		
35.0	-27.0	-26.4	-26.3	-27.1		
40.0	-32.1	-31.1	-27.1	-26.6		
45.0	-31.7	-30.4	-29.2	-26.4		

POLARIZATION: VH			TIME: 11:55		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-30.9	-29.0	-11.2	-10.6	5.8
5.0	-30.8	-30.5	-8.0	-7.8	3.4
10.0	-30.8	-33.1	-9.5	-20.8	-10.1
15.0	-41.7	-34.4	-22.5		
20.0	-36.2	-35.5	-27.5		
25.0	-41.7	-37.5	-39.4		
30.0					-17.8
40.0		-47.5			-17.7

DATE : FEB. 12, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV			TIME: 02:46		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	4.3	5.3	8.4	9.7	12.5
2.1	3.8	4.8			
2.6			8.1	8.3	12.5
4.6	3.3	4.4			
5.1			3.1	-1.2	9.3
7.1	1.4	3.3			
7.6			-1.5	-3.3	1.5
9.6	-0.1	1.4			
10.1			-5.8	-4.9	-2.8
12.1	-0.7	-0.5			
15.1			-7.8	-12.2	-3.6
17.1	-2.2	-8.0			
20.1			-7.6	-14.2	-7.5
22.1	-4.8	-5.6			
25.1			-10.2	-7.6	-8.1
27.1	-8.2	-11.7			
30.1			-8.7	-11.0	-5.7
32.1	-11.8	-13.2			
35.1			-5.4	-10.9	-4.3
37.1	-16.2	-14.6			
40.1			-10.0	-14.0	-6.4
42.1	-17.2	-15.1			
45.1			-10.3	-12.7	-7.2
47.1	-20.1	-16.0			
50.1			-11.2	-11.2	-11.2
52.1	-19.1	-15.3			

POLARIZATION: VV			TIME: 03:45		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.1	2.0	4.3	12.5	15.5	15.8
2.1	1.8	3.9	11.3	14.8	15.6
4.1	1.3	3.0			
5.1			1.4	3.5	1.6
7.1	0.1	2.0			
7.6			-2.1	-3.9	0.9
9.6	-1.5	0.8			
10.1			-4.0	-2.4	-8.4
12.1	-3.3	-1.5			
15.1			-5.7	-3.4	-3.3
17.1	-6.5	-7.8			
20.1			-6.7	1.1	0.5
22.1	-9.2	-6.6			
25.1			-7.7	-7.4	-5.0
27.1	-11.1	-8.8			
30.1			-6.0	-9.5	-7.2
32.1	-14.3	-11.0			
35.1			-10.8	-9.8	-5.2
37.1	-15.9	-13.7			
40.1			-12.7	-9.2	-10.2
42.1	-15.5	-15.0			
45.1			-12.4	-13.3	-13.2
47.1	-15.9	-18.6			
50.1			-13.4	-7.9	-12.2
52.1	-18.6	-17.2			

POLARIZATION: VV		TIME: 13:45				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	2.8	5.7	11.4	13.0	16.5	
3.0	1.3	3.7	3.0	2.1	6.5	
5.5	0.9	2.4	0.9	-2.4	7.9	
8.0	-0.7	-0.9	-1.8	-1.1	6.3	
13.0	-4.3	-4.3	-6.2	-2.5	1.3	
18.0	-7.1	-4.6	-6.2	-3.2	-2.4	
23.0	-9.9	-7.3	-4.3	-5.9	-7.9	
28.0	-12.2	-10.8	-11.2	-10.7	-8.1	
33.0	-12.7	-11.1	-10.6	-9.2	-5.7	
38.0	-15.4	-12.1	-9.2	-9.8	-7.0	
43.0	-14.8	-12.3	-9.9	-10.4	-11.2	
48.0	-16.3	-13.6	-11.6	-13.1	-10.6	

POLARIZATION: VV			TIME: 16:38		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.2	5.1	9.8	10.9	14.3
5.0	1.9	4.2	2.8	1.0	5.1
10.0	-0.1	-0.6	0.1	-2.6	4.7
15.0	-3.5	-4.5	-6.7	-2.2	4.8
20.0	-7.2	-5.1	-5.6	-3.5	-6.9
30.0	-11.4	-10.0	-15.0	-9.2	-3.2

DATE : FEB. 12, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: --:--

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	4.4	6.5	18.1	20.6	25.4
5.0	3.6	5.8	14.9	14.7	18.0
10.0	0.9	2.2	-3.8	-0.6	5.4
15.0	-3.3	-1.5	-5.1	-12.0	-7.1
20.0	-6.5	-4.3	-13.8	-7.2	-5.4
30.0	-16.3	-17.1	-17.5	-19.8	-9.3

DATE : FEB. 15, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV TIME: 08:19

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.8	4.0	14.9	17.8	21.2
2.5	1.5	3.4	8.5	8.3	10.9
5.0	0.3	1.3	-1.5	-5.8	4.6
7.5	-1.0	-0.7	-3.7	-5.6	-0.8
10.0	-2.5	-2.6			
12.5			-7.1	-8.7	-8.1
15.0	-7.0	-6.9			
17.5			-10.6	-2.6	-5.5
20.0	-9.7	-9.3			
22.5			-16.3	-10.1	-10.0
25.0	-12.6	-13.1			
27.5			-13.2	-14.4	
30.0	-16.0	-16.7			
32.5			-14.9	-16.5	-15.6
35.0	-19.1	-18.9			
37.5			-14.3	-16.0	
40.0	-21.4	-21.2			
42.5			-20.0	-24.4	-17.6
45.0	-23.9	-22.5			
47.5			-24.1	-21.7	
50.0	-25.8	-23.9			

POLARIZATION: HH TIME: 09:40

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	2.1	3.0	15.5	8.3	20.5
2.0	1.8	2.7			
2.5			13.9	6.4	16.7
4.5	1.6	1.9			
5.0			8.4	-1.9	5.6
7.0	1.0	0.5			
7.5			2.7	3.0	4.2
9.5	0.1	-0.8			
10.0			-1.2	2.8	4.8
12.0	-1.2	-1.9			
15.0			-8.7	-5.4	-7.5
17.0	-4.7	-5.0			
20.0			-8.9	-12.2	-7.7
22.0	-9.0	-8.9			
25.0			-11.8	-19.8	-11.3
27.0	-13.6	-13.6			
30.0			-15.9	-18.4	-11.1
32.0	-18.2	-16.8			
35.0			-18.4	-20.2	-20.3
37.0	-21.0	-21.8			
40.0			-19.9	-18.6	-15.7
42.0	-20.9	-24.4			
45.0			-20.1	-25.5	-19.2
47.0	-21.8	-24.6			

POLARIZATION: VH TIME: 09:07

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	-31.8	-29.0	-9.2	-3.0	2.1
2.0	-32.9	-30.7	-11.0	-11.0	1.7
4.0	-33.0	-33.0	-9.0	-12.4	-2.1
7.0	-34.6	-35.6		-13.8	-7.7
12.0		-38.6	-14.6	-18.6	-11.2
17.0	-41.9	-48.5	-21.2	-20.4	-11.8
22.0		-41.6	-22.9	-26.5	-12.9
27.0	-45.3	-40.9	-25.2	-27.3	-15.6
32.0		-50.5	-28.7	-39.7	
42.0	-41.8	-40.2	-30.5		-28.7

DATE : MAR. 04, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV

TIME: 24:35

ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.8		15.2	17.0	19.7
2.5	1.2		13.4	13.2	16.2
5.0	0.4		8.8	0.9	5.1
7.5	-0.8		-0.7	-4.7	0.9
10.0	-2.8		-7.0	-5.1	-3.4
15.0	-6.5		-5.2	-11.2	-4.0
20.0	-10.9		-10.1	-6.1	-7.7
25.0	-15.2		-16.9	-11.6	-11.6
30.0	-17.6		-16.0	-14.4	
35.0	-23.3		-20.0	-15.5	-15.6
40.0	-24.6		-19.8	-21.7	
45.0	-26.0		-24.7	-24.2	

DATE : MAR. 08, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV			TIME: --:--		
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	0.3		14.5	14.4	18.0
10.0	-4.1		-5.2	-8.1	-9.4
20.0	-14.0		-9.2	-10.1	-12.1
30.0	-19.6		-16.4	-18.6	-15.8
40.0	-24.6		-20.2	-31.7	-15.0

POLARIZATION: VV		TIME: --:--				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	-7.5		4.7	4.3	11.8	
5.0	-5.4		-0.5	9.0	10.6	
10.0	-4.5		0.5	-4.5	2.1	
15.0	-9.3		-3.7	-11.9	-0.5	
20.0	-8.2		-5.7	-9.8	-3.9	
25.0	-7.8		-15.7	-11.6	-10.7	
30.0	-8.9		-16.4	-16.9	-14.1	
35.0	-14.0		-11.6	-12.0	-7.2	
40.0	-17.7		-13.3	-14.4	-10.3	
45.0	-17.9		-15.9	-19.4	-11.1	

POLARIZATION: VV		TIME: --:--				
ANGLE	FREQUENCY (GH)					
DEGREES	5.0	5.9	9.6	13.6	16.6	
0.0	-11.1		-6.2	-4.3	-5.9	
5.0	-6.8		6.9	1.2	6.0	
10.0	-7.3		-3.5	-8.8	-4.8	
15.0	-9.2		-2.7	-7.2	-4.6	
20.0	-8.9		-7.5	-11.2	-1.5	
25.0	-10.8		-5.5	-6.7	-5.1	
30.0	-11.1		-8.4	-11.2	-2.3	
35.0	-10.8		-6.7	-11.8	-5.9	
40.0	-12.9		-10.1	-8.8	-5.4	
45.0	-14.2		-10.8	-14.7	-8.1	

DATE : MAR. 18, 1985

SCENE: ICE SHEET #3

POLARIZATION: VV TIME: 22:45

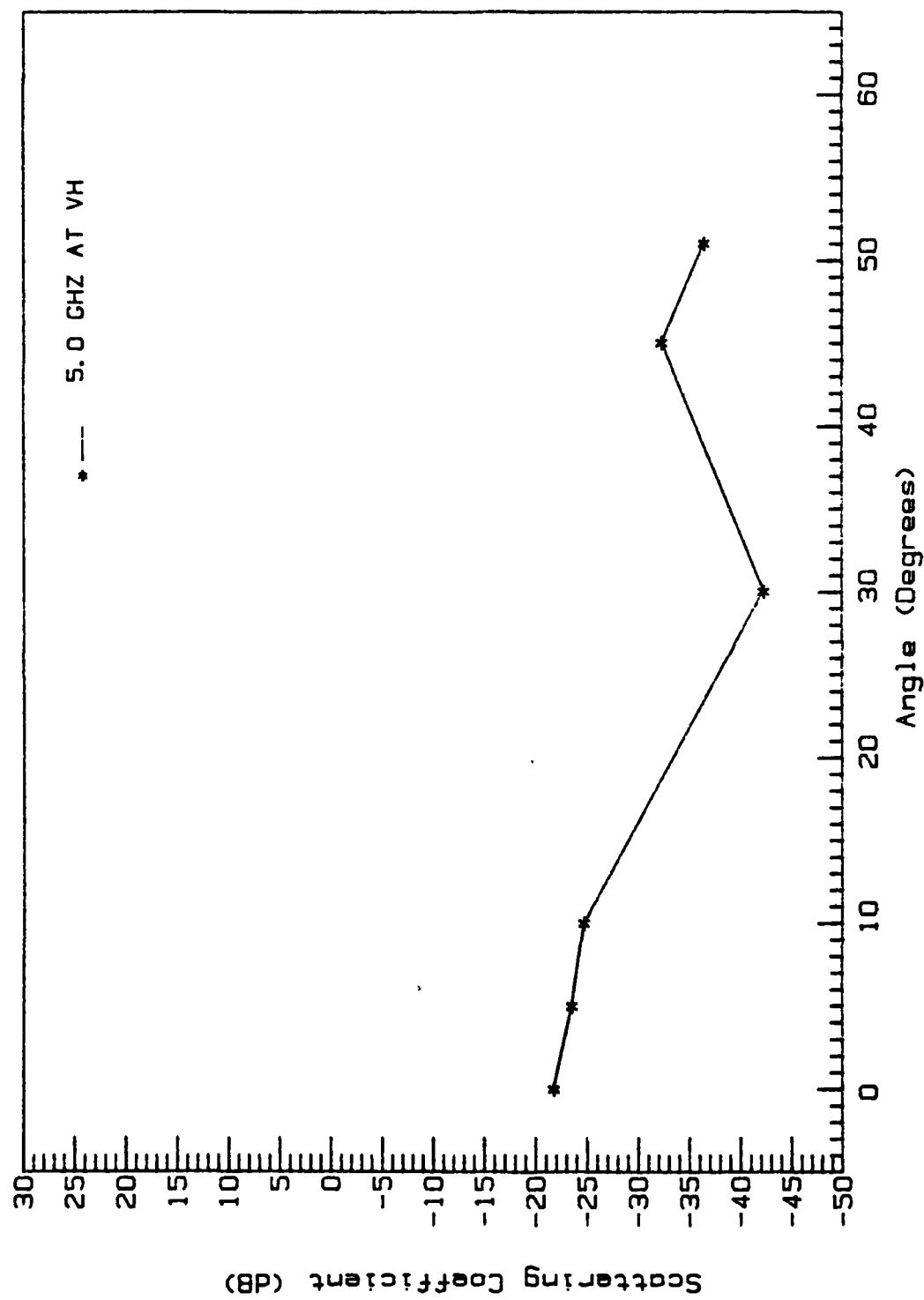
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	1.6	3.7	12.6	10.1	15.3
2.5	0.0	2.2	8.9	8.2	7.6
4.5			1.4		6.5
5.0	-3.3	-1.6		-6.1	
7.0	-6.9	-6.3		-3.1	
7.5			-7.4		-2.5
10.0	-13.0	-14.4		-1.1	
12.5			-9.7		-6.7
15.0	-13.2	-13.3		-11.0	
17.5			-13.3		-9.3
20.0	-16.5	-17.5		-11.9	
22.5			-15.0		-6.9
25.0	-15.6	-15.8		-12.8	
27.5			-16.3		-7.8
30.0	-22.3	-20.1		-17.8	
32.5			-16.7		-8.6
35.0	-21.5	-19.1		-14.1	
37.5			-17.5		-13.1
40.0	-21.1	-19.3		-16.5	
42.5			-22.2		-12.3
45.0	-21.5	-20.5		-17.5	

POLARIZATION: HH TIME: --:--

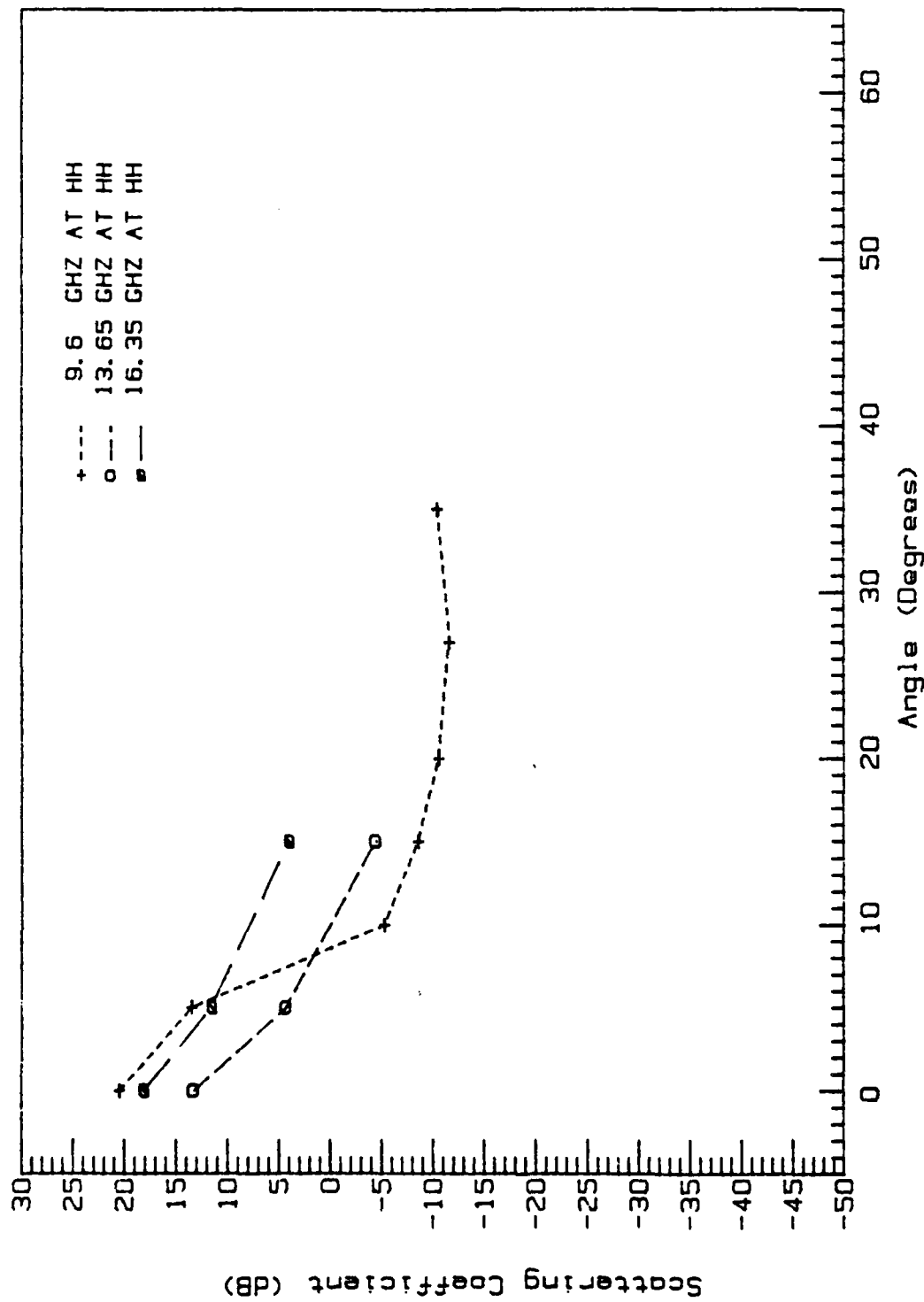
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0	0.2	1.7	12.8	6.2	14.8
2.5	-1.4	0.1	11.3	1.4	11.0
5.0	-5.3	-5.1	4.5	-5.4	4.6
7.5	-9.5	-12.0	-4.4	-3.8	0.7
10.0	-13.9	-15.6	-10.5	-6.4	-5.7
15.0	-14.2	-16.1	-13.8	-13.7	-6.2
20.0	-16.1	-18.9	-13.6	-13.7	-8.1
25.0	-17.9	-21.0	-17.0	-13.0	-8.9
30.0	-23.5	-22.3	-17.2	-18.8	-10.5
35.0	-23.9	-22.7	-16.9	-15.1	-12.3
40.0	-22.7	-21.8	-19.2	-17.9	-10.0
45.0	-25.2	-24.2	-21.7	-19.2	-26.7

POLARIZATION: VH TIME: --:--

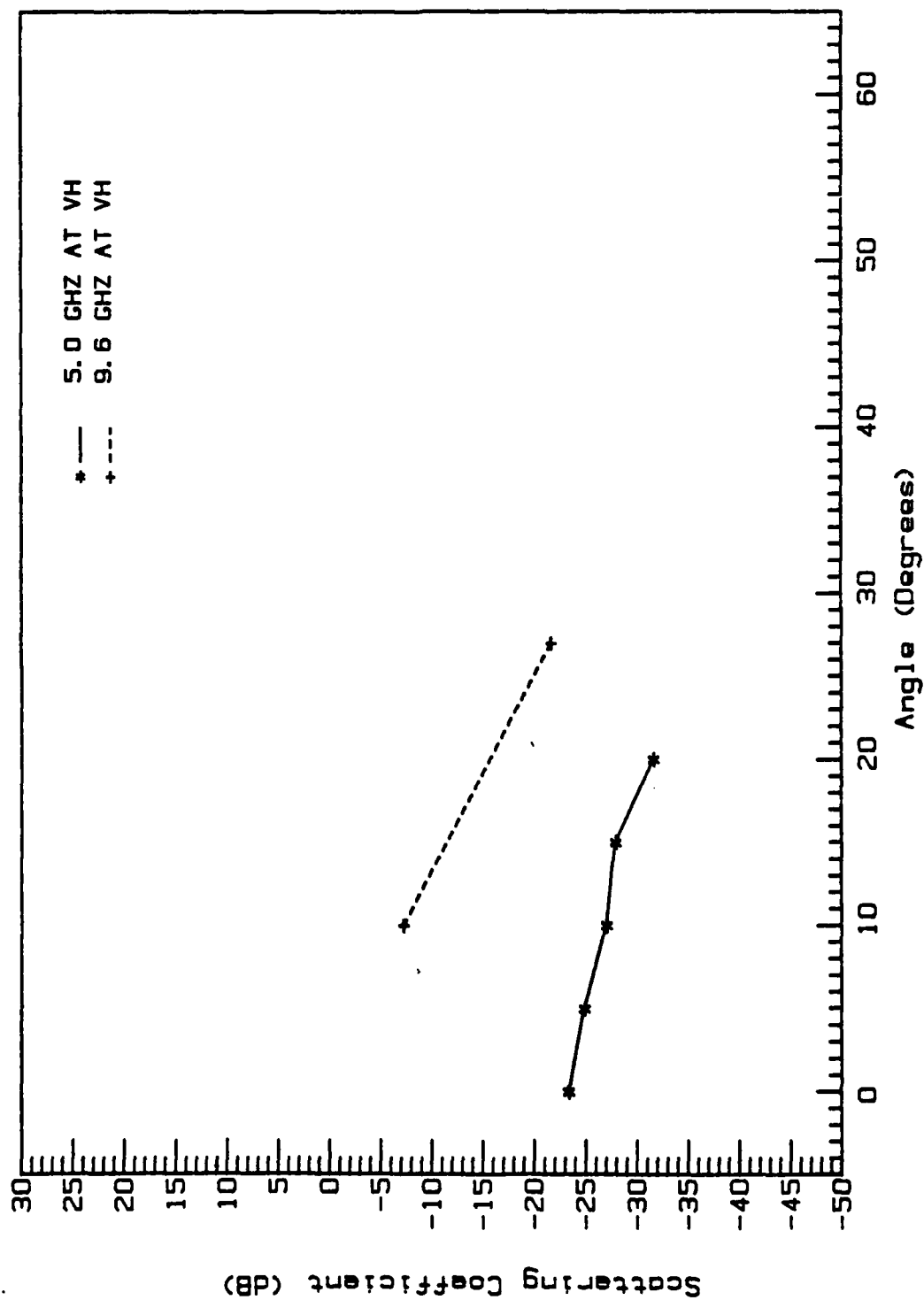
ANGLE	FREQUENCY (GH)				
DEGREES	5.0	5.9	9.6	13.6	16.6
0.0			-11.4	-8.1	-1.8
5.0			-11.6	-15.3	-5.2
10.0			-22.3	-19.0	-11.7
20.0			-28.0	-30.2	-12.0
30.0			-29.5	-29.7	-15.8
40.0			-28.2	-25.3	-23.0



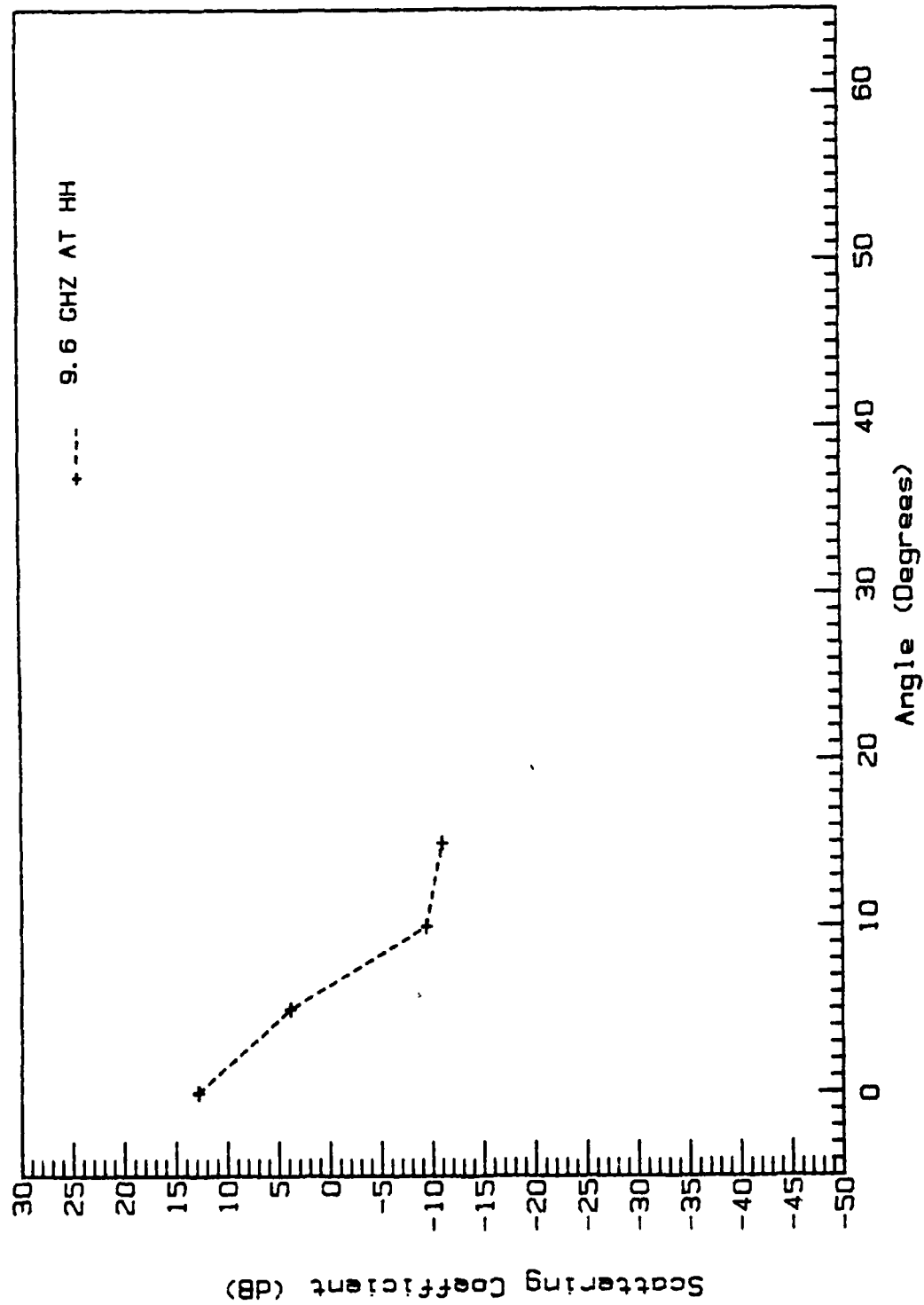
SIGMA OF WATER SURFACE, JAN. 17, CRREL-84



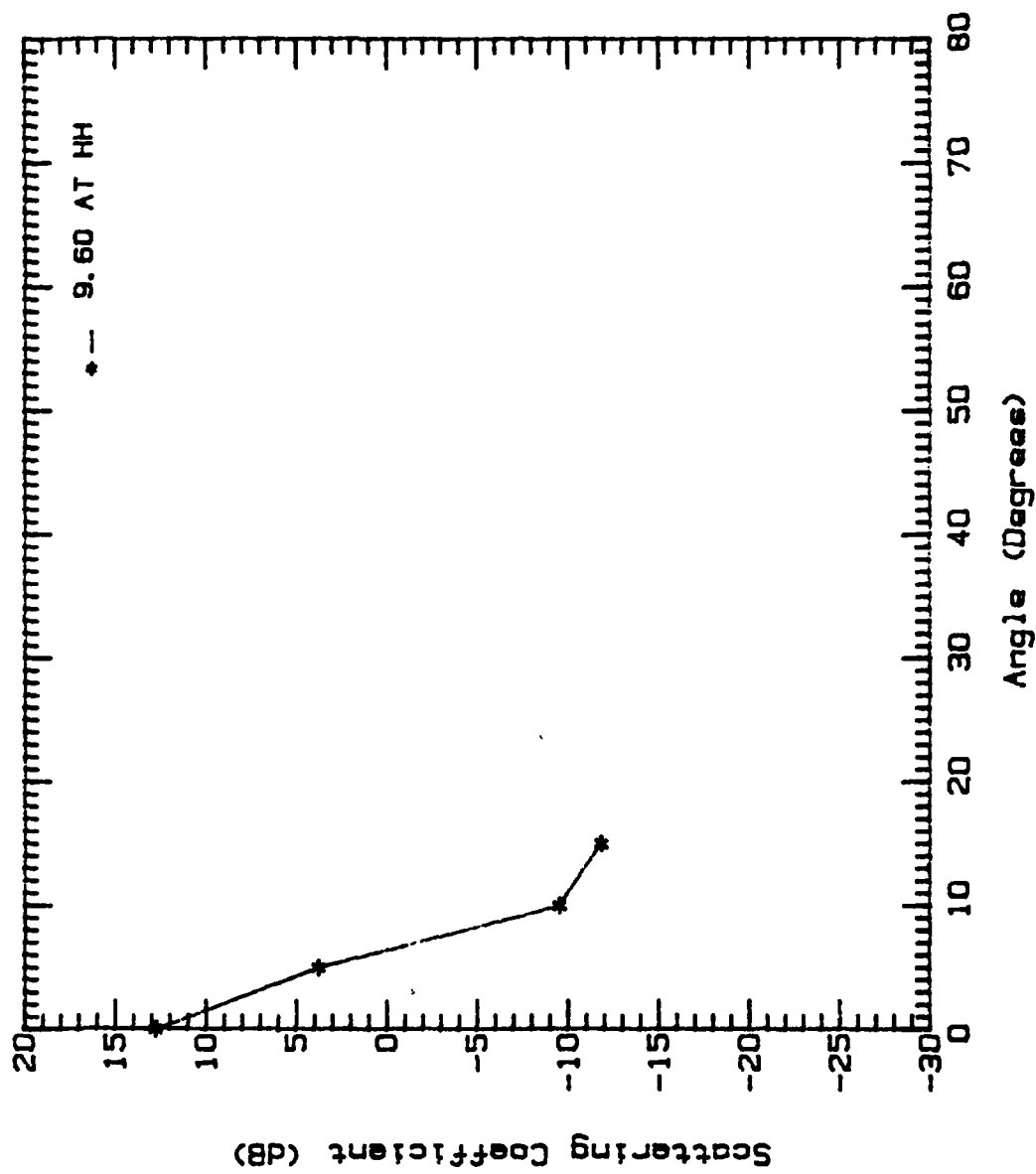
SIGMA OF SHEET ICE, JAN. 17, CRREL-84



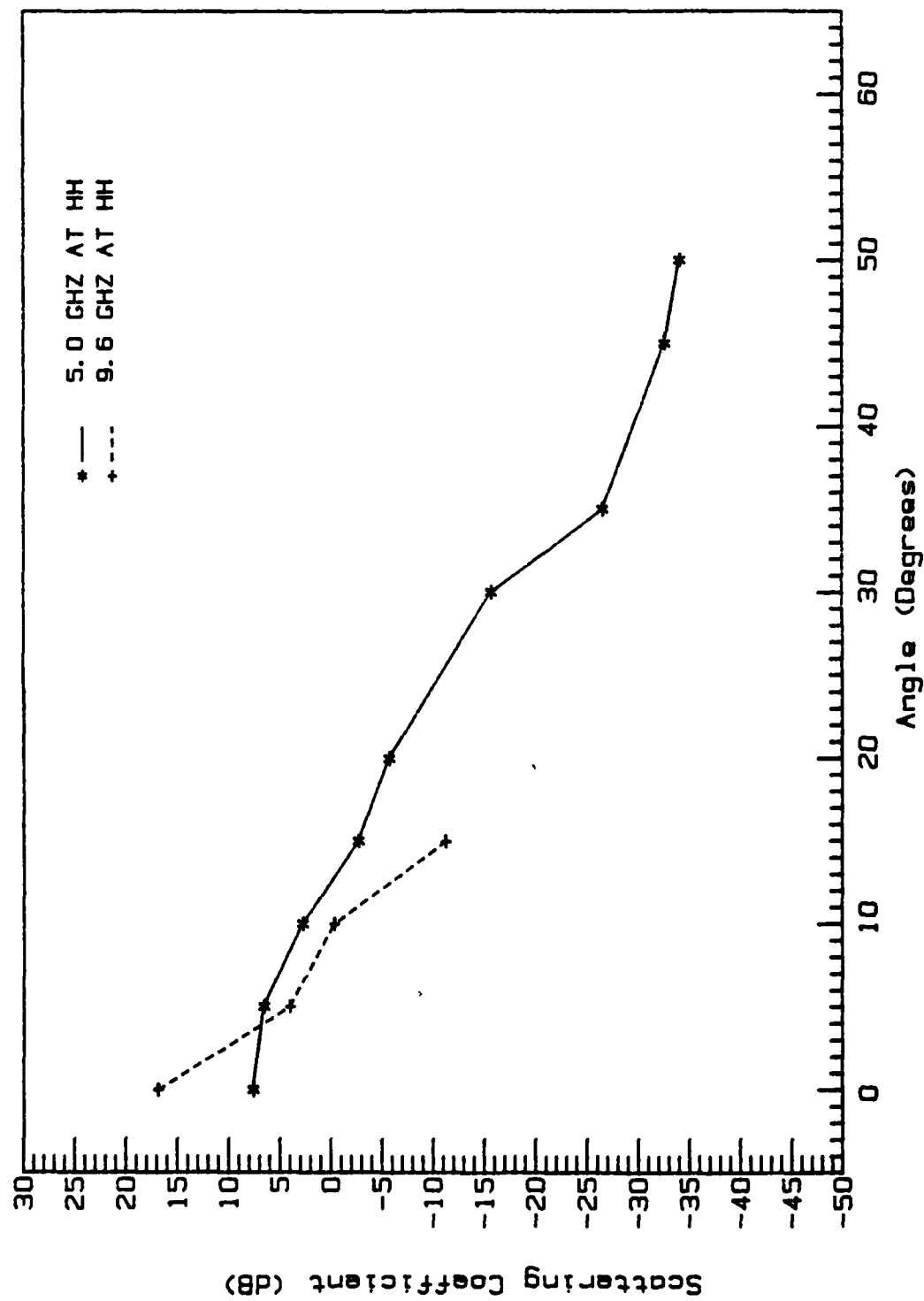
SIGMA OF SHEET ICE, JAN. 17, CRREL-84



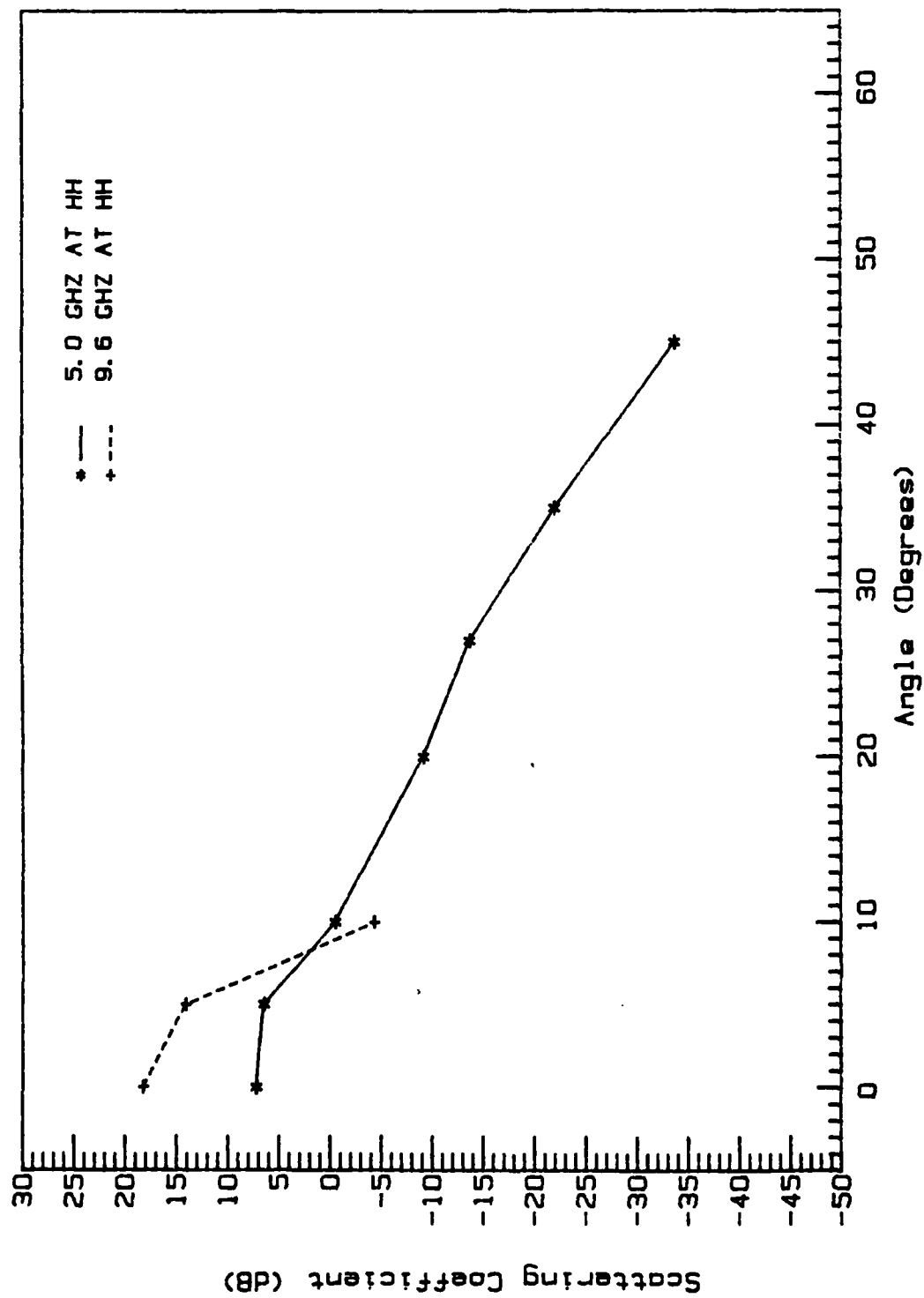
SIGMA OF SHEET ICE. JAN. 18. CRREL-84



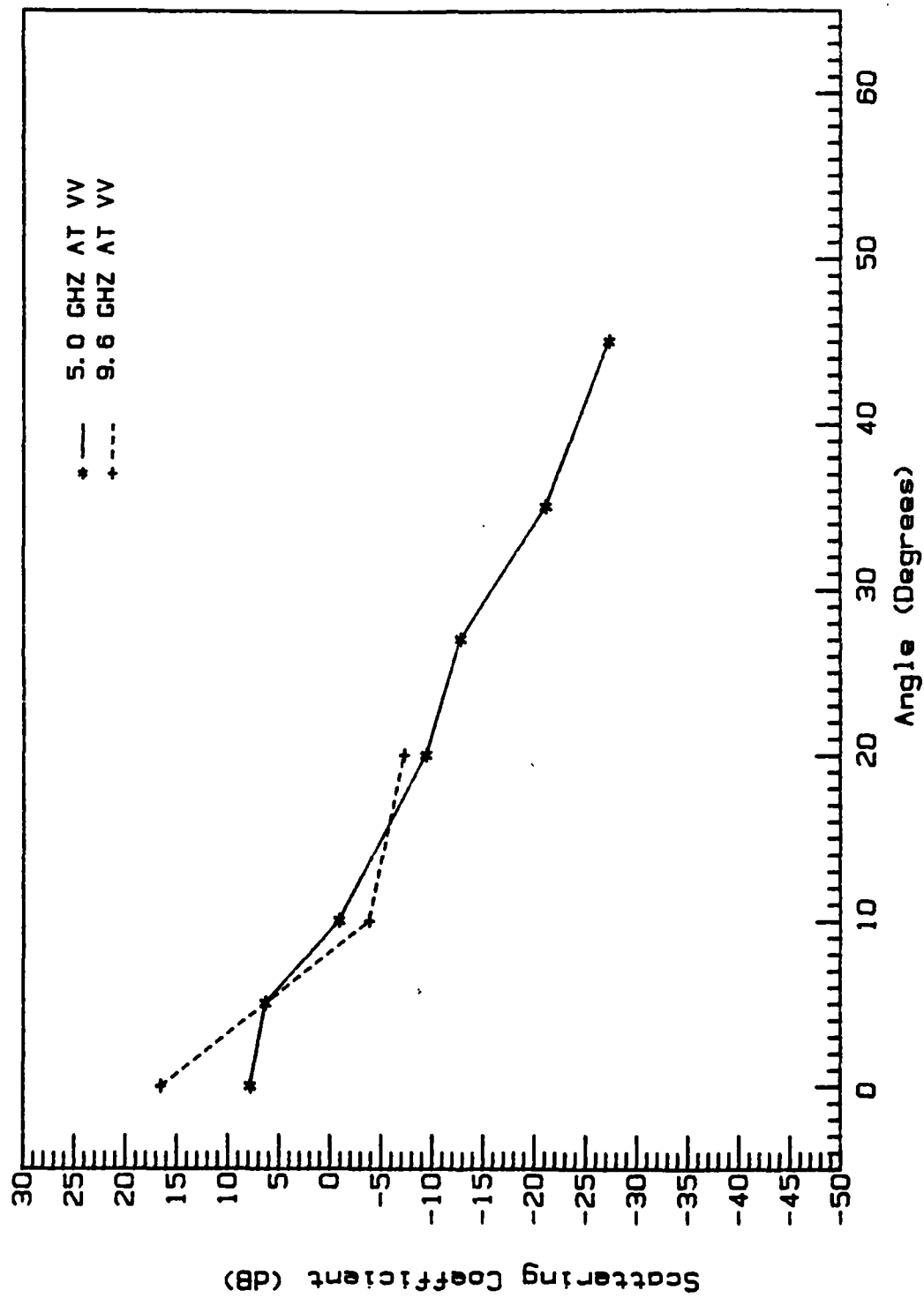
CRREL 84, JAN. 18, 1984



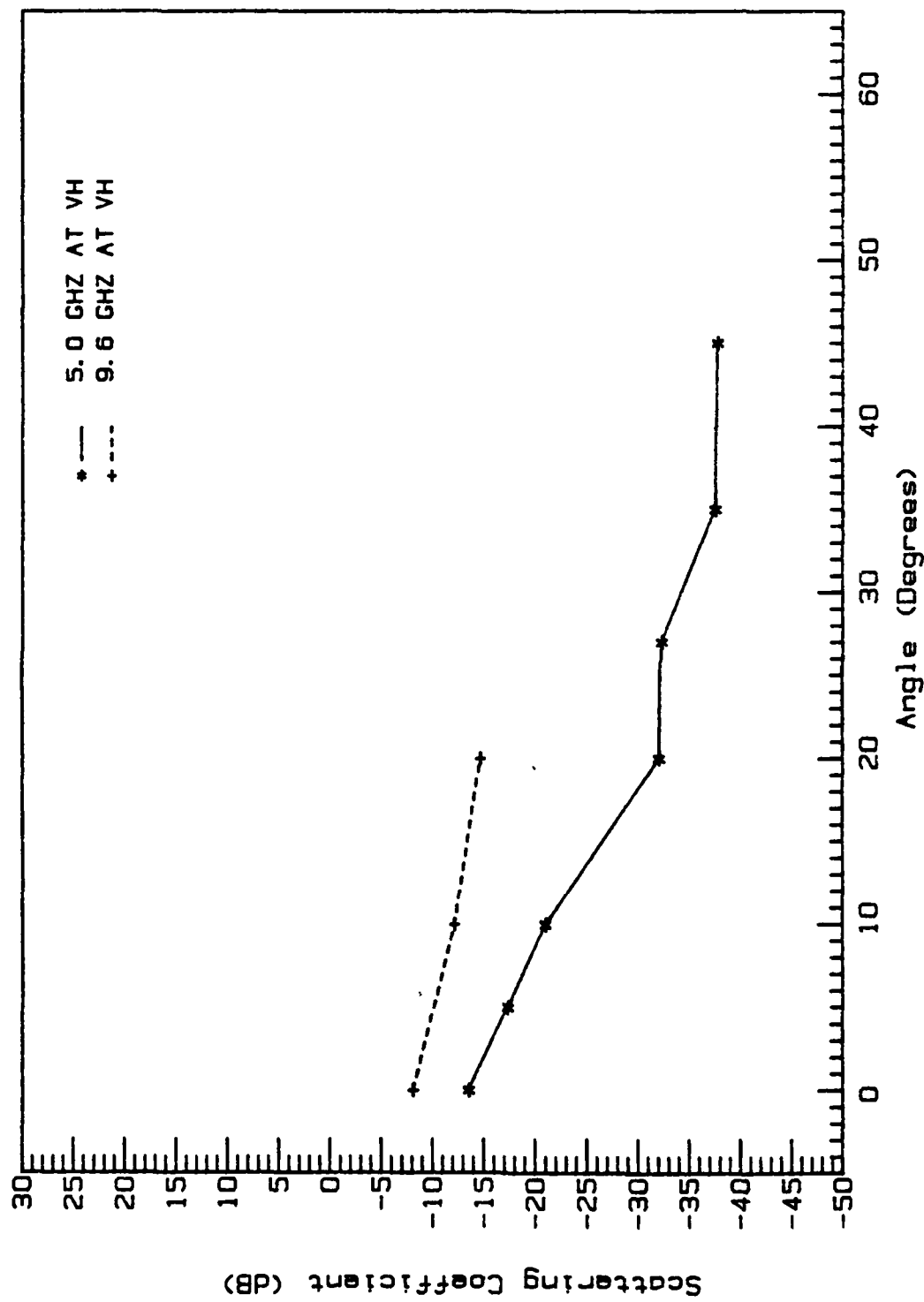
SIGMA OF SHEET ICE (SCENE 1). JAN. 19. CRREL-84



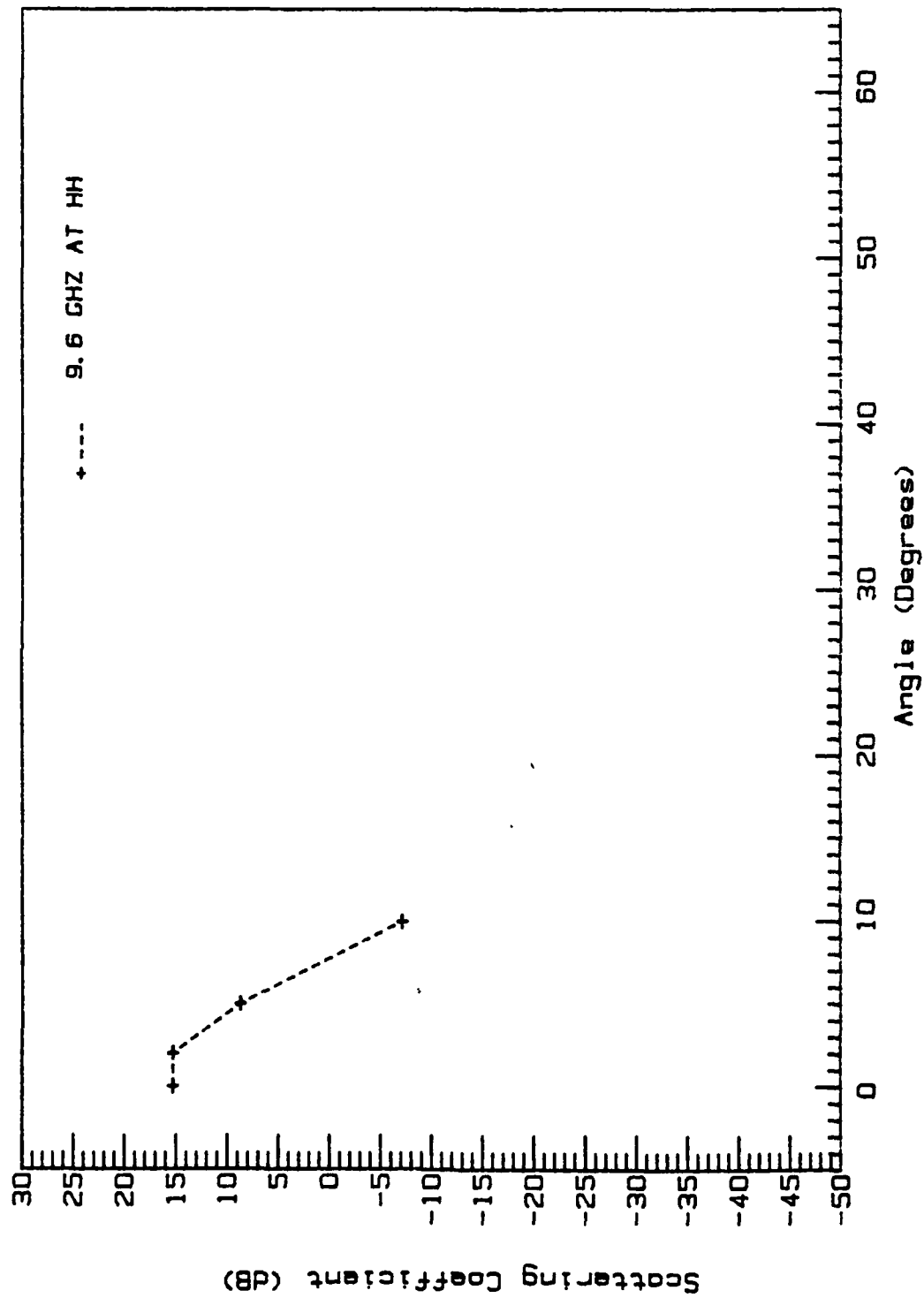
SIGMA OF SHEET ICE (SCENE 2), JAN. 19, CRREL-84



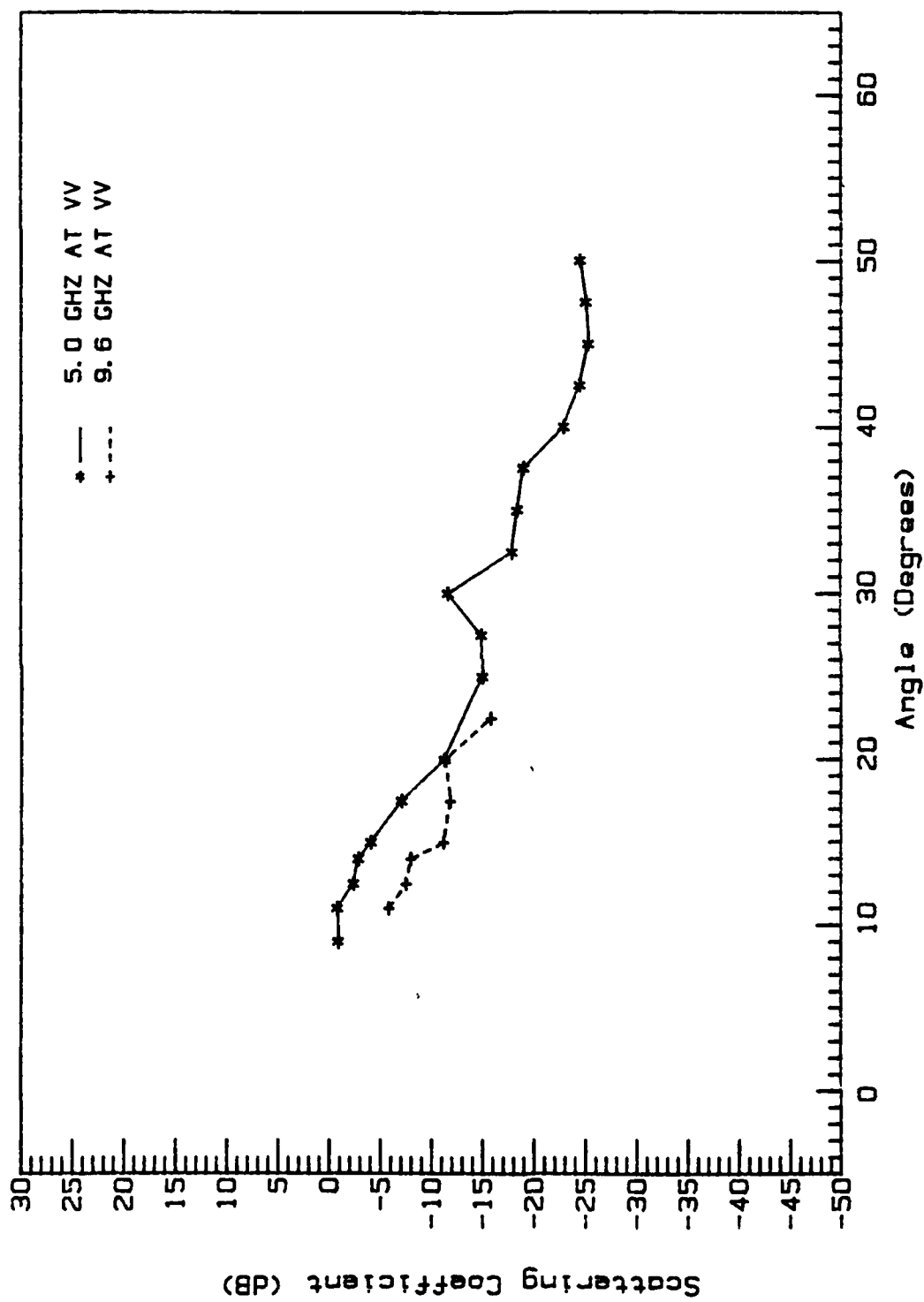
SIGMA OF SHEET ICE (SCENE 2), JAN. 19, CRREL-84



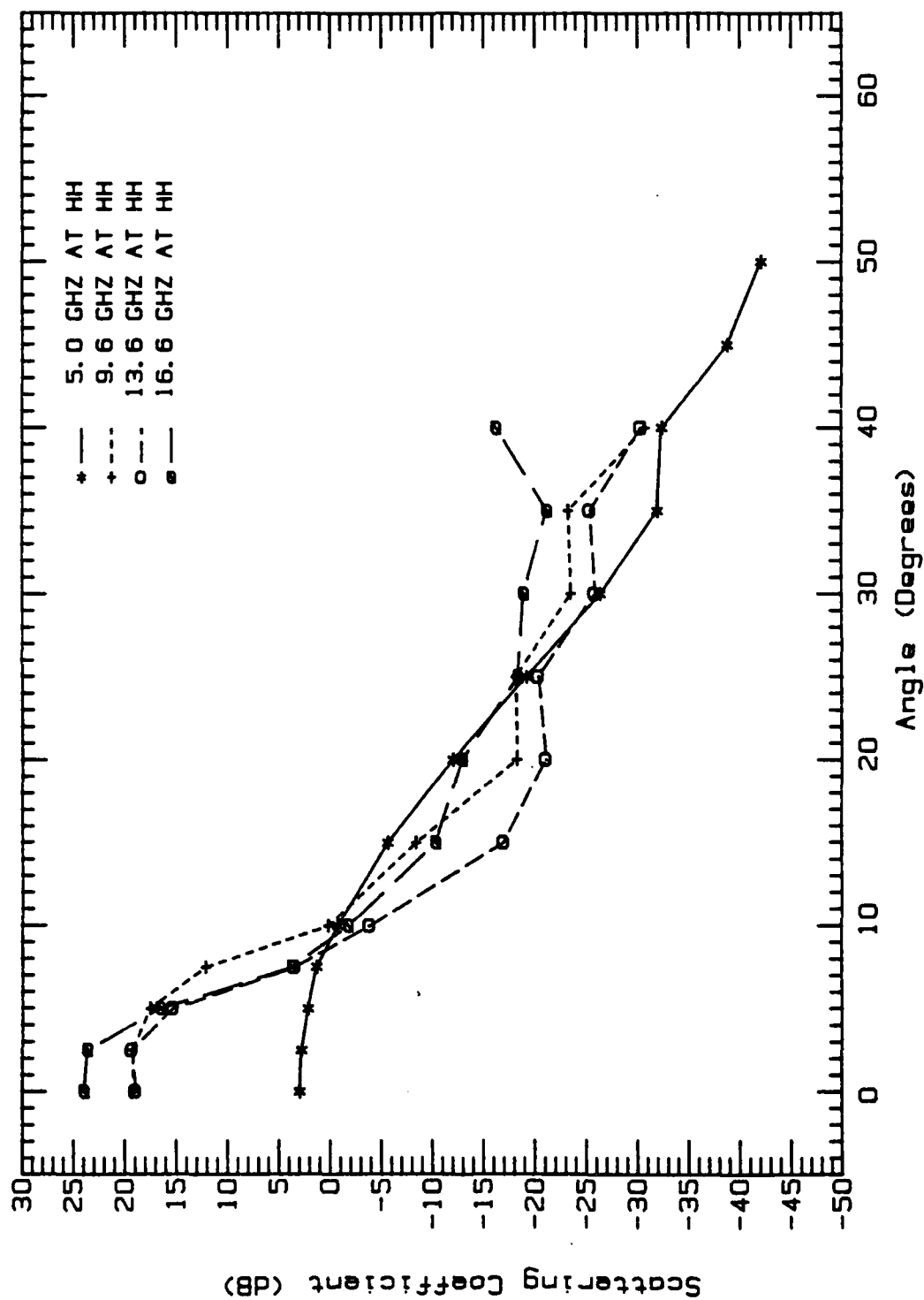
SIGMA OF SHEET ICE (SCENE 2), JAN. 19, CRREL-84



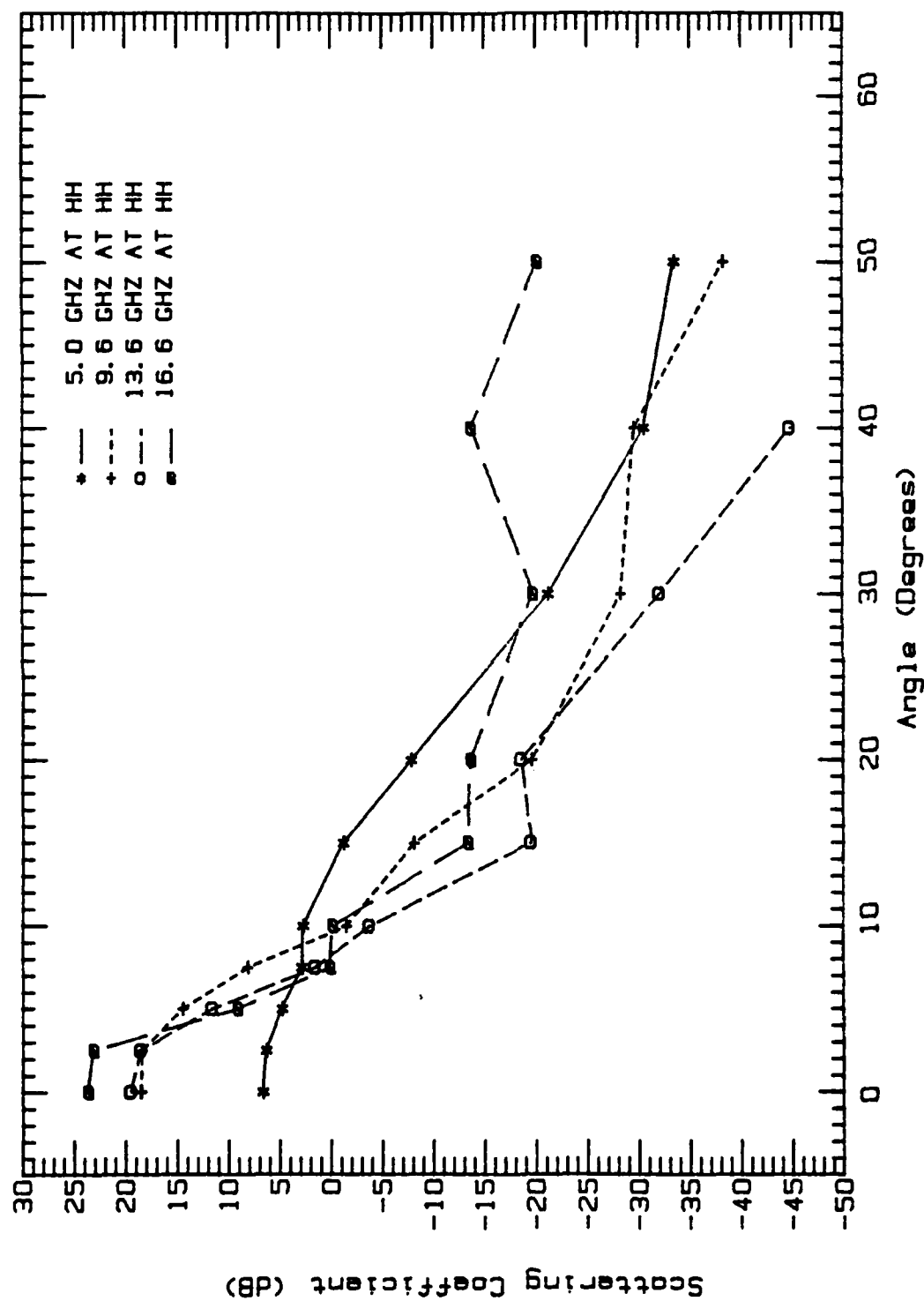
SIGMA OF SHEET ICE, JAN. 20, CRREL-84



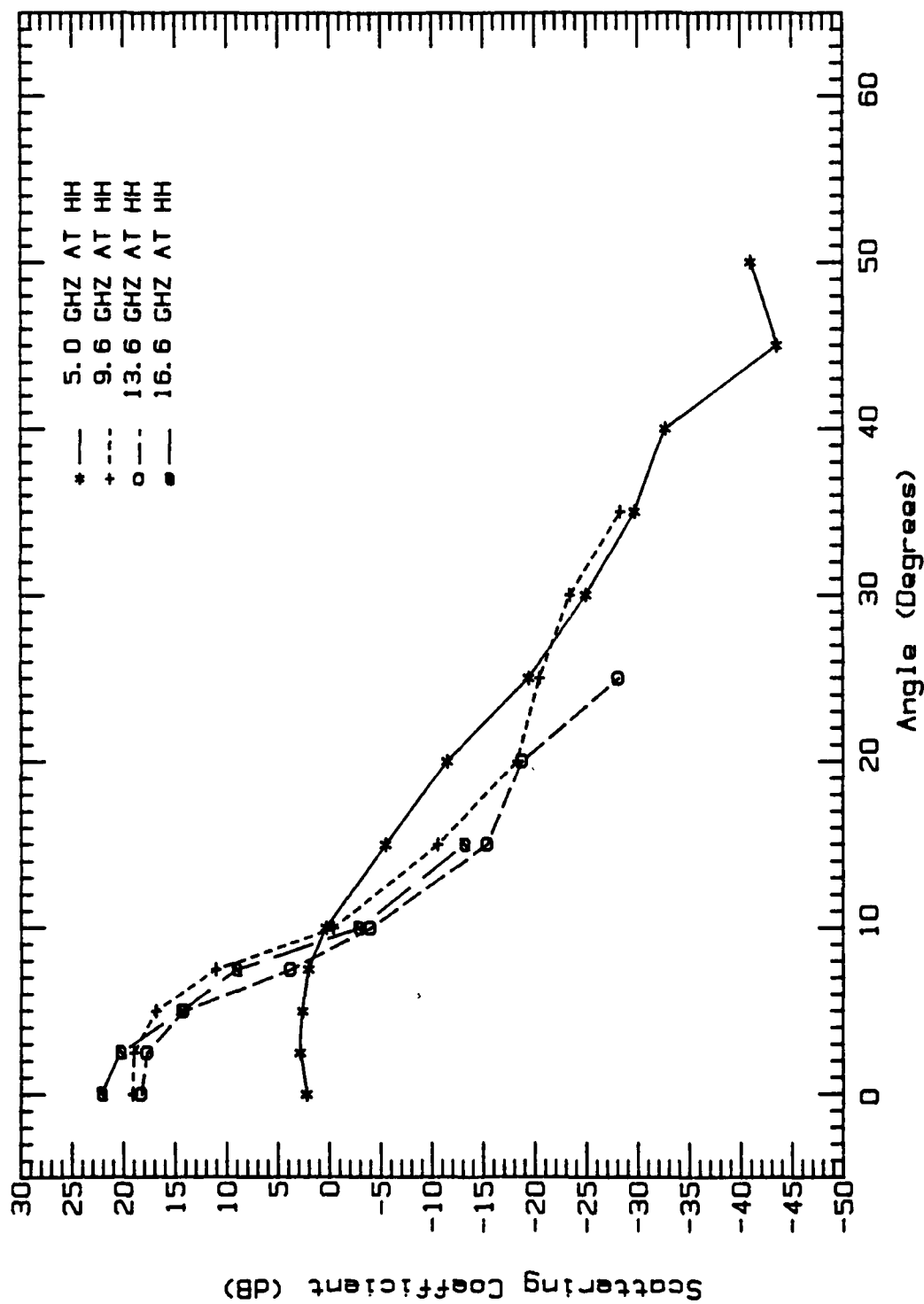
SIGMA OF SHEET ICE, FEB. 22, CRREL-84



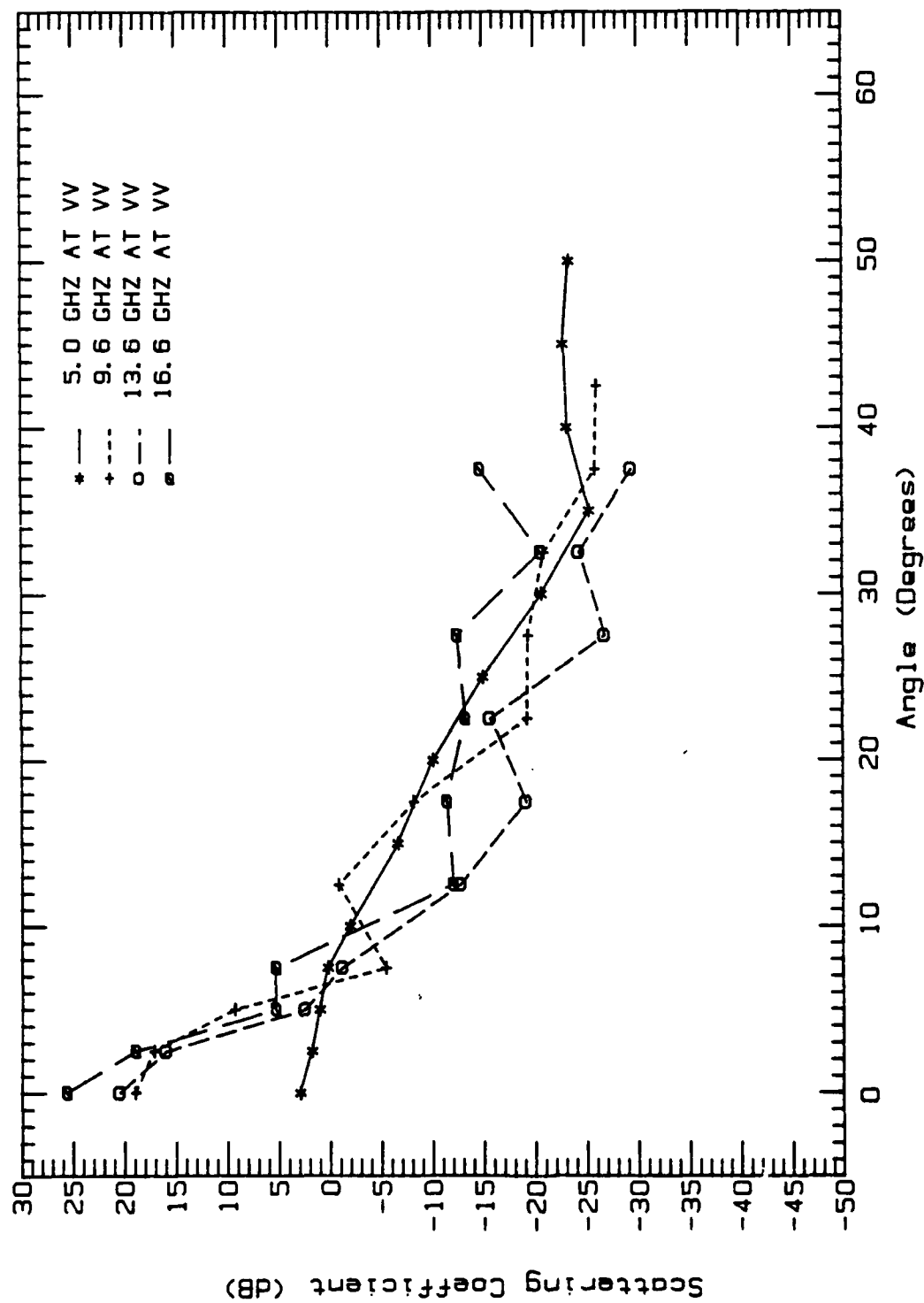
SIGMA OF SMOOTH ICE, JAN. 7, CRREL-85



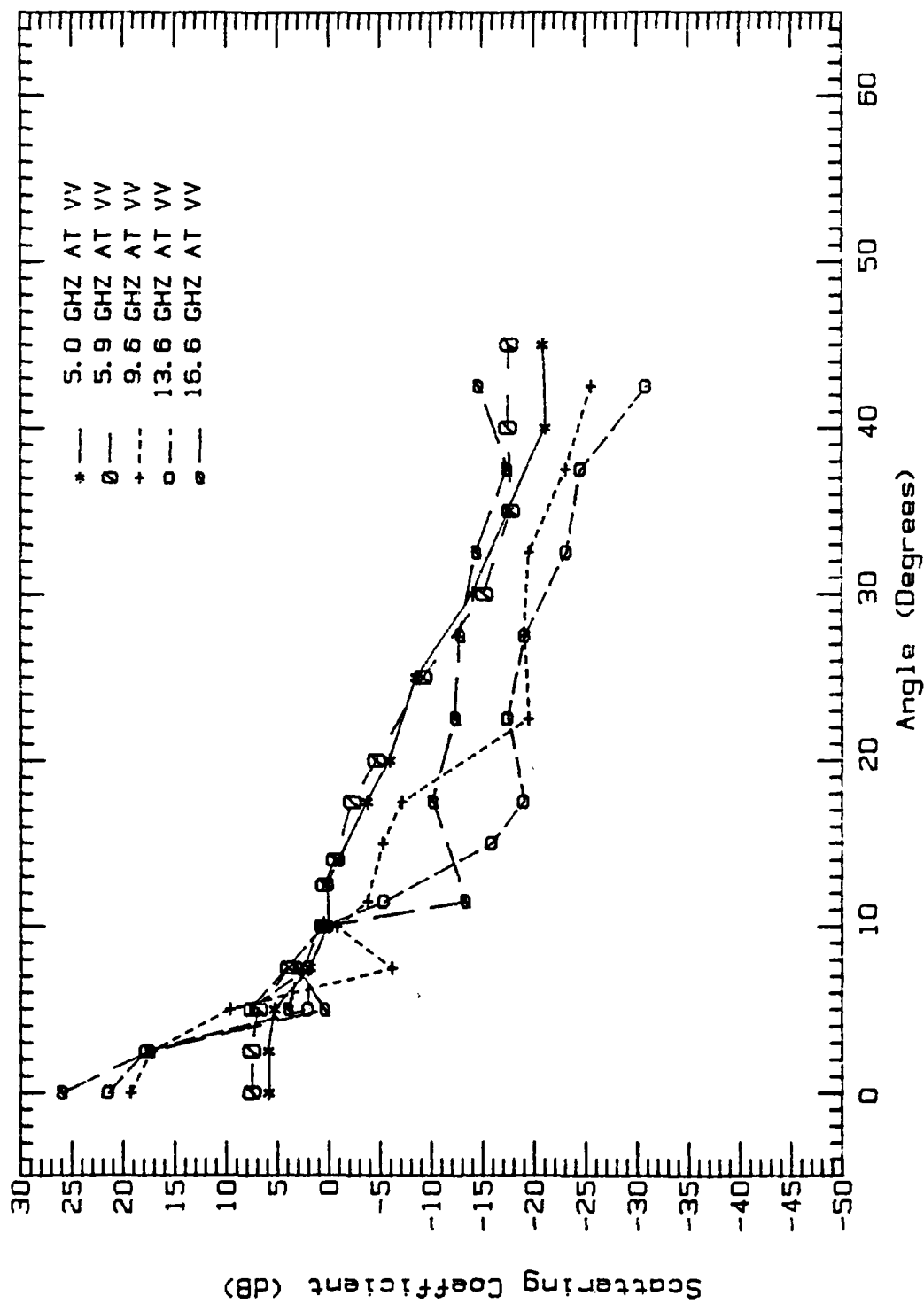
SIGMAD OF SHEET ICE, JAN. 4, CRREL-85



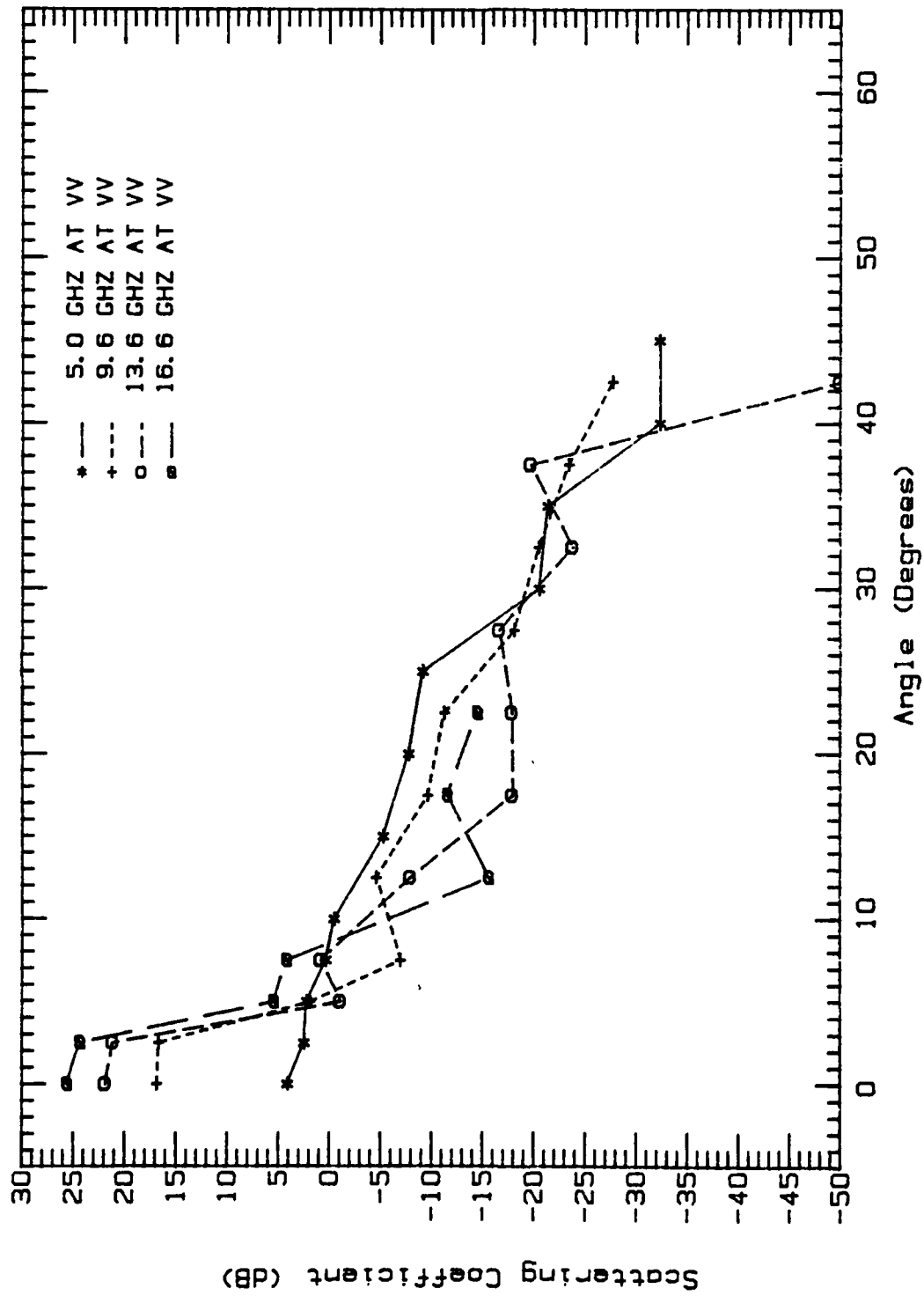
SIGMAD OF SHEET ICE. JAN. 6, CRREL-85



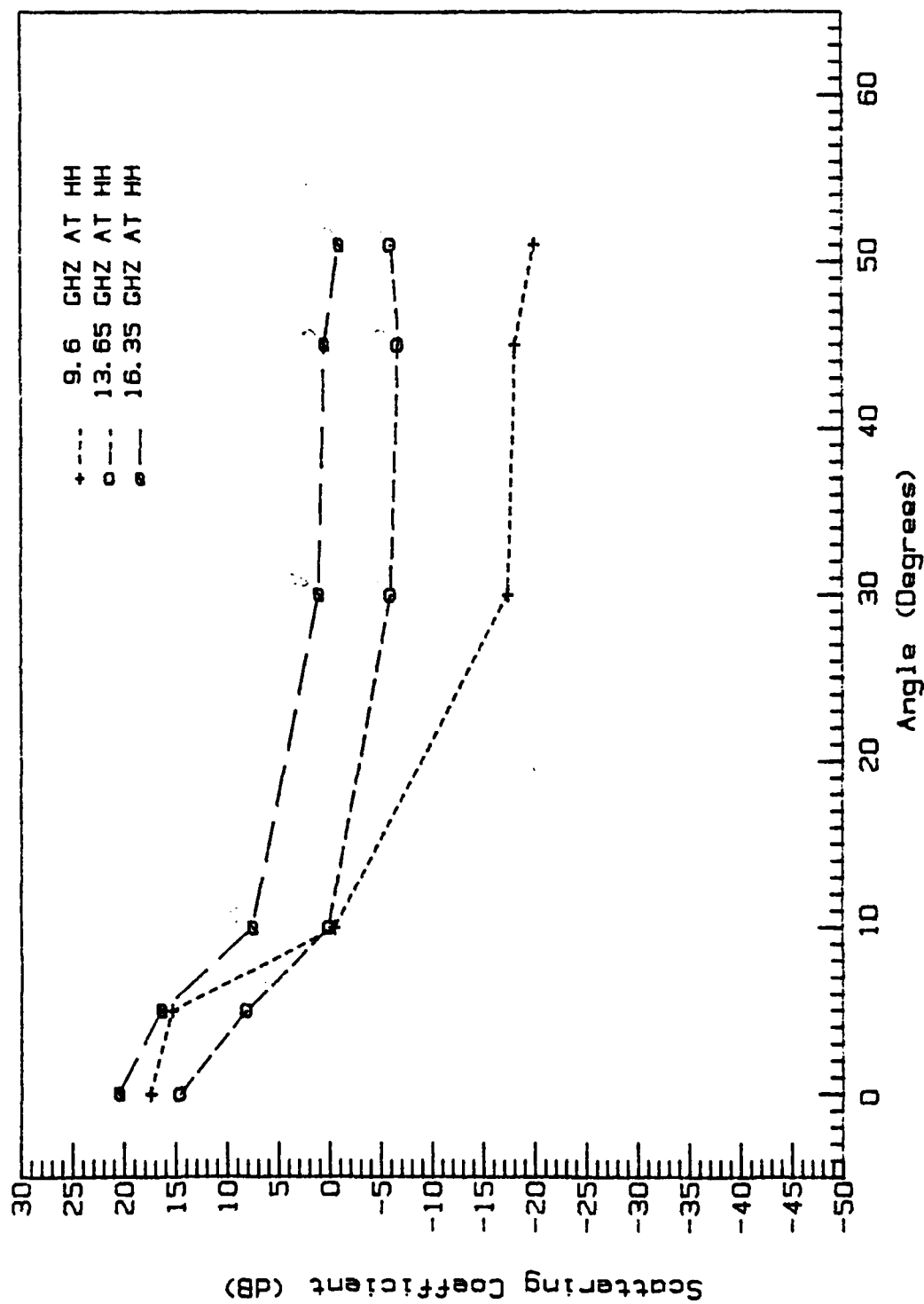
SIGMA OF SMOOTH ICE, JAN. 7, CRREL-85



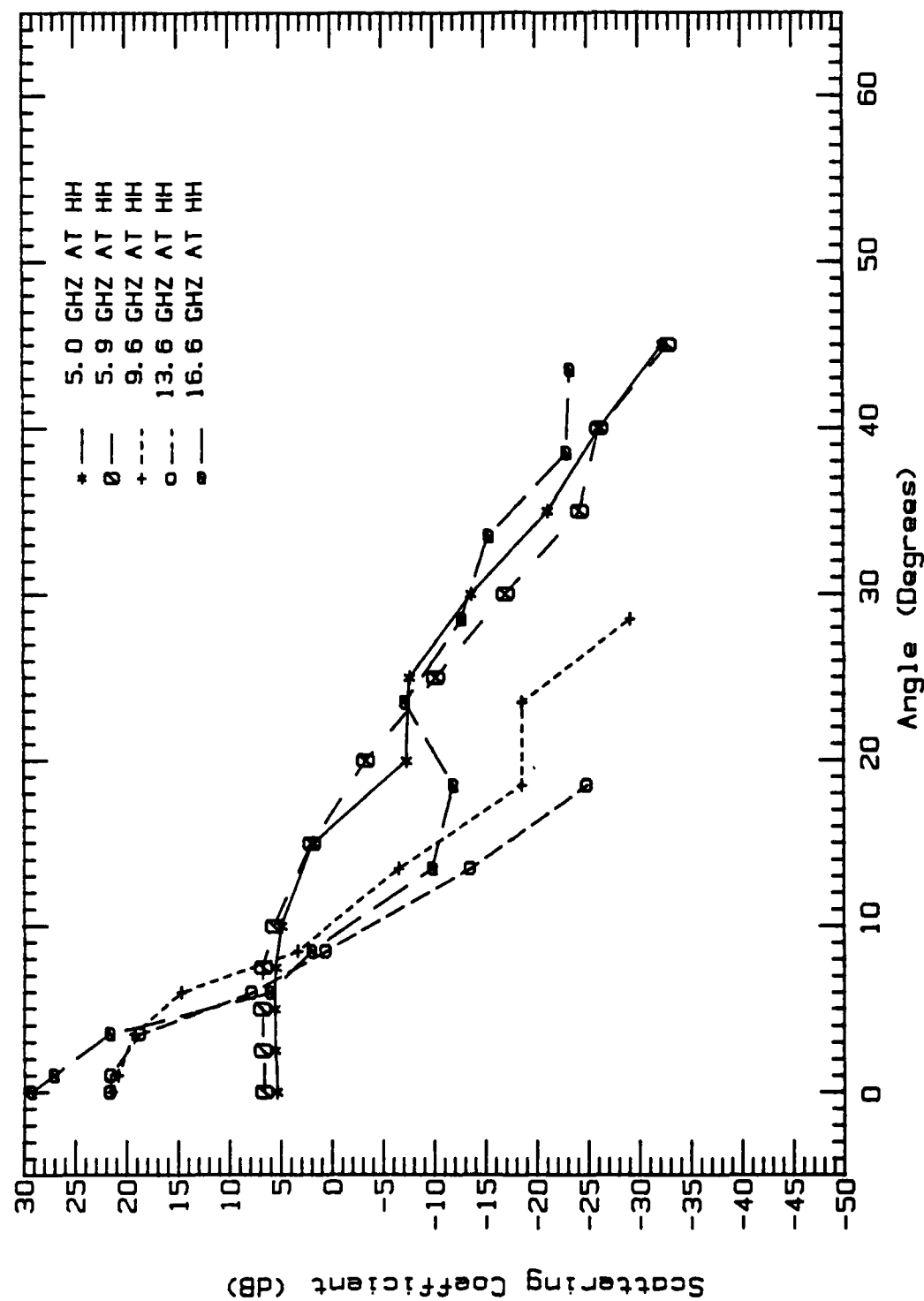
SIGMA OF SHEET ICE, JAN. 16, CRREL-85



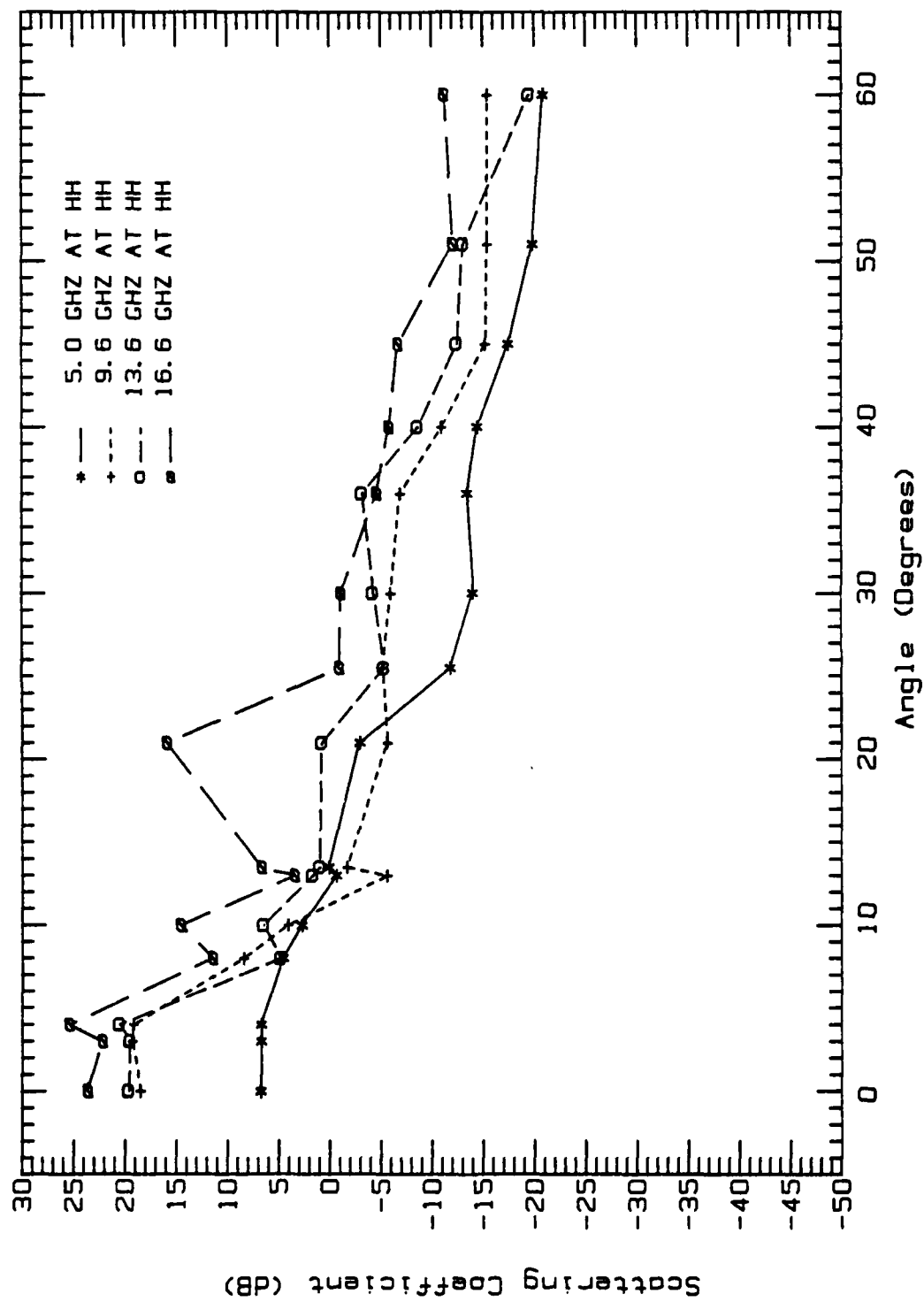
SIGMA OF SHEET ICE, JAN. 11, CRREL-85



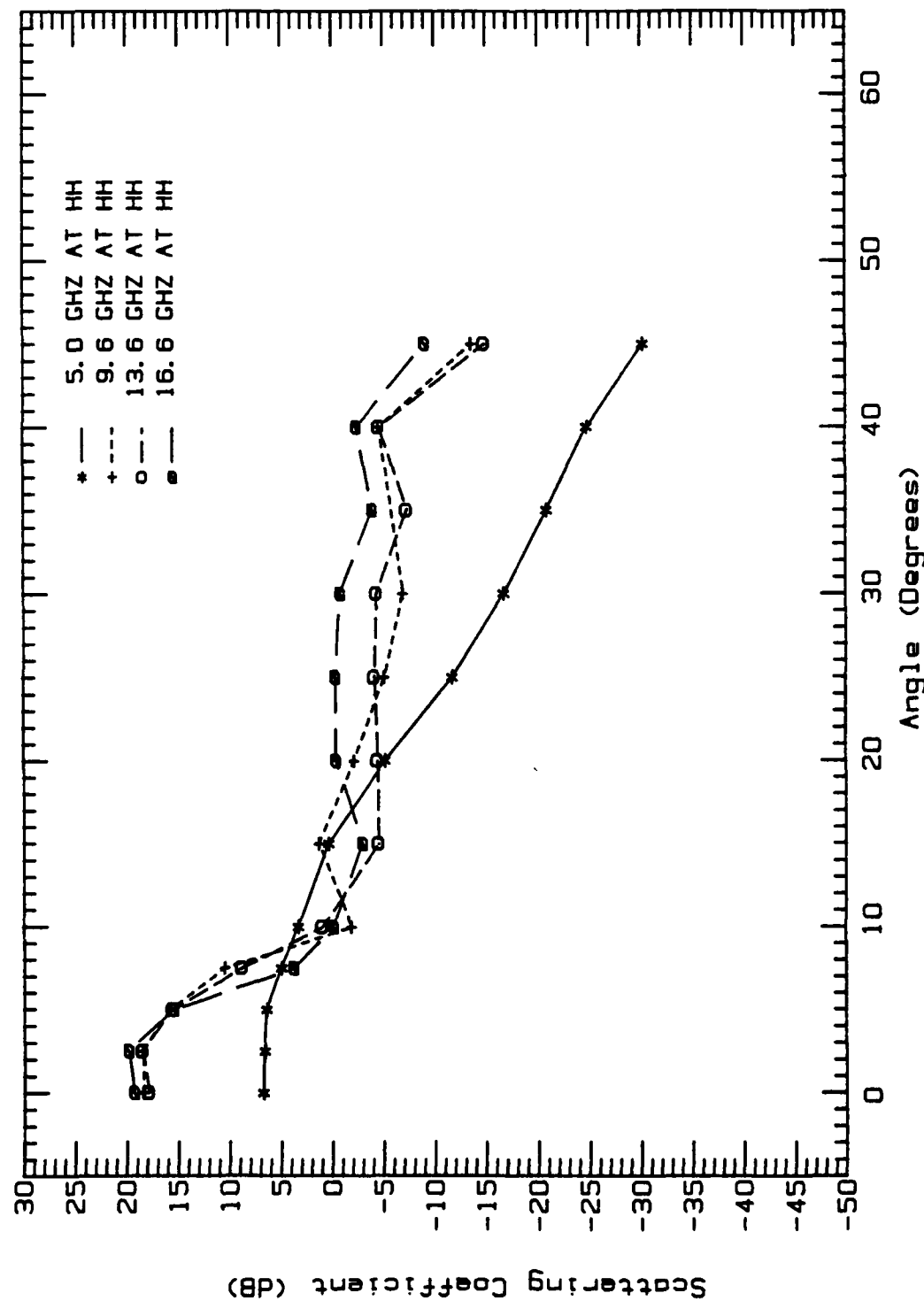
' SIGMA OF WATER SURFACE, JAN. 17. CRREL-84



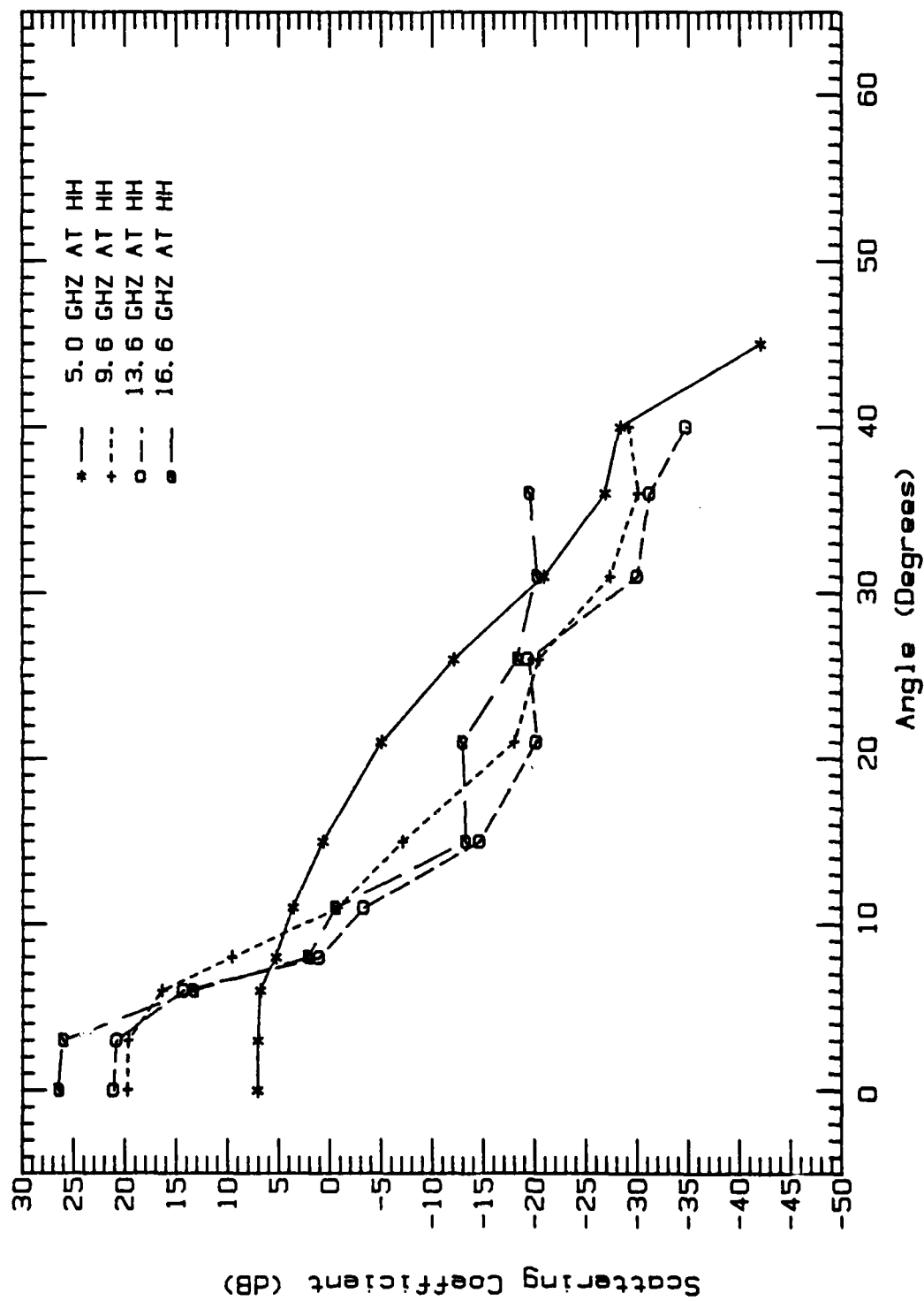
' SIGMA OF WATER SURFACE, JAN. 14, CRREL-85



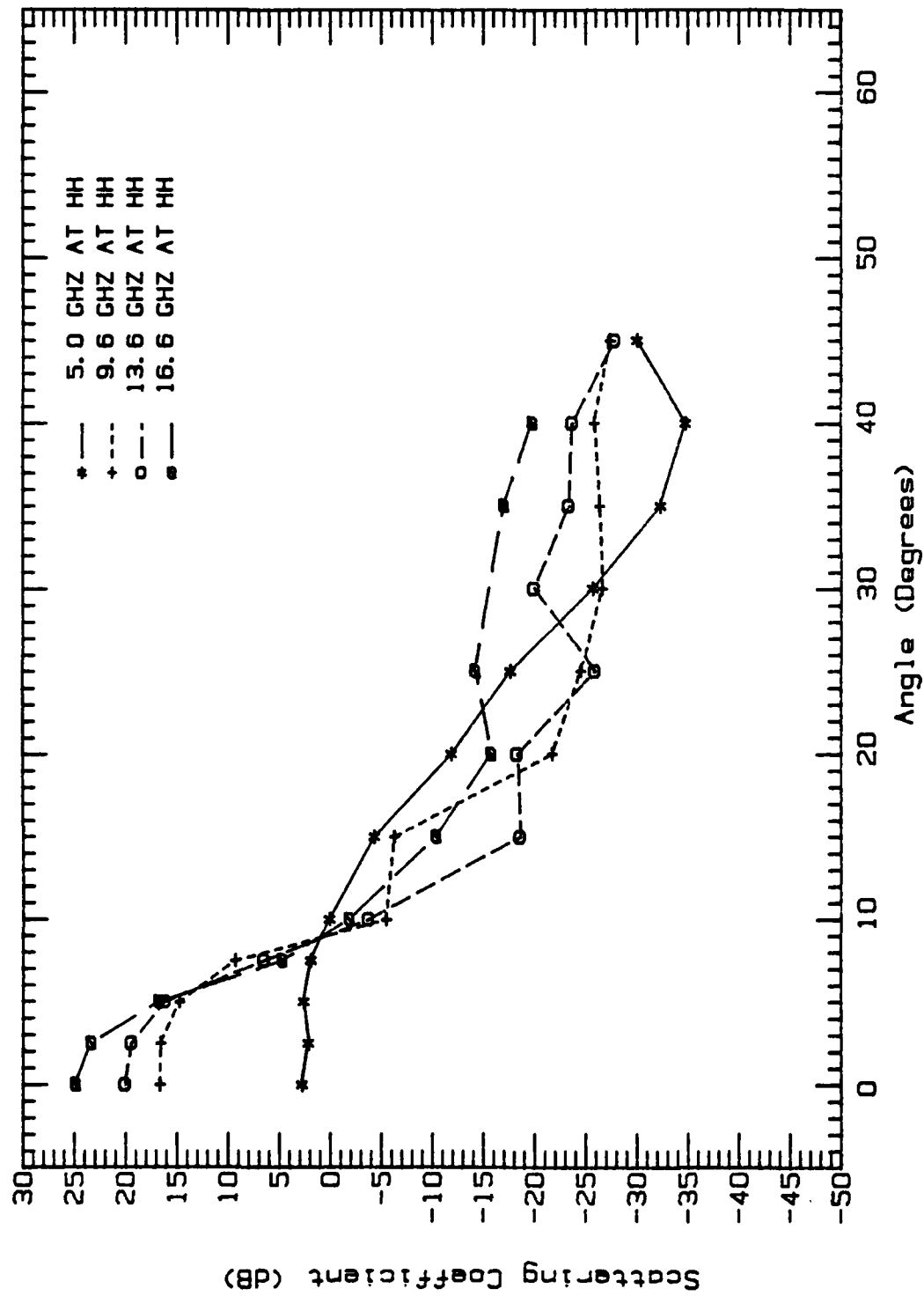
' SIGMA OF SNOW COVERED ICE. JAN. 8. CRREL-85



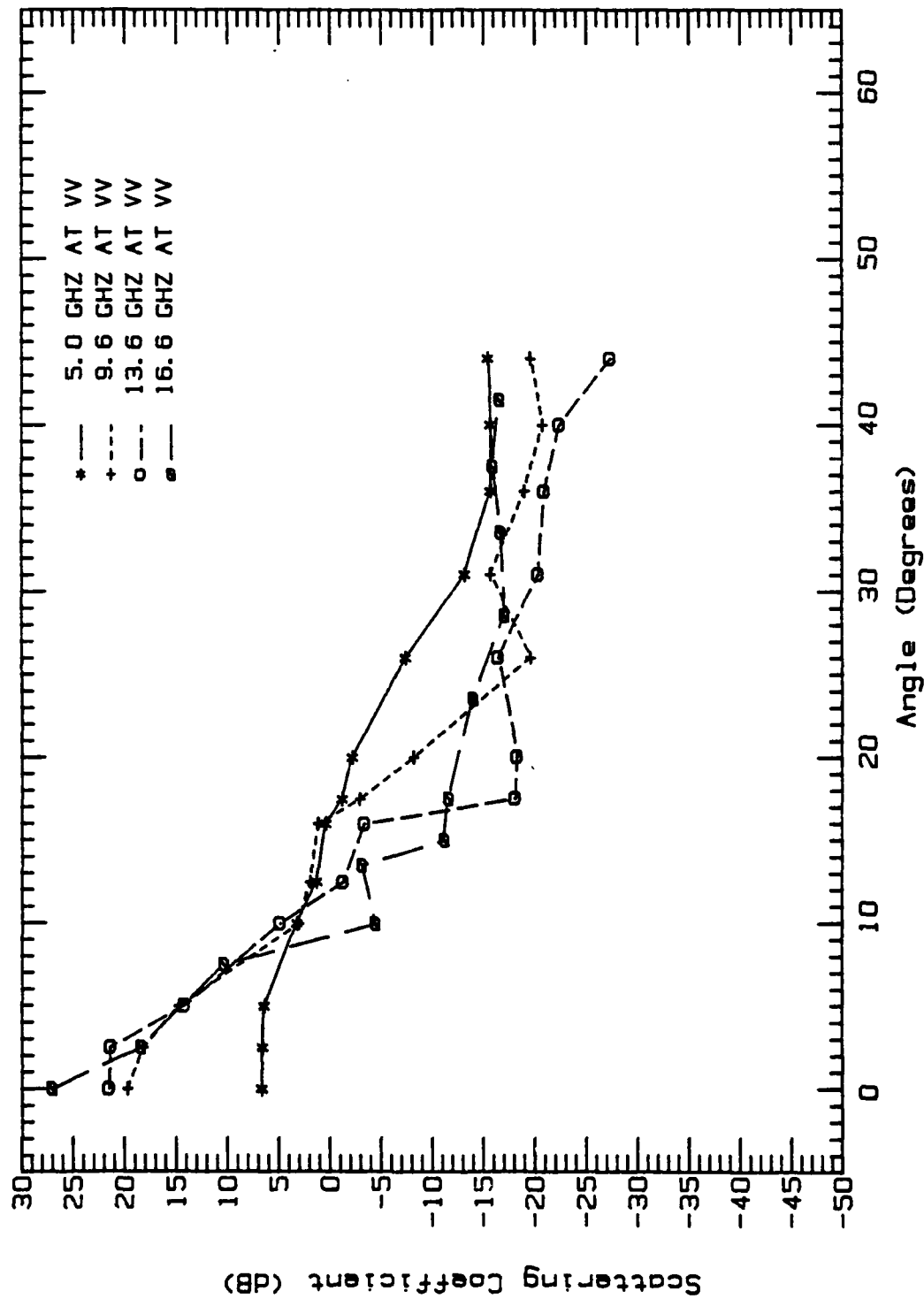
SIGMA OF ROUGH ICE, JAN. 7, CRREL-85



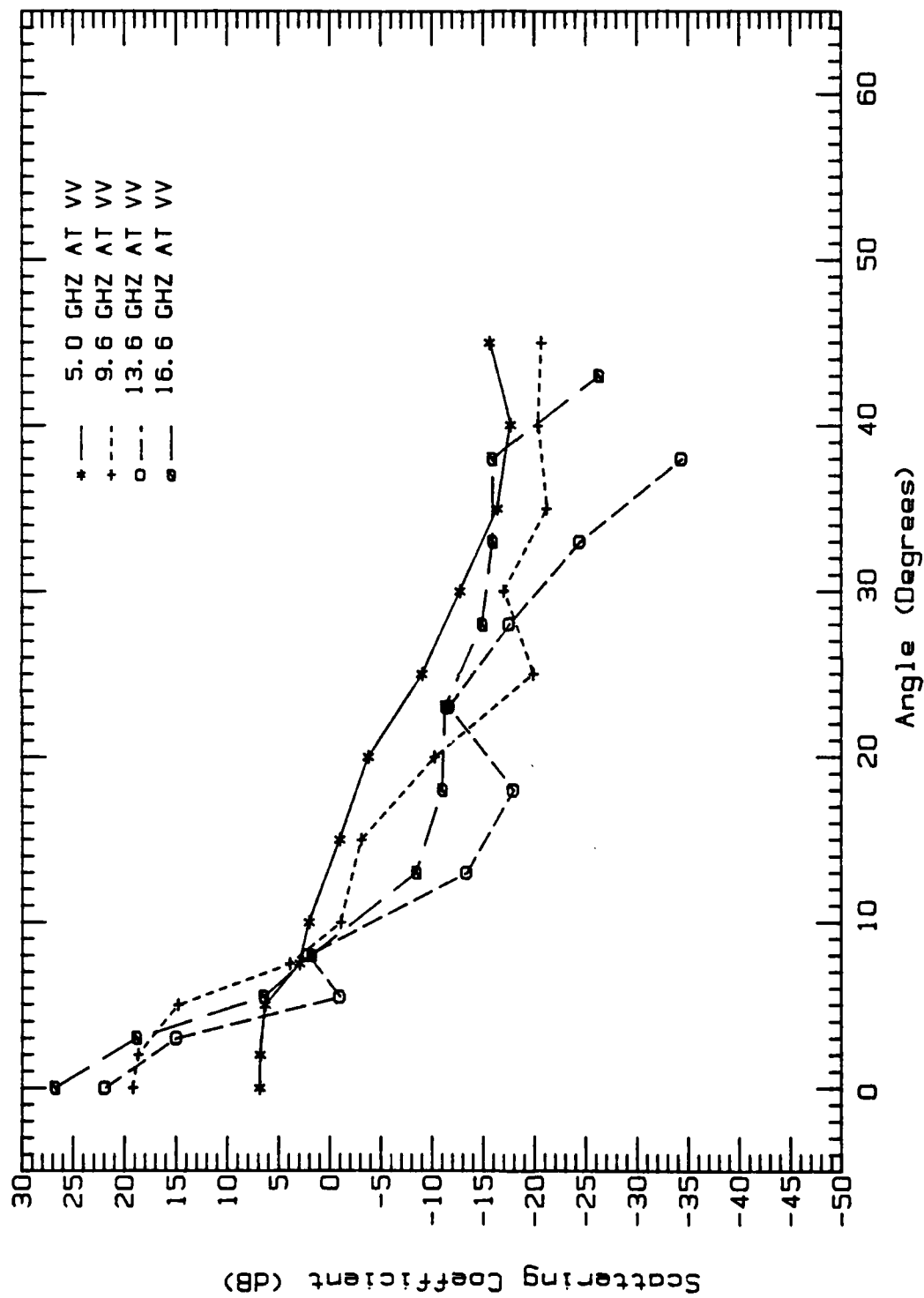
SIGMA OF GREASE ICE. JAN. 8, CRREL-85



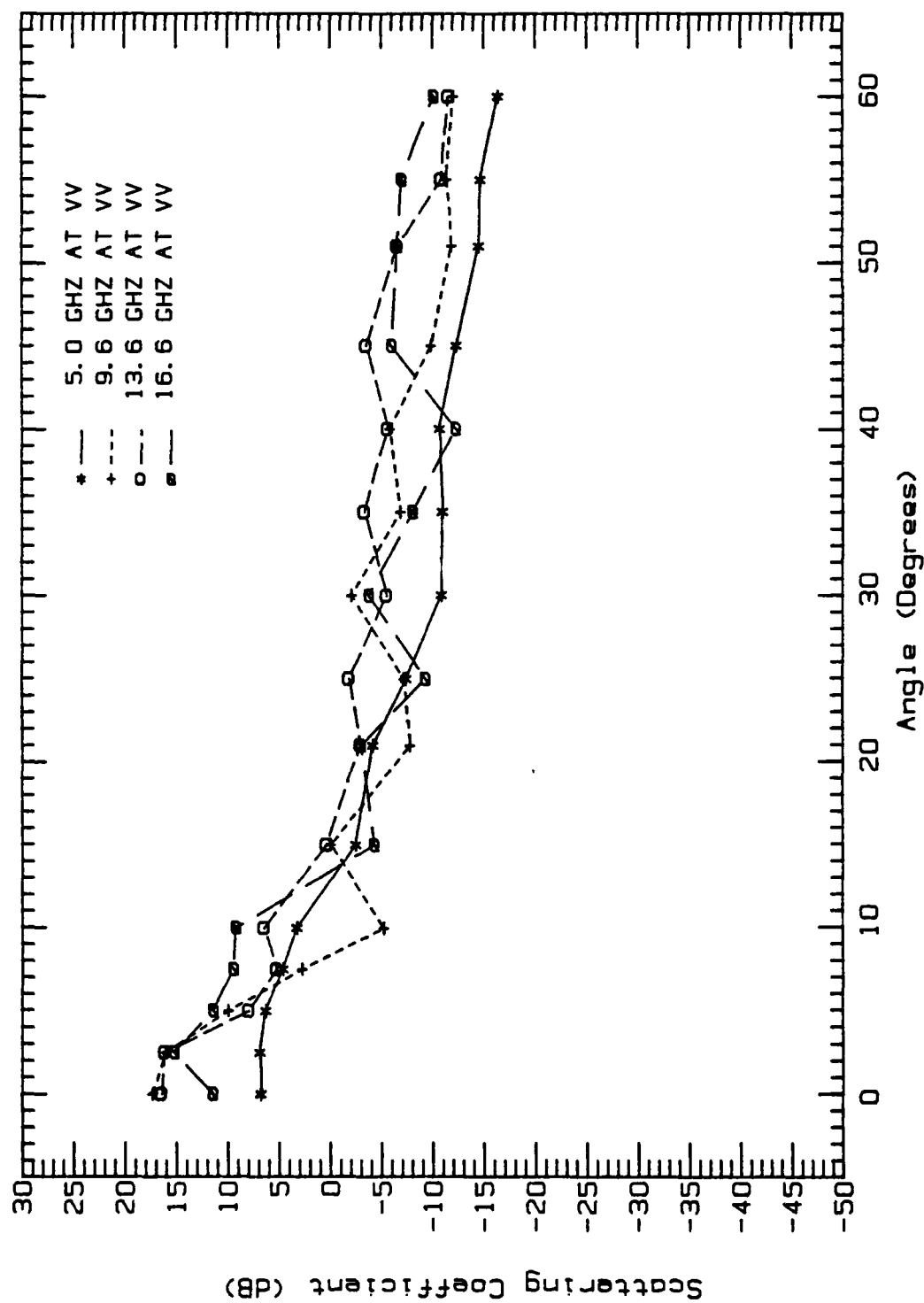
SIGMA OF SHEET ICE, JAN. 11, CRREL-85



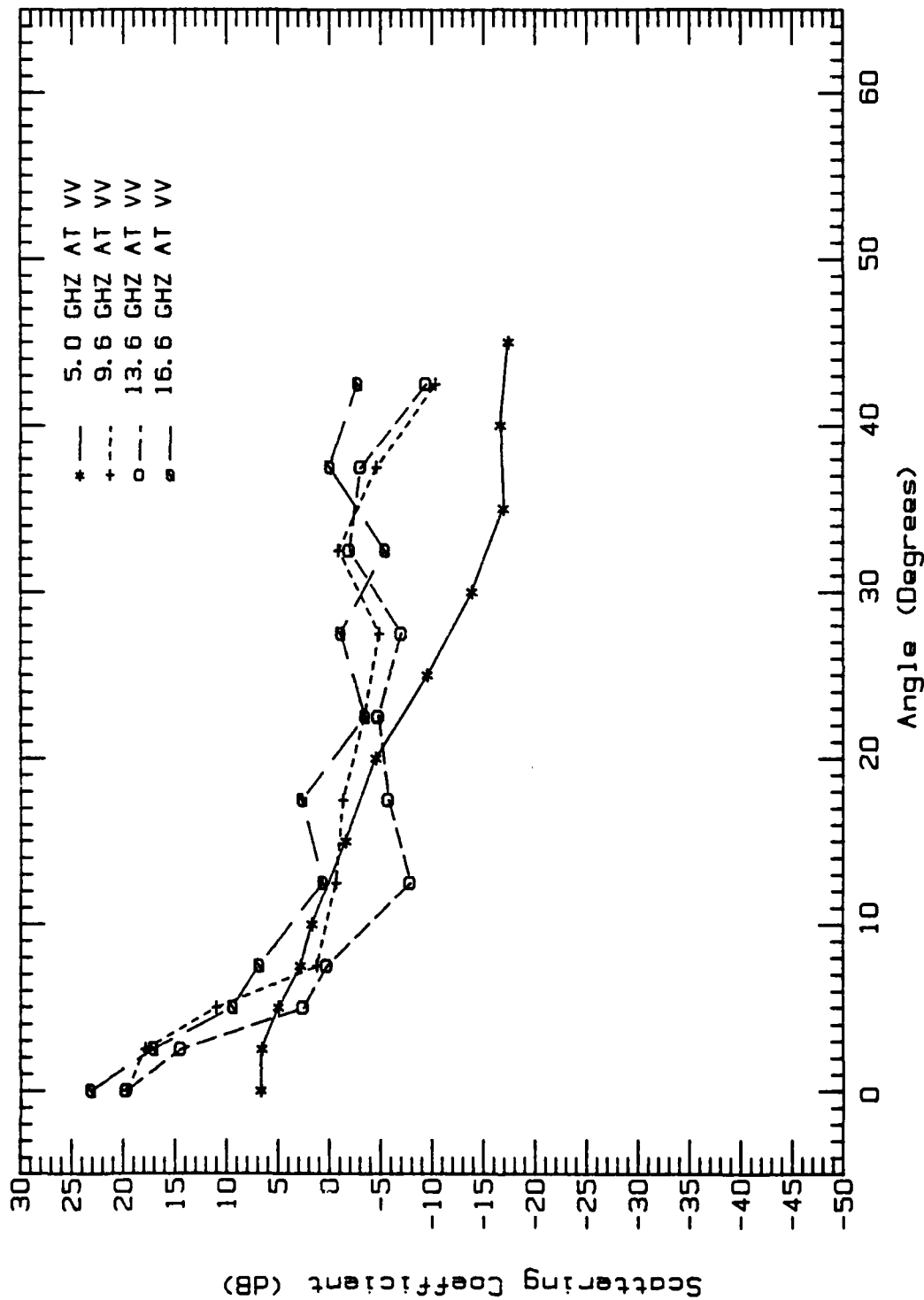
' SIGMA OF WATER SURFACE. JAN. 8. CRREL-85



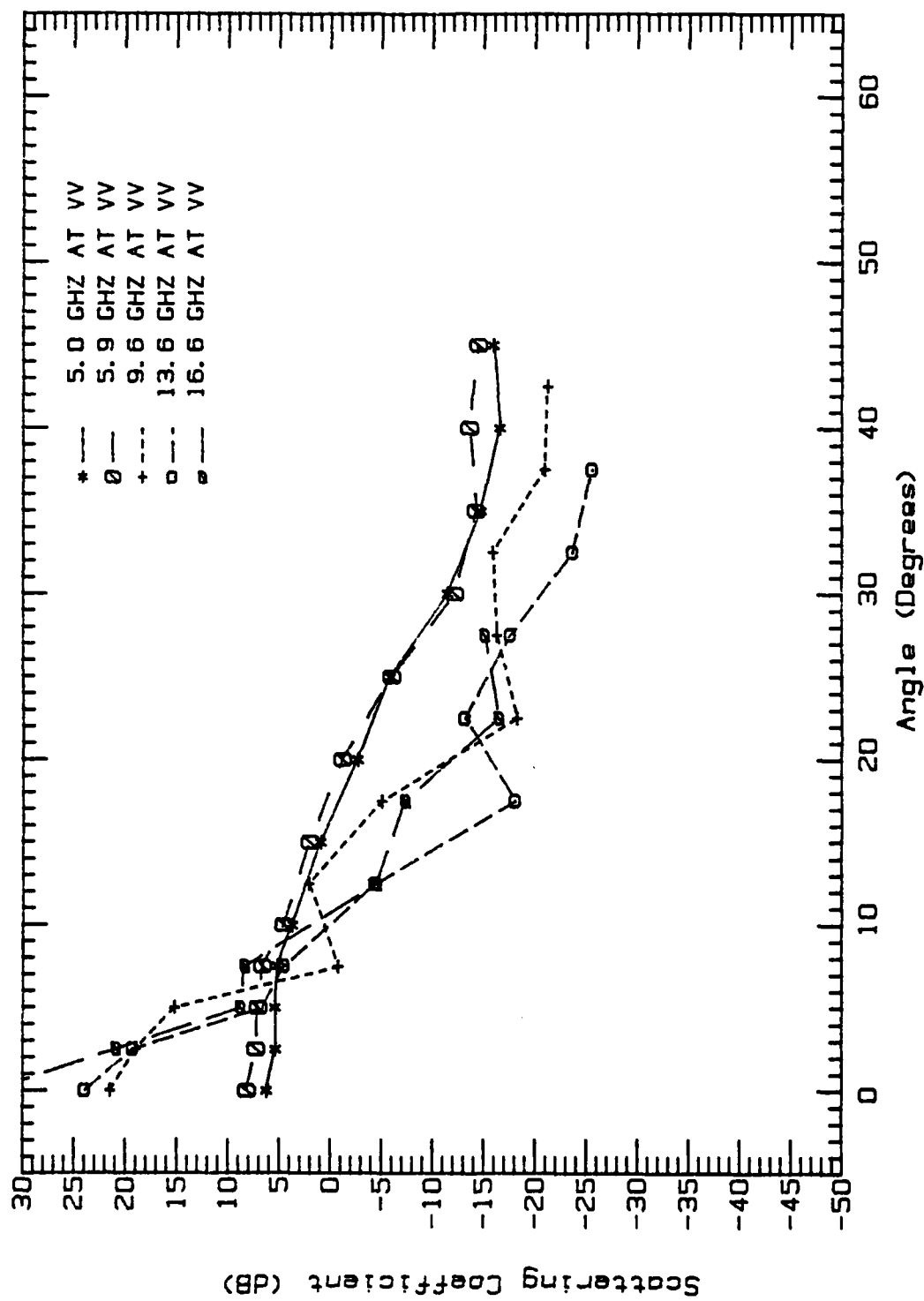
SIGMA OF GREASE ICE, JAN. 8, CRREL-85



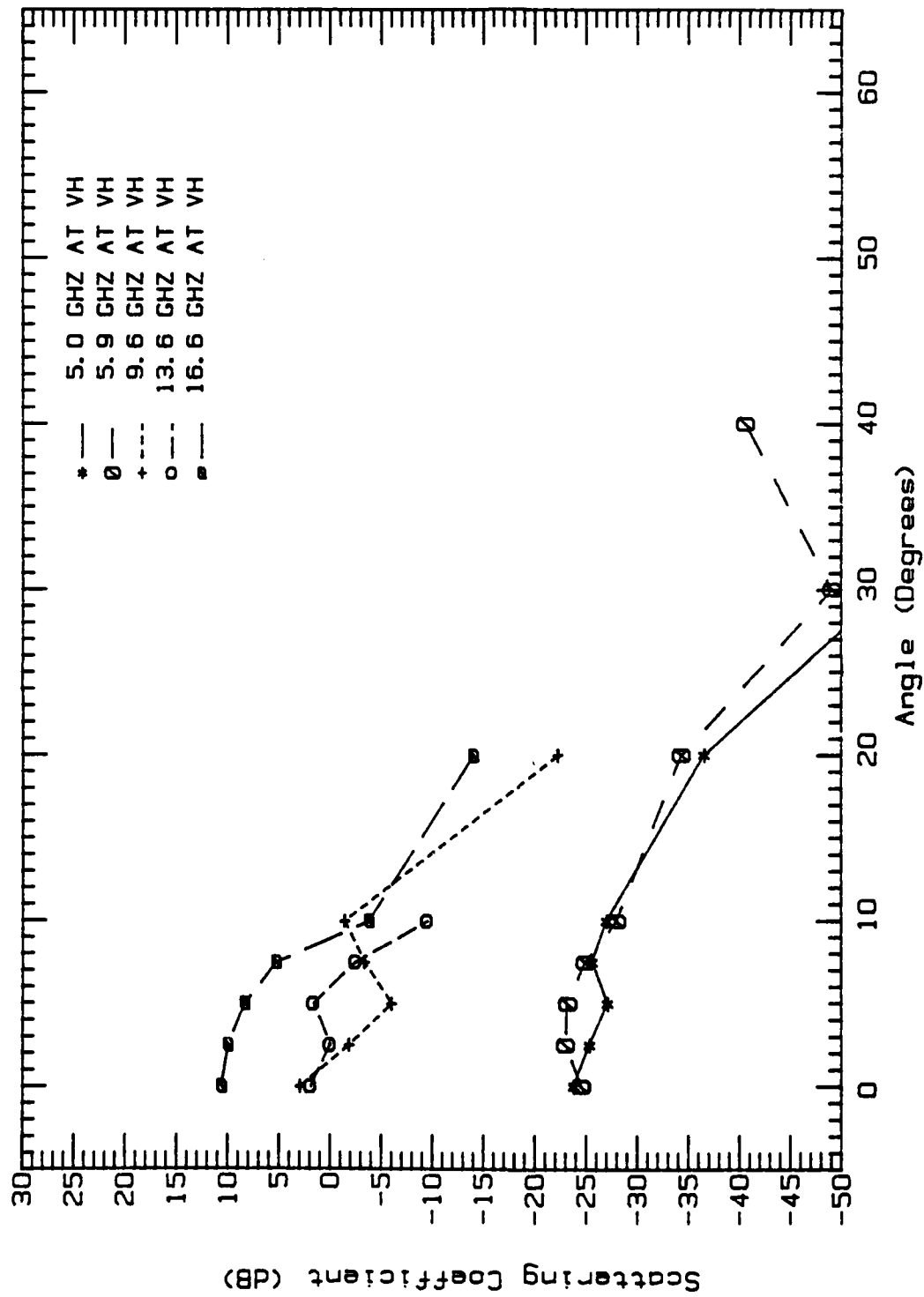
' SIGMA OF SNOW COVERED ICE, JAN. 8. CRREL-85



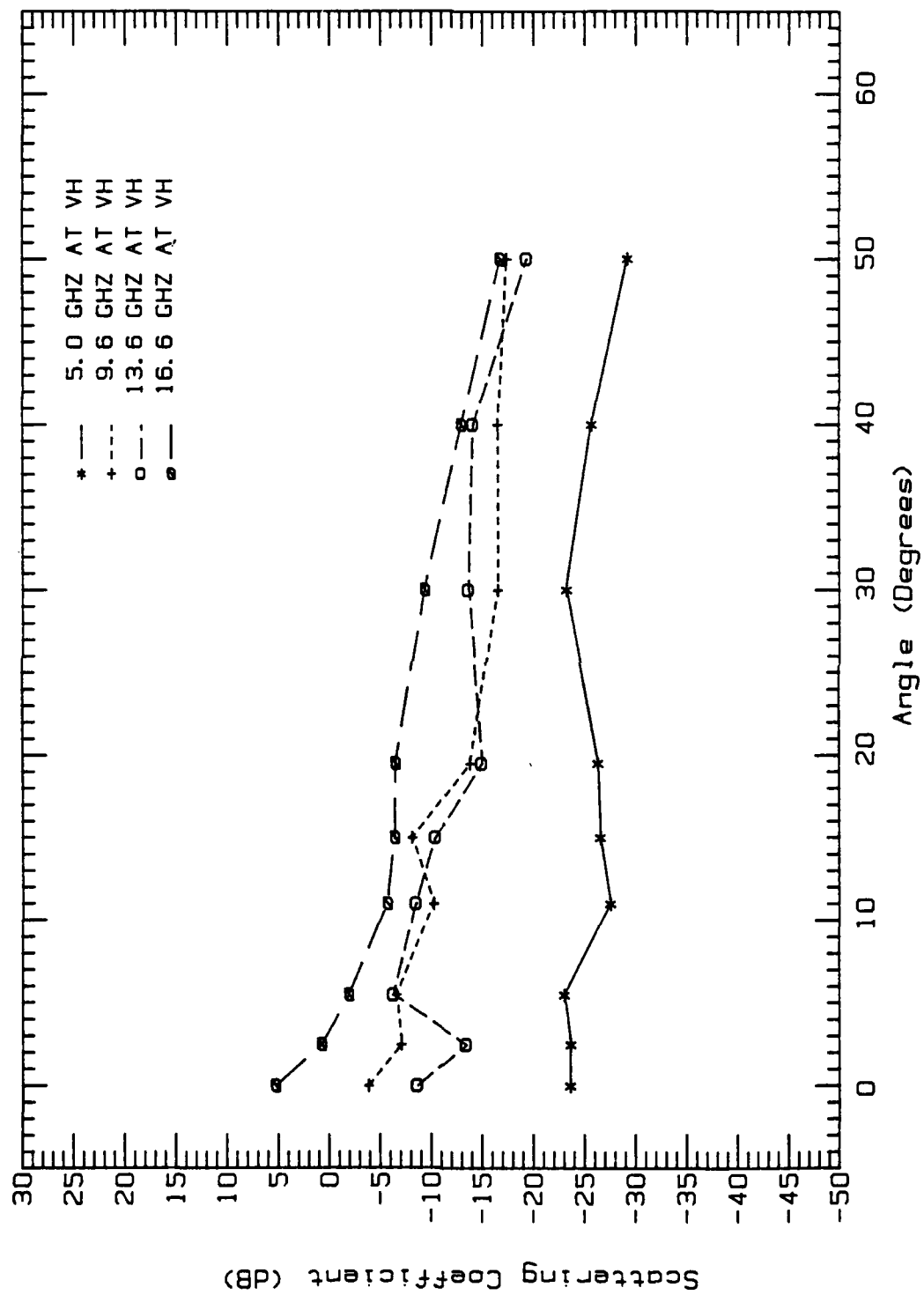
SIGMA OF ROUGH ICE, JAN. 7, CRREL-85



SIGMA OF WATER SURFACE, JAN. 14, CRREL-85



SIGMA OF WATER SURFACE, JAN. 14, CRREL-85



' SIGMA OF SNOW COVERED ICE, JAN. 8, CRREL-85

AD-A160 788

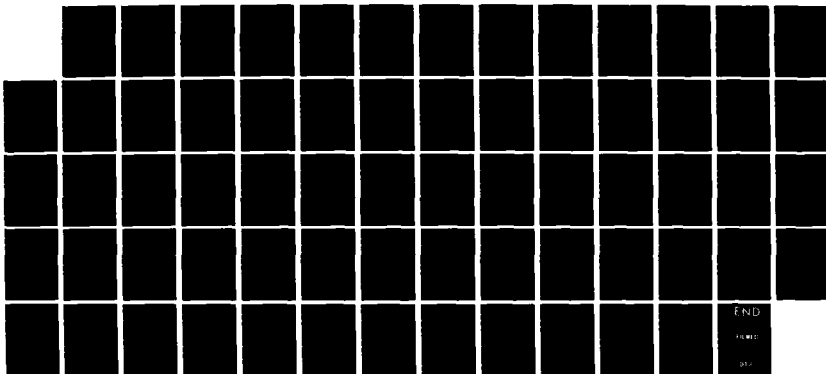
INVESTIGATION OF THE PROPERTIES OF RADAR BACKSCATTER
FROM SEA ICE(U) KANSAS UNIV/CENTER FOR RESEARCH INC
LAWRENCE REMOTE SENSING LAB R K MOORE ET AL. AUG 85
RSL-TR-3311-5 N00014-76-C-1105

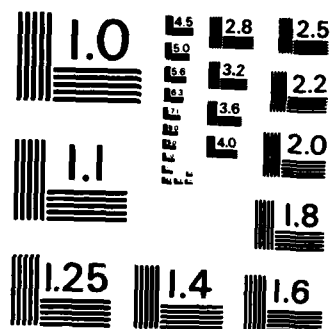
272

UNCLASSIFIED

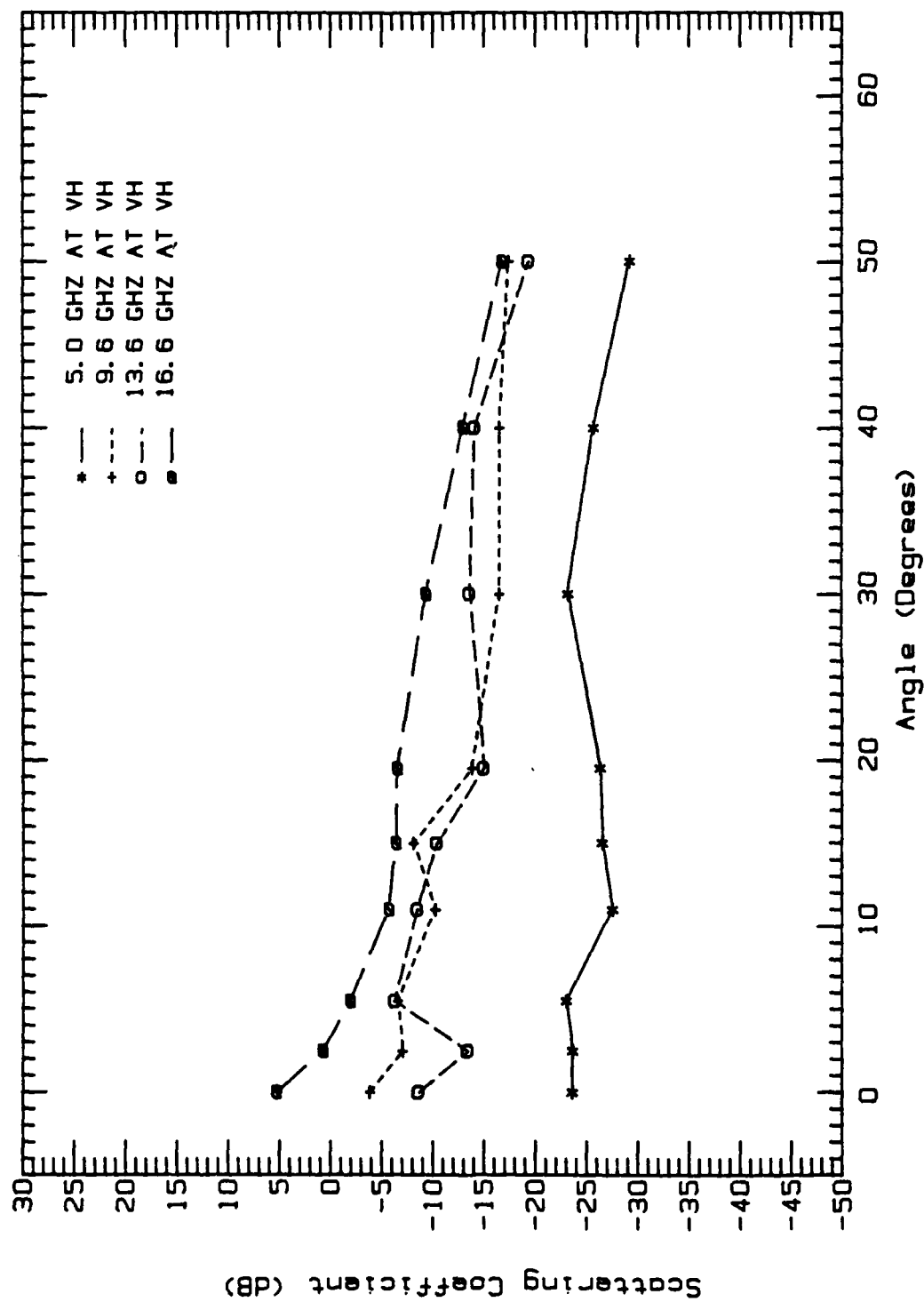
F/G 8/12

NL

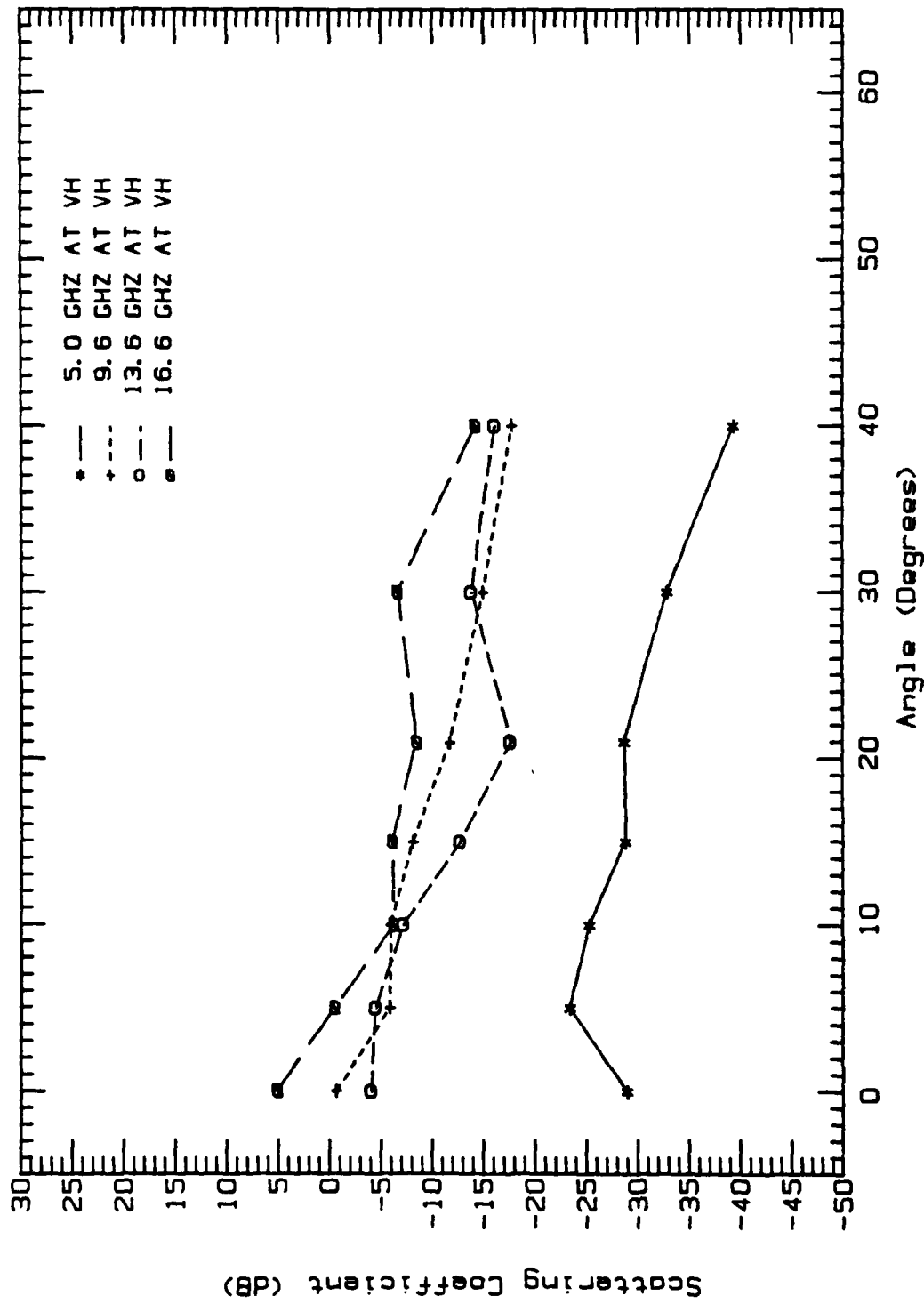




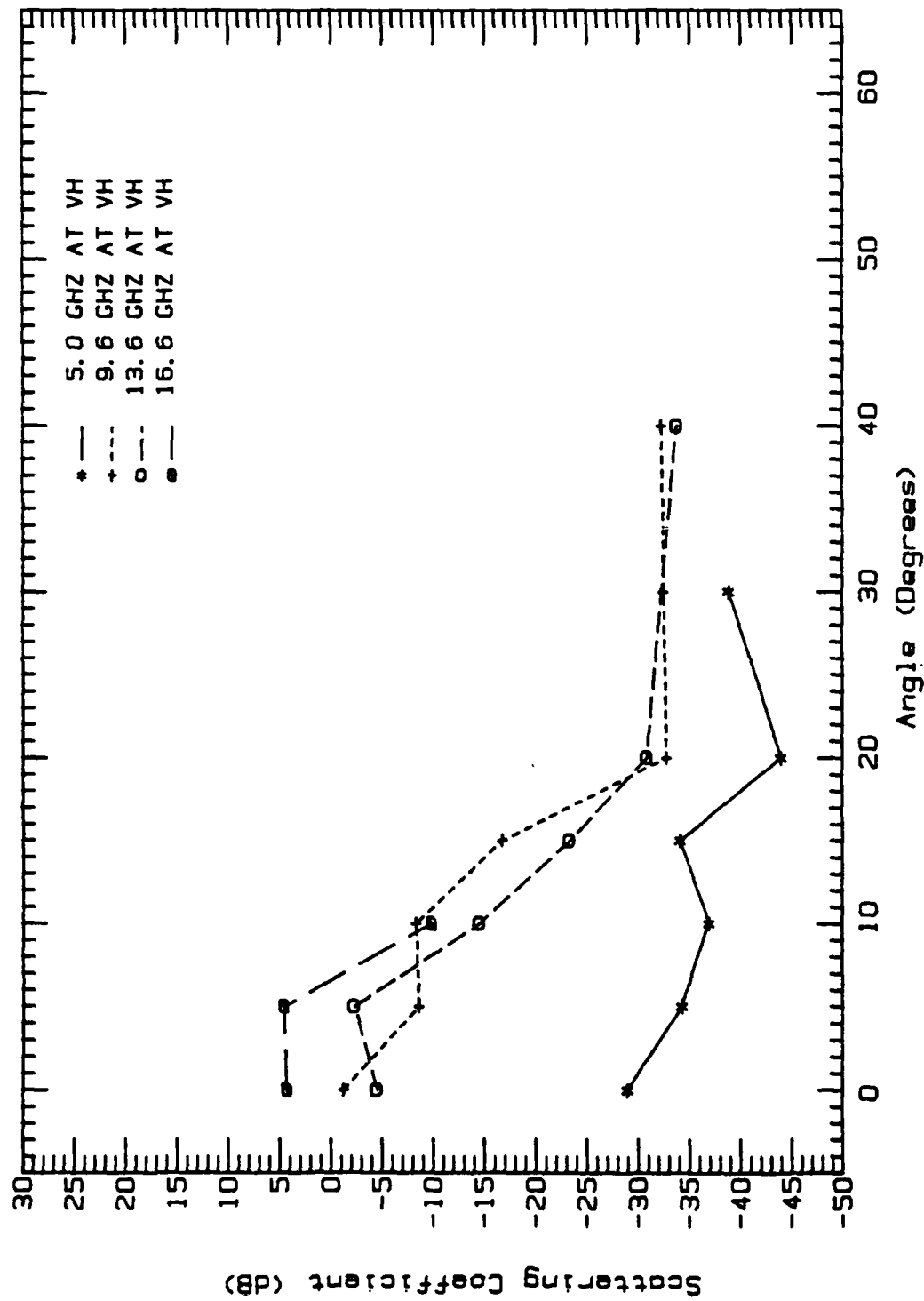
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



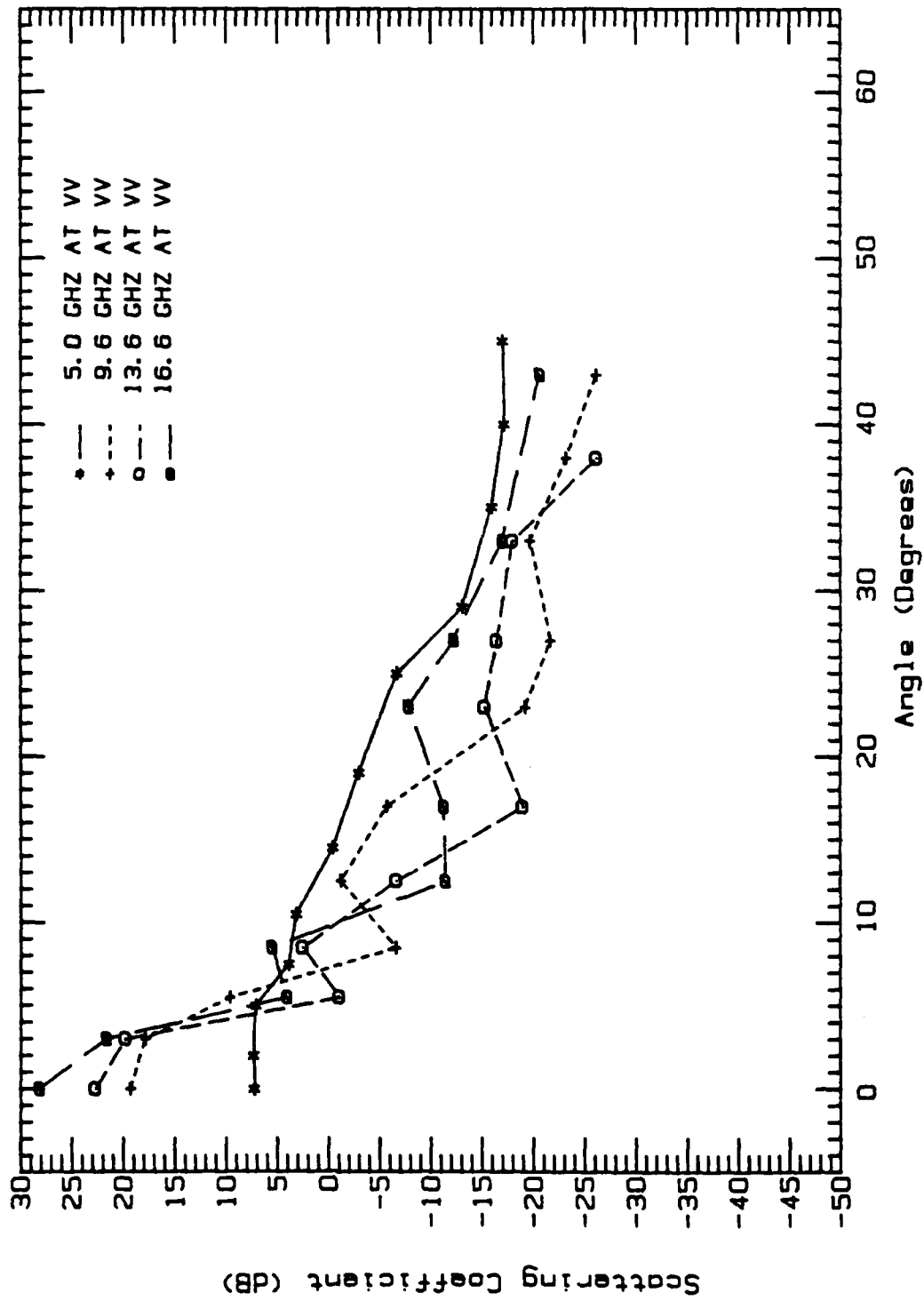
' SIGMA OF SNOW COVERED ICE, JAN. 8, CRREL-85



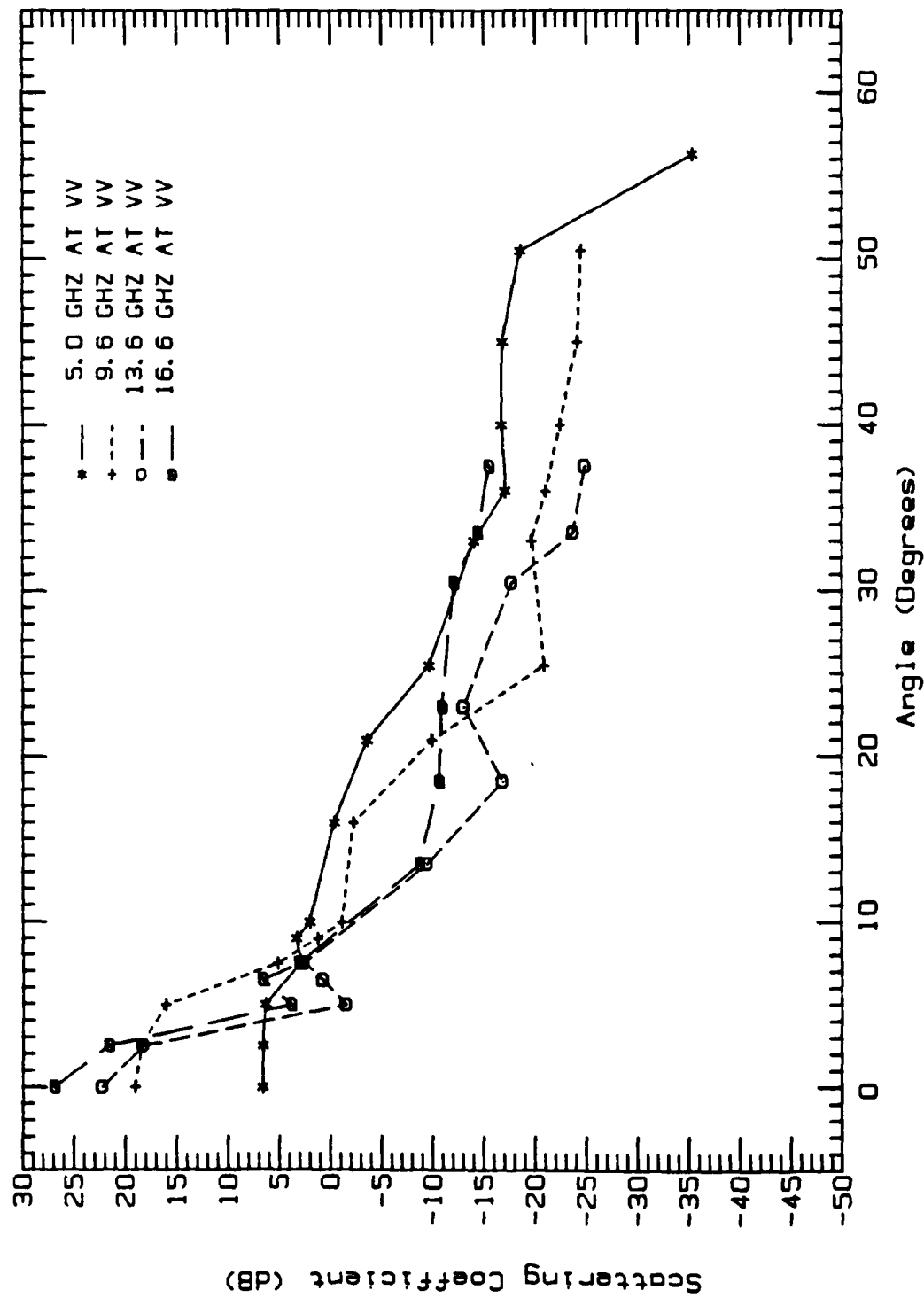
SIGMA OF ROUGH ICE. JAN. 7. CRREL-85



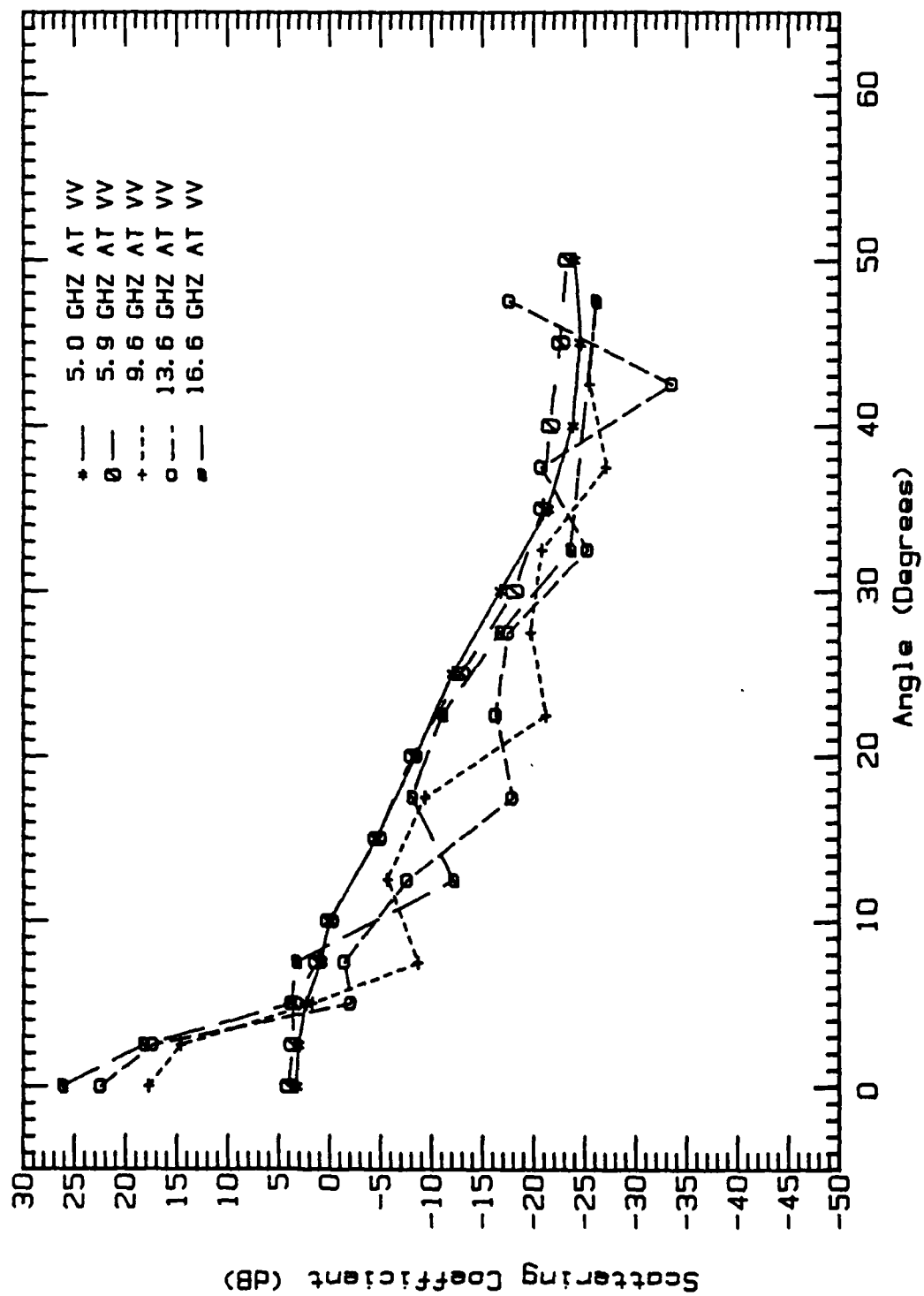
SIGMA OF SMOOTH ICE, JAN. 7, CRREL-85



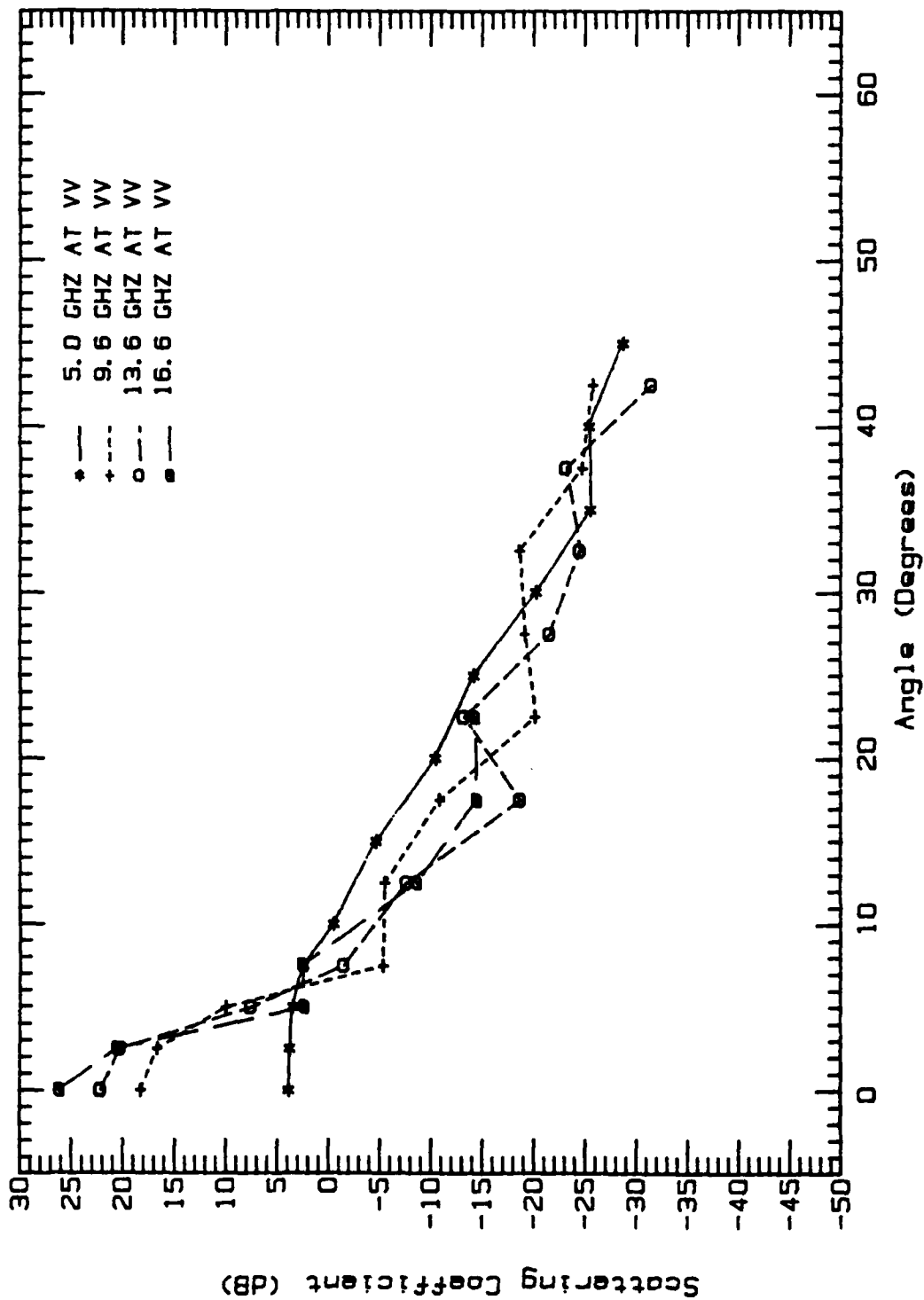
SIGMA OF GREASE ICE, JAN. 8, CRREL-85



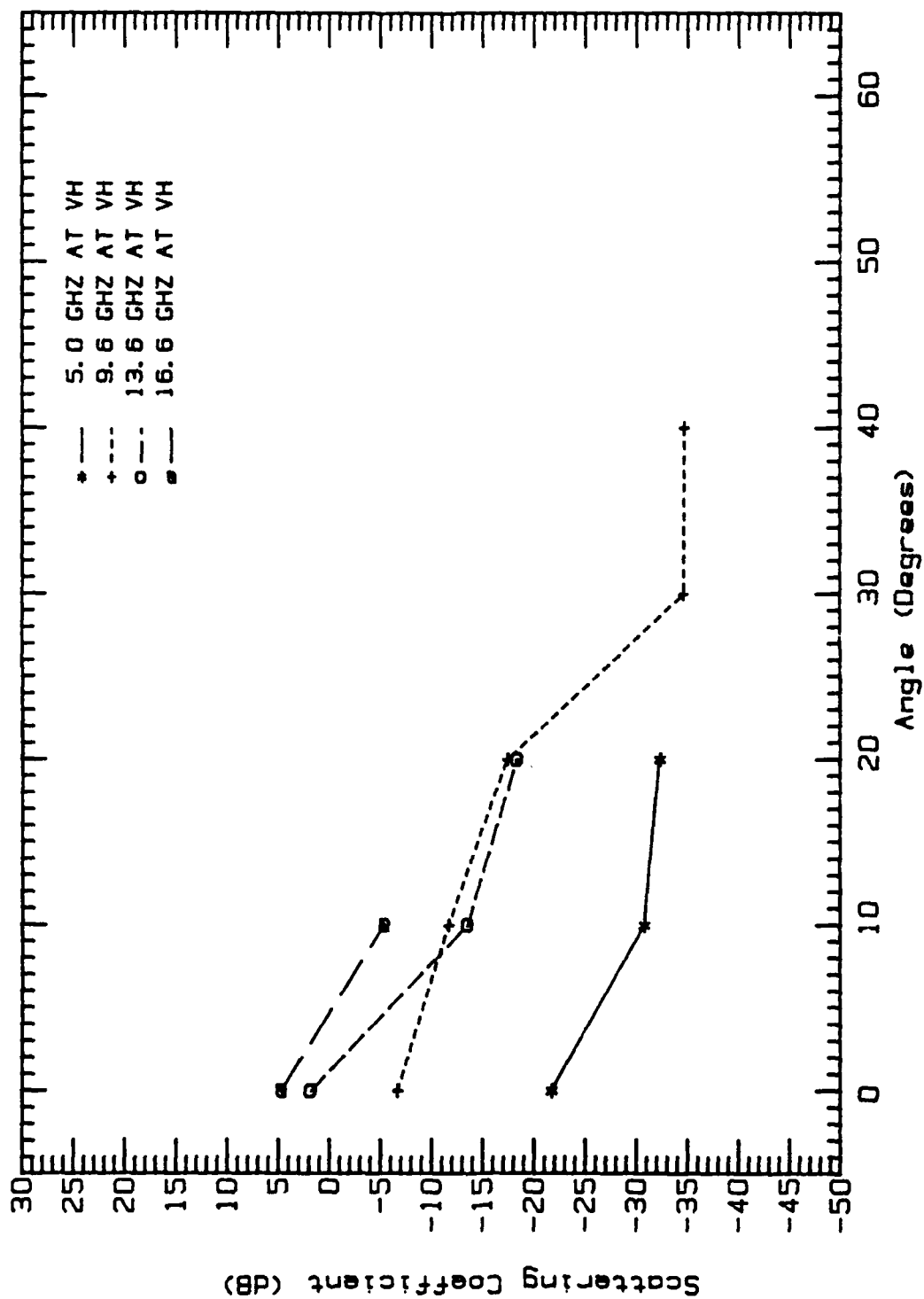
SIGMA OF GREASE ICE, JAN. 8, CRREL-85



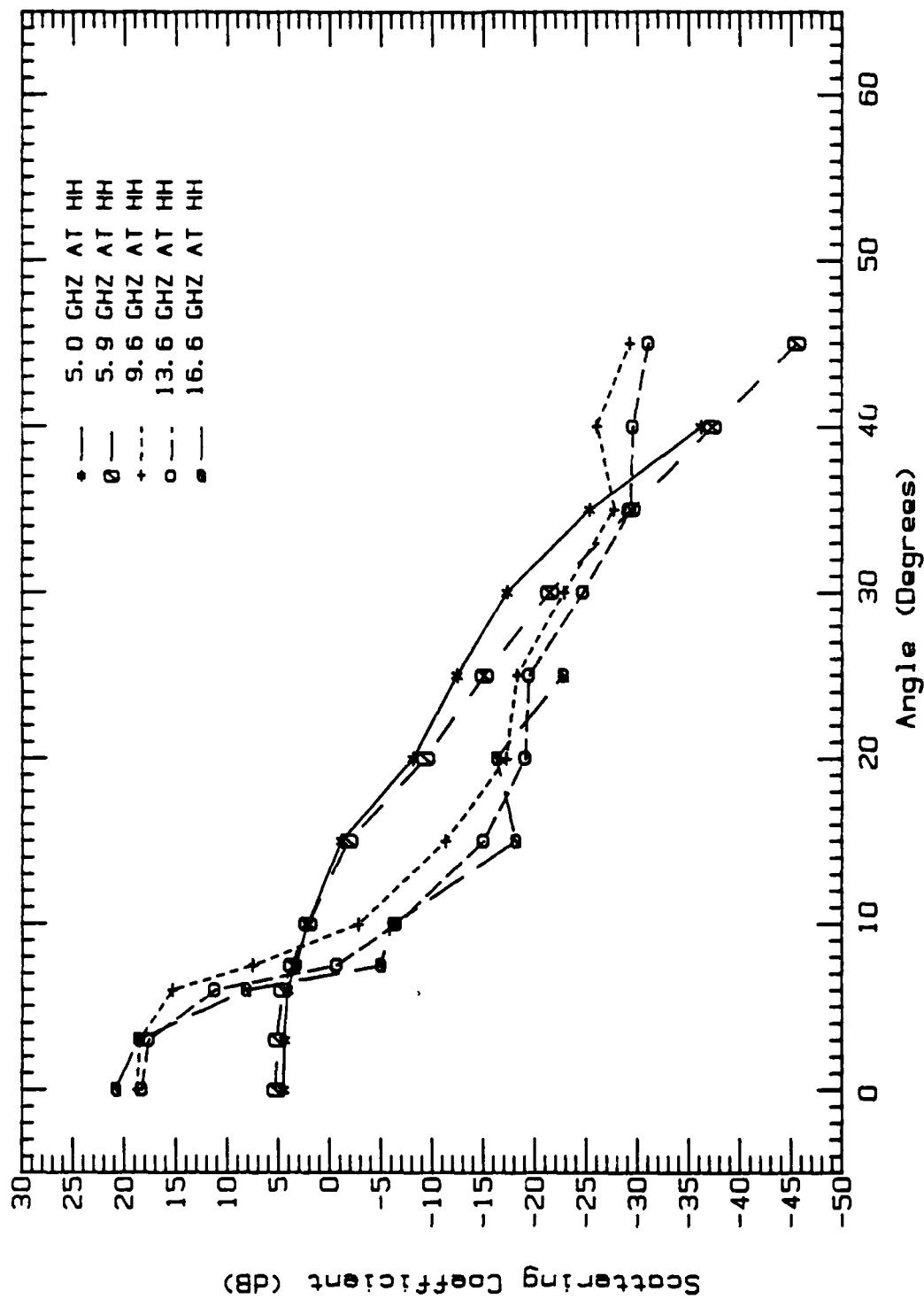
SIGMA OF SHEET ICE. JAN. 12, CRREL-85



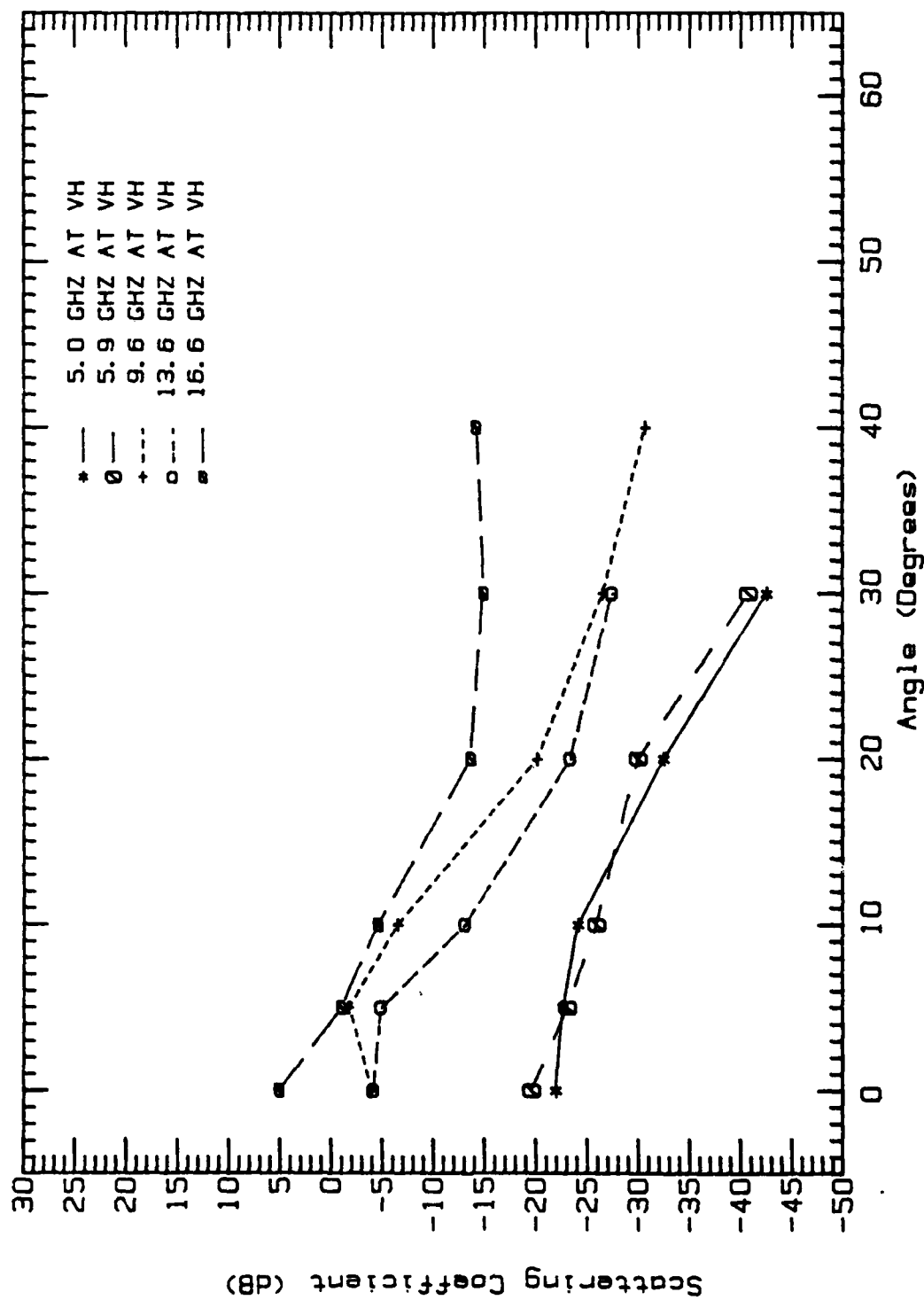
SIGMA OF SHEET ICE, JAN. 13, CRREL-85



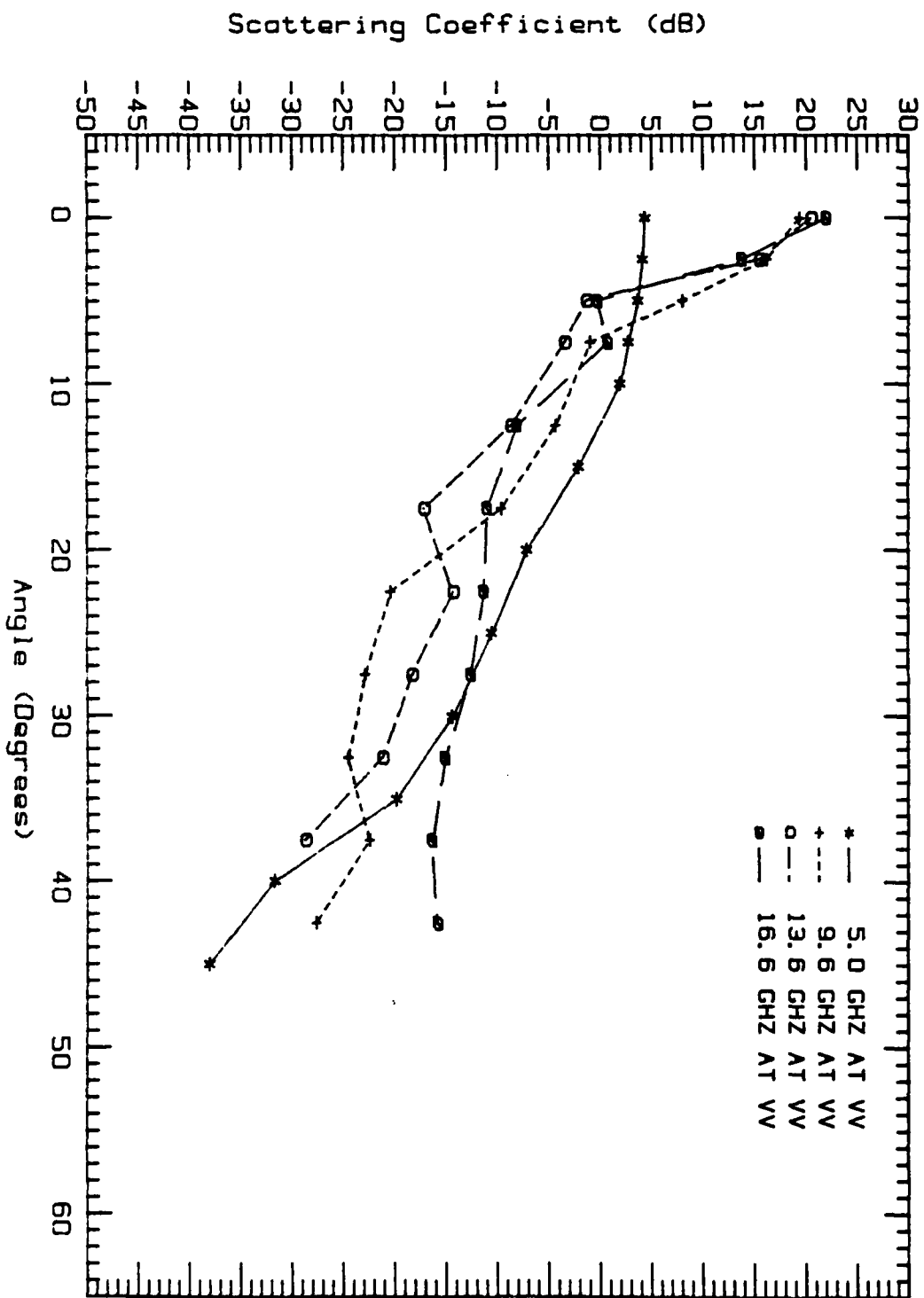
SIGMA OF SHEET ICE, JAN. 13, CRREL-85



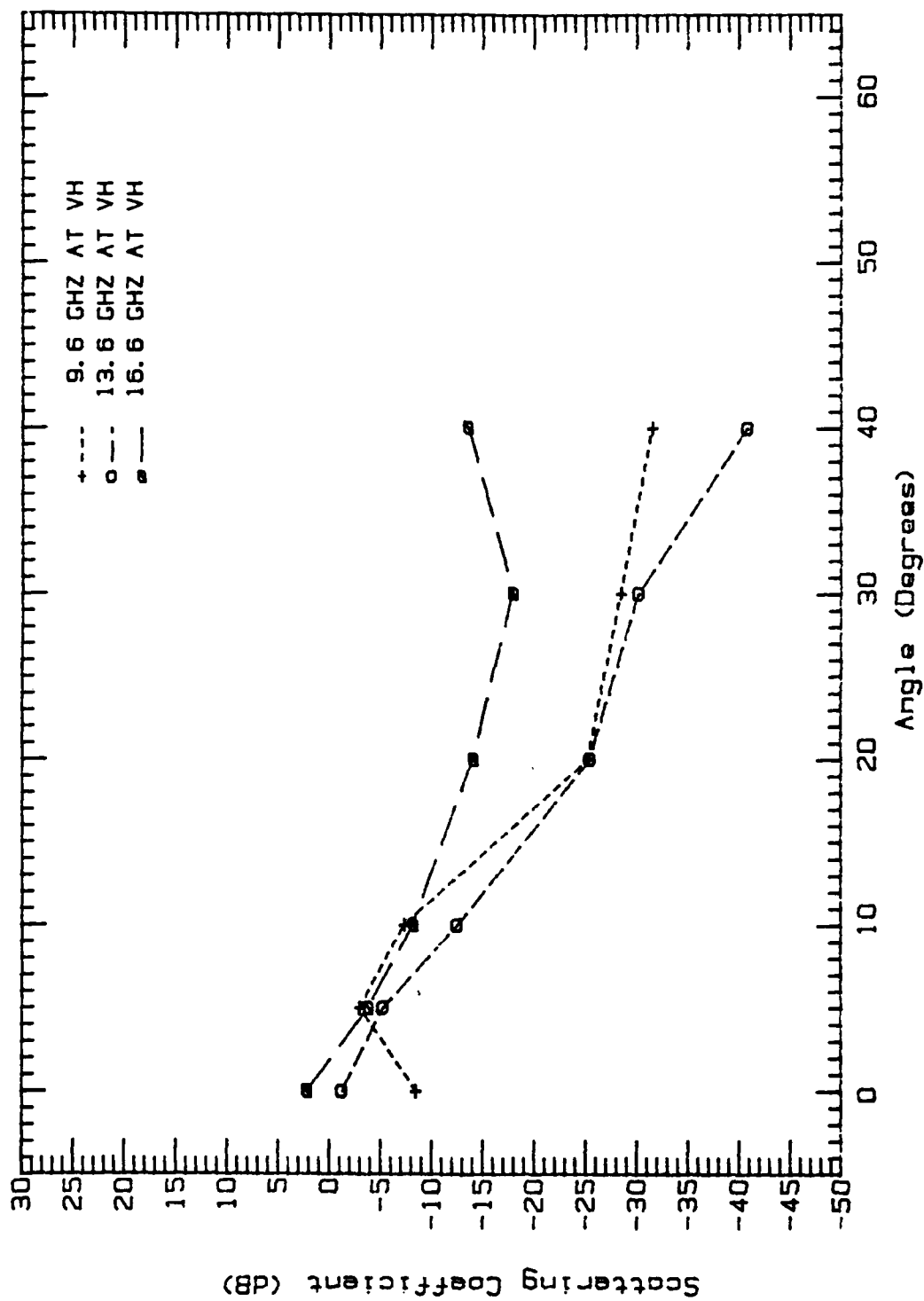
SIGMA OF SEEDED ICE, JAN. 16, CRREL-85



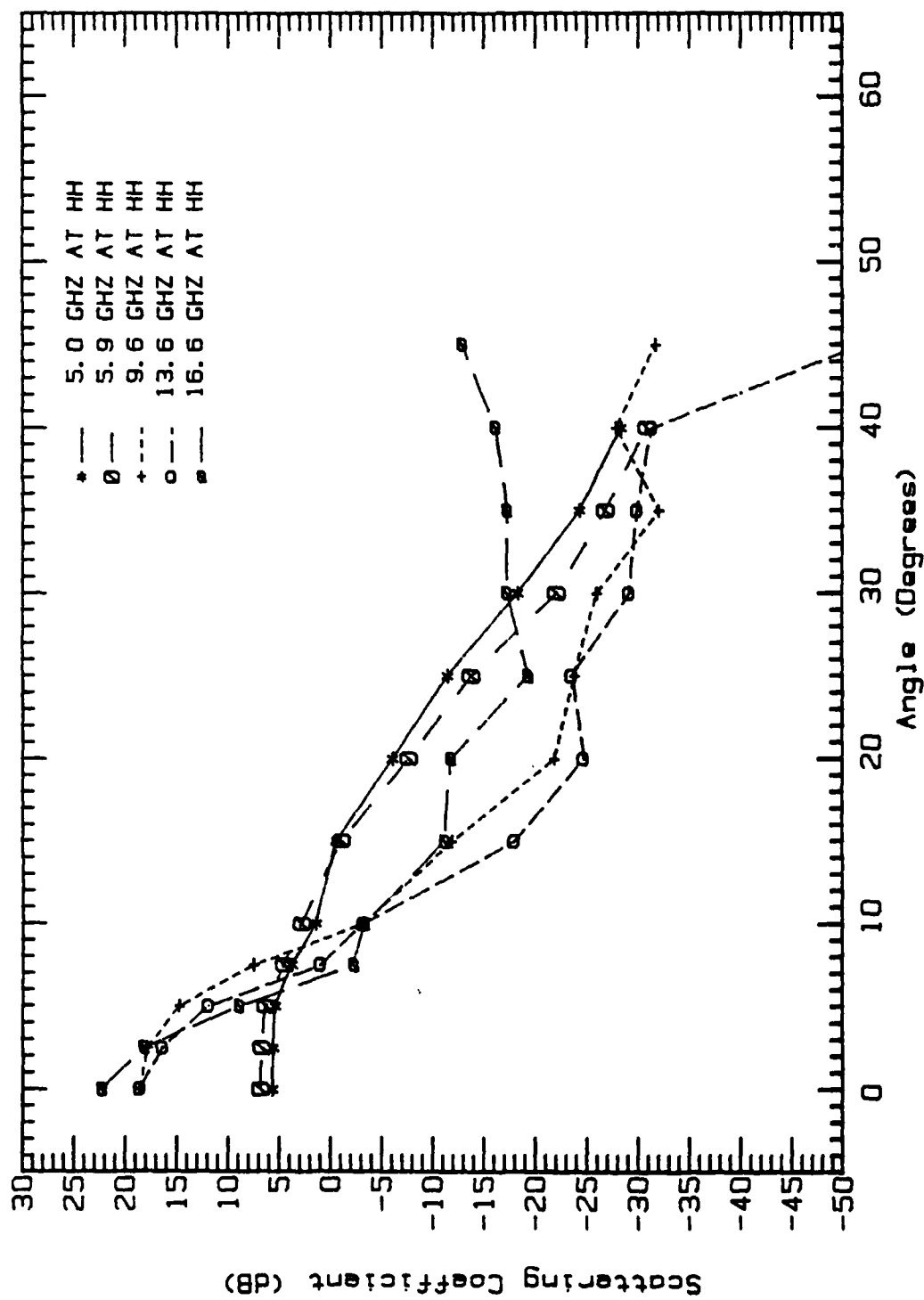
SIGMA OF SHEET ICE, JAN. 16, CRREL-85



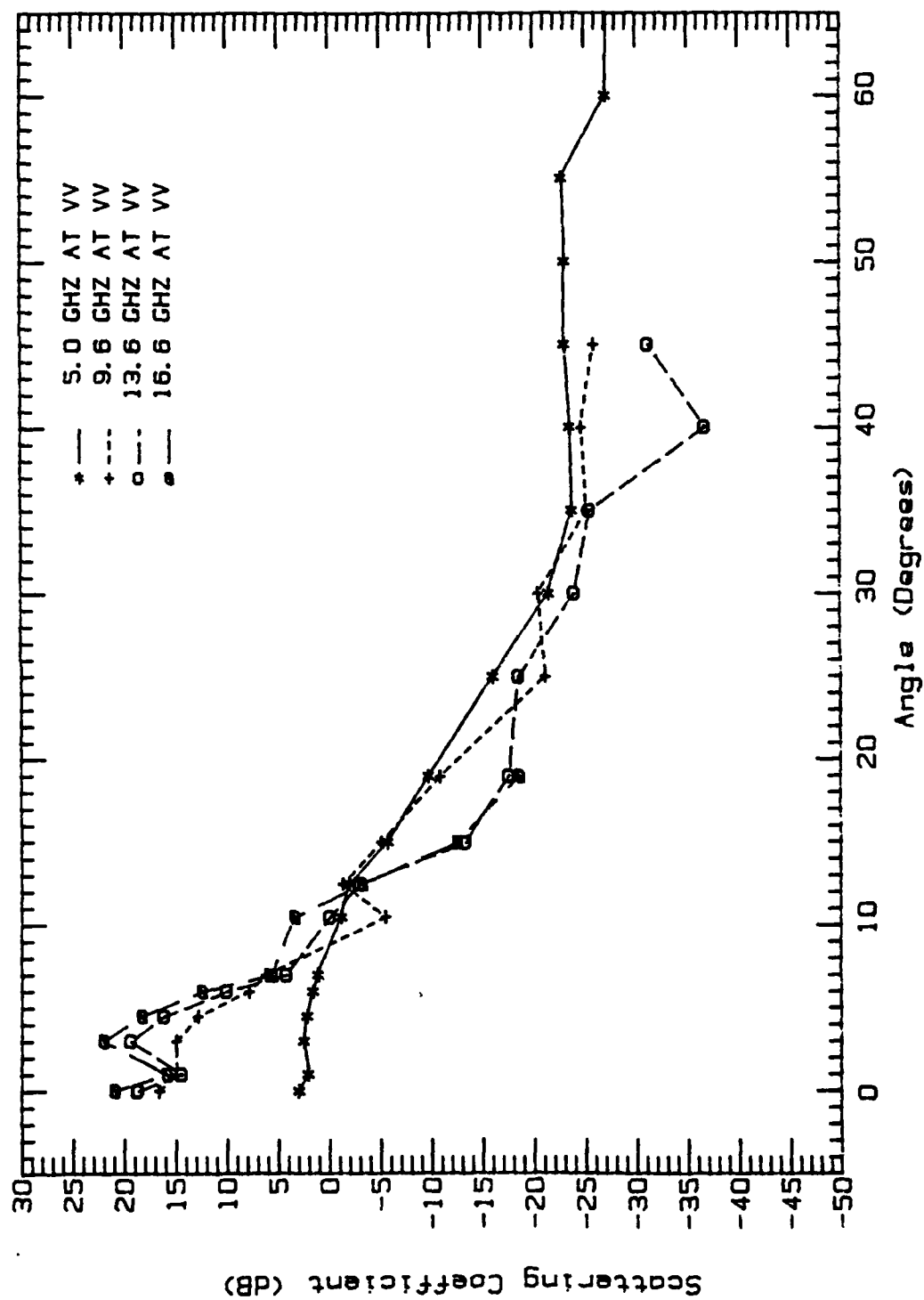
SIGMA OF SHEET ICE, JAN. 17, CRREL-85



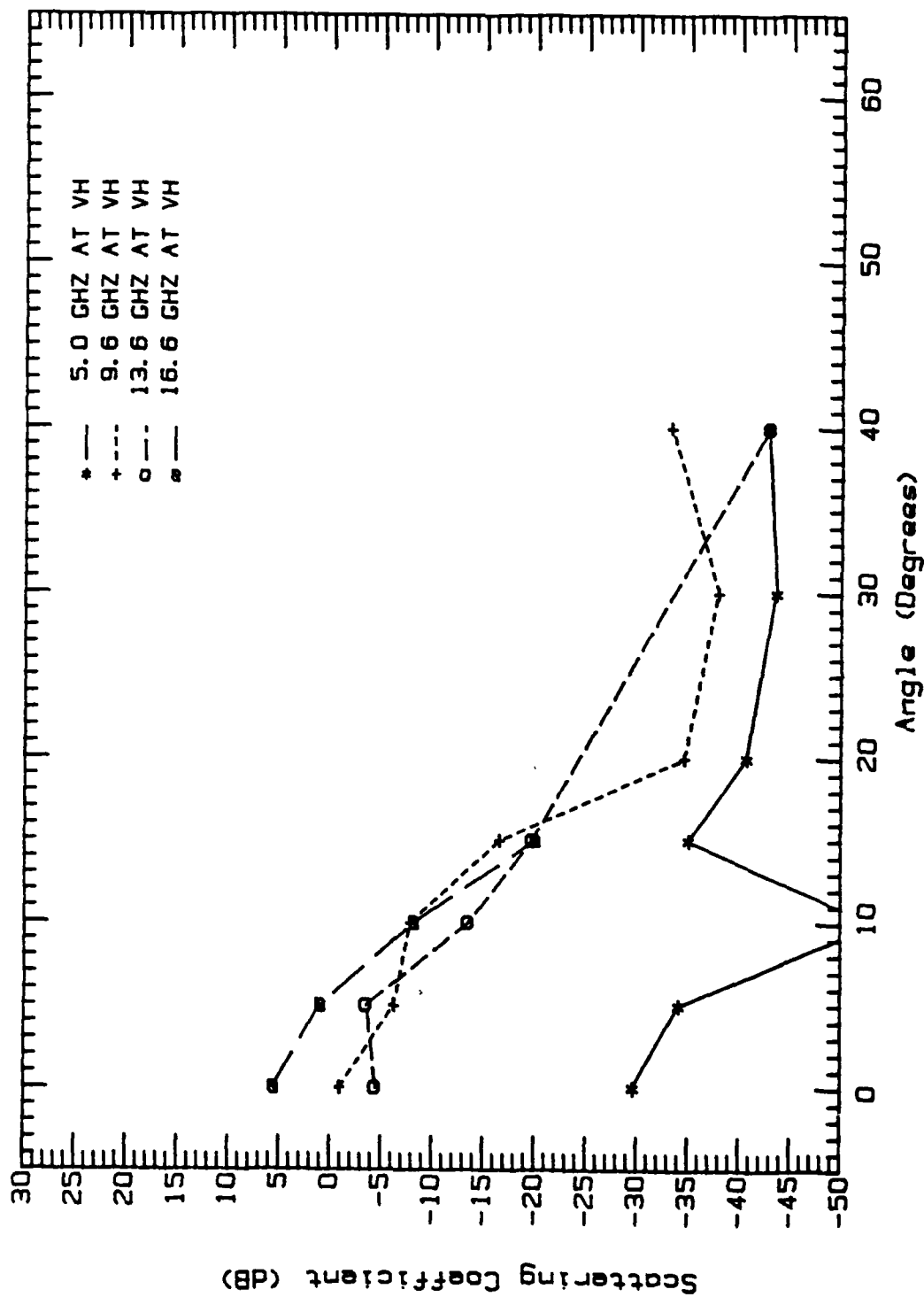
SIGMAD OF SHEET ICE, JAN. 17. CRREL-85



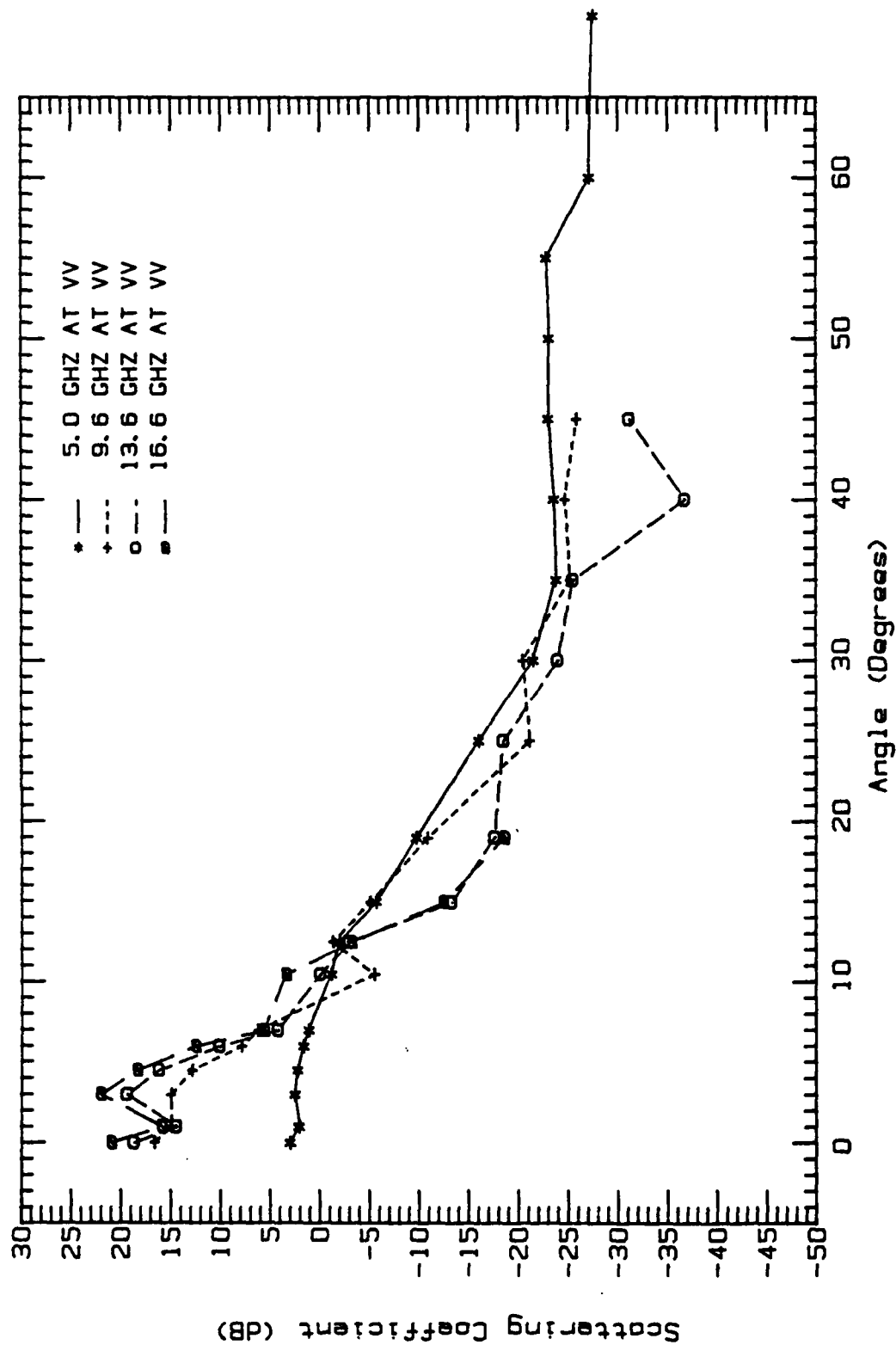
SIGMA OF SHEET ICE, JAN. 16, CRREL-85



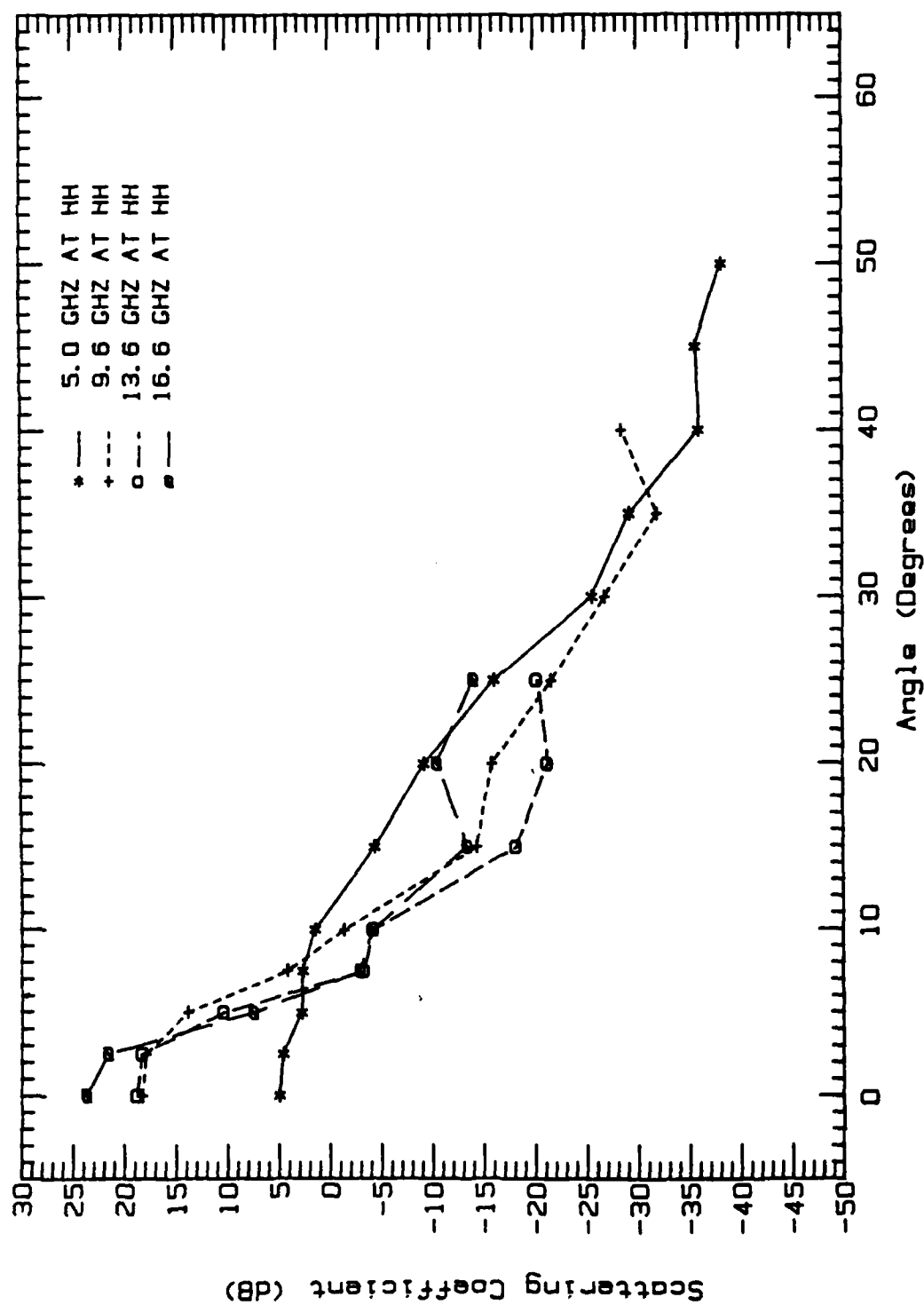
SIGMA OF SHEET ICE, JAN. 6, CRREL-85



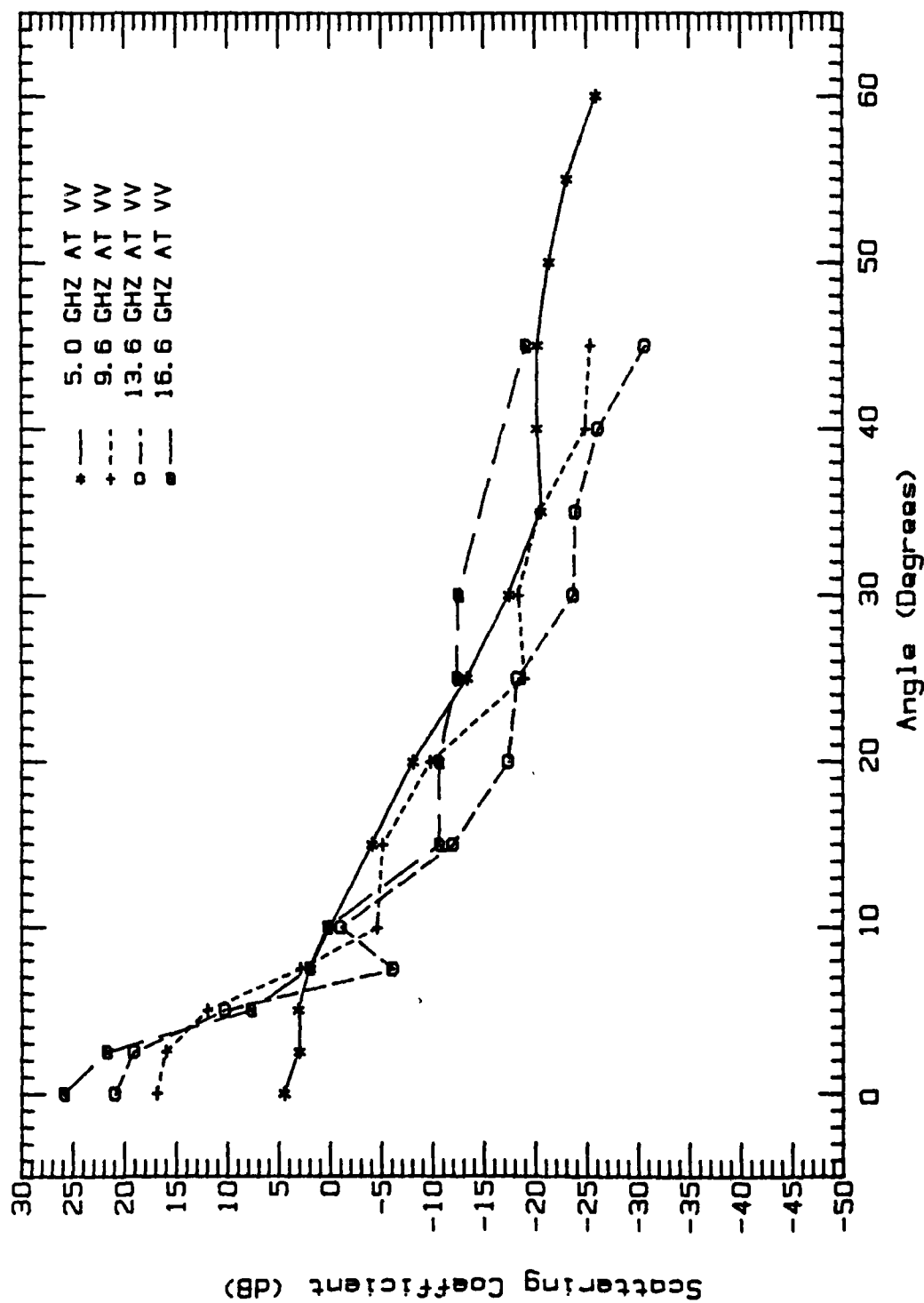
SIGMA OF SHEET ICE, JAN. 6, CRREL-85



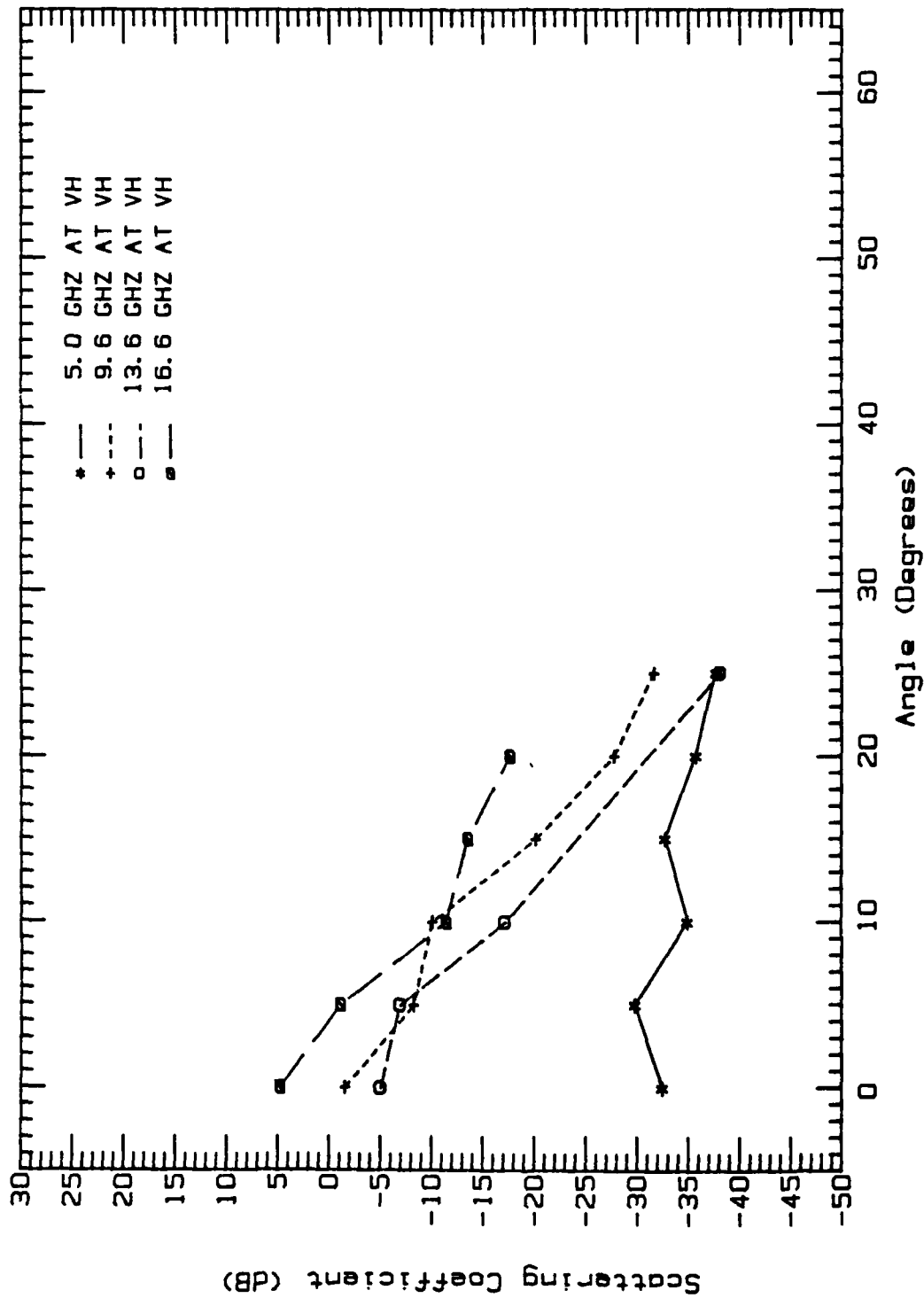
SIGMA OF SHEET ICE, JAN. 6, CRREL-85



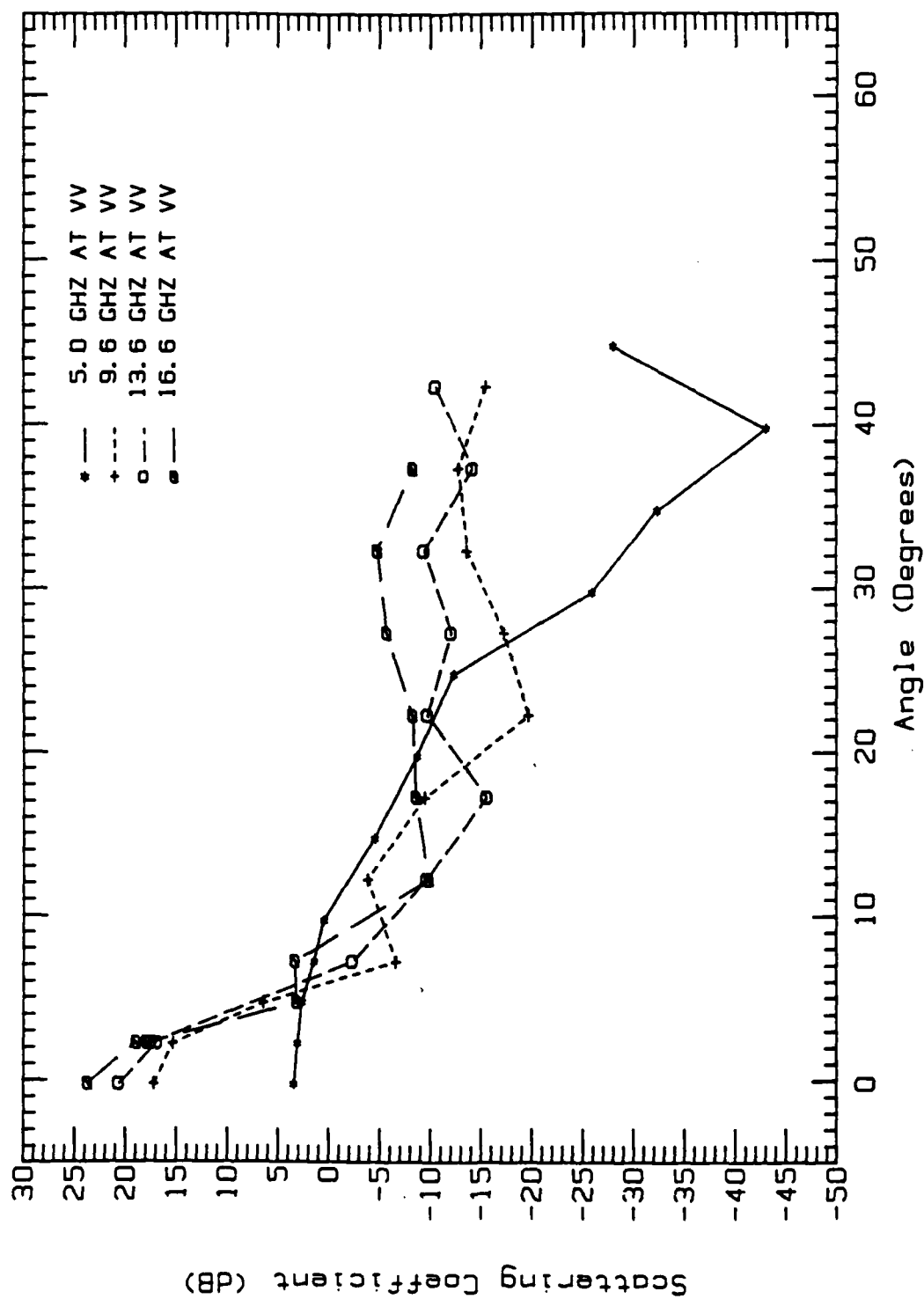
SIGMA OF SHEET ICE. JAN. 5. CRREL-85



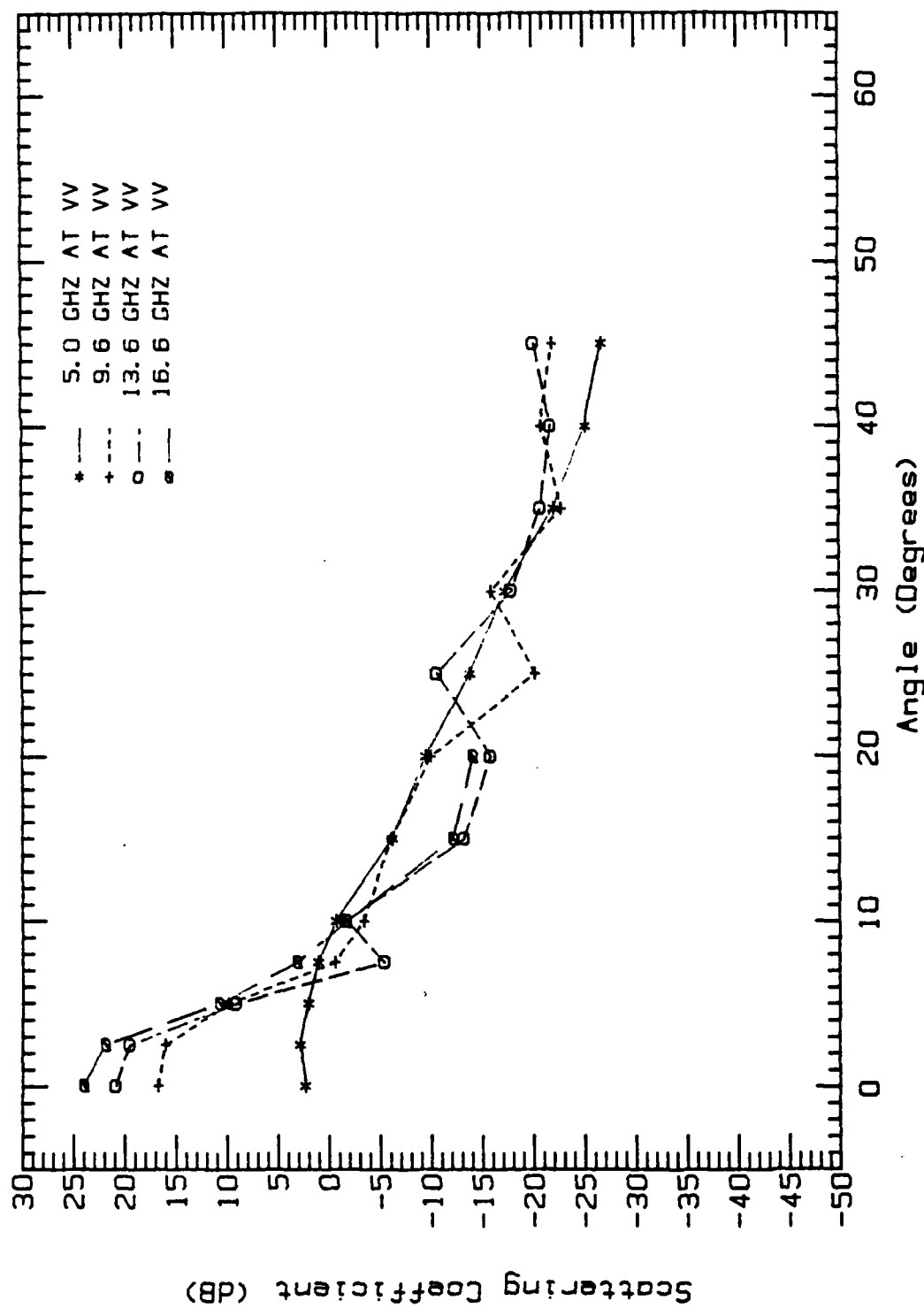
SIGMA OF SHEET ICE, JAN. 5, CRREL-85



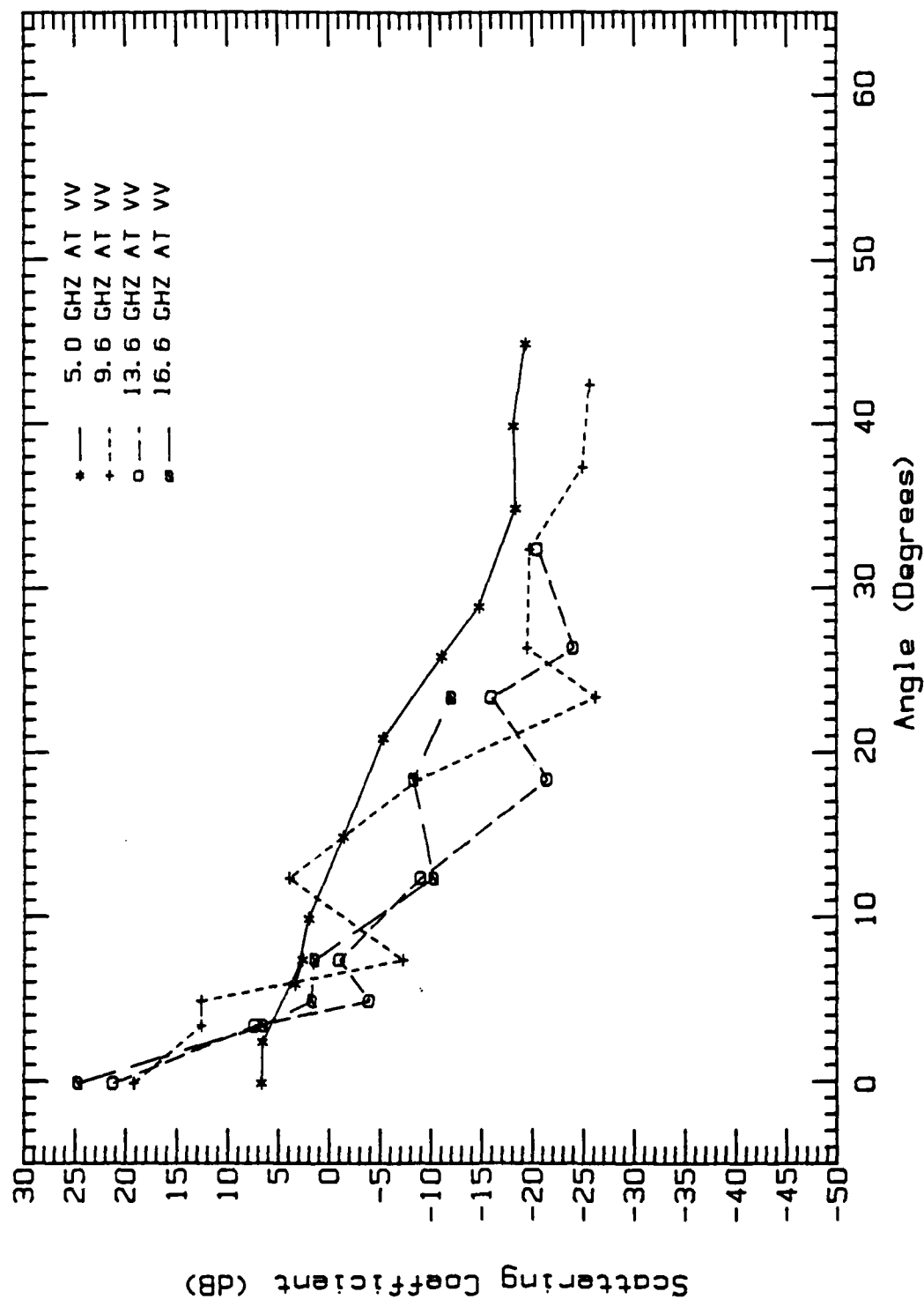
SIGMA OF SHEET ICE, JAN. 5, CRREL-85



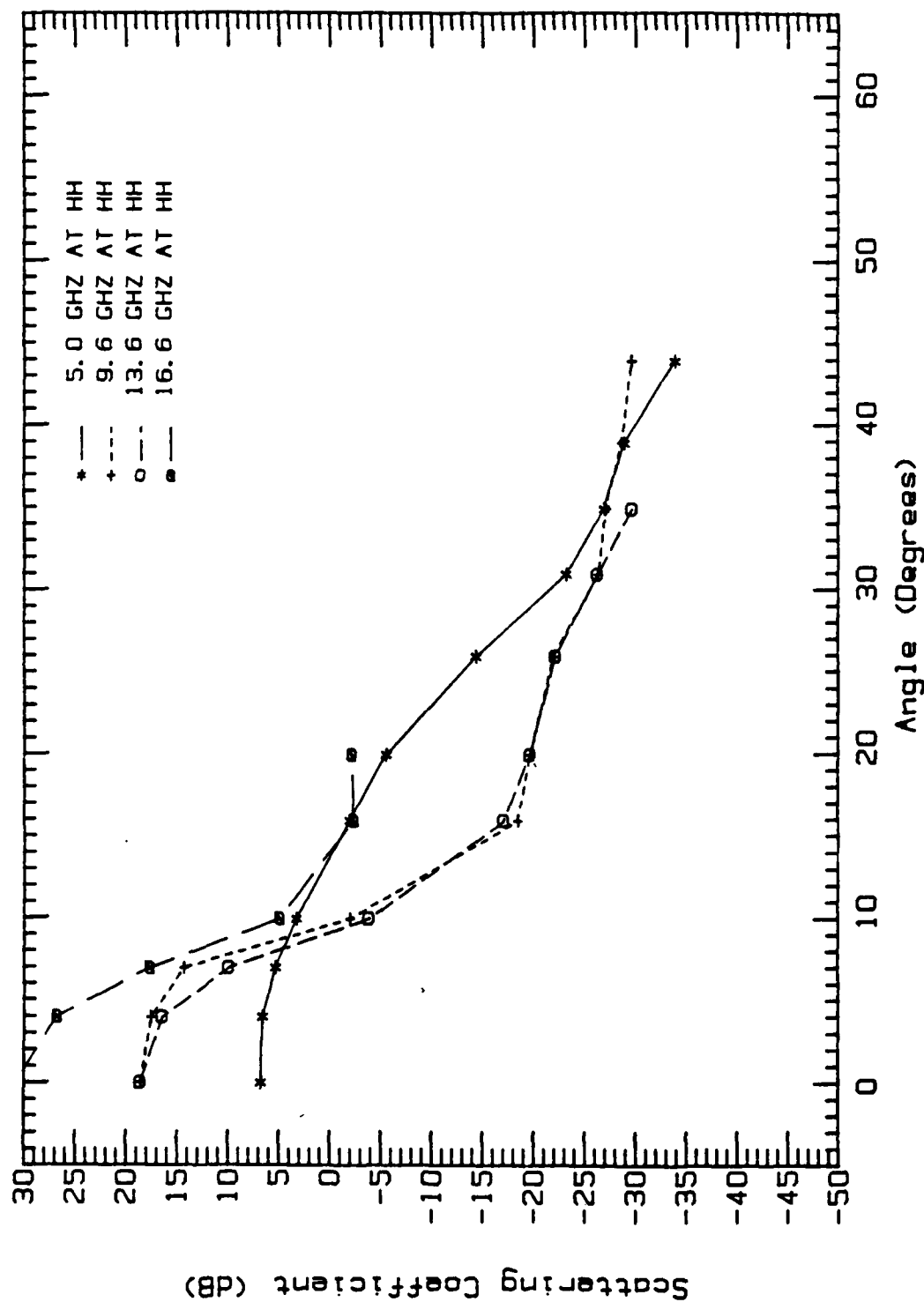
CRREL-85, JAN. 21, TIME: 11:45



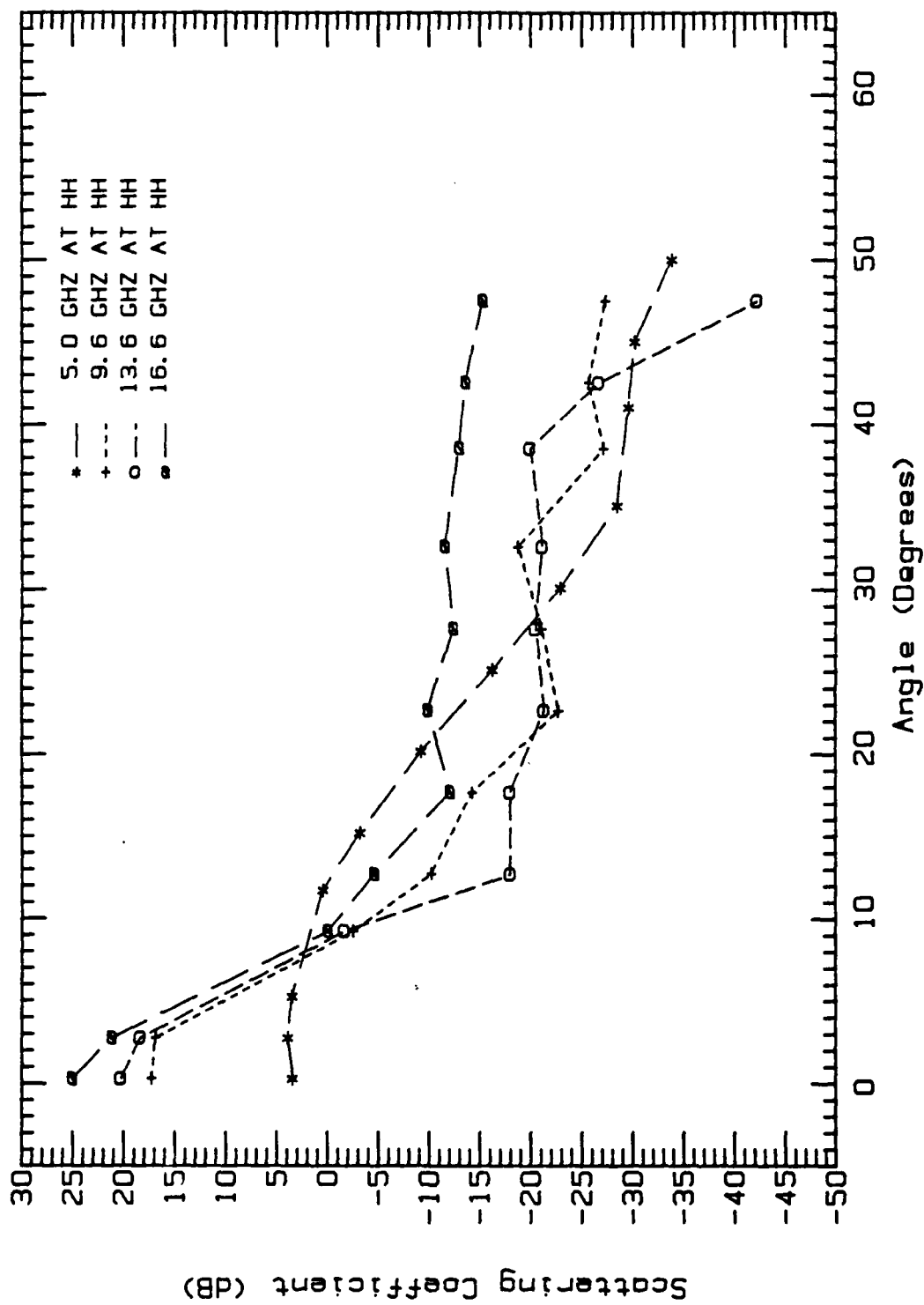
CRREL-85, JAN. 25, TIME: 8:44



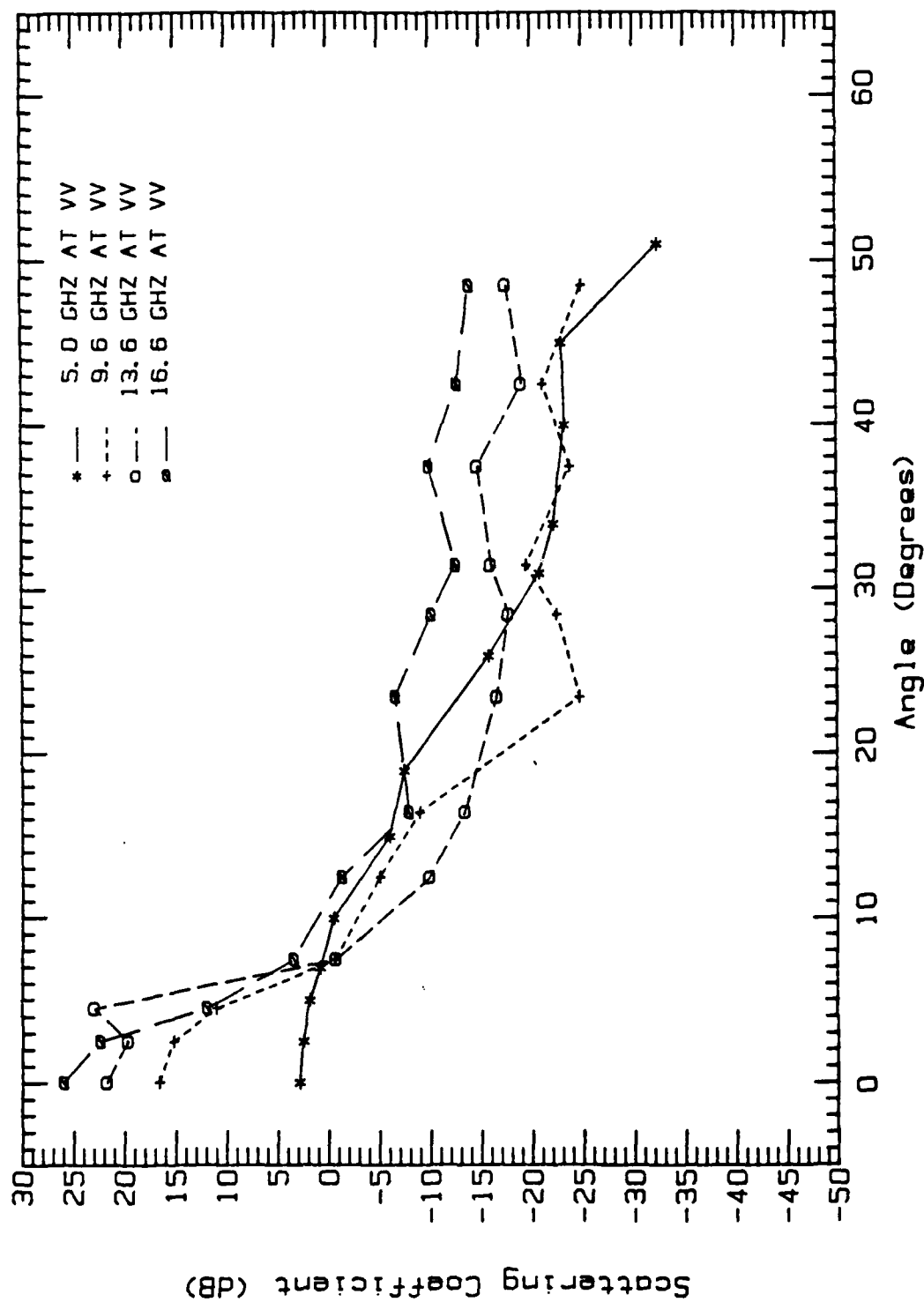
CRREL-85, JAN. 8, TIME: 23:00



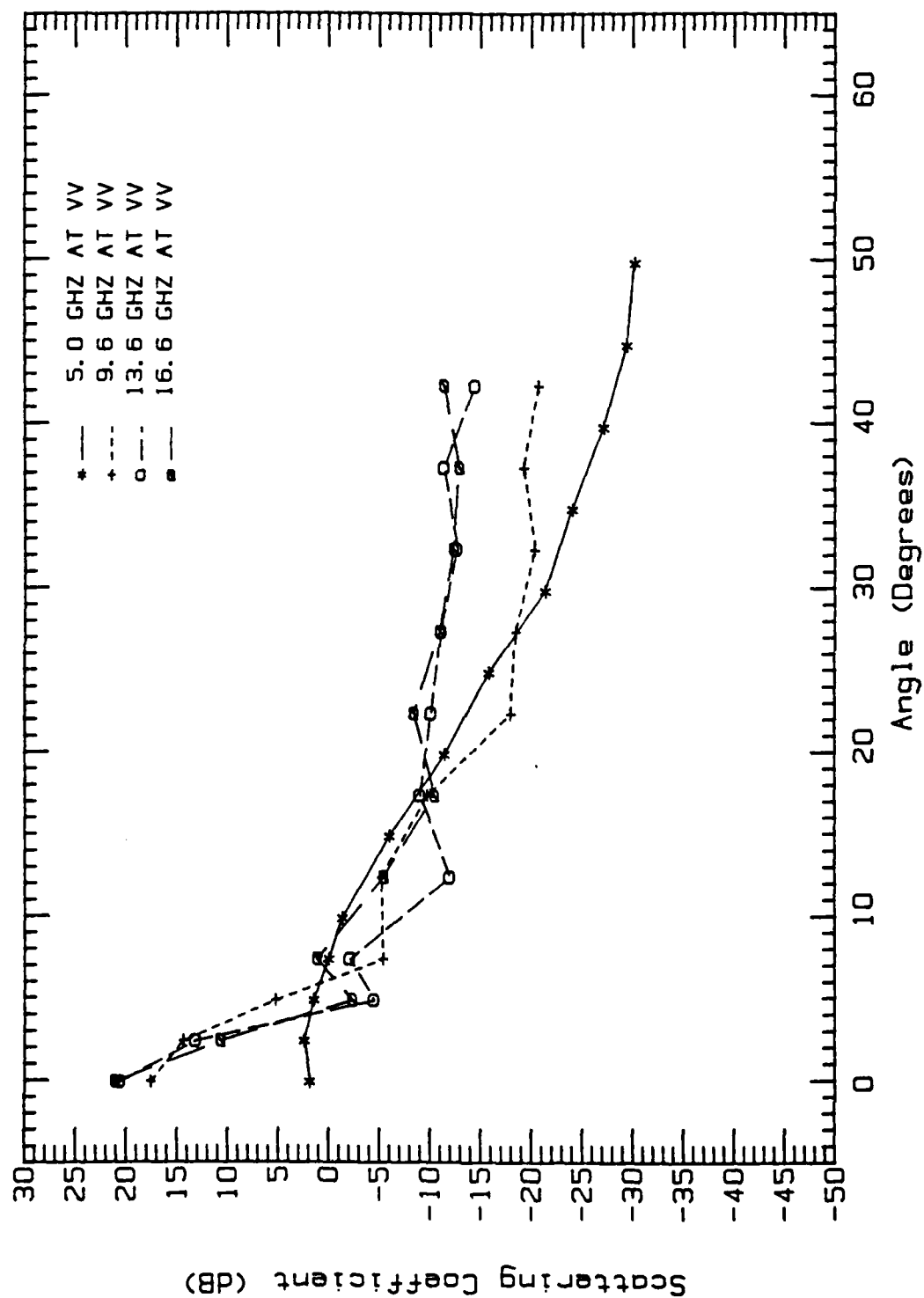
CRREL-85, JAN. 8, TIME: 23:35



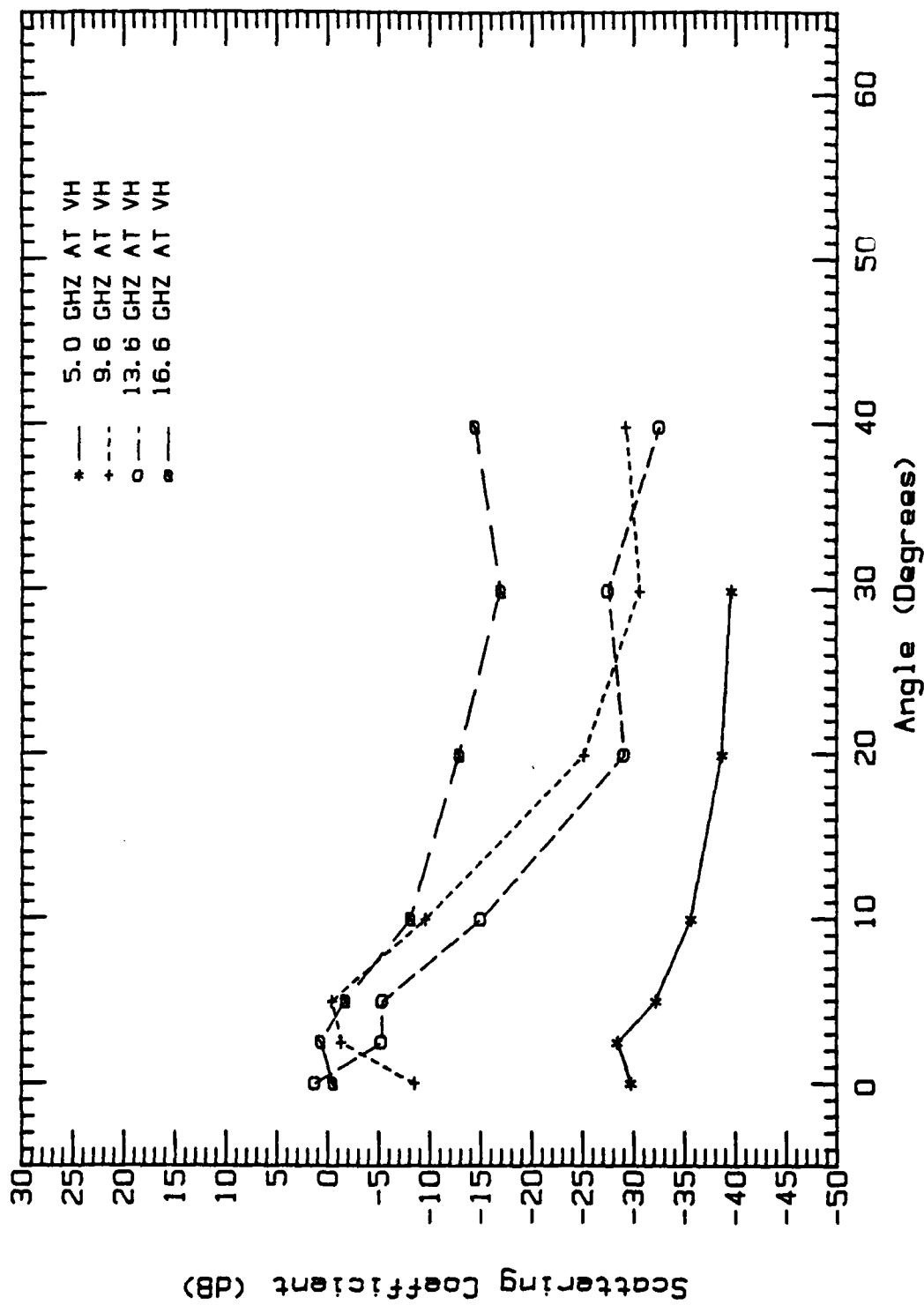
CRREL-85, JAN. 9, TIME: 11:11



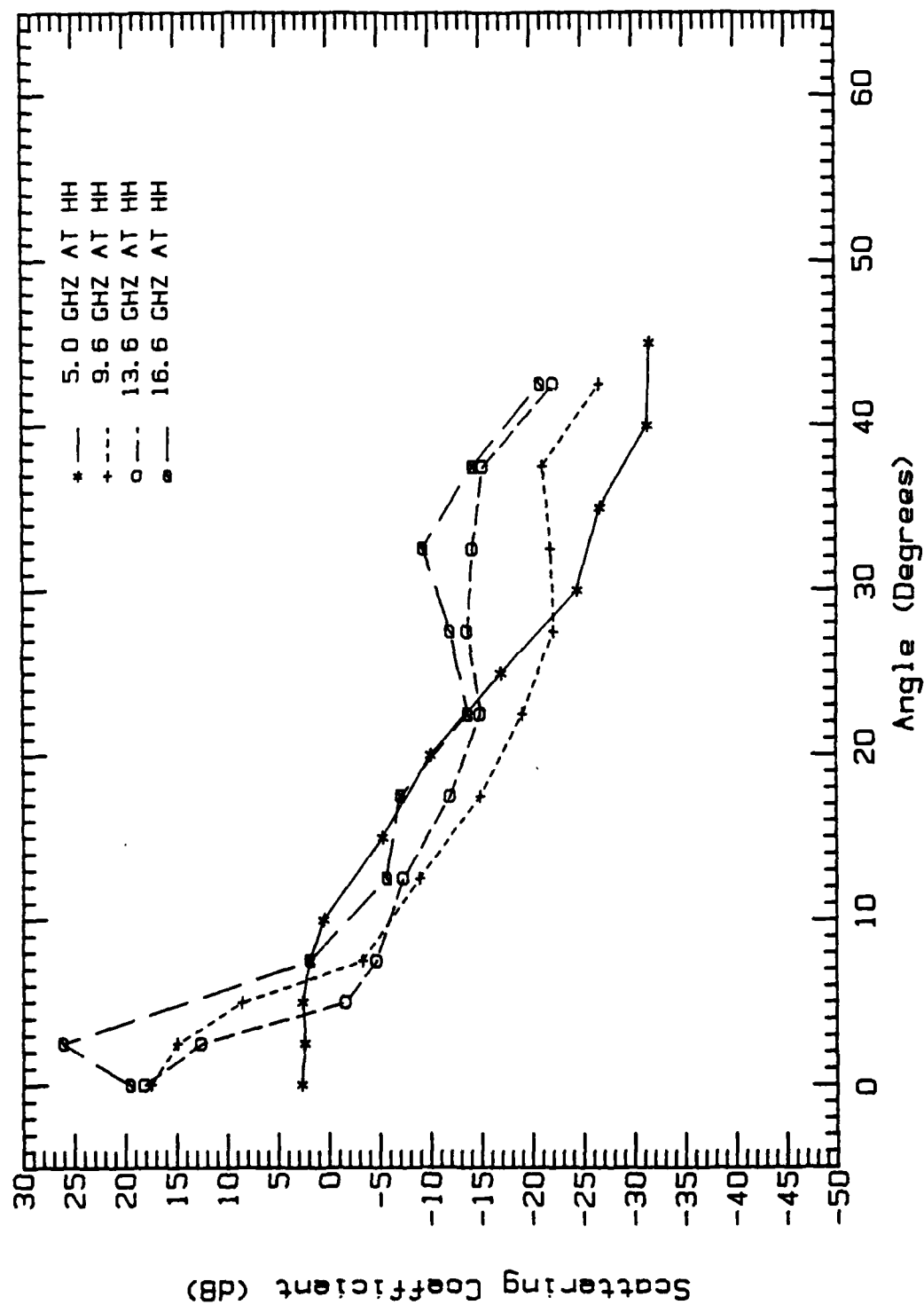
CRREL-85, JAN. 9, TIME: 12:42



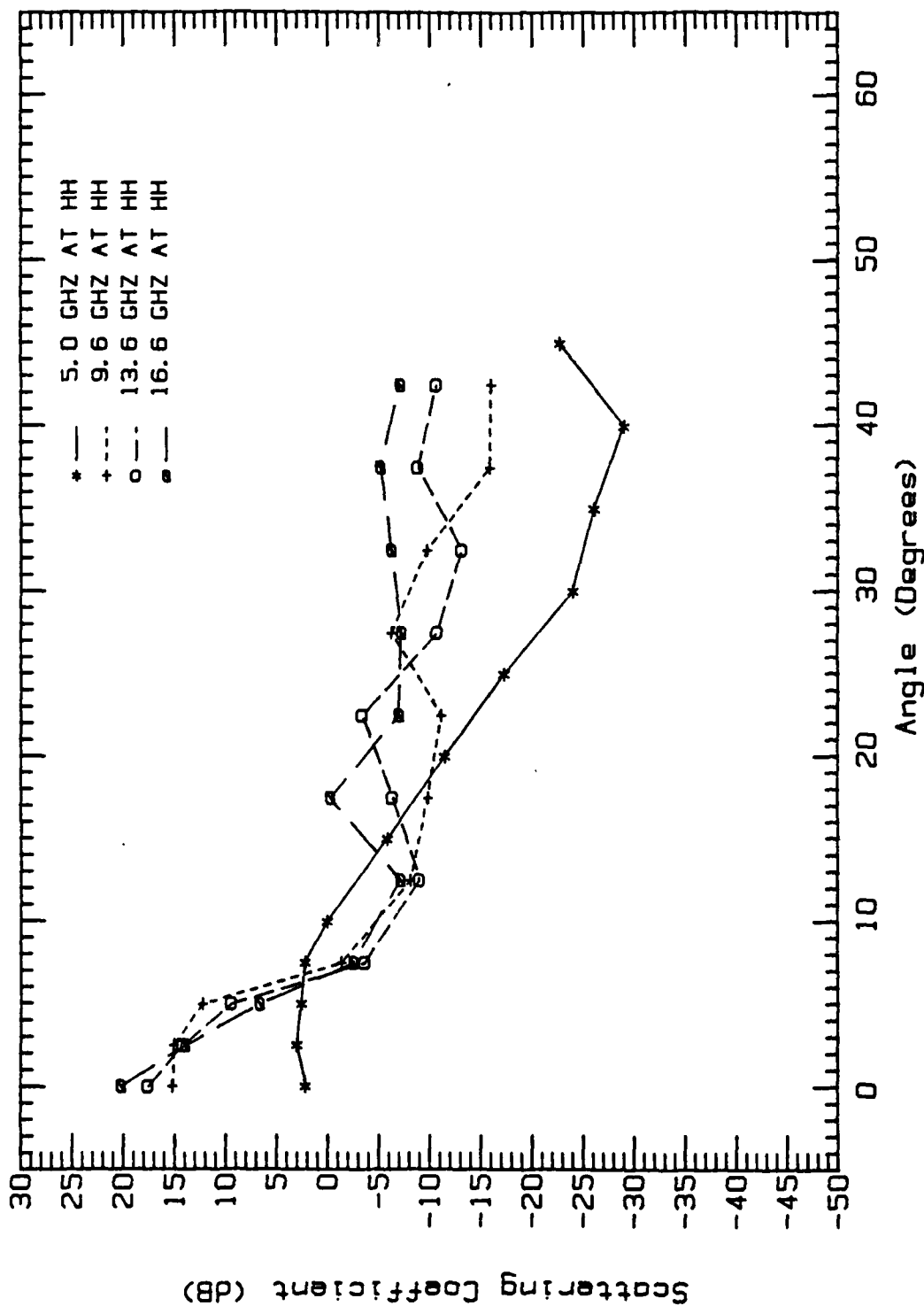
CRREL-85, JAN. 9, TIME: 18:43



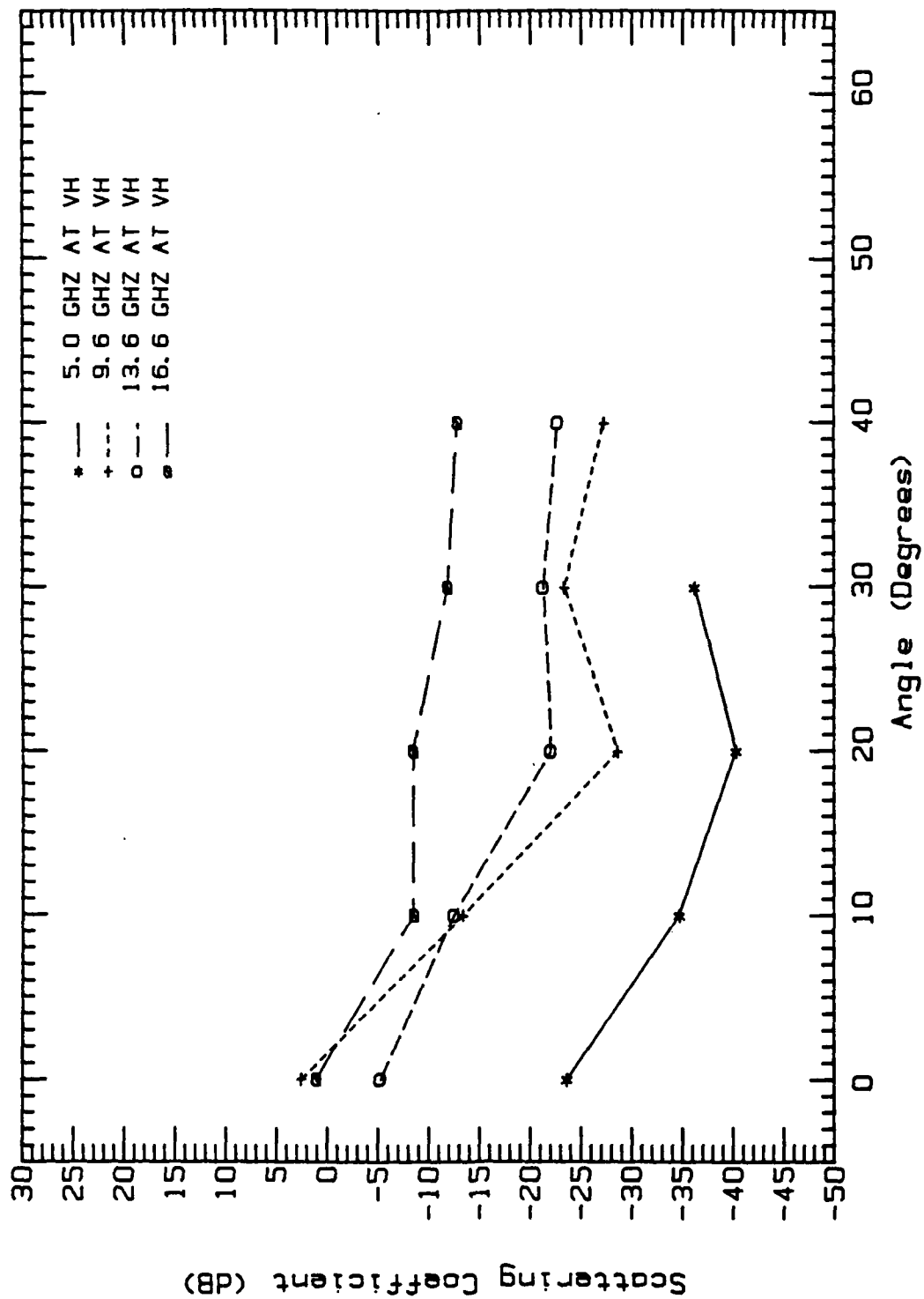
CRREL, JAN. 9, TIME: 19:00



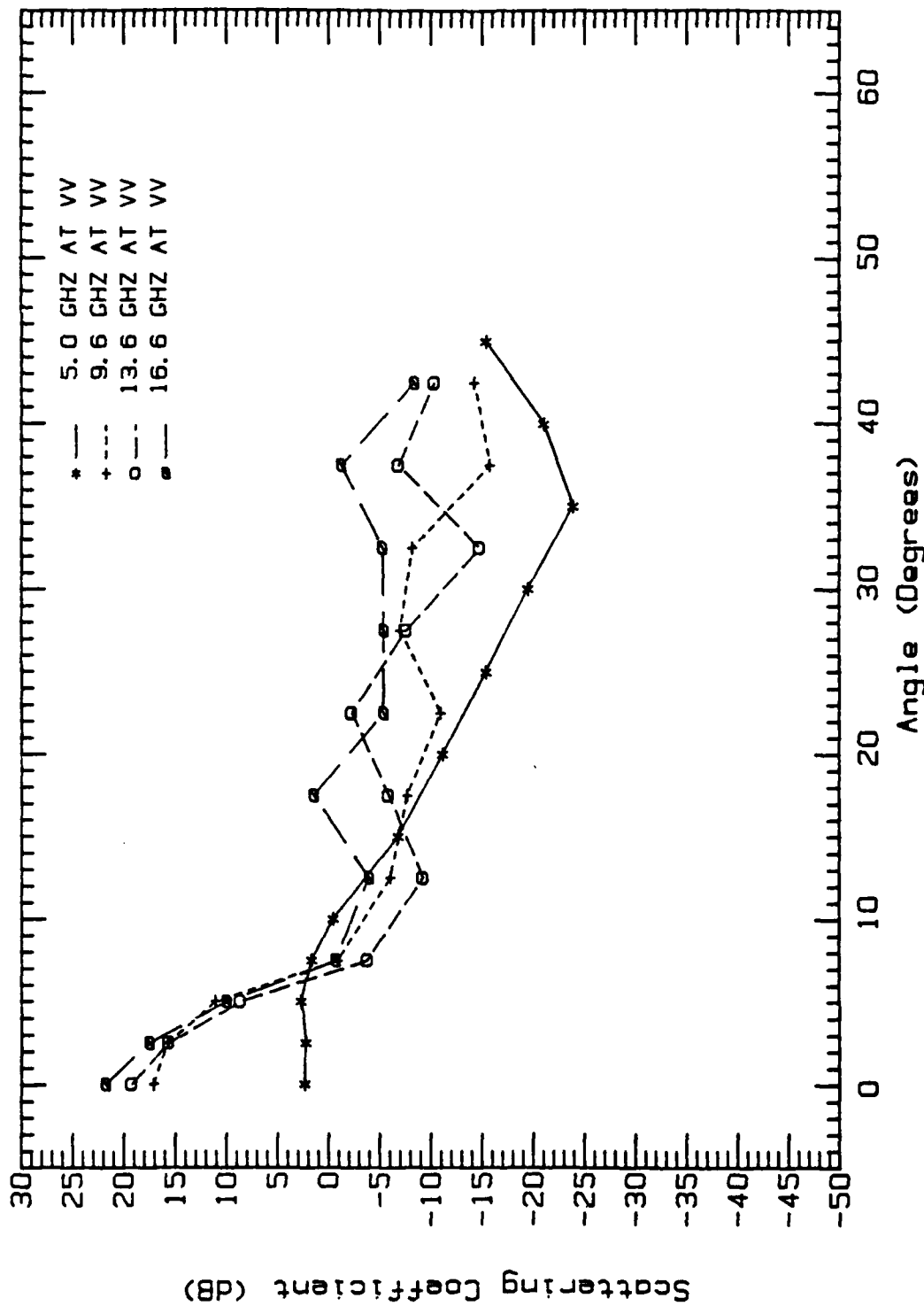
CRREL-85. JAN. 9. TIME: 19:32



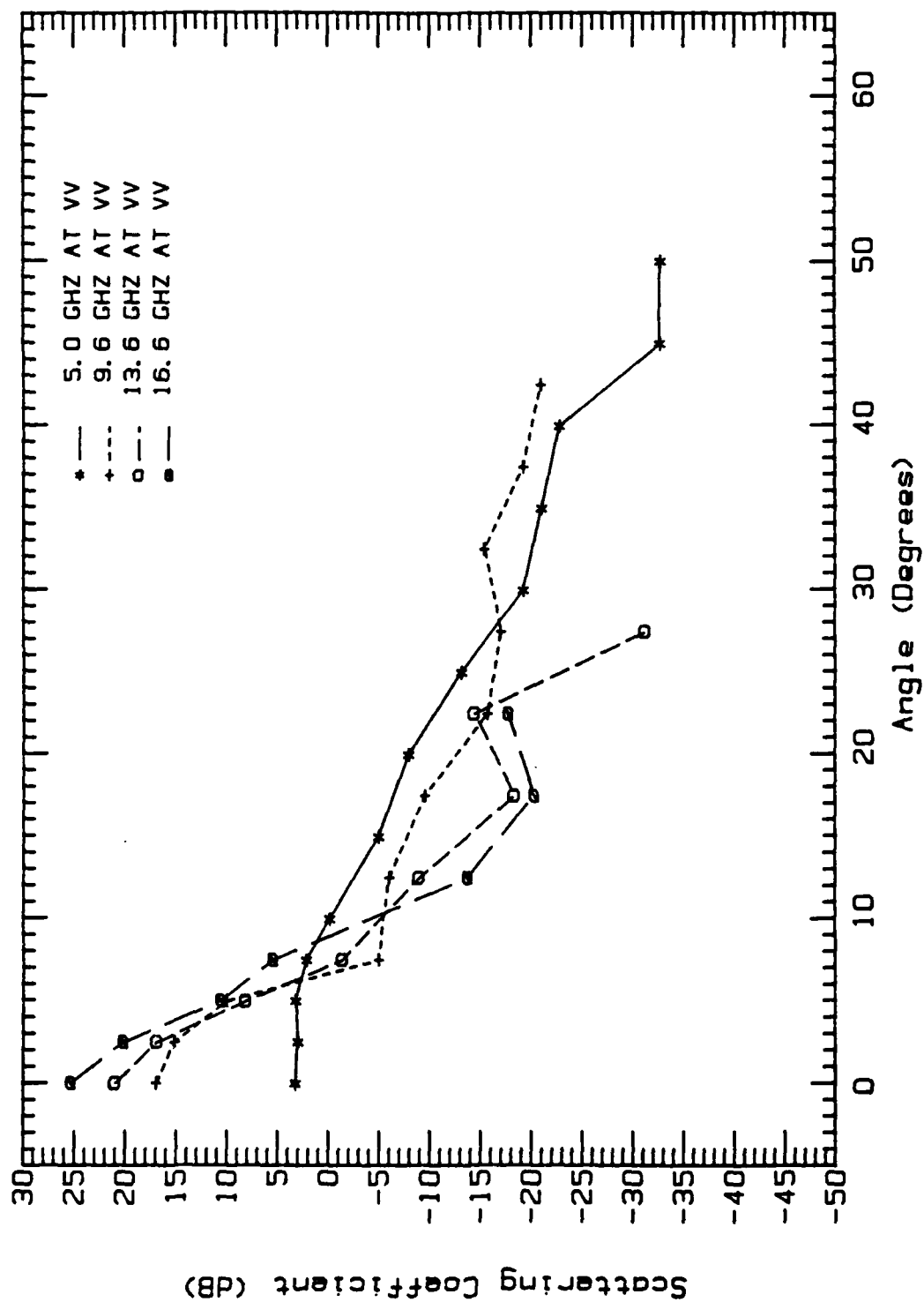
CRREL-85, JAN. 9, TIME: 20:06



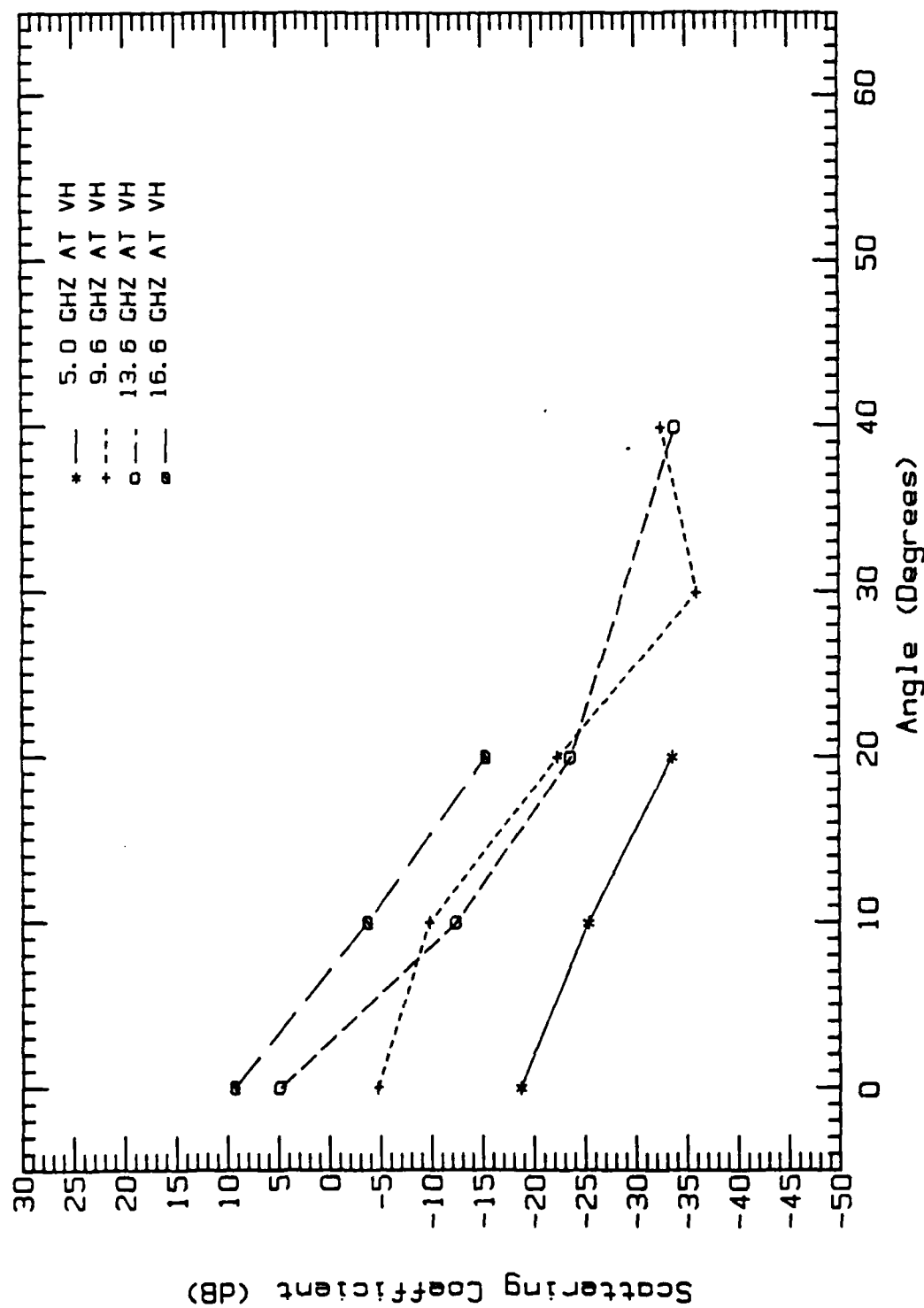
CRREL-85, JAN. 9, TIME: 20:36



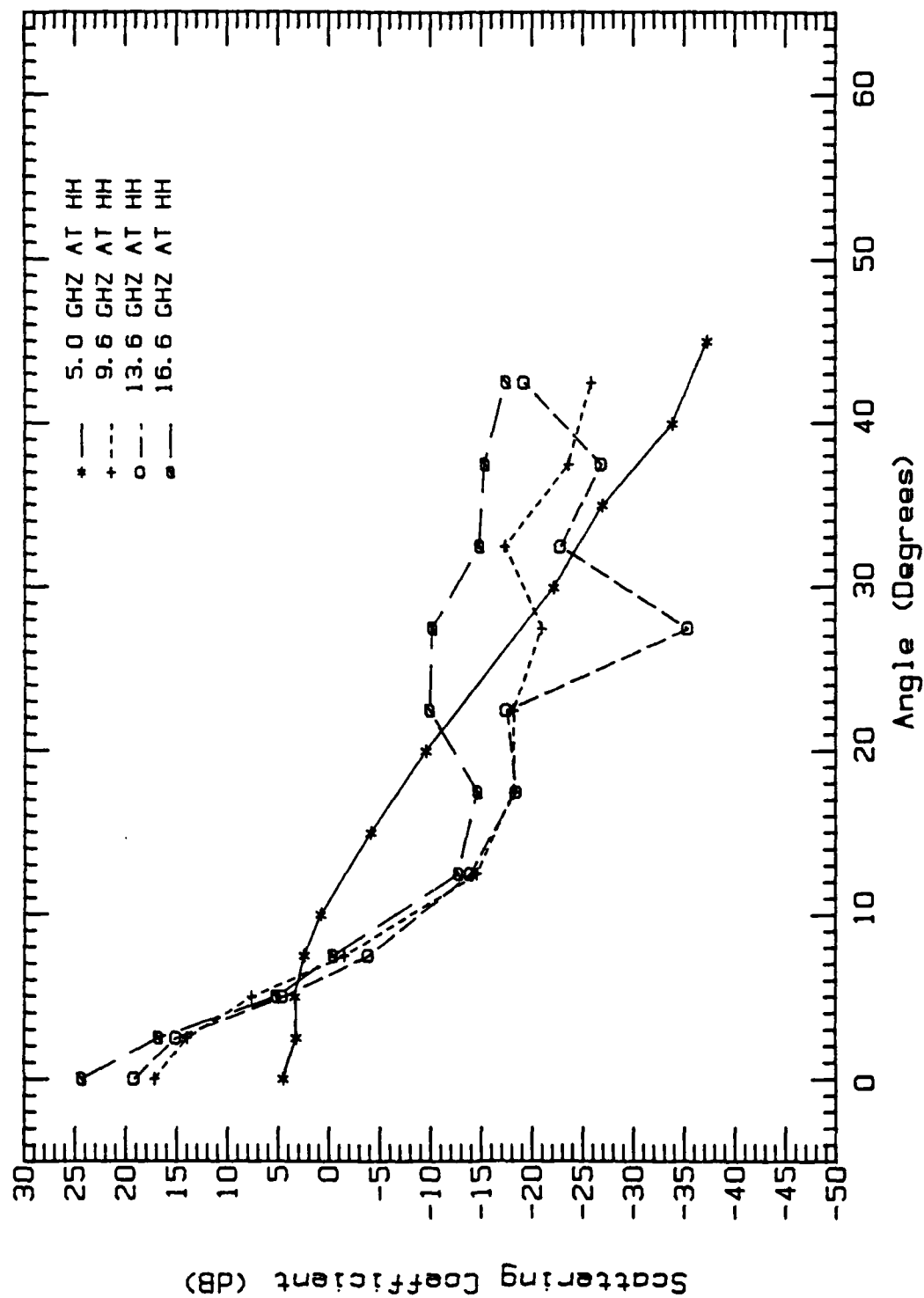
CRREL-85, JAN. 9, TIME: 20:40



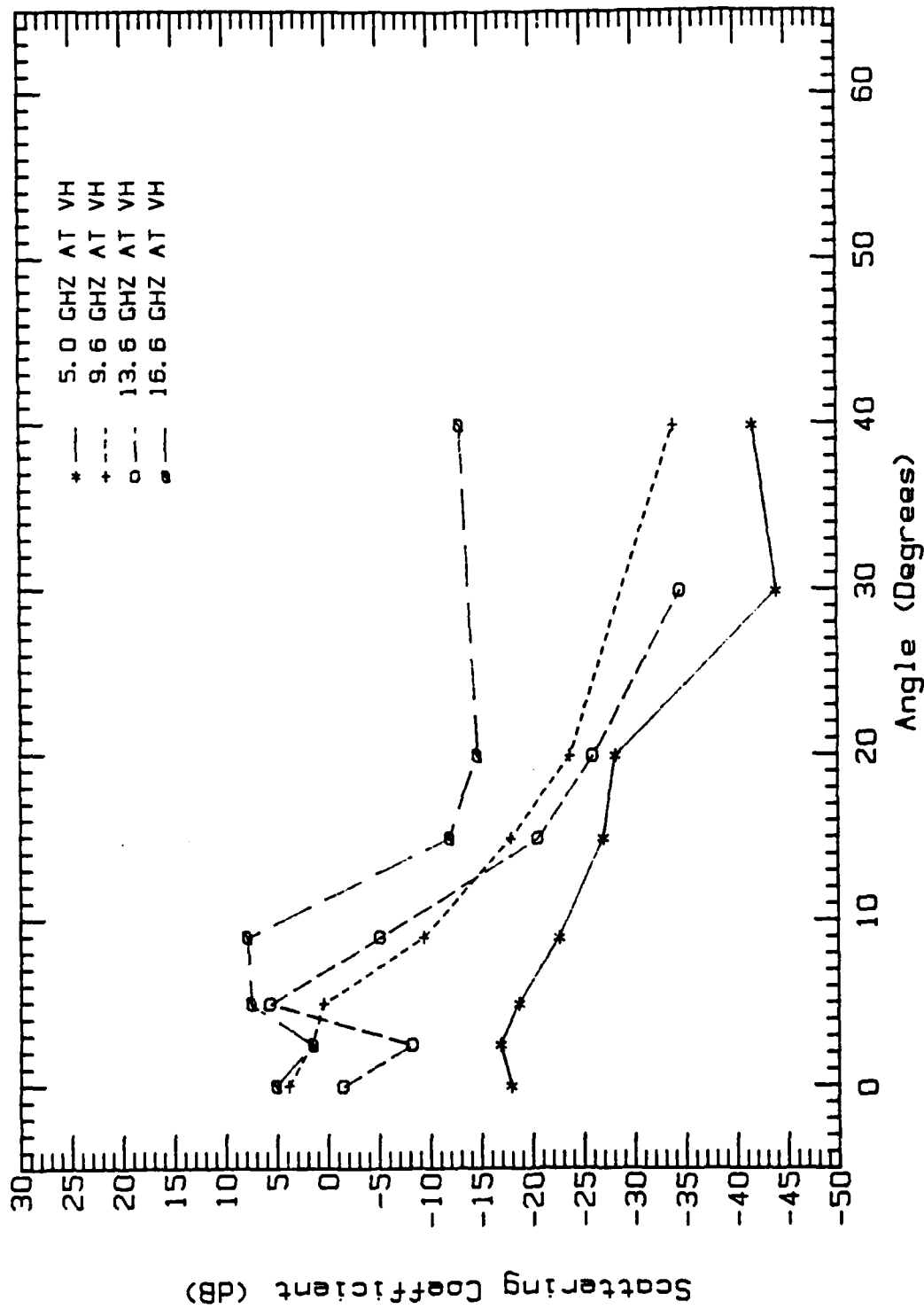
CRREL-85, JAN. 9, TIME: 23:26



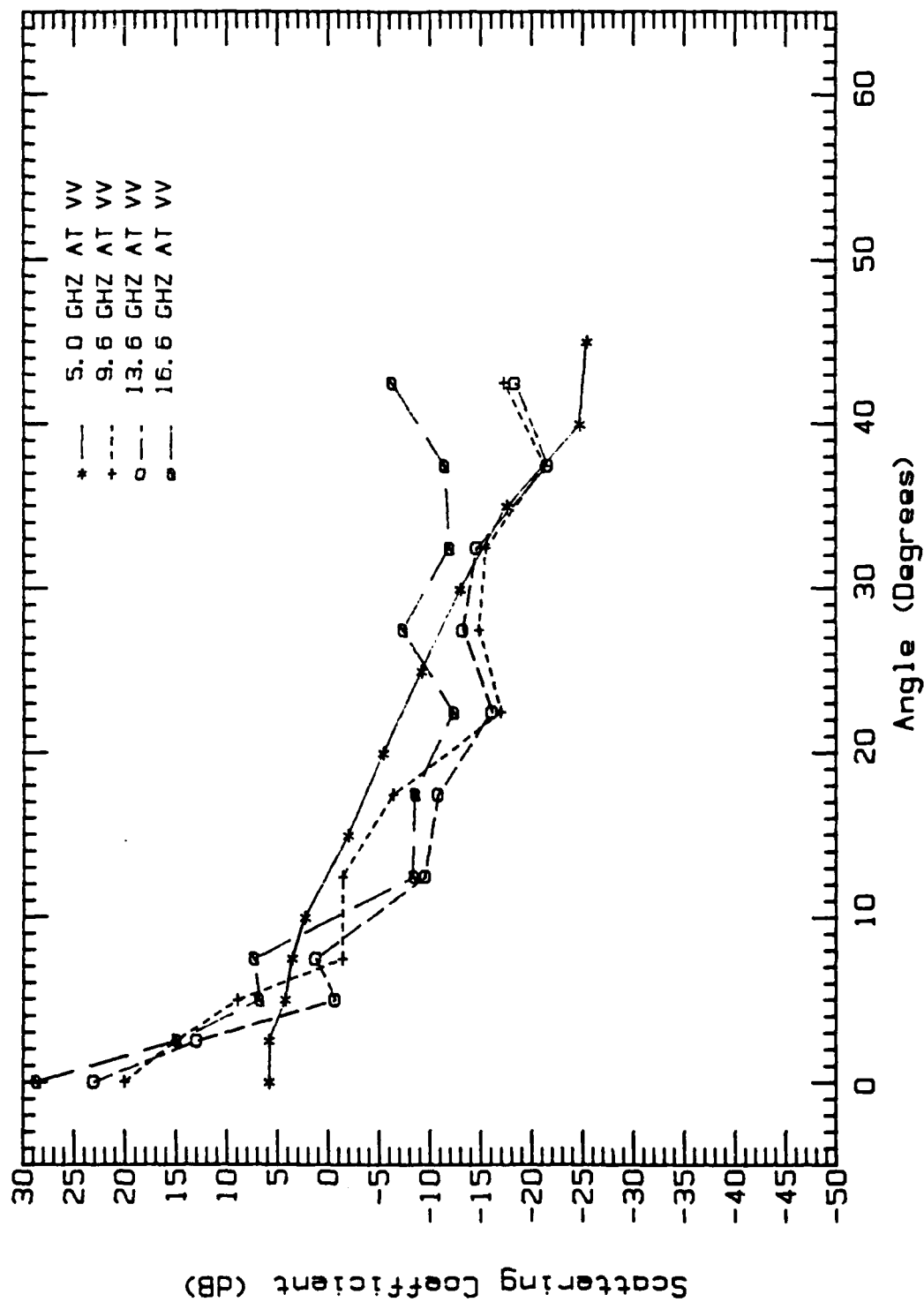
CRREL-85, JAN. 9, TIME: 23:50



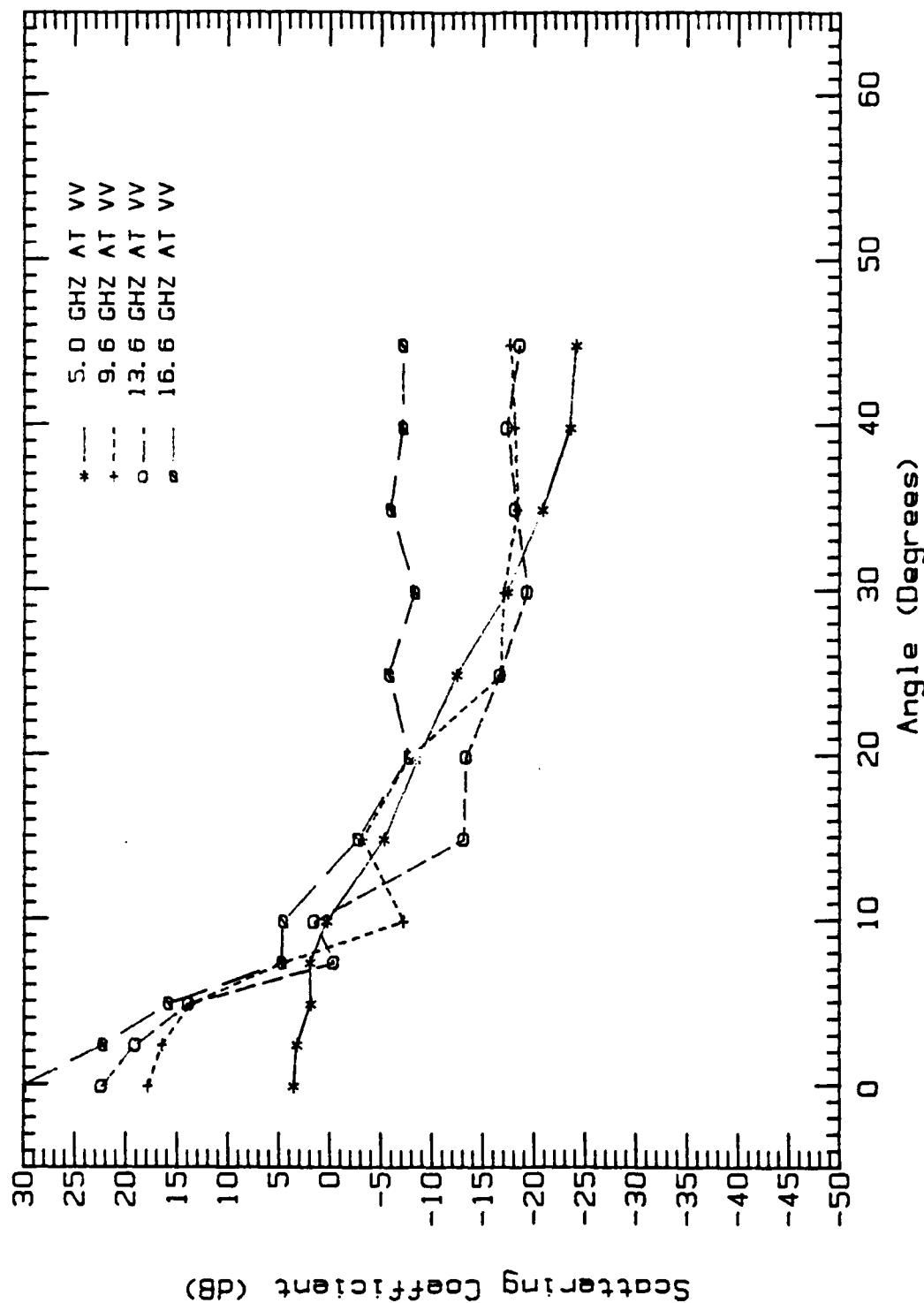
CRREL-85, JAN. 9, TIME: *24:10



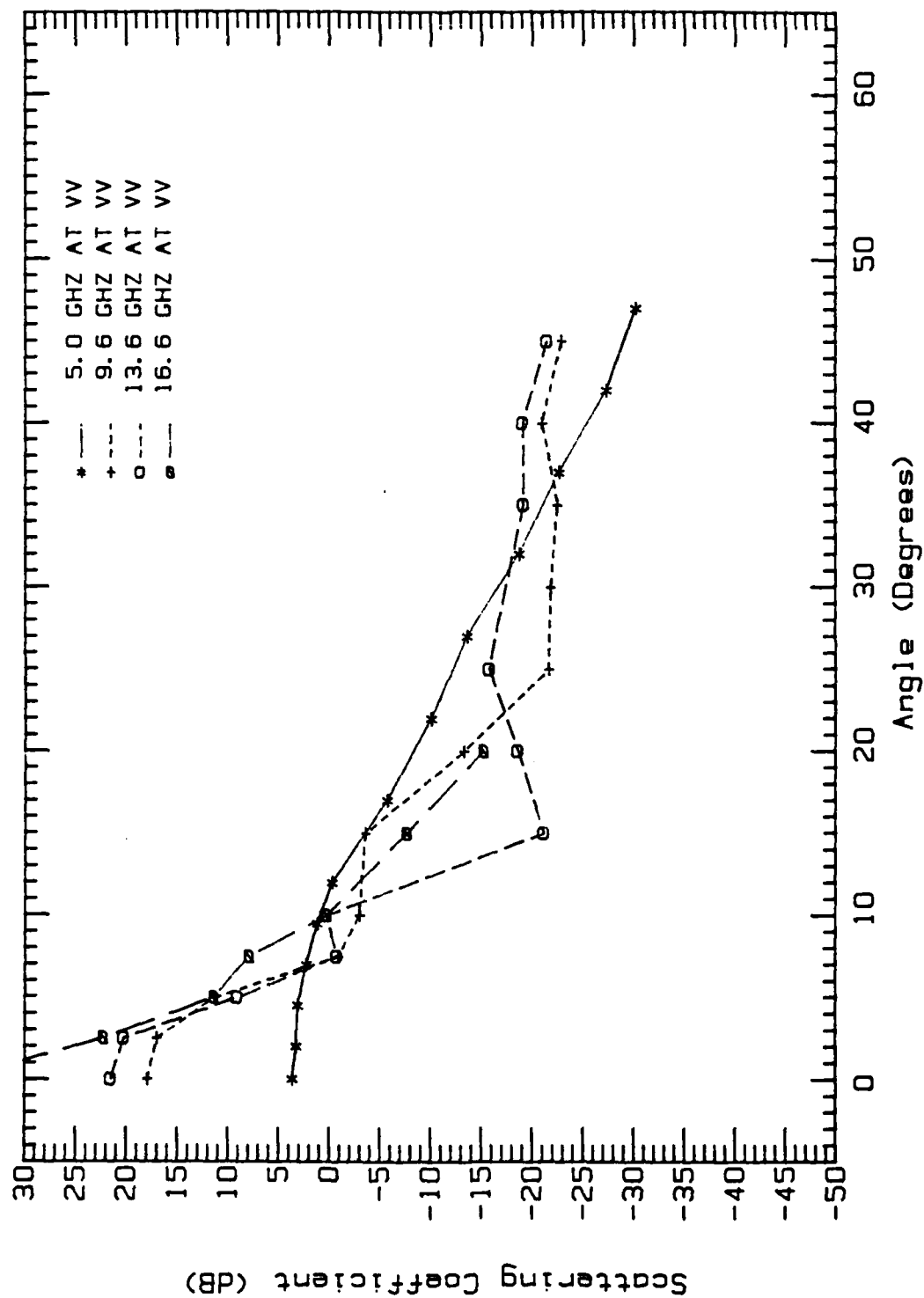
CRREL-85, JAN. 19, TIME: 11:37



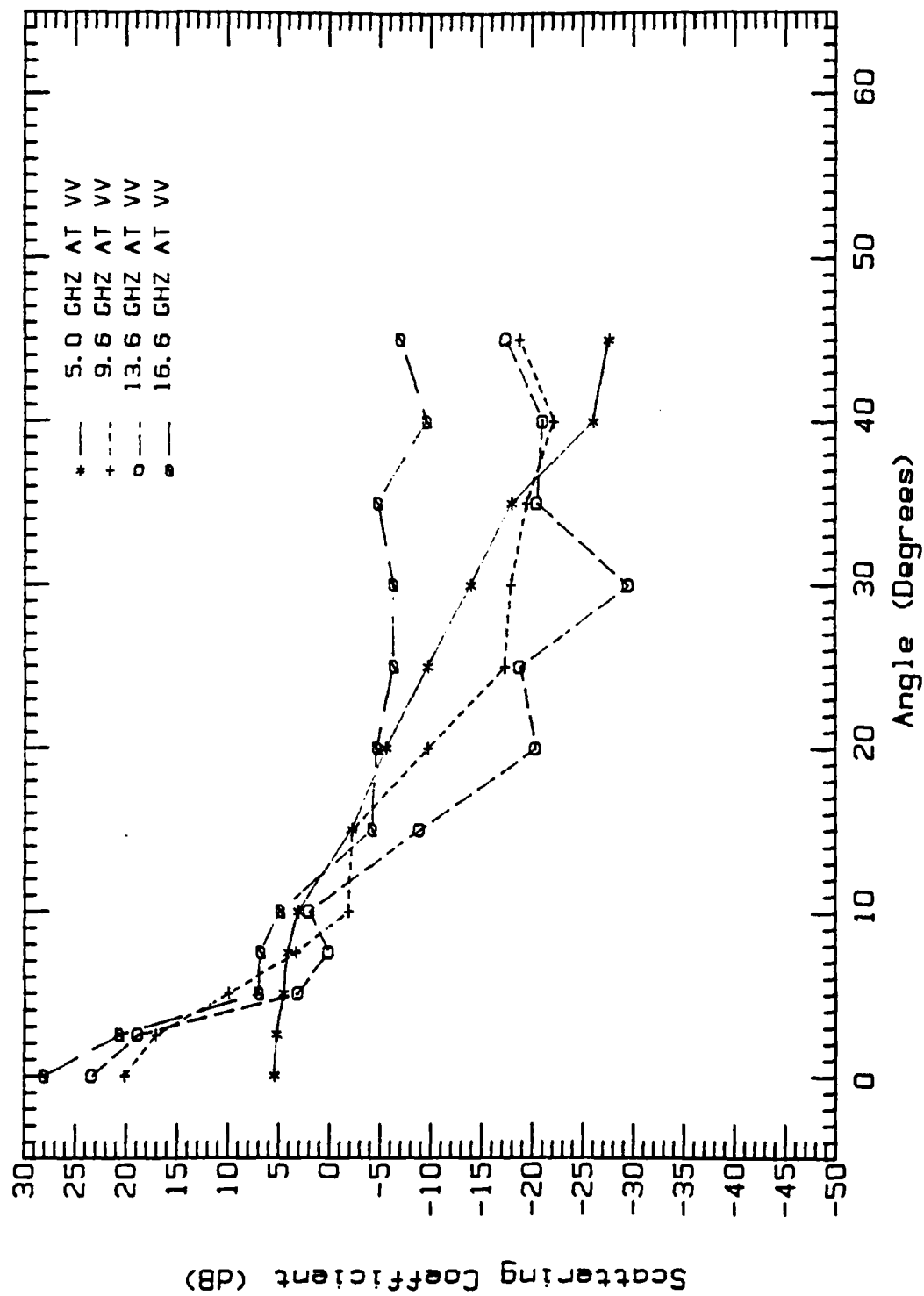
CRREL-85, JAN. 23, TIME: 7:40



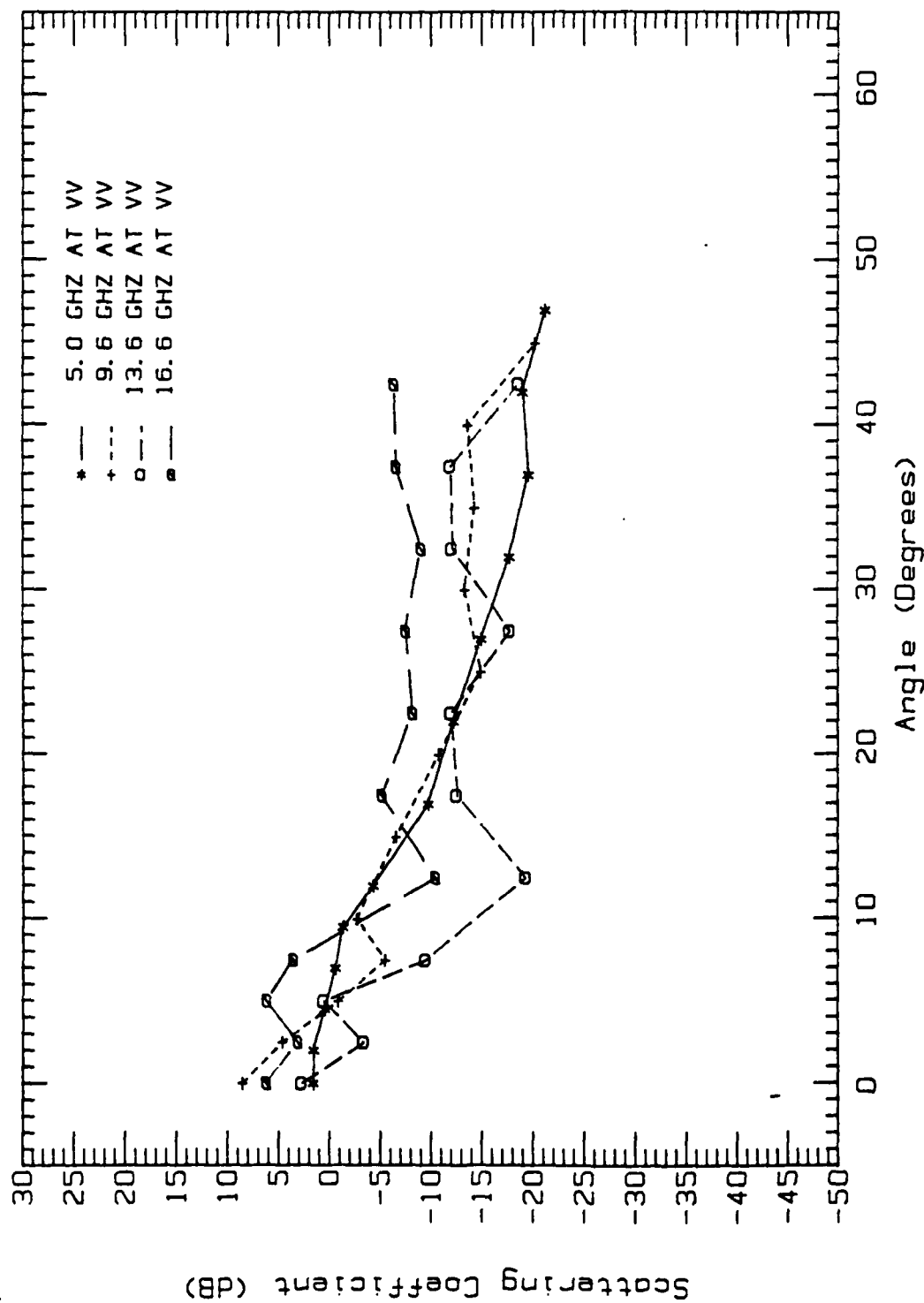
CRREL-85, JAN. 26, TIME: 13:50



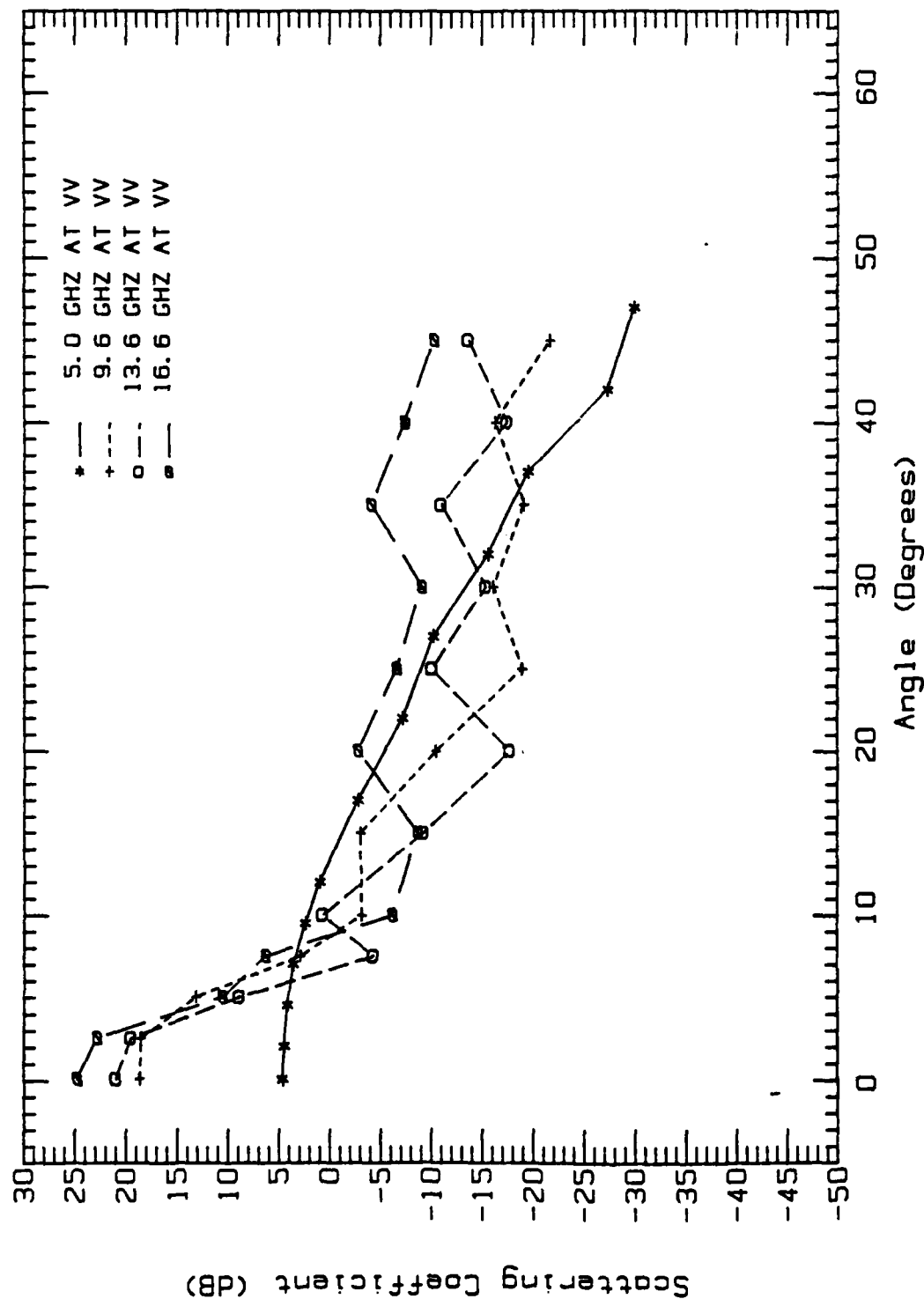
CRREL-85. JAN. 28. TIME: 8:30



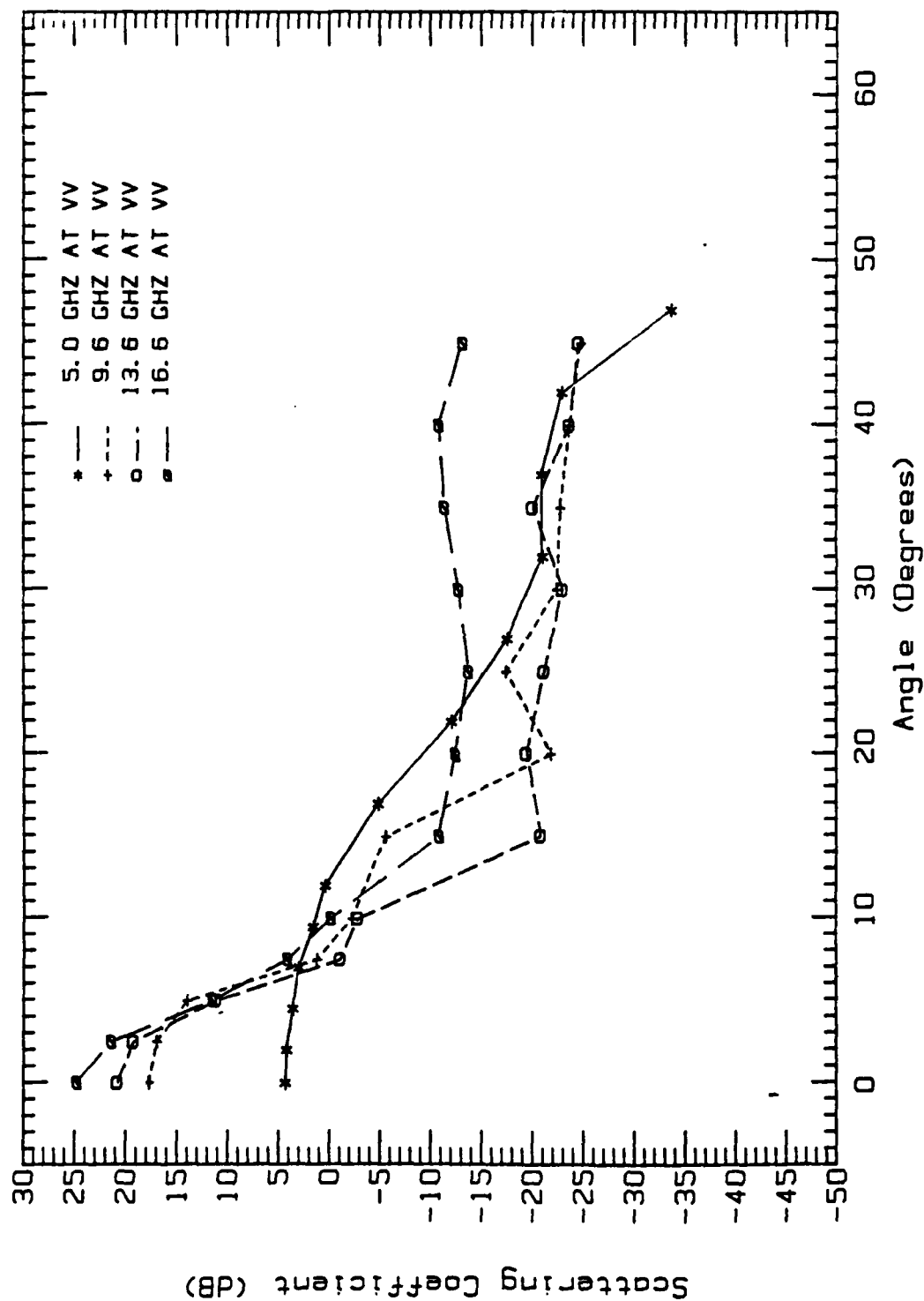
CRREL-85, FEB. 1, TIME: 10:00



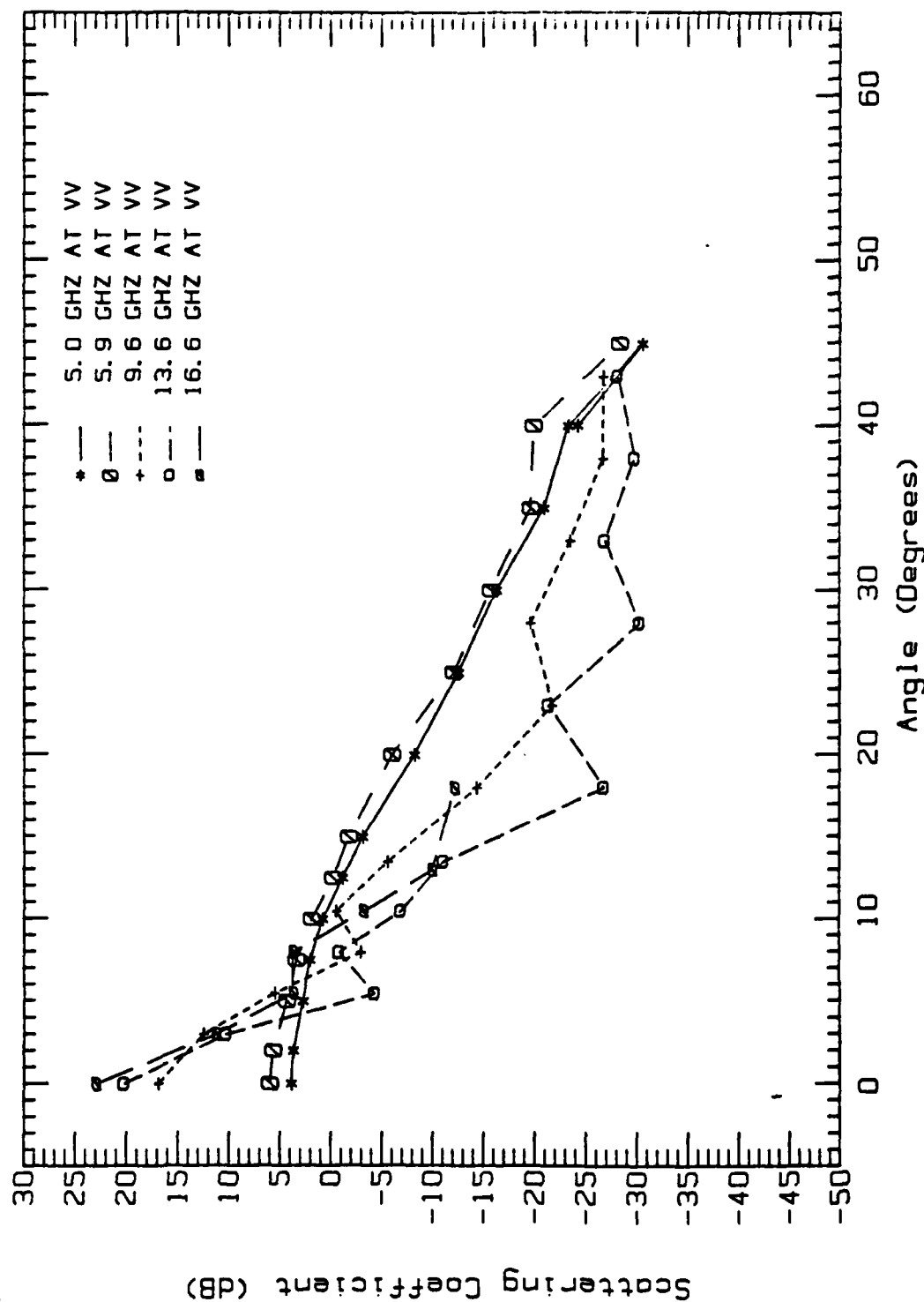
CRREL-85, FEB. 2, TIME: 10:40



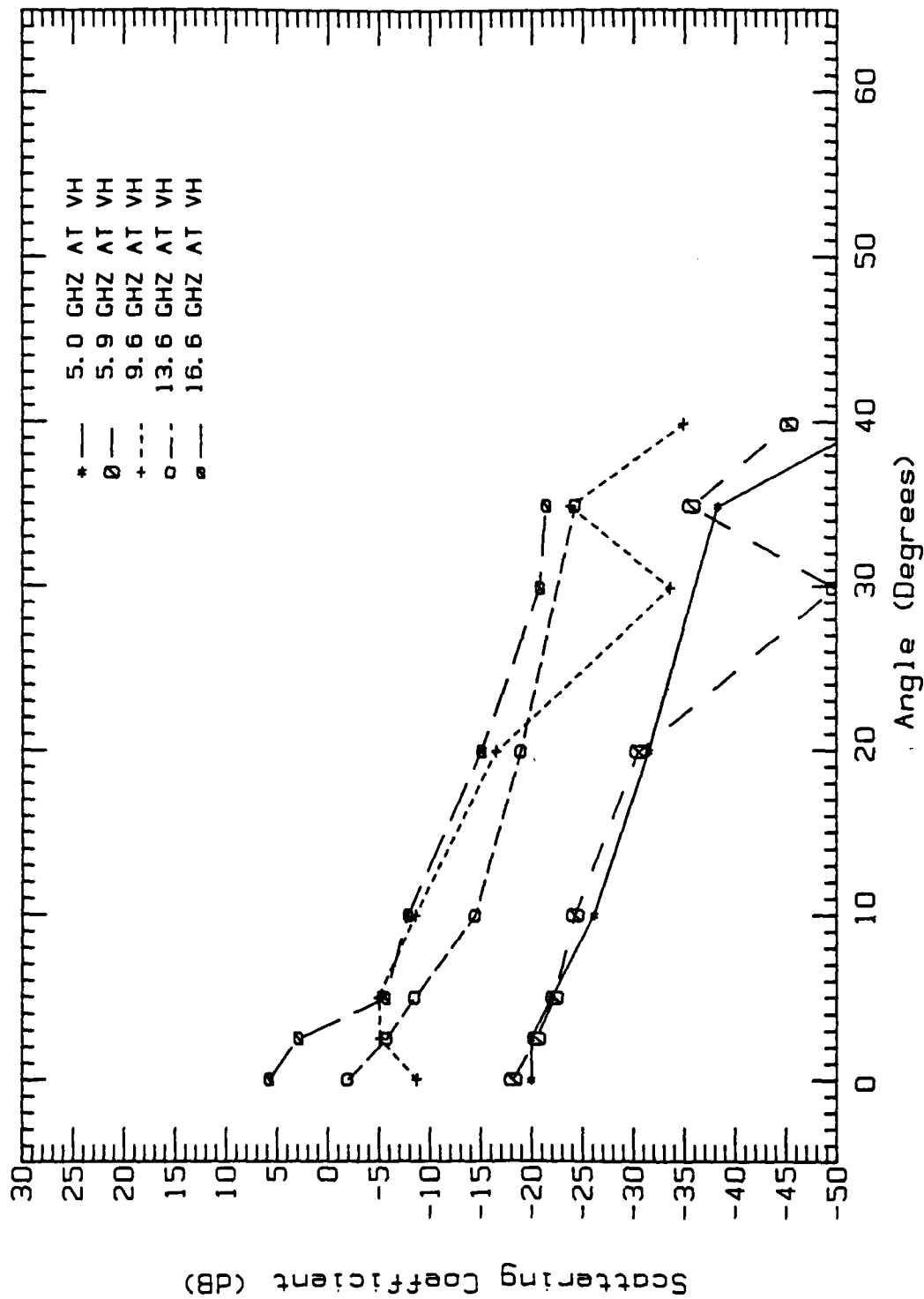
CRELL-85, FEB. 4, TIME: 8:18



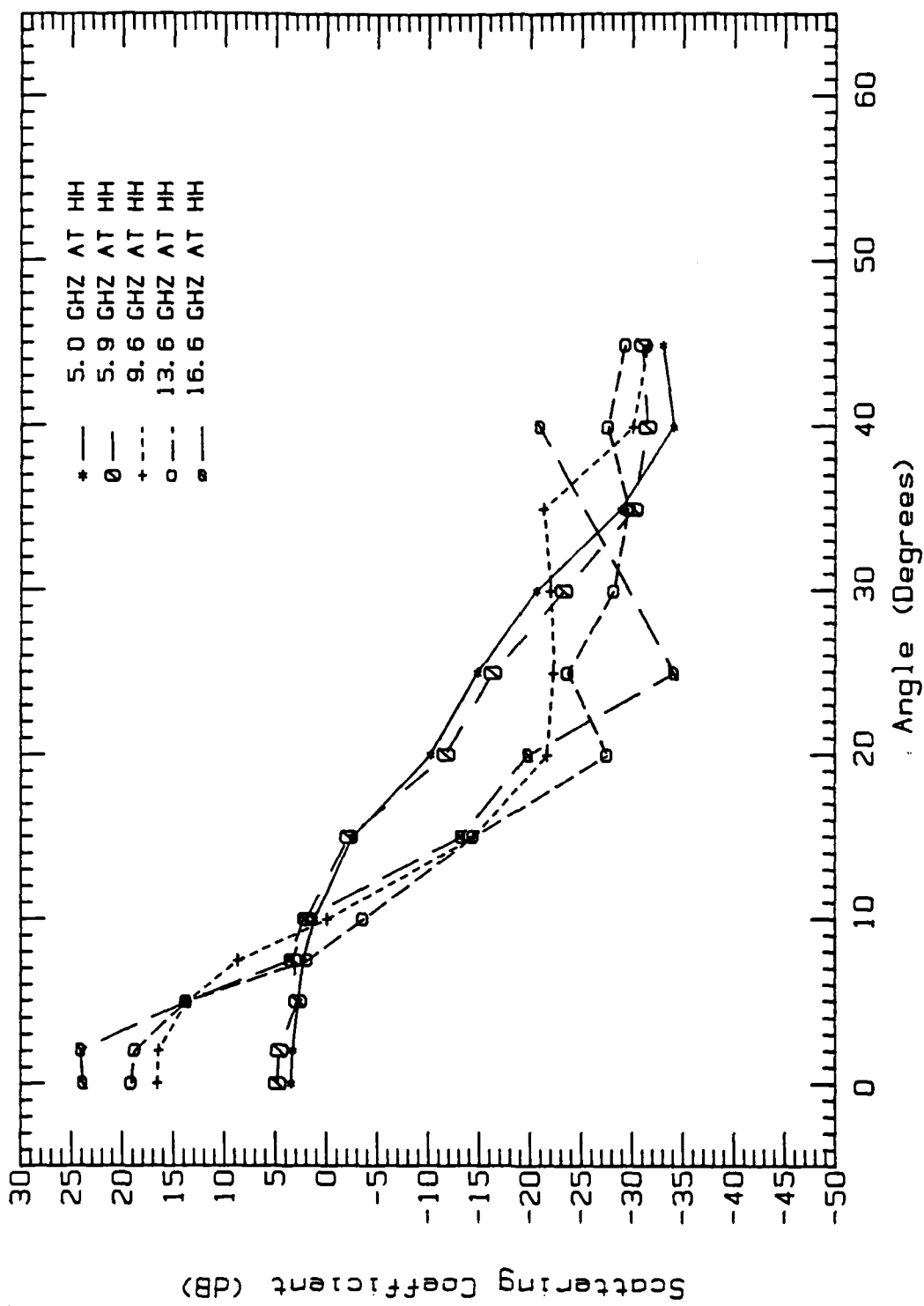
CRREL-85, FEB. 8, TIME: 7:55



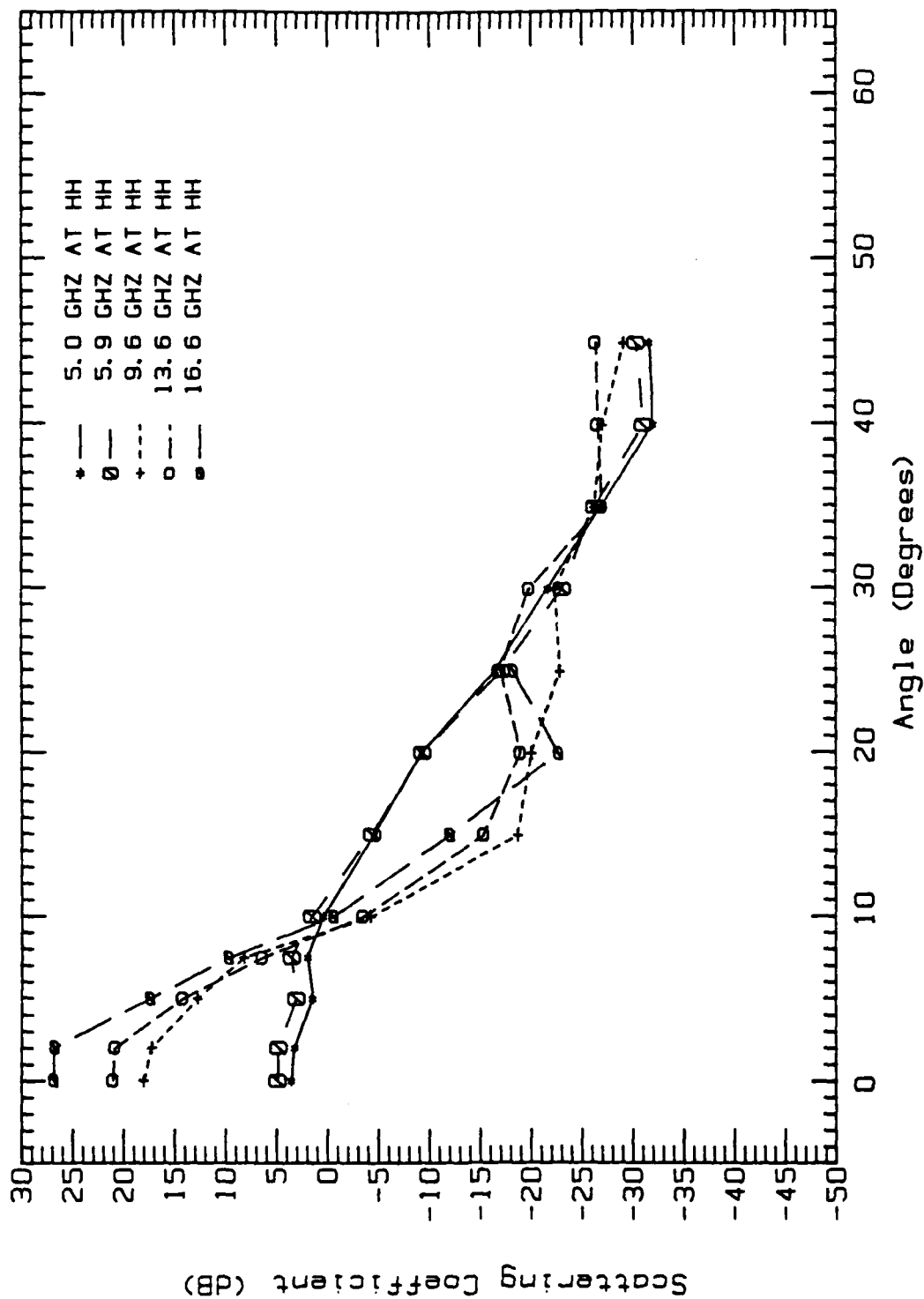
CRREL-85, FEB. 9, TIME: 11:48



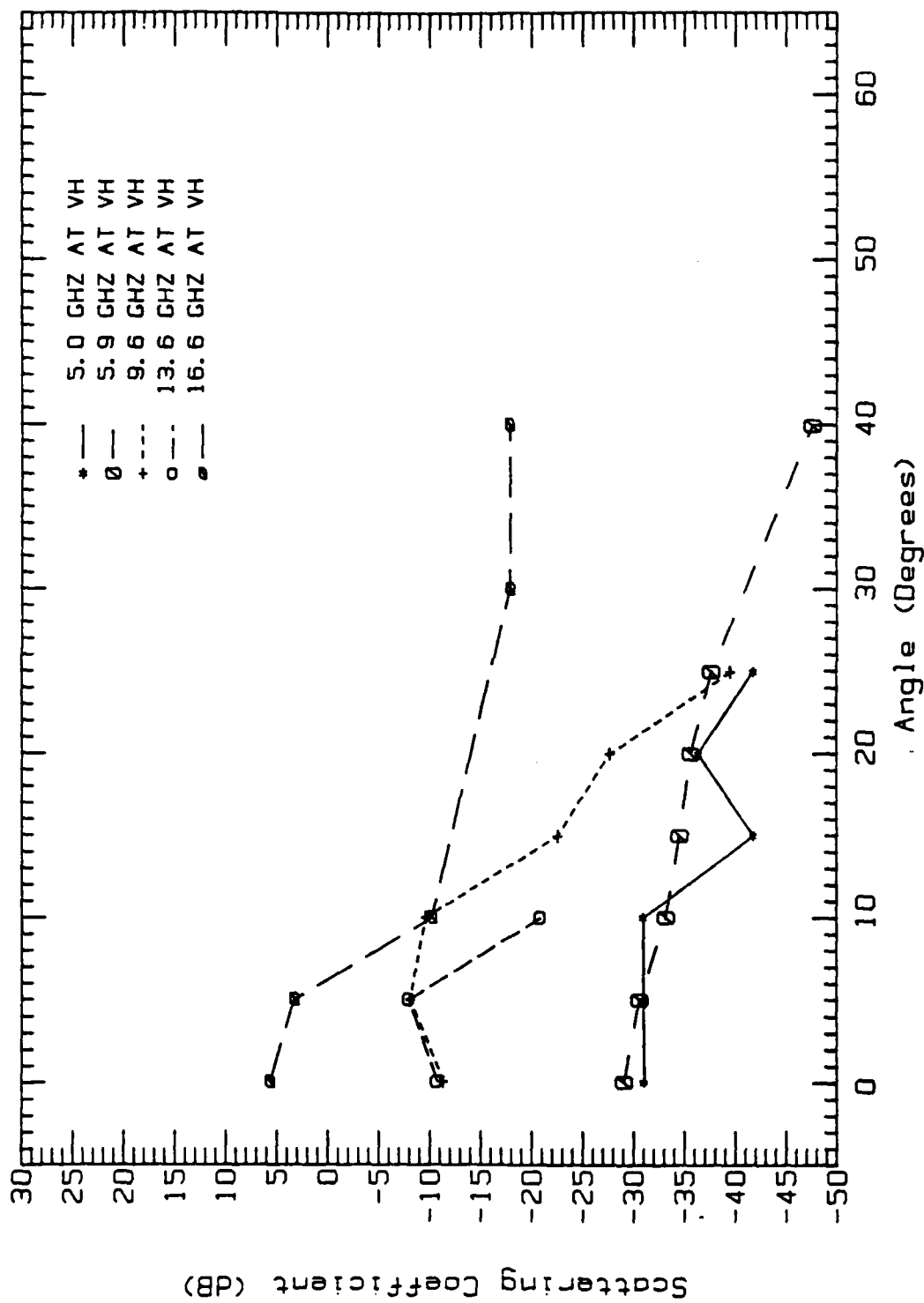
CRREL-85, FEB. 9, TIME: 12:10



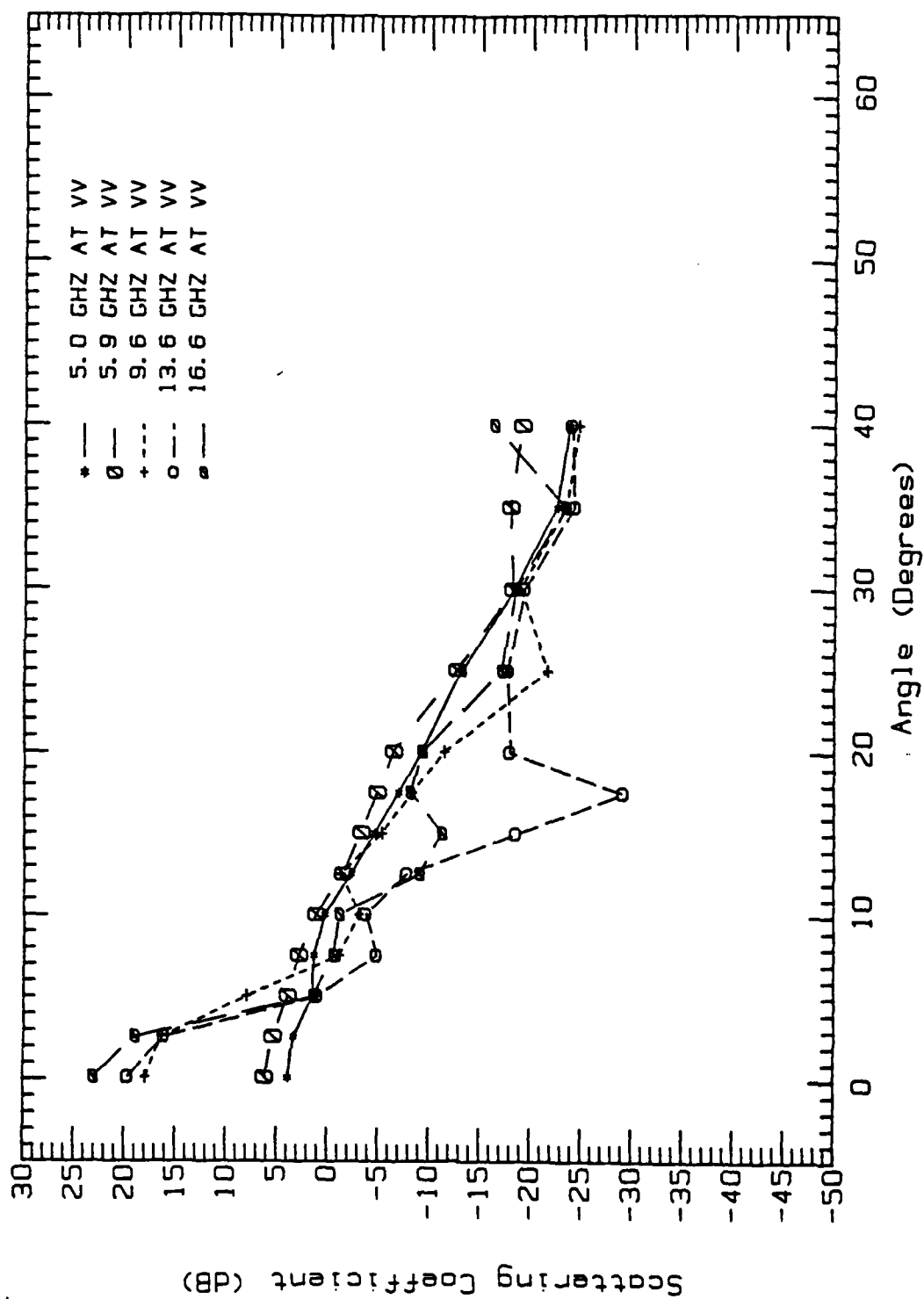
CRREL-85, FEB. 9, TIME: 13:19



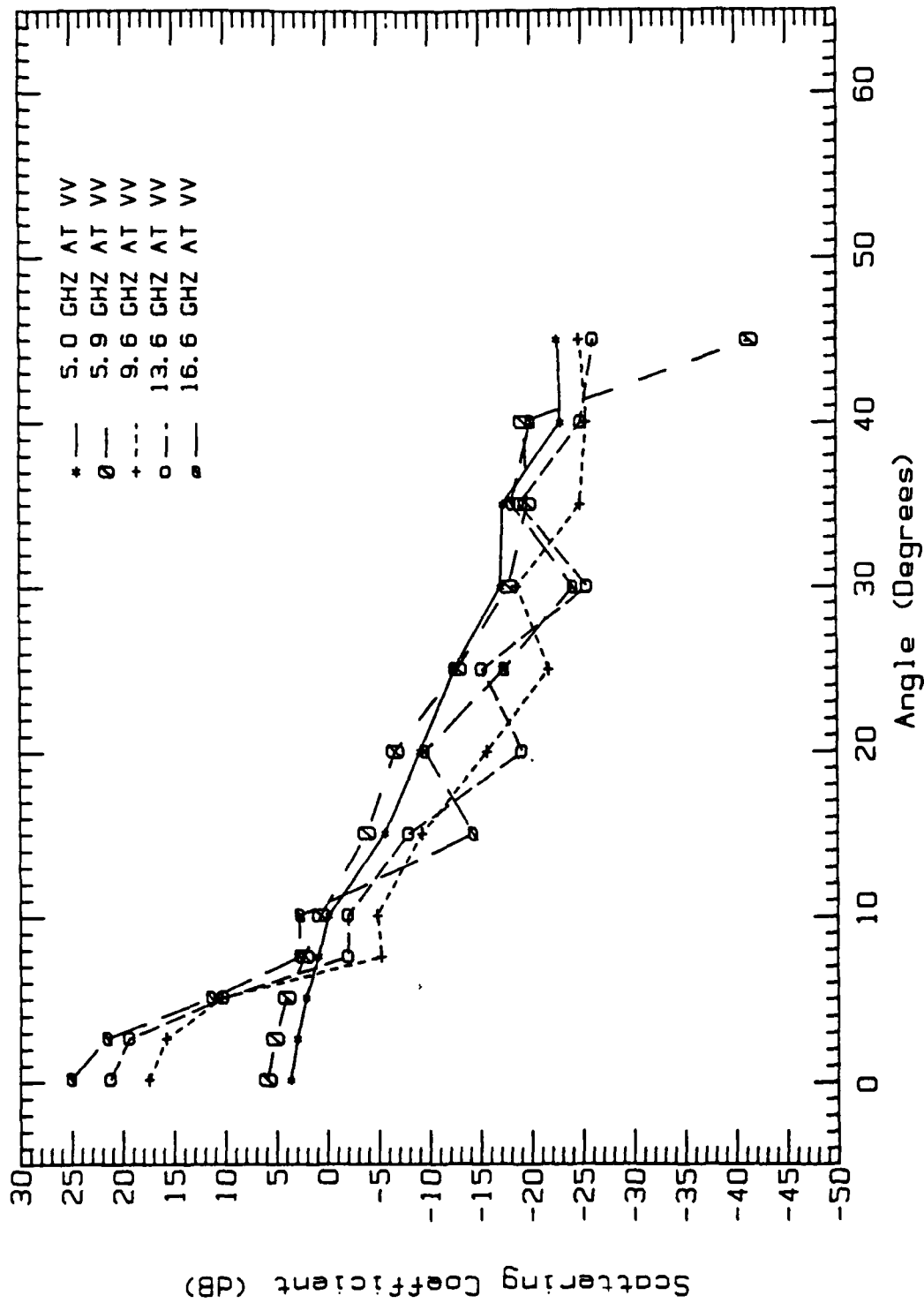
CRREL-85, FEB. 11, TIME: 11:55



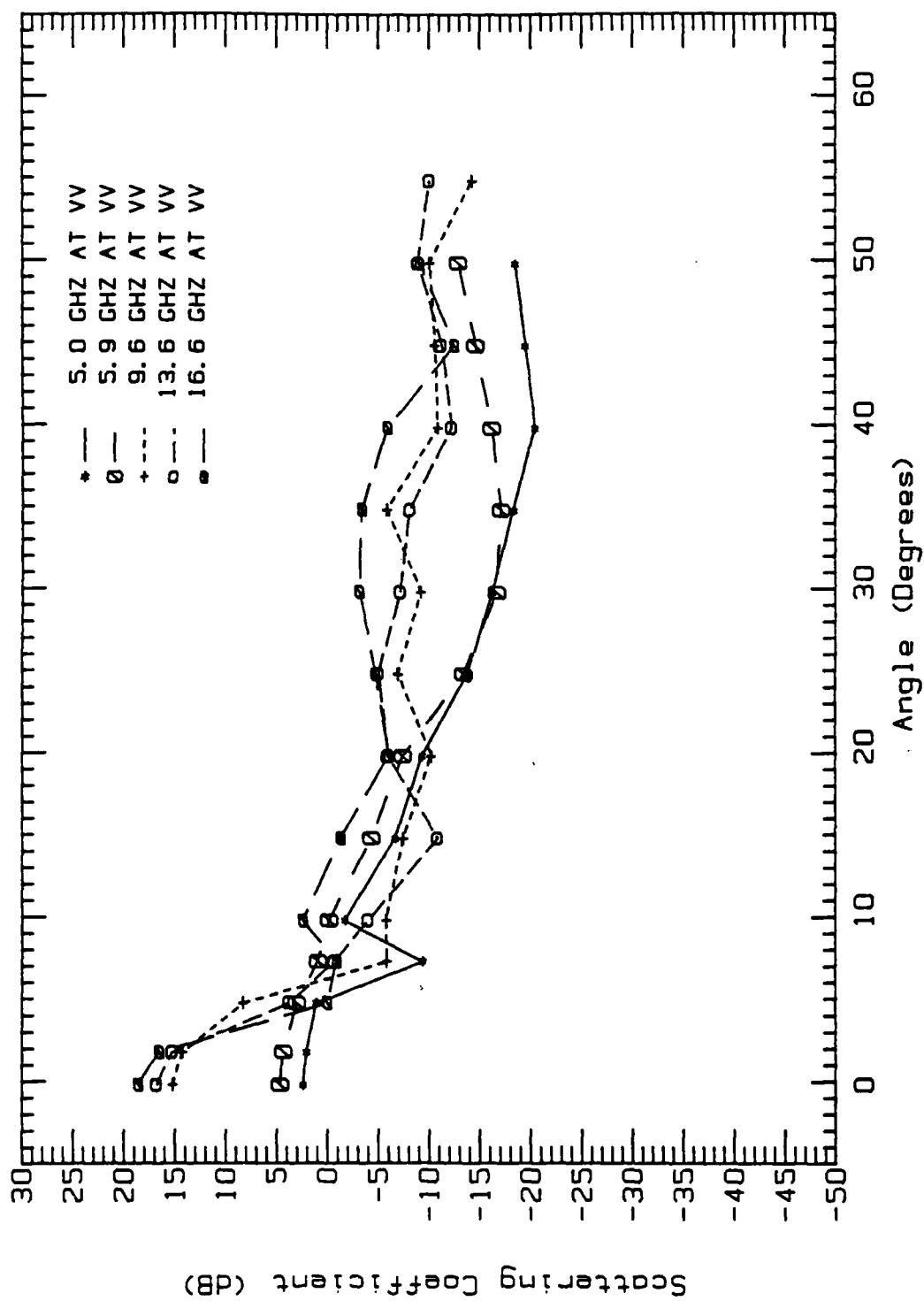
CRREL-85, FEB. 11, TIME: *12:30



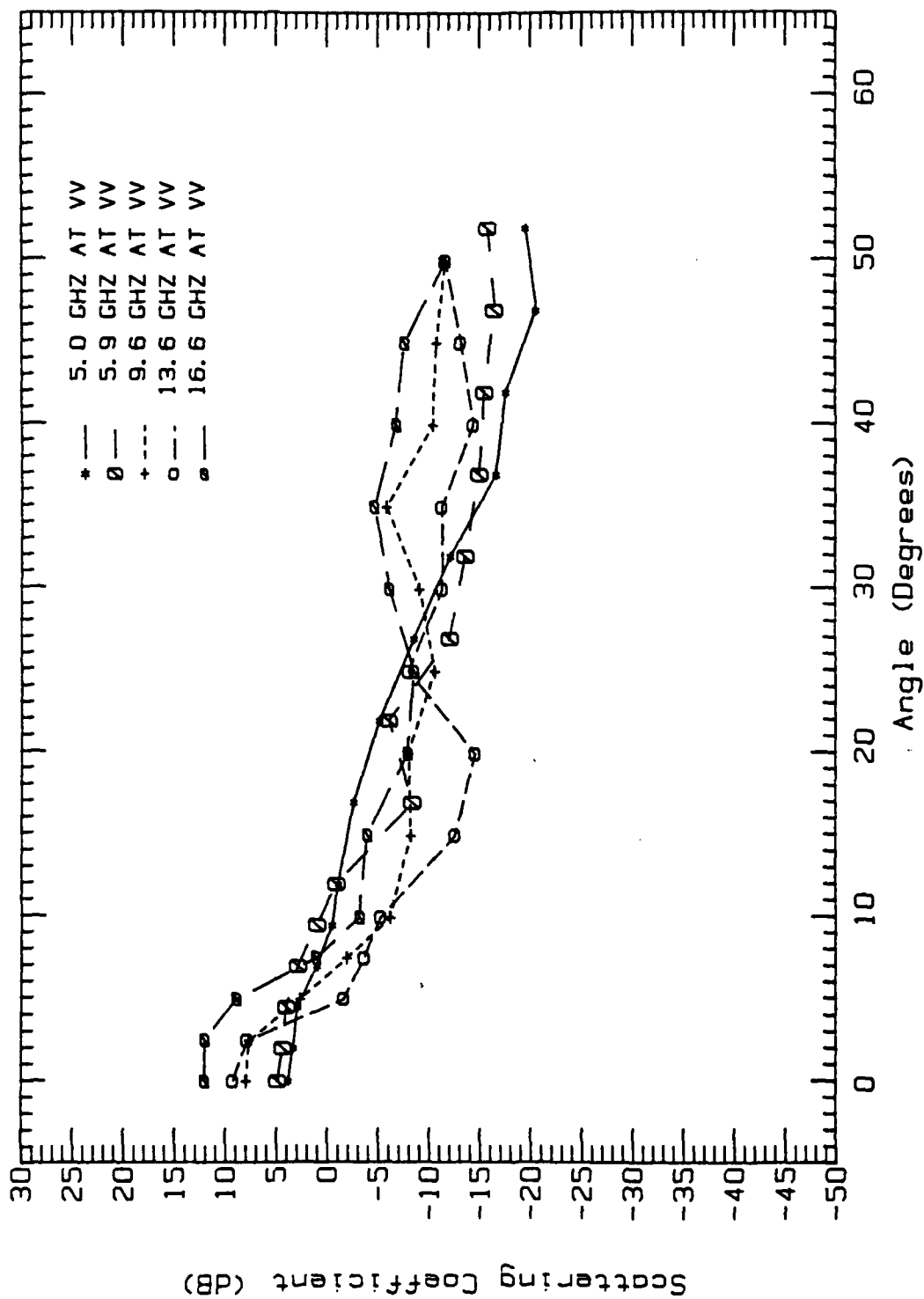
CRREL-85, FEB. 11, TIME: 12:46



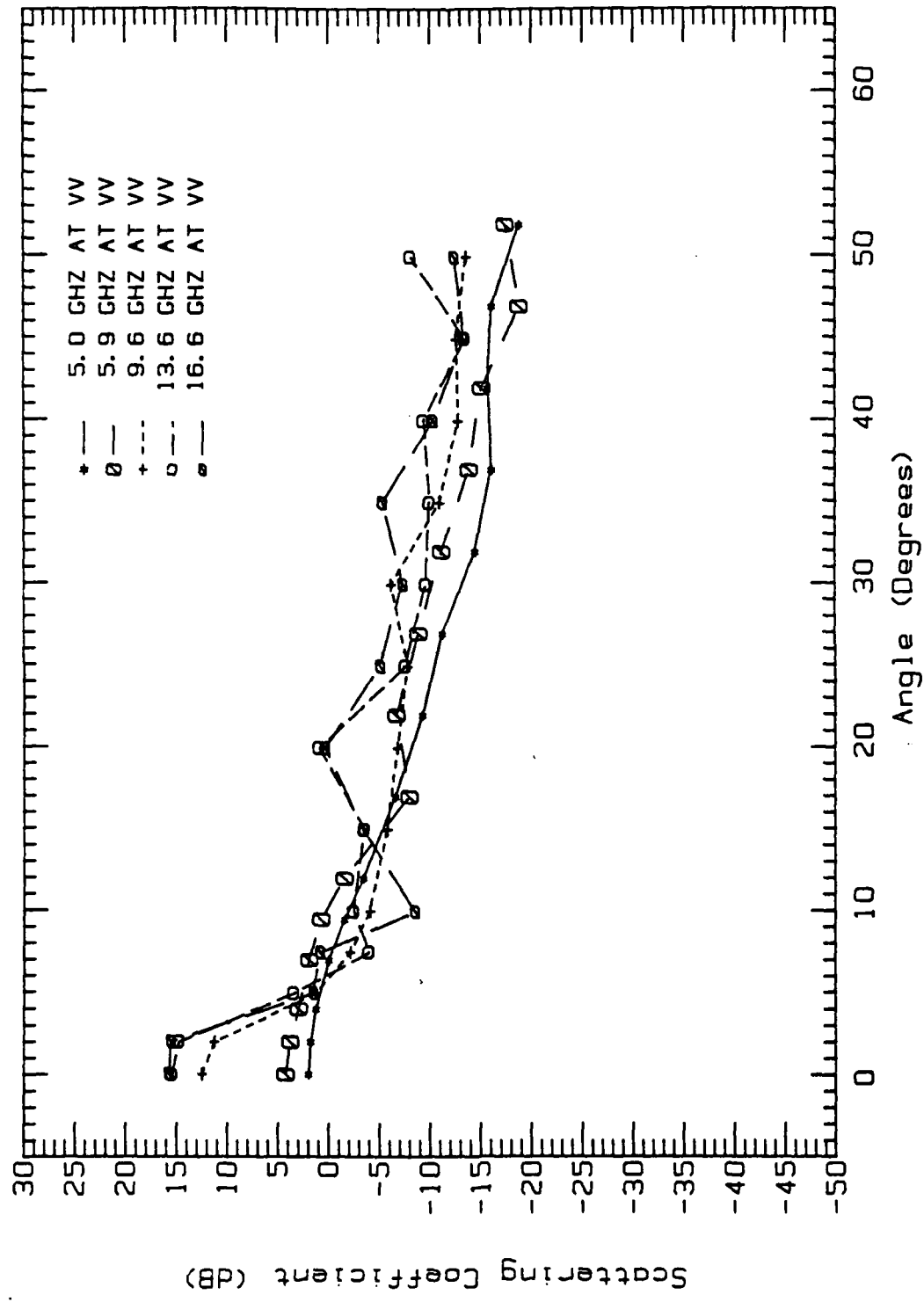
CRREL-85, FEB. 11, TIME: 21:45



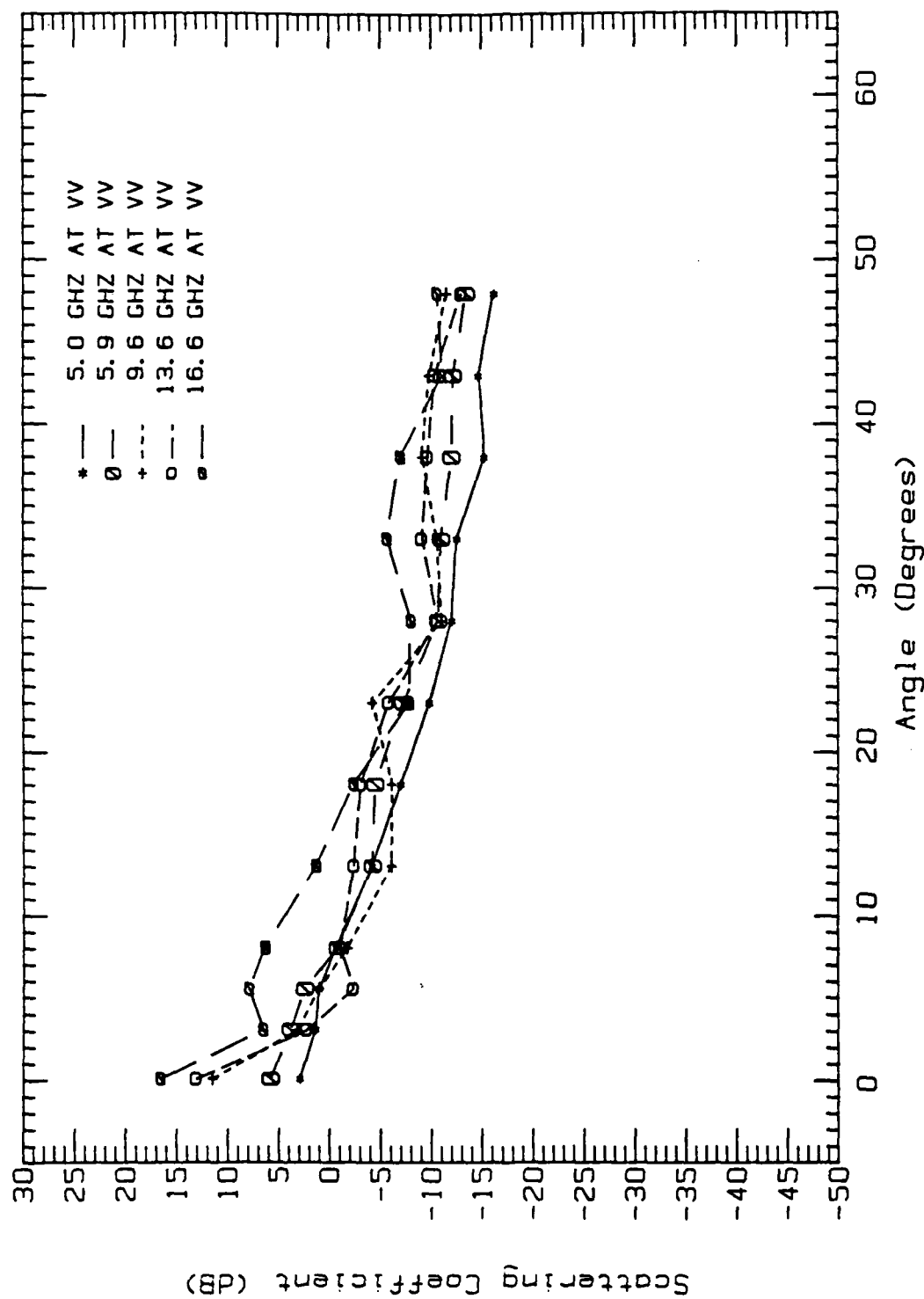
CRREL-85, FEB. 11. TIME: 23:32



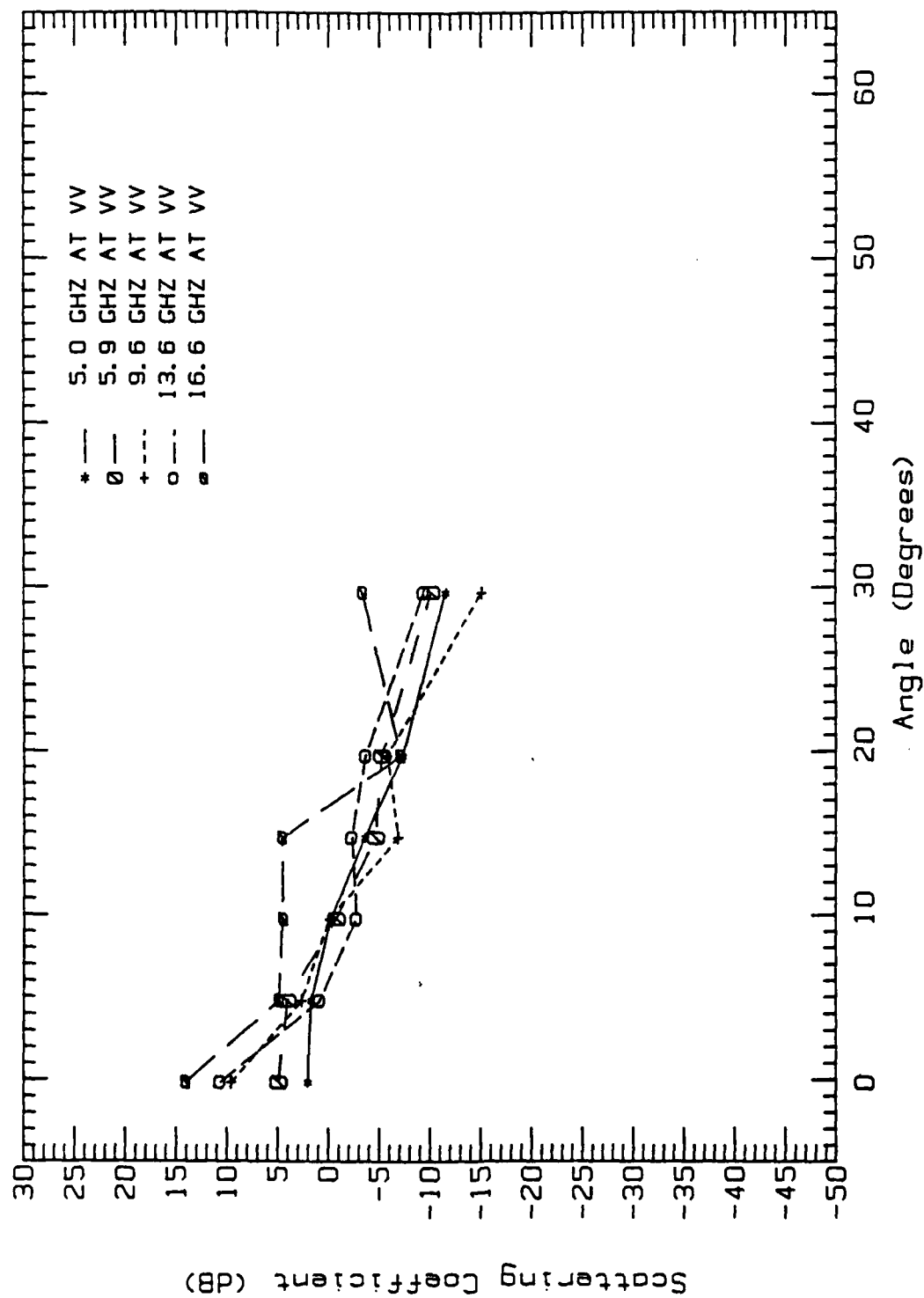
CRREL-85. FEB. 12. TIME: 2:46



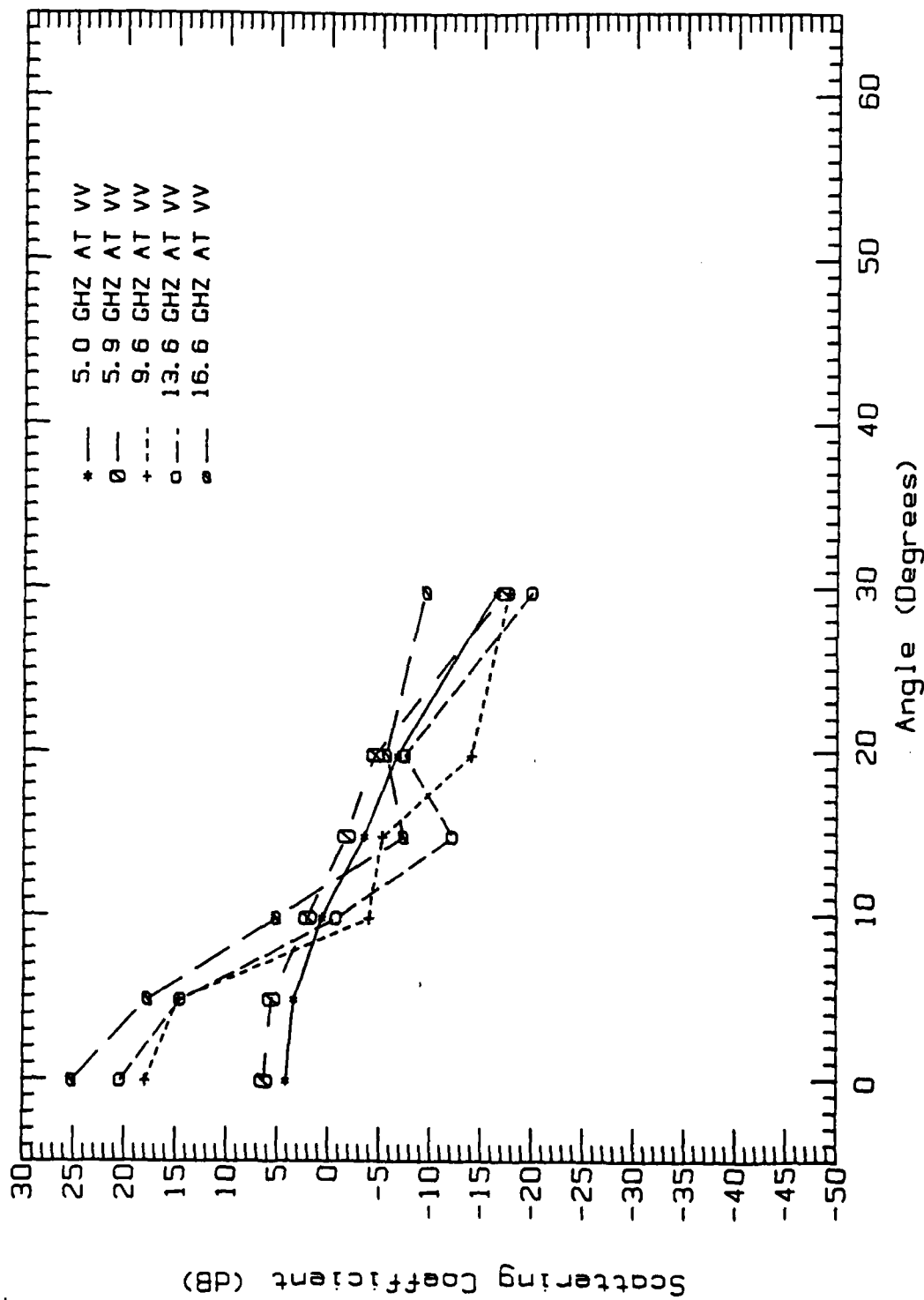
CRREL-85, FEB. 12, TIME: 3:45



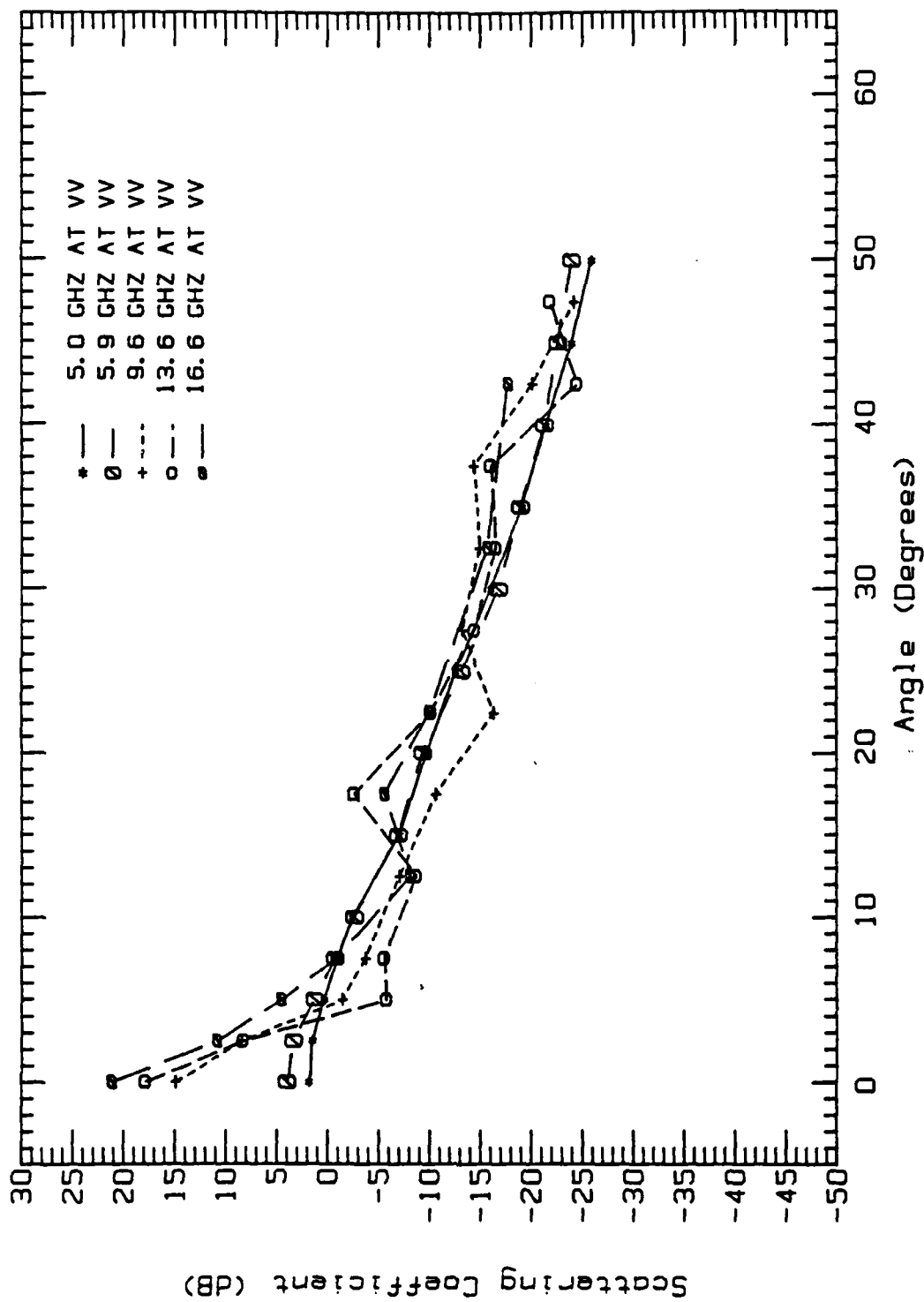
CRREL-85, FEB. 12, TIME: 13:45



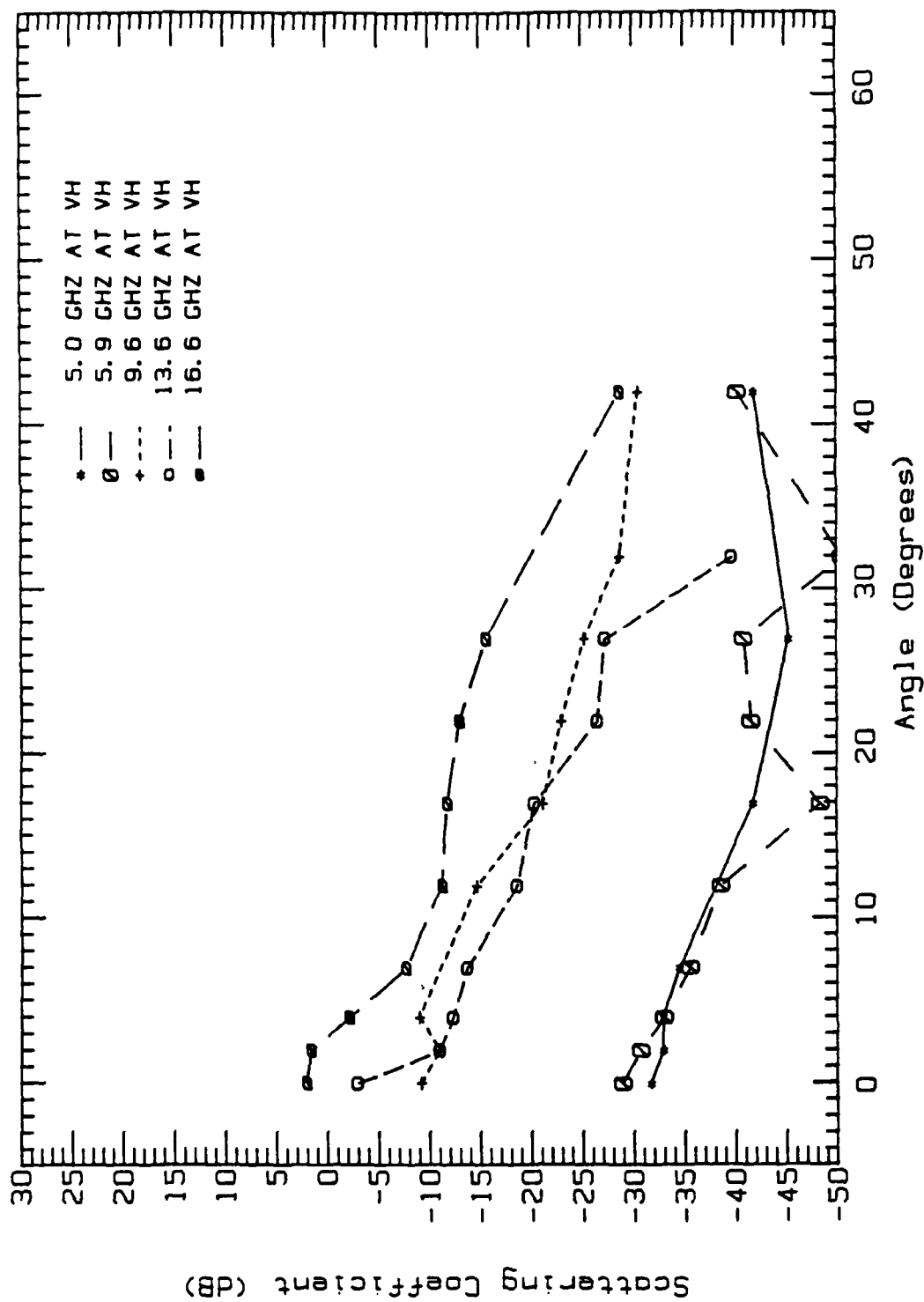
CRREL-85, FEB. 12, TIME: 16:38



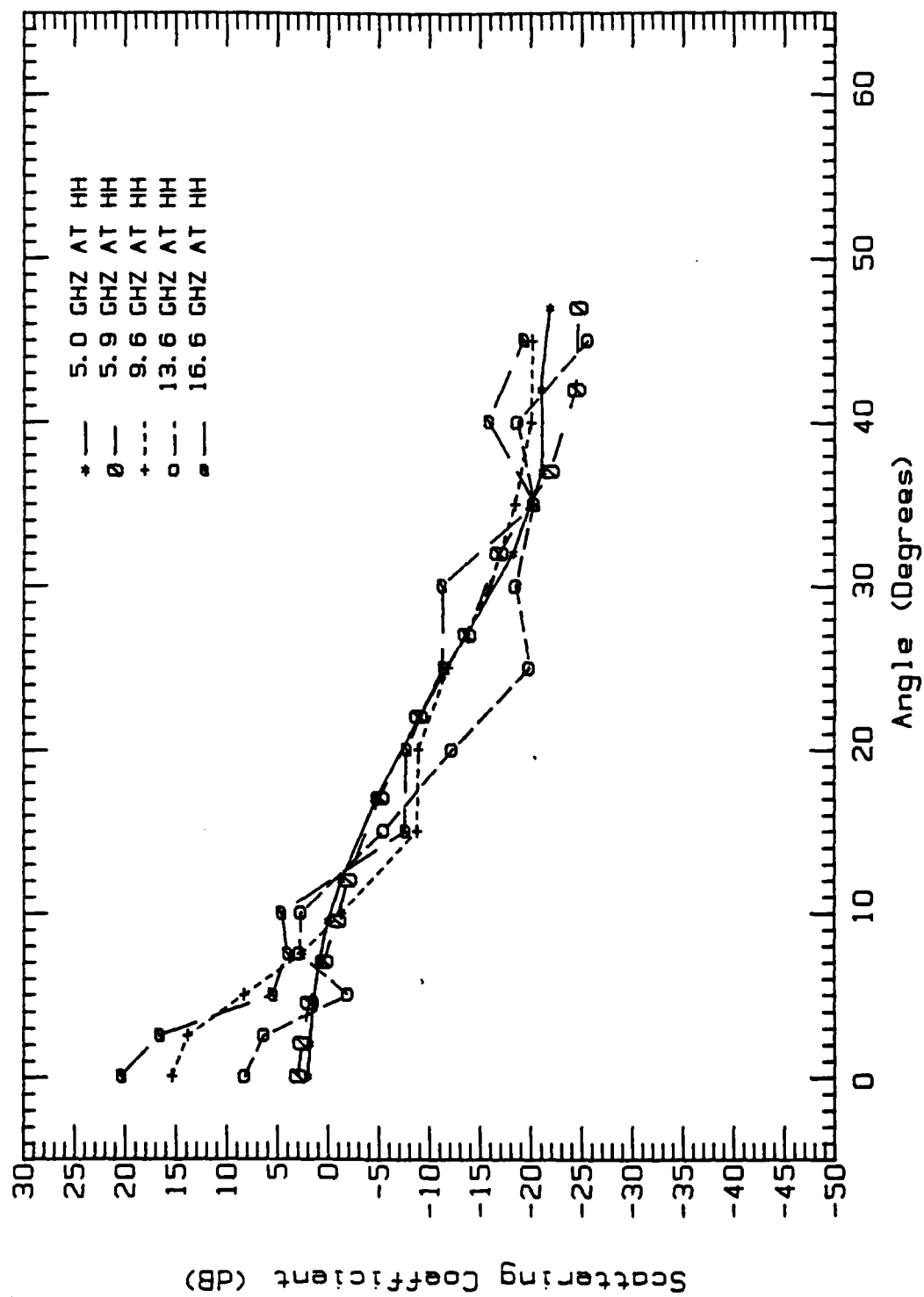
CRREL-85, FEB. 12, TIME: 17:00



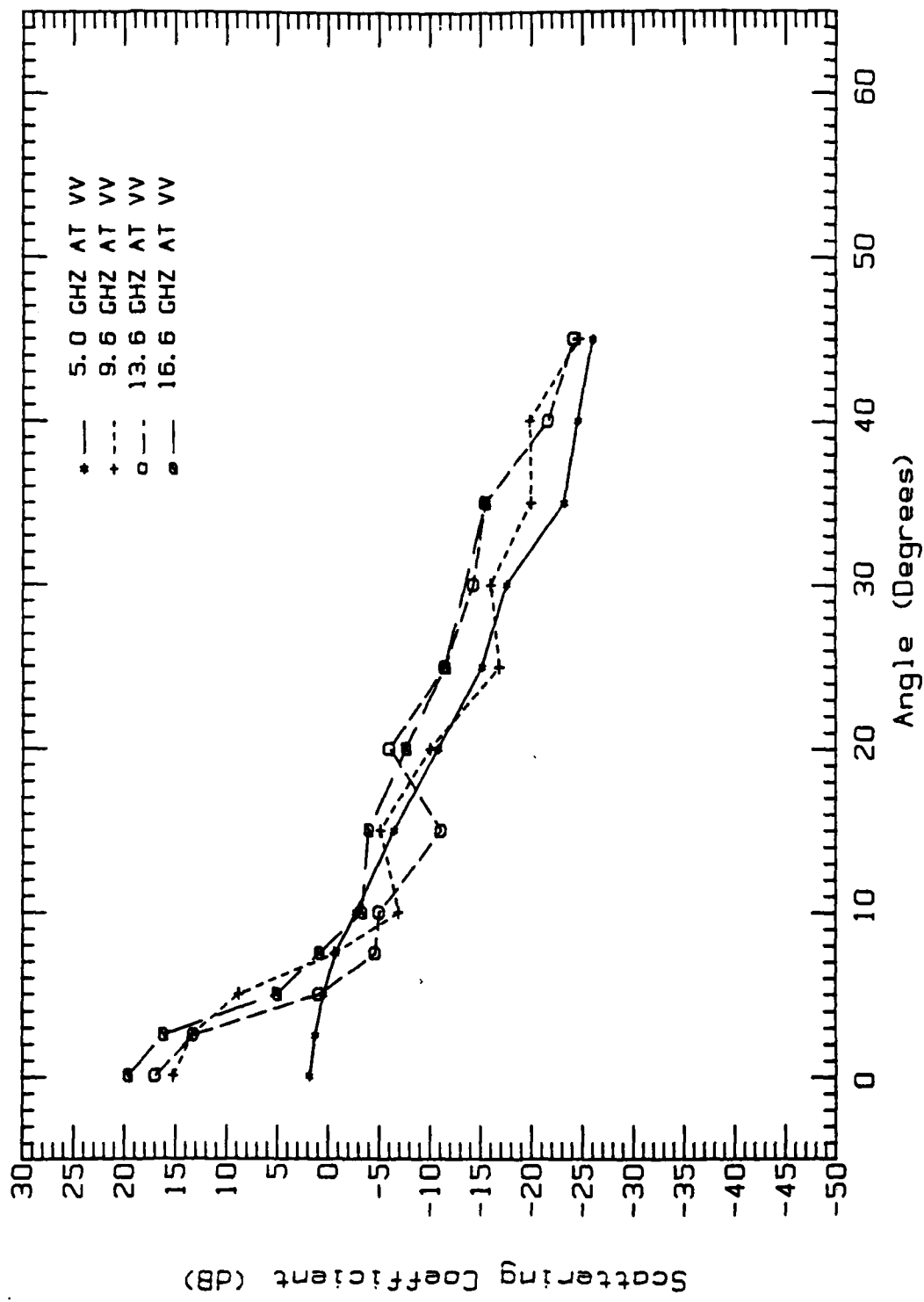
CRREL-85, FEB. 15, TIME: 8:19



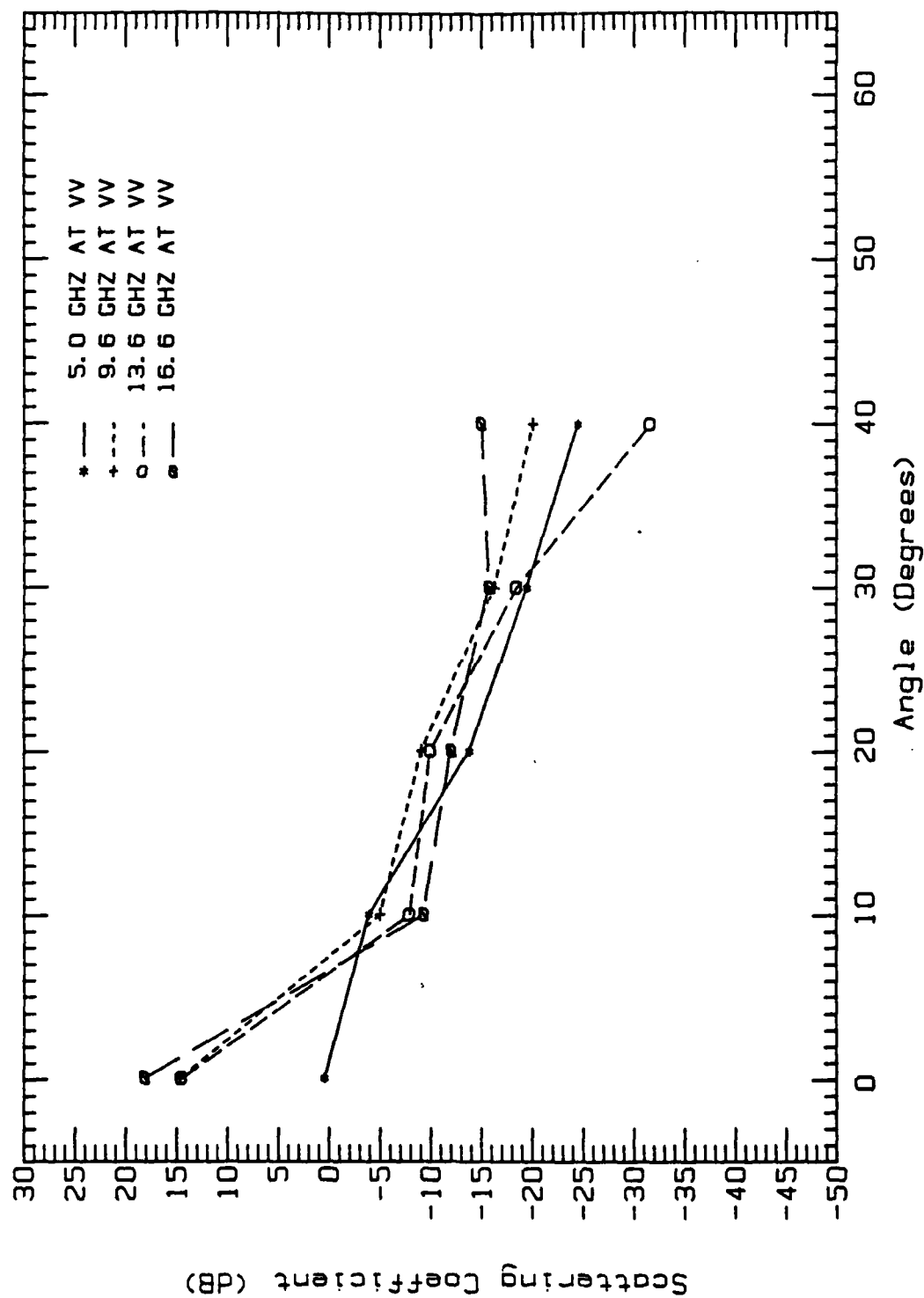
CRREL-85, FEB. 15, TIME: 9:07



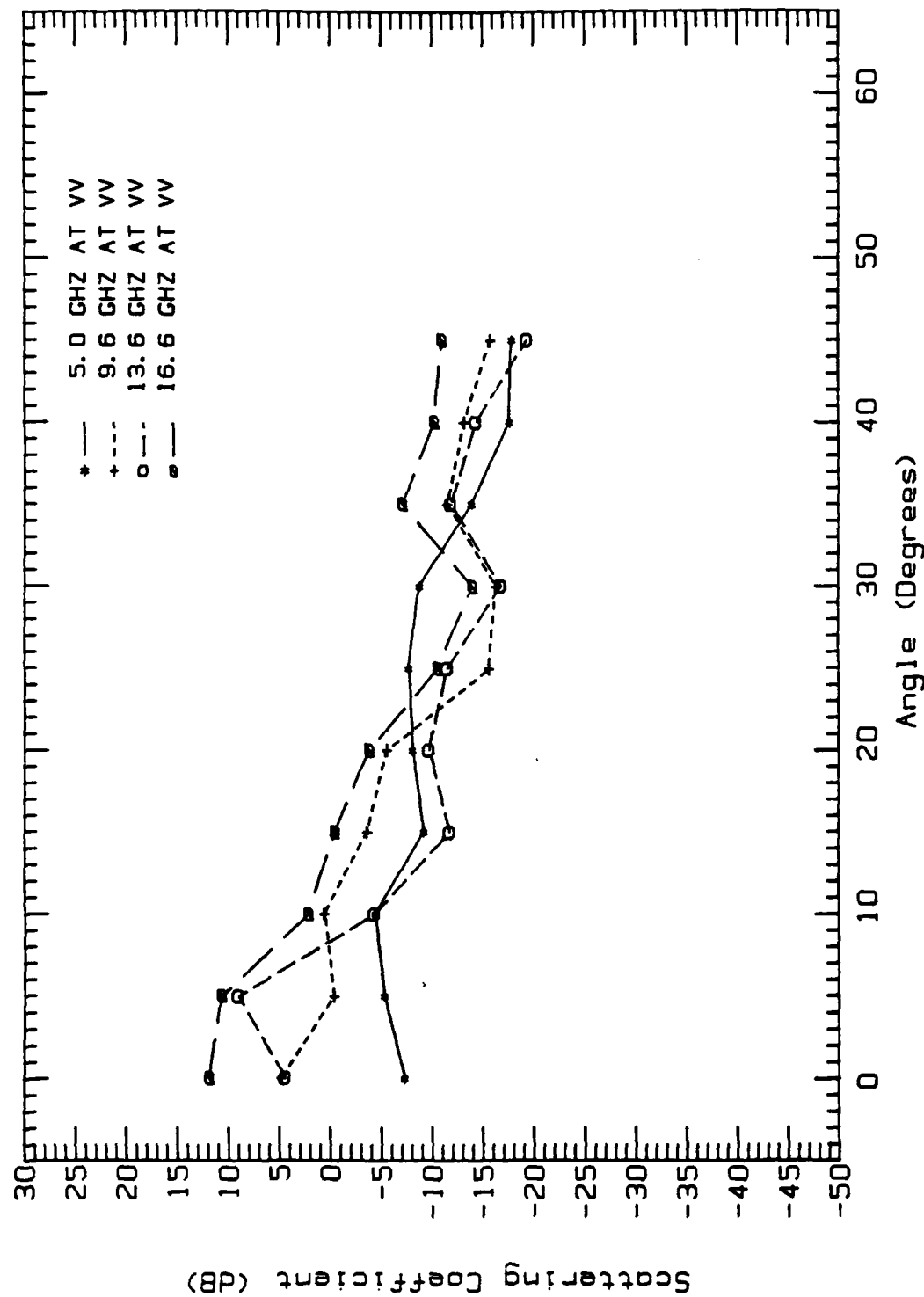
CRREL-85, FEB. 15, TIME: 9:40



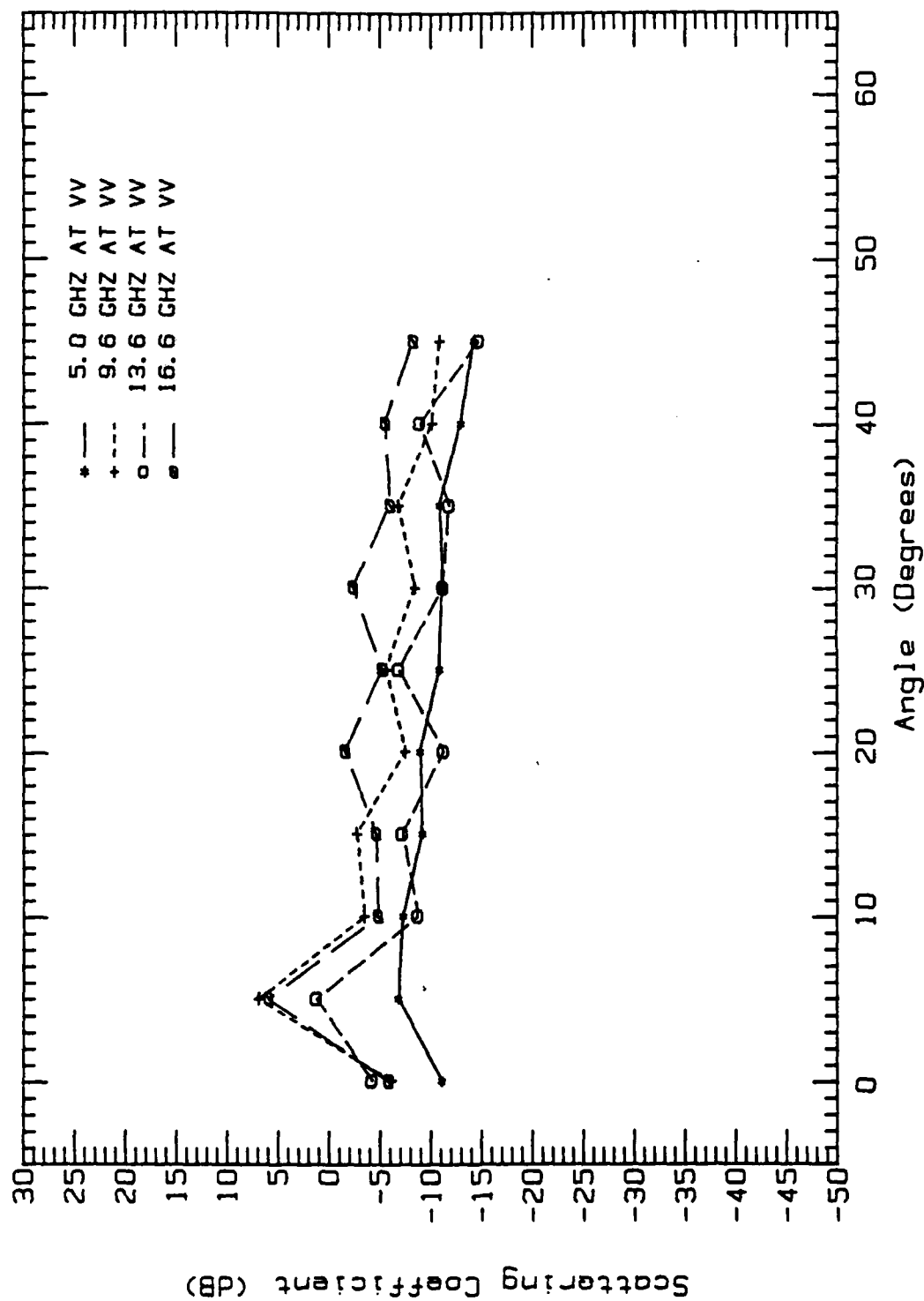
CRREL-85, MAR. 4, TIME: 12:35



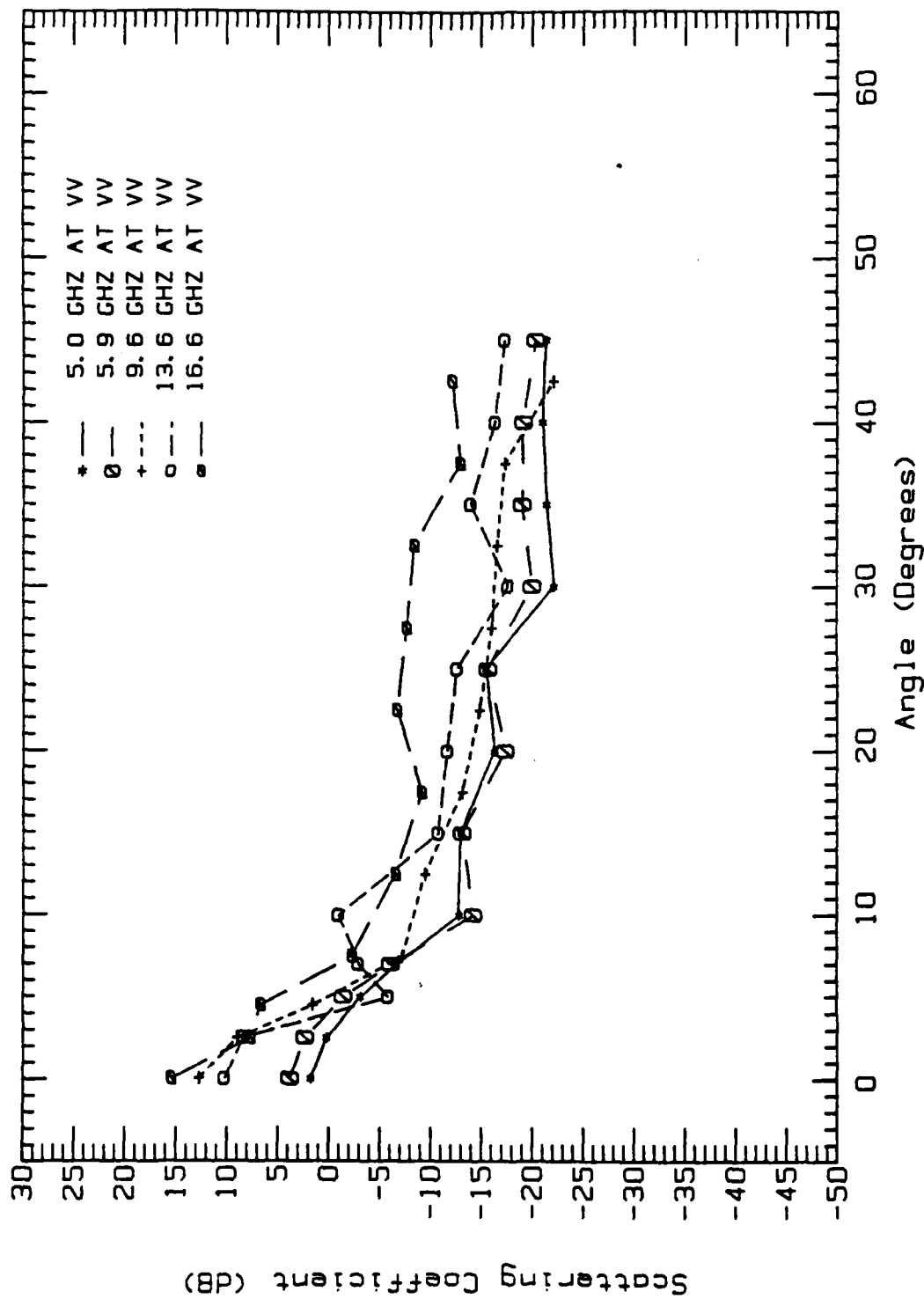
CRREL-85, MAR. 8, NO SNOW COVER



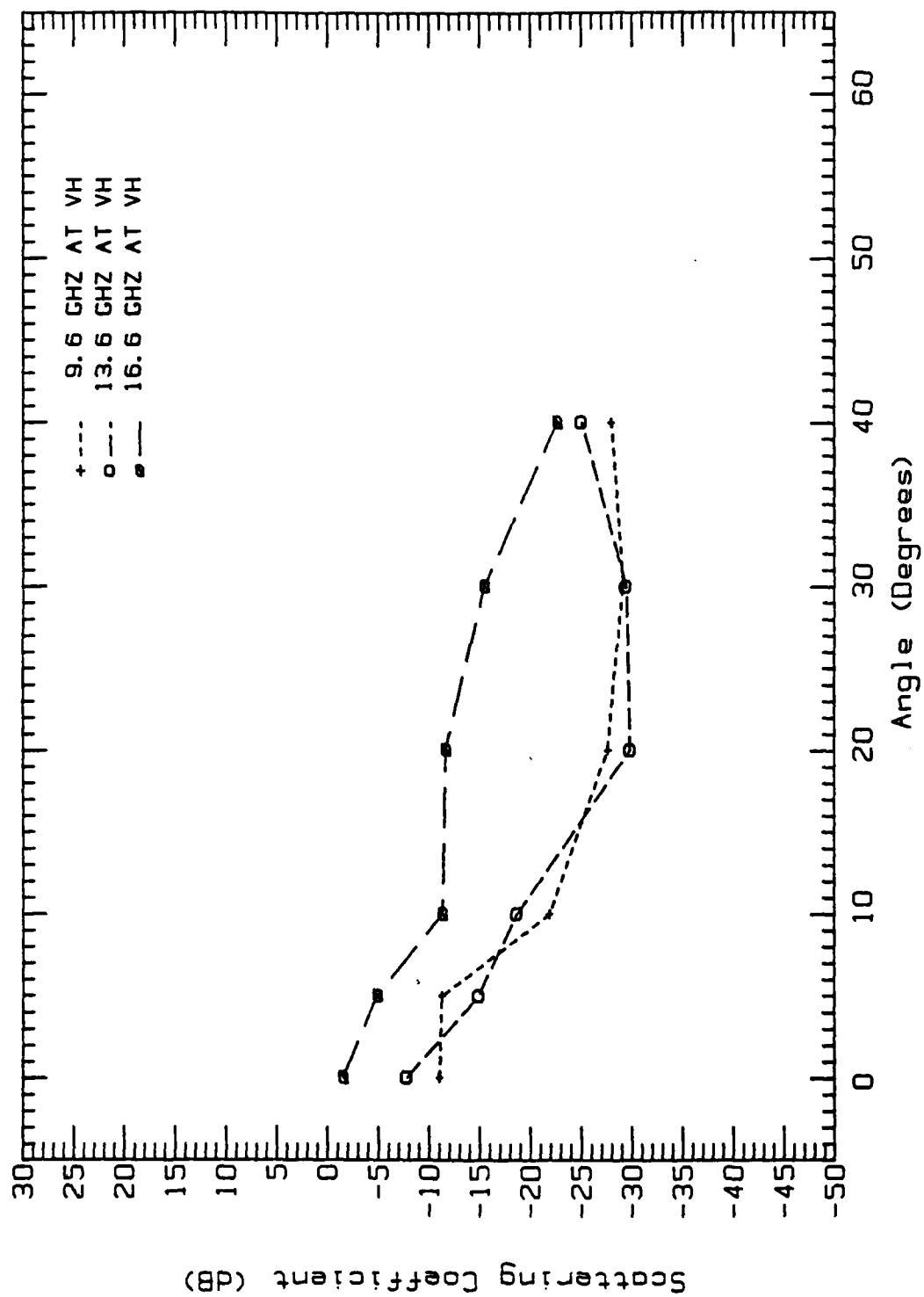
CRREL-85, MAR. 8, SMOOTH SNOW COVER



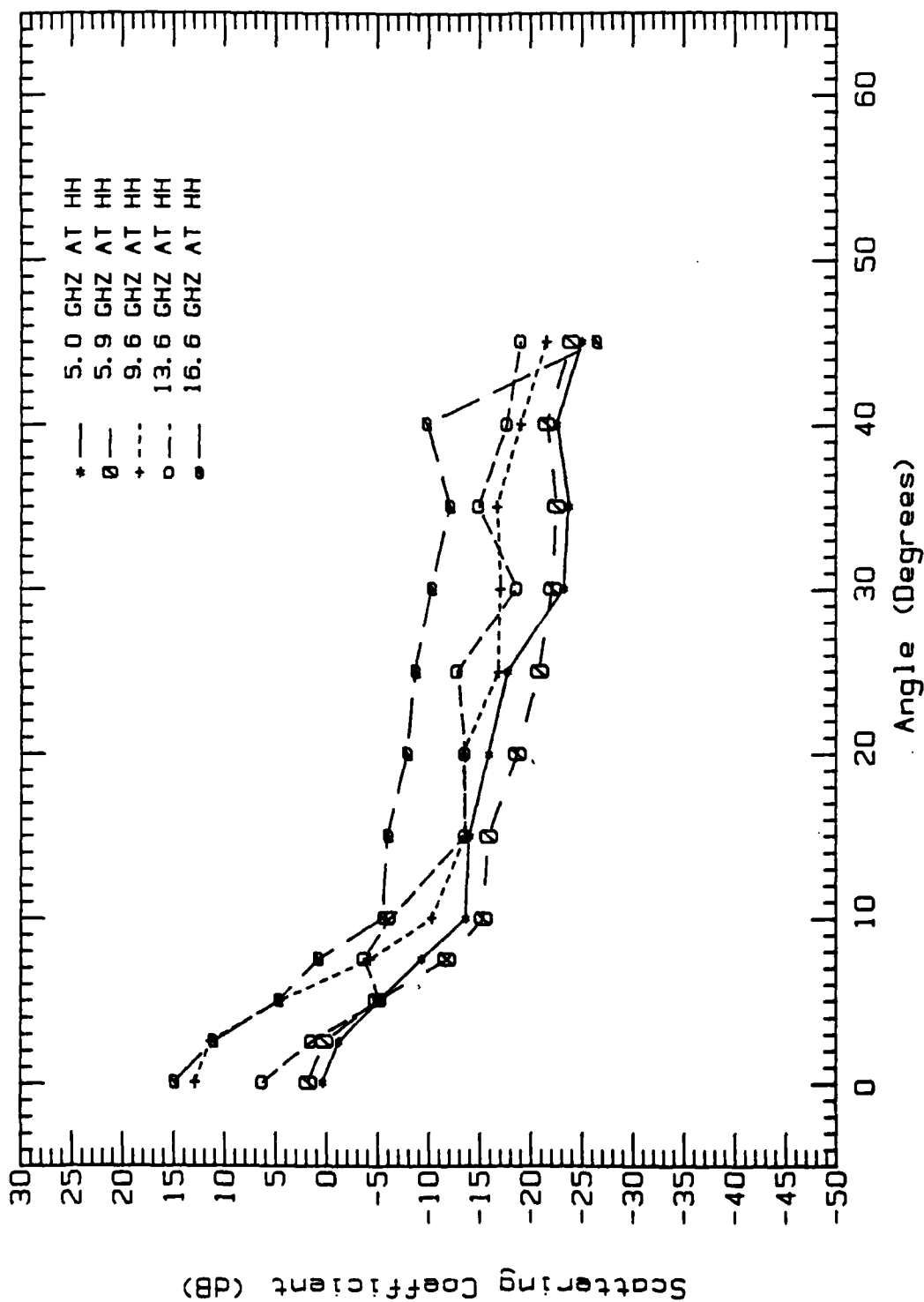
CRREL-85. MAR. 8. ROUGHENED SNOW COVER



CRREL-85. MAR. 18. TIME: 22:45



CRREL-85, MAR. 18, TIME: 23:30



CRREL-85, MAR. 18, TIME: 23:45

CRINC LABORATORIES

Chemical Engineering Low Temperature Laboratory

Remote Sensing Laboratory

Flight Research Laboratory

Chemical Engineering Heat Transfer Laboratory

Nuclear Engineering Laboratory

Environmental Health Engineering Laboratory

Information Processing Laboratory

Water Resources Institute

Technical Transfer Laboratory

Air Pollution Laboratory

Satellite Applications Laboratory

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