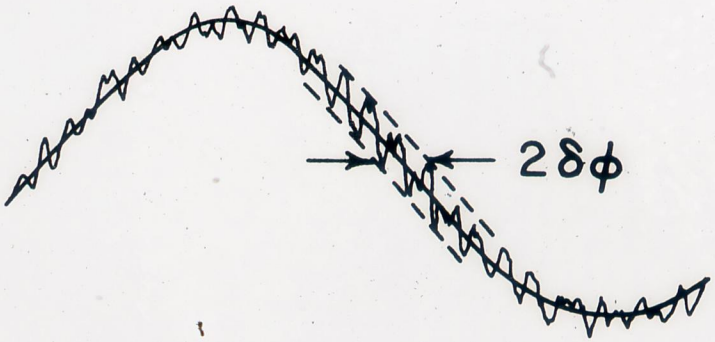
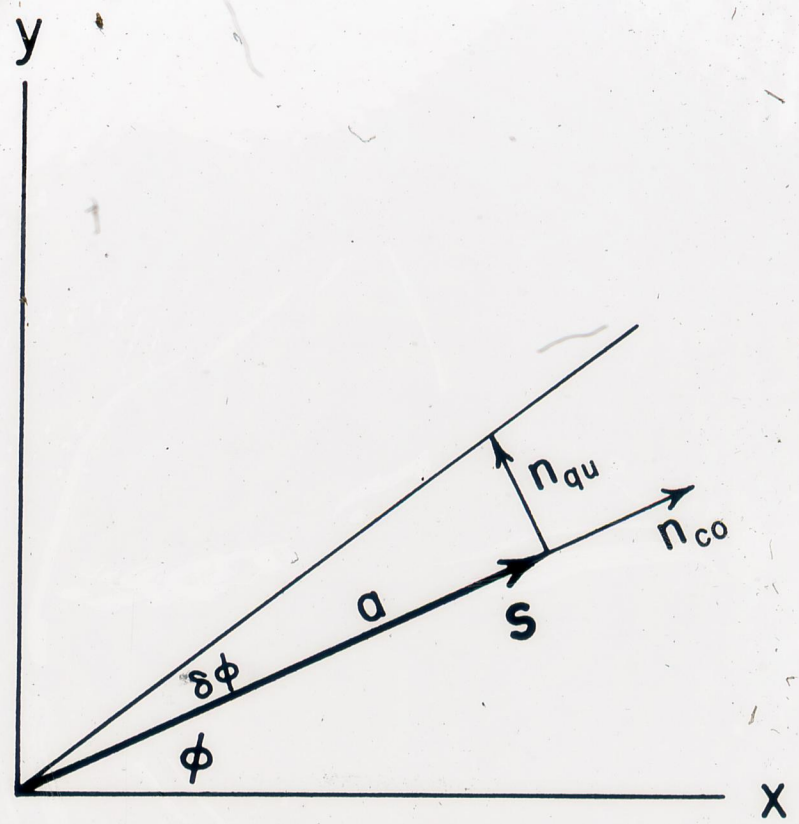
Slide images from the **Walter Munk Papers. SMC 17. Special Collections & Archives, UC San Diego.**

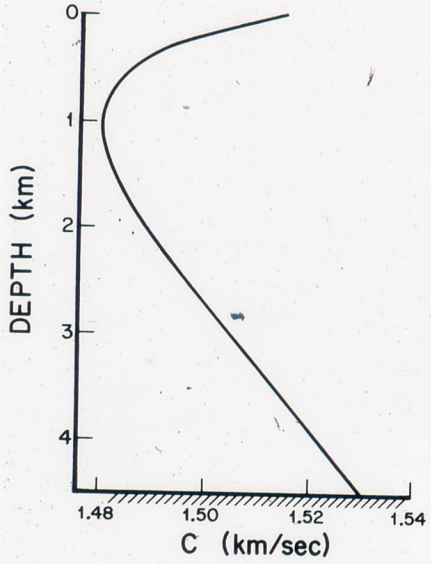
Slide groupings were determined by the original order of Walter Munk's slide collection, and a corresponding inventory. Titles and descriptions were transcribed from Munk's labels and the inventory, with some editing for consistency and clarity.

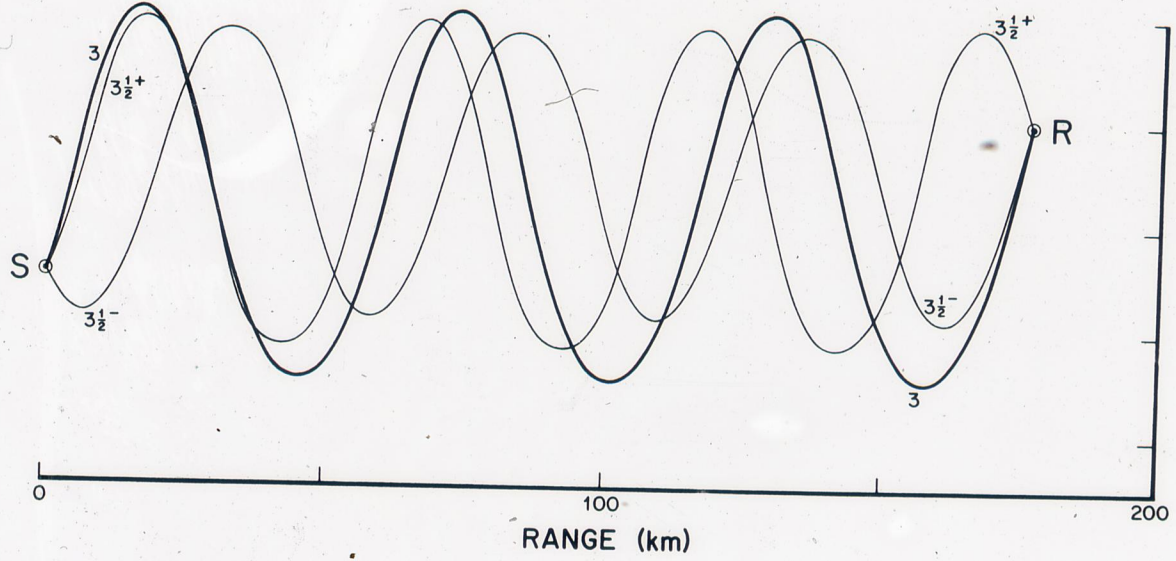
Ocean limits to precision acoustic ranging

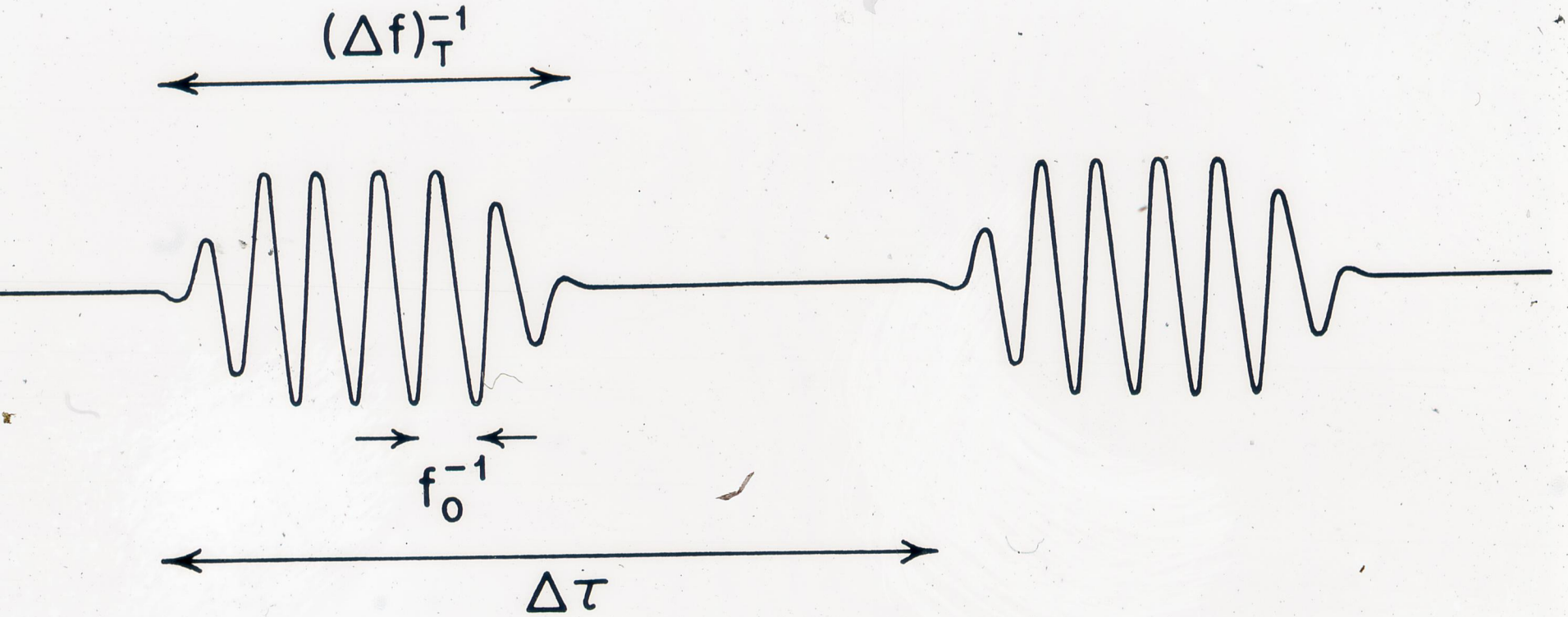
1. Graph
2. Graph
3. Graph
4. Graph
5. Scatter diagram
6. Diagram
7. Diagram
8. Graph
9. Raw received signal, complex demodulated, inverse filtered, and strong scatter - Frequency diagrams
10. Weak, stronger (unsaturated), and very strong (saturated) - Scatter diagrams
11. Diagram

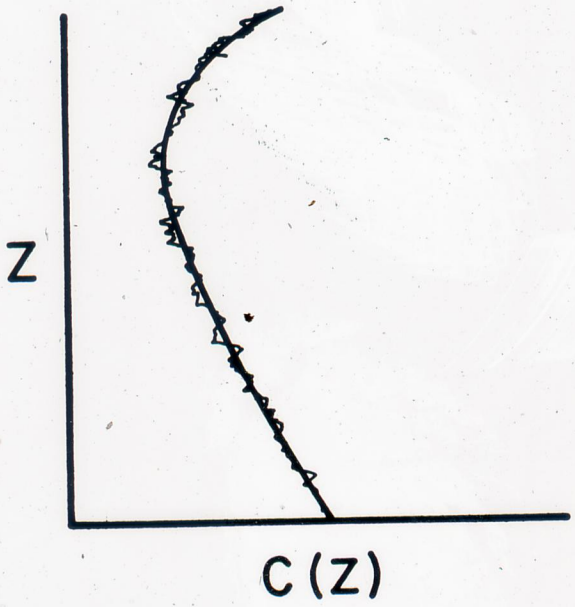

2δφ

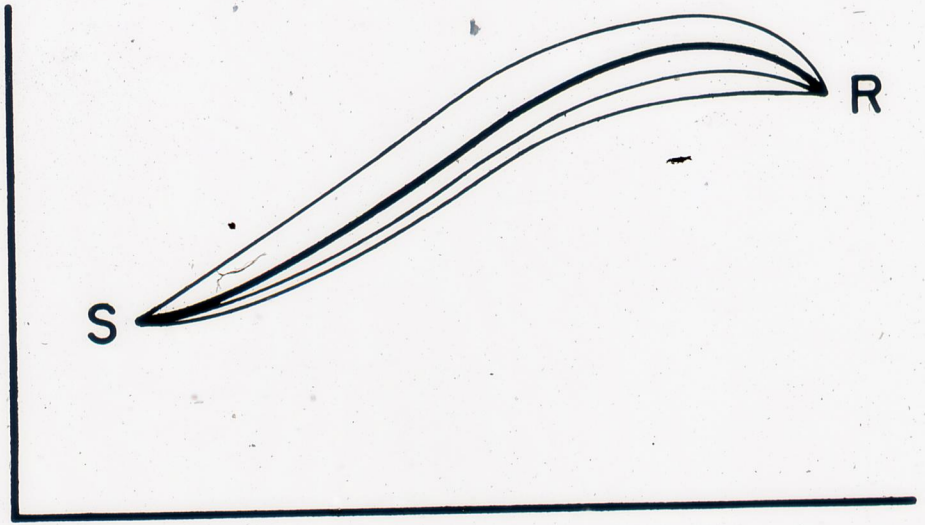

y
x
n_{qu}
n_{co}
a
s
δφ
φ


0
1
2
3
4
DEPTH (km)
1.48
1.50
1.52
1.54
C (km/sec)

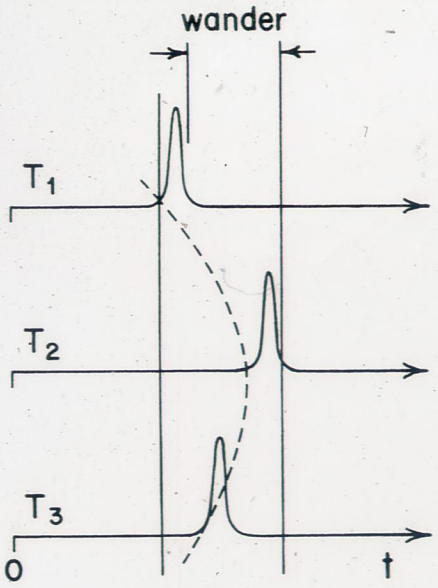

3
3½+
3½−
S
R
3½+
3½−
3
0
100
200
RANGE (km)

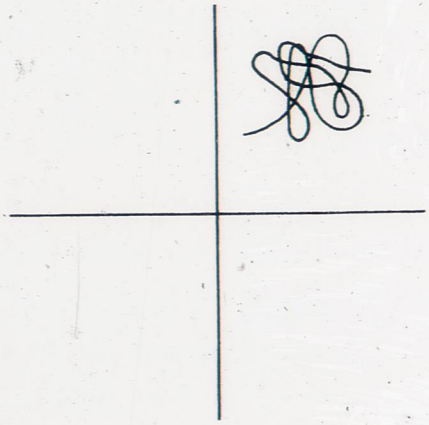

$(\Delta f)_T^{-1}$
f_0^{-1}
$\Delta\tau$


Z
C(Z)

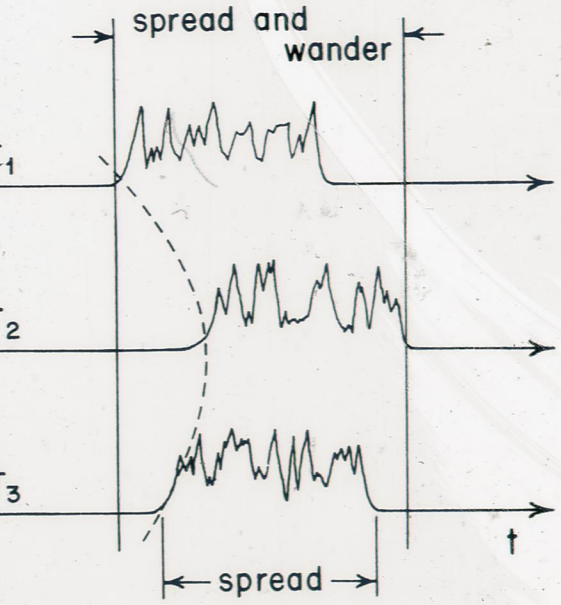

S
R

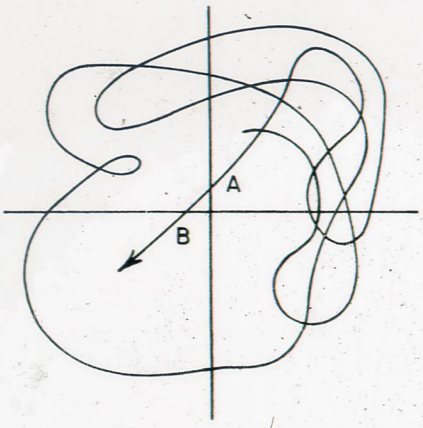
Very Weak Scatter

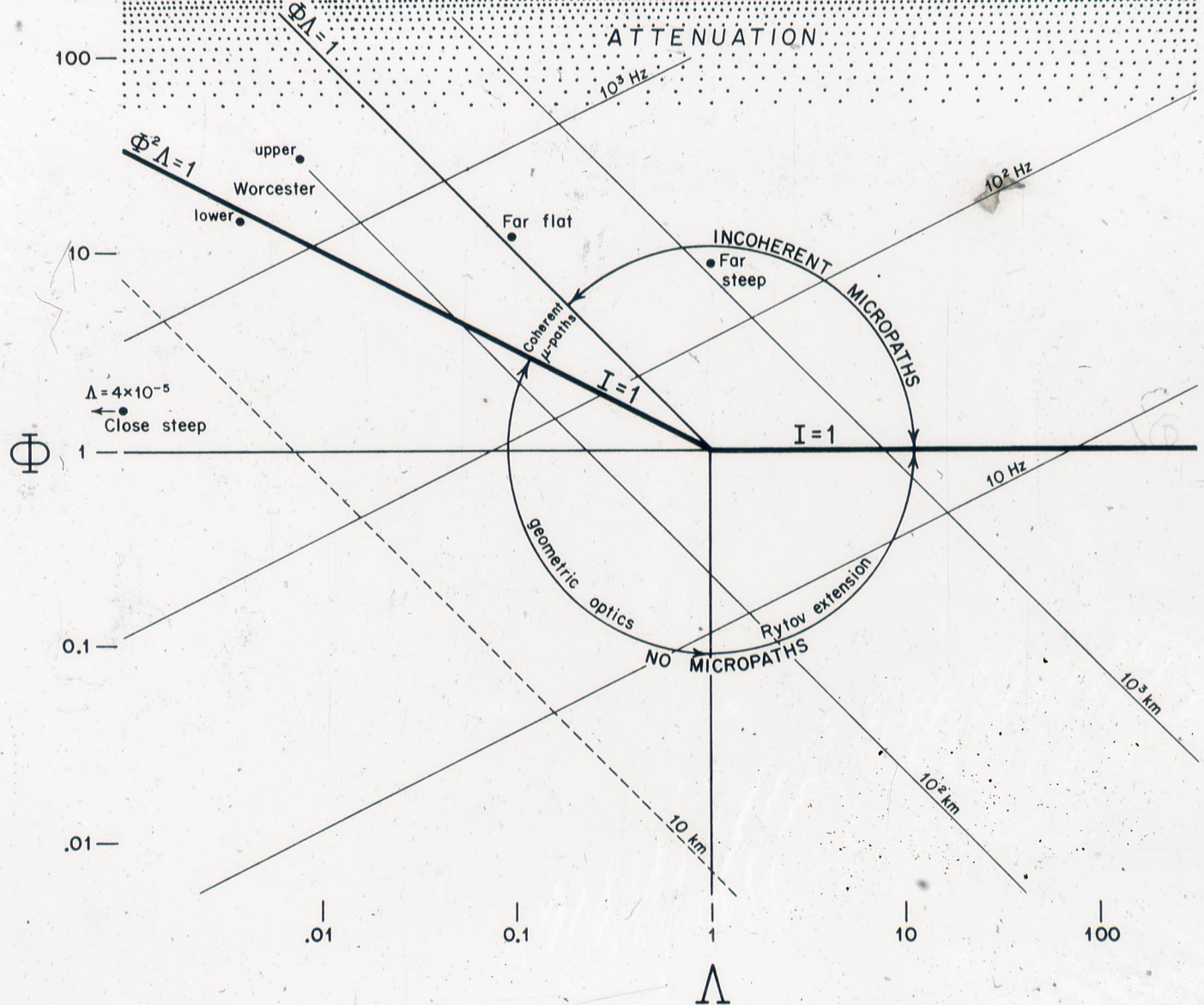


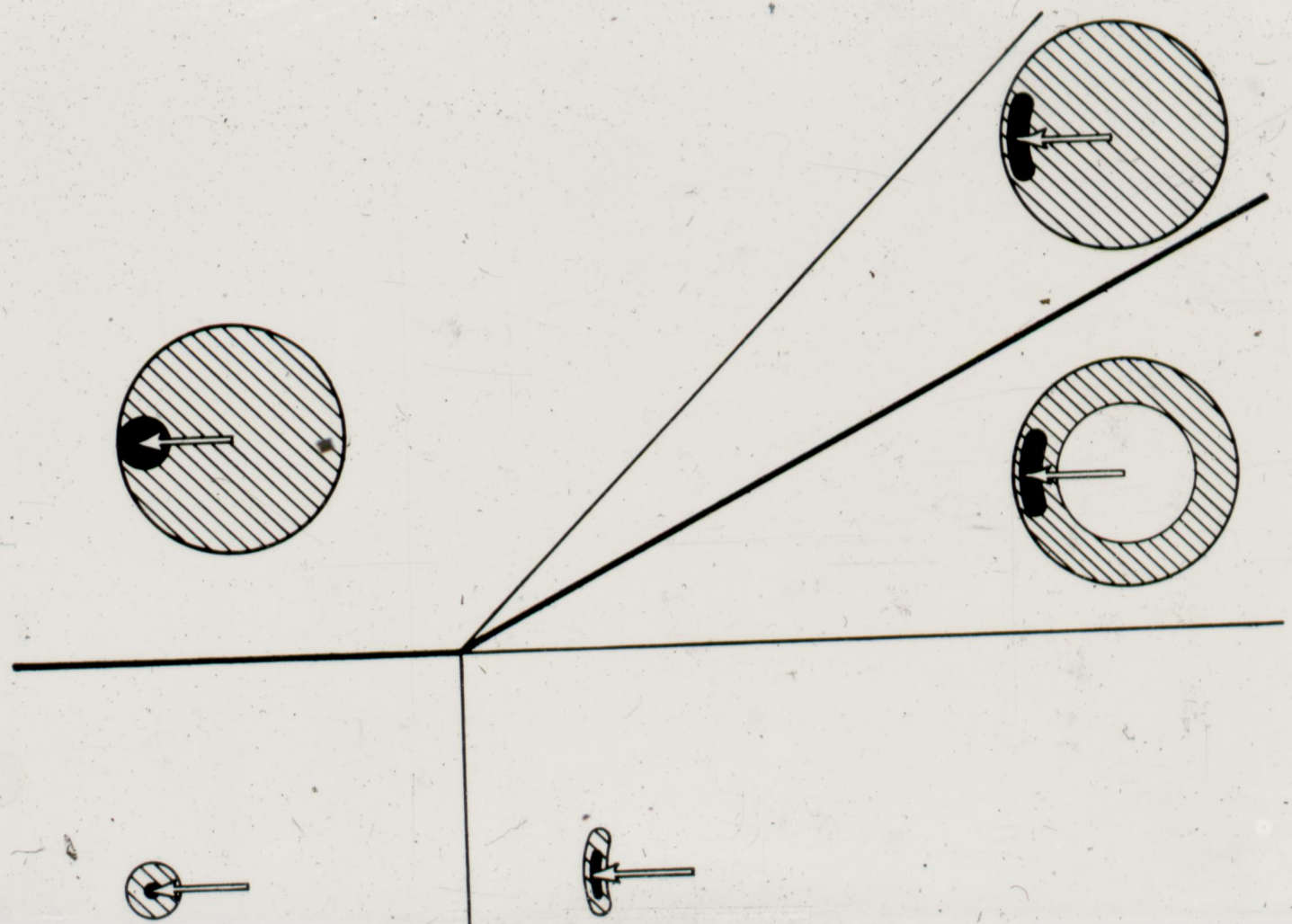


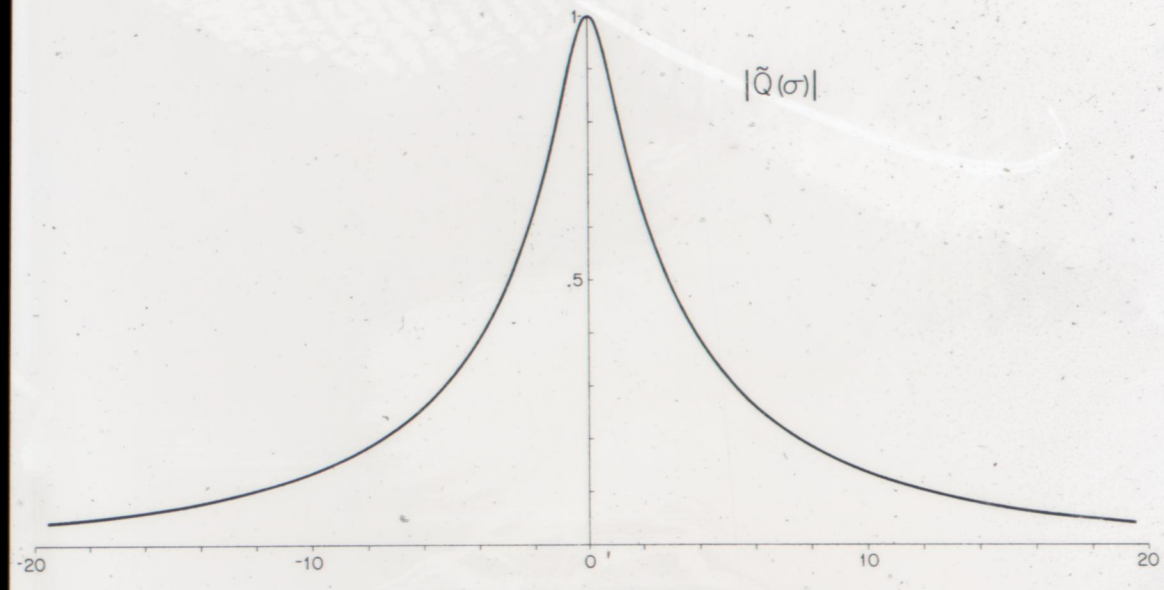
Very Strong Scatter

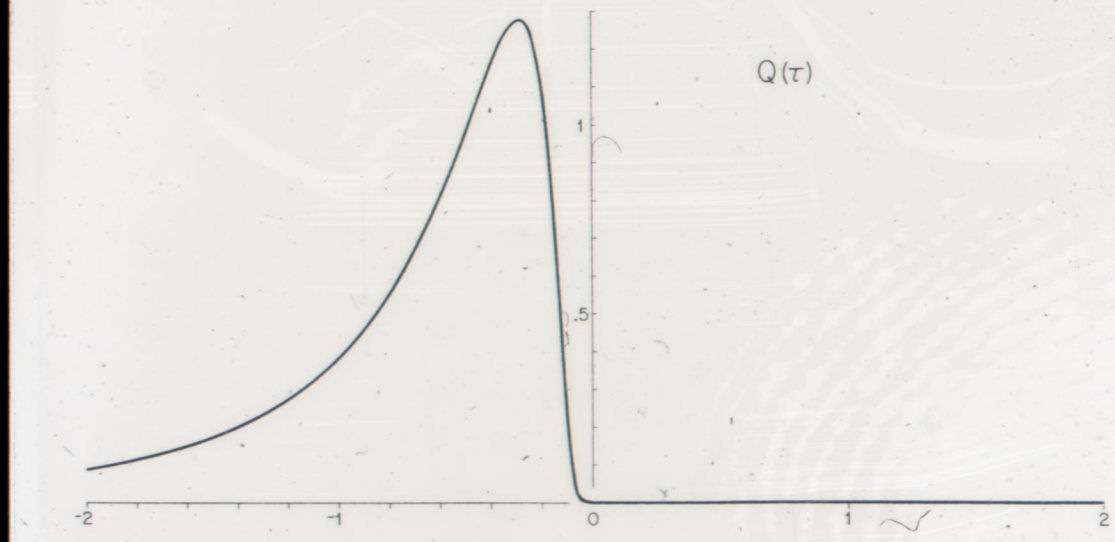




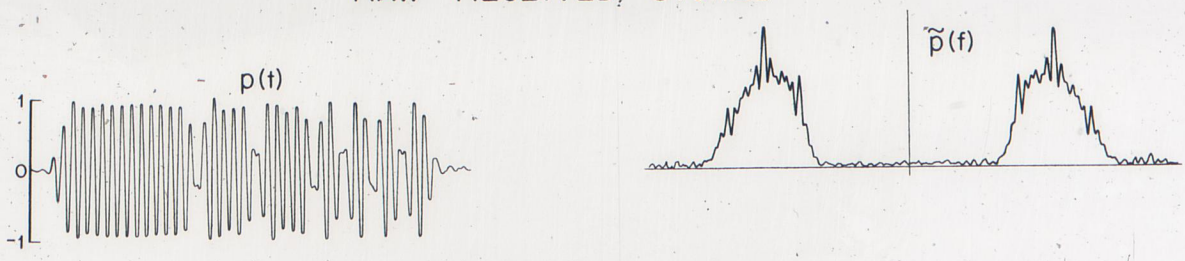

ATTENUATION
$\Phi\Lambda=1$
$\Phi^2\Lambda=1$
100
10
1
0.1
.01
Φ
10^3 Hz
10^2 Hz
10 Hz
upper
Worcester
lower
Far flat
INCOHERENT MICROPATHS
Far steep
Coherent μ-paths
I=1
I=1
$\Lambda=4\times10^{-5}$
Close steep
geometric optics
Rytov extension
NO MICROPATHS
10^3 km
10^2 km
10 km
.01
0.1
1
10
100
Λ




$|\tilde{Q}(\sigma)|$
1
.5
-20
-10
0
10
20

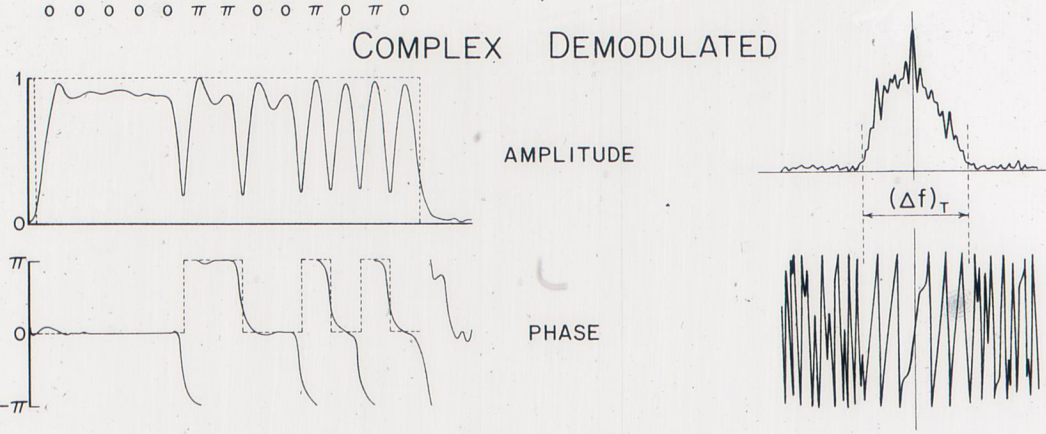

$Q(\tau)$
1
.5
-2
-1
0
1
2

RAW RECEIVED SIGNAL



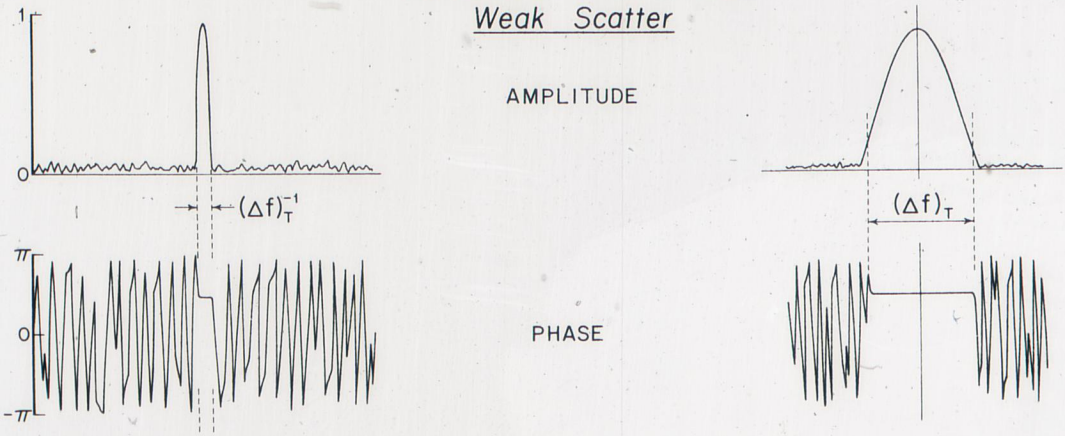
o o o o o π π o o π o π o

COMPLEX DEMODULATED

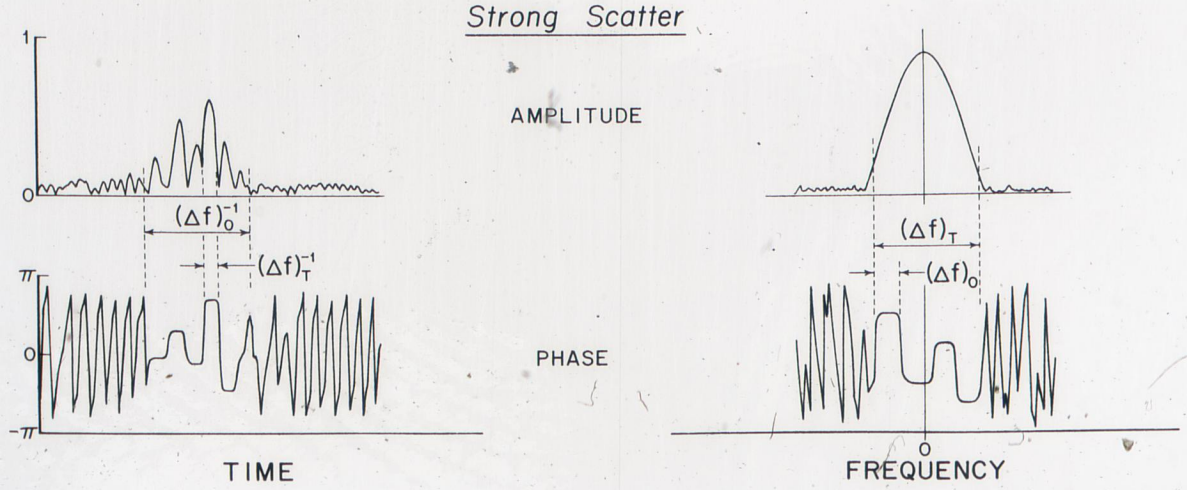


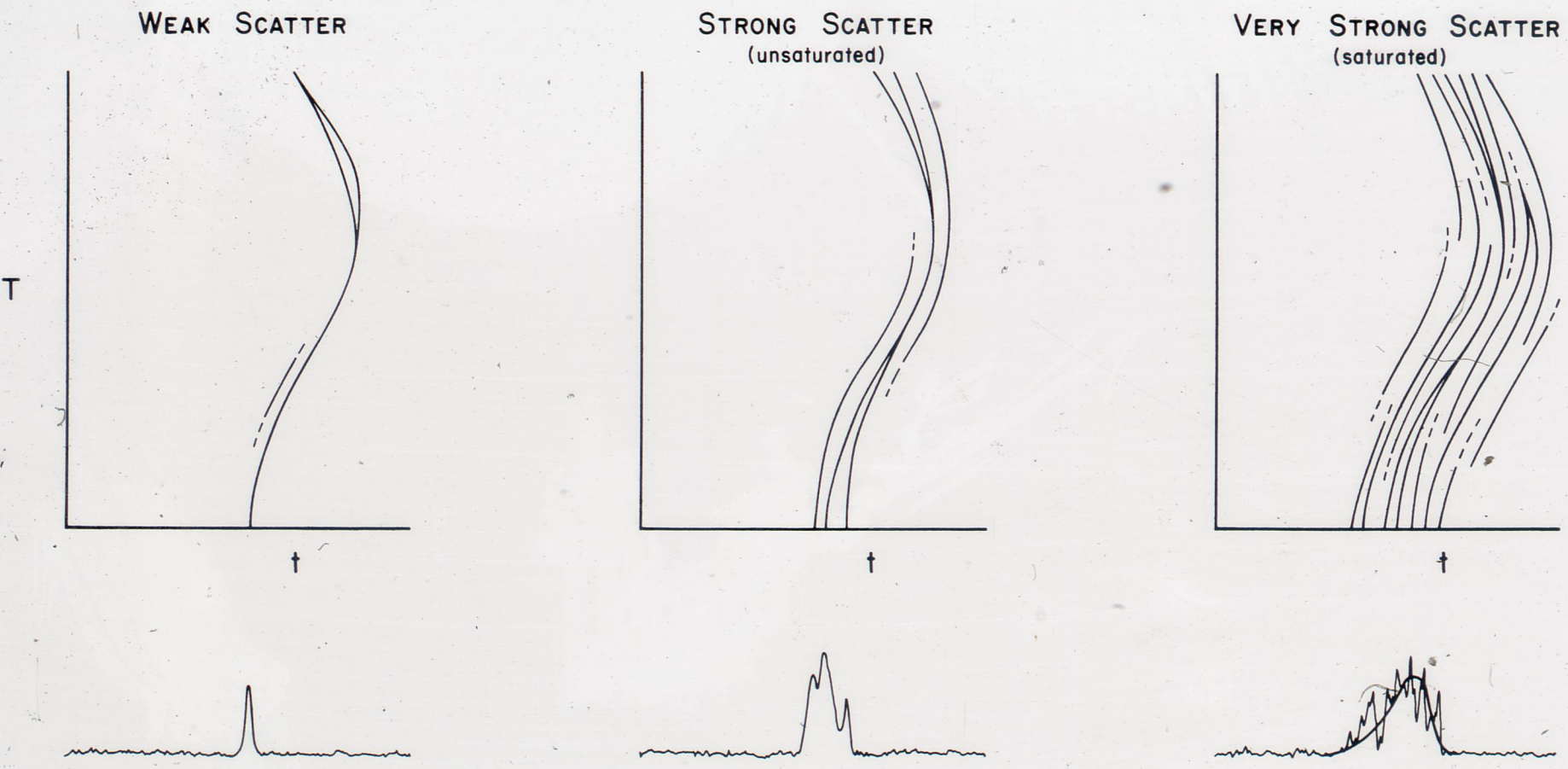
INVERSE FILTERED

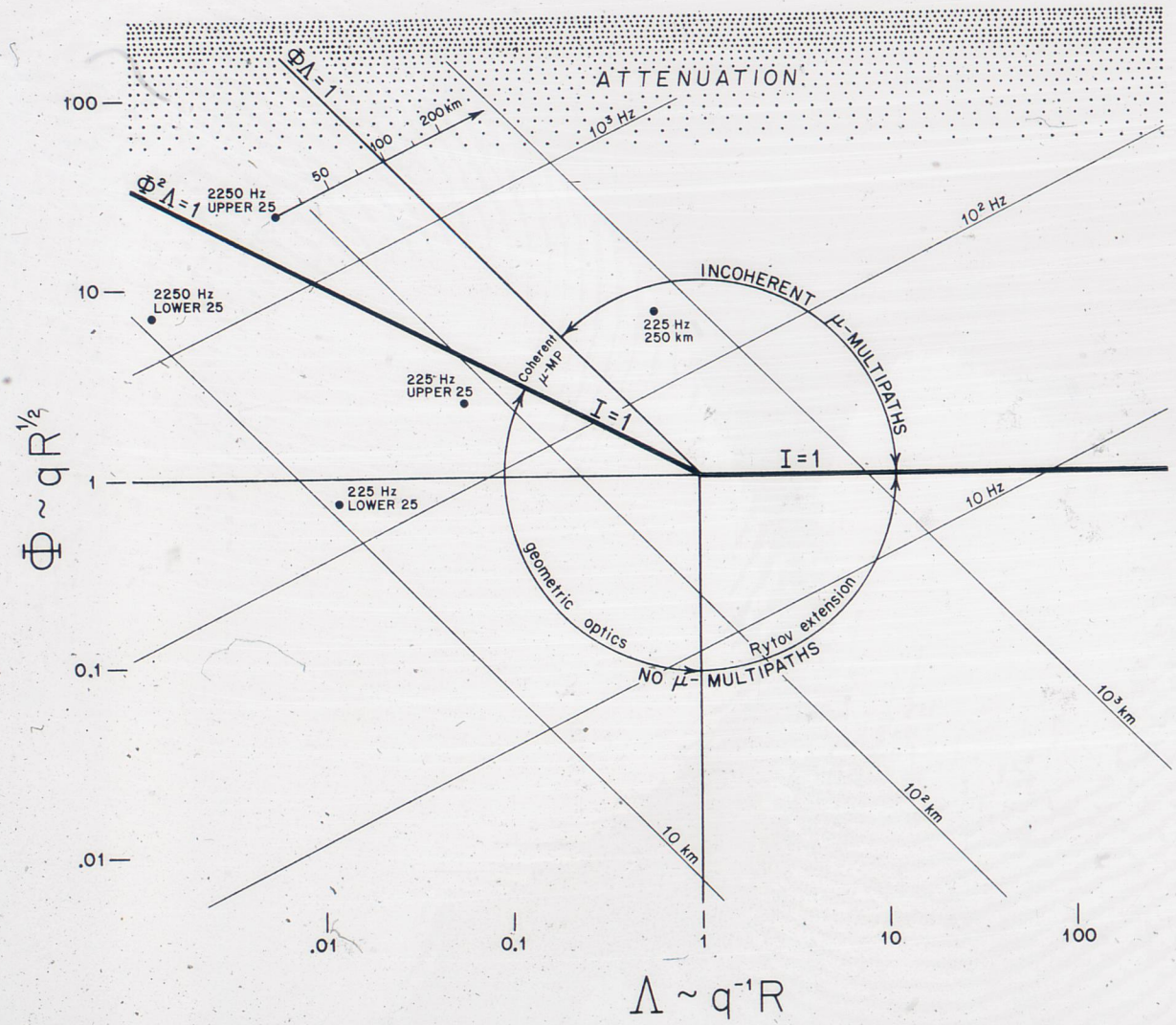
Weak Scatter

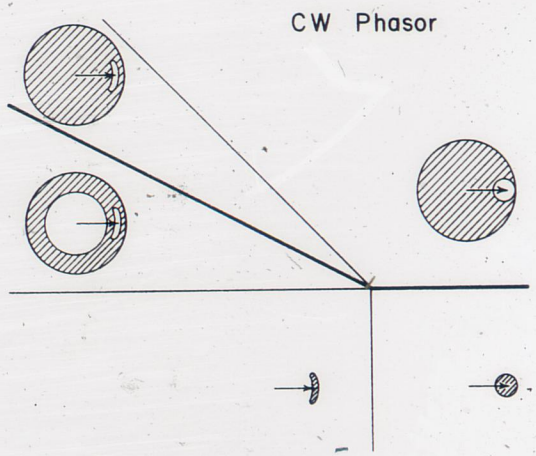


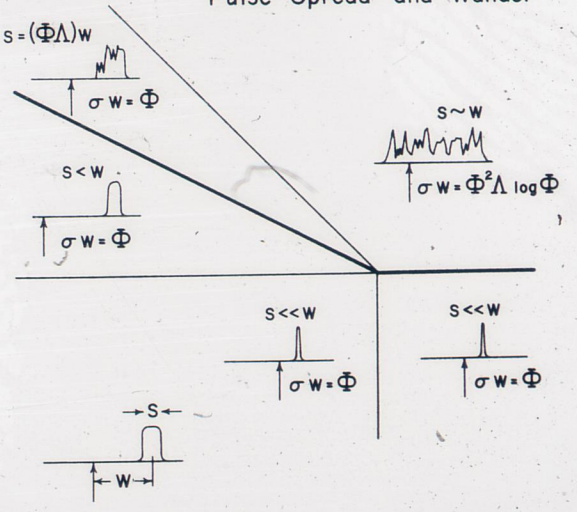
Strong Scatter




WEAK SCATTER
STRONG SCATTER
(unsaturated)
VERY STRONG SCATTER
(saturated)
T
t
t
t


ATTENUATION
ΦΛ = 1
Φ²Λ = 1
200 km
100
50
10³ Hz
10² Hz
10 Hz
10³ km
10² km
10 km
2250 Hz
UPPER 25
2250 Hz
LOWER 25
225 Hz
UPPER 25
225 Hz
LOWER 25
225 Hz
250 km
INCOHERENT
μ-MULTIPATHS
Coherent
μ-MP
I = 1
I = 1
geometric optics
Rytov extension
NO μ- MULTIPATHS
100
10
1
0.1
.01
.01
0.1
1
10
100
Φ ~ qR^1/2
Λ ~ q^-1R


CW Phasor


Pulse Spread and Wander
S = (ΦΛ)W
σW = Φ
S ~ W
σW = Φ²Λ log Φ
S < W
σW = Φ
S << W
σW = Φ
S << W
σW = Φ
S
W