

SNR issues: Definitions, theory and practice

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Simpson Weather Associates

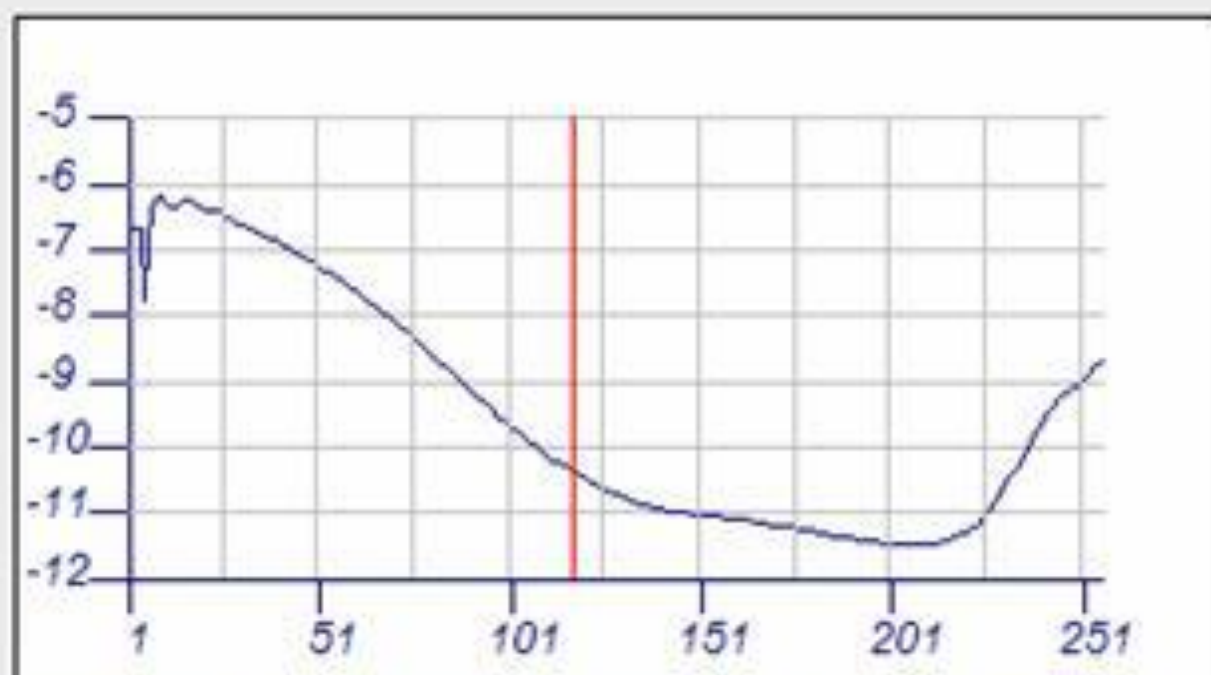
Working Group on Space-based Lidar Winds
June 28- July 1, 2005
Welches, Oregon

Issues

- What is the correct figure of merit for obtaining the correct LOS wind speed from a coherent DWL?
- Which SNR should we use?
- CNR, wideband, narrow band
- Peak, FWHM, power under spectral feature
- Complex returns due to shear and velocity variation

Peak detection

- Perform complex FFT on each shot and account for variation of transmitted frequency and start of digitization
- Accumulate the spectrum of N shots
- Level “noise floor”
- Pick the spectral peak within the search window (10 m/s)

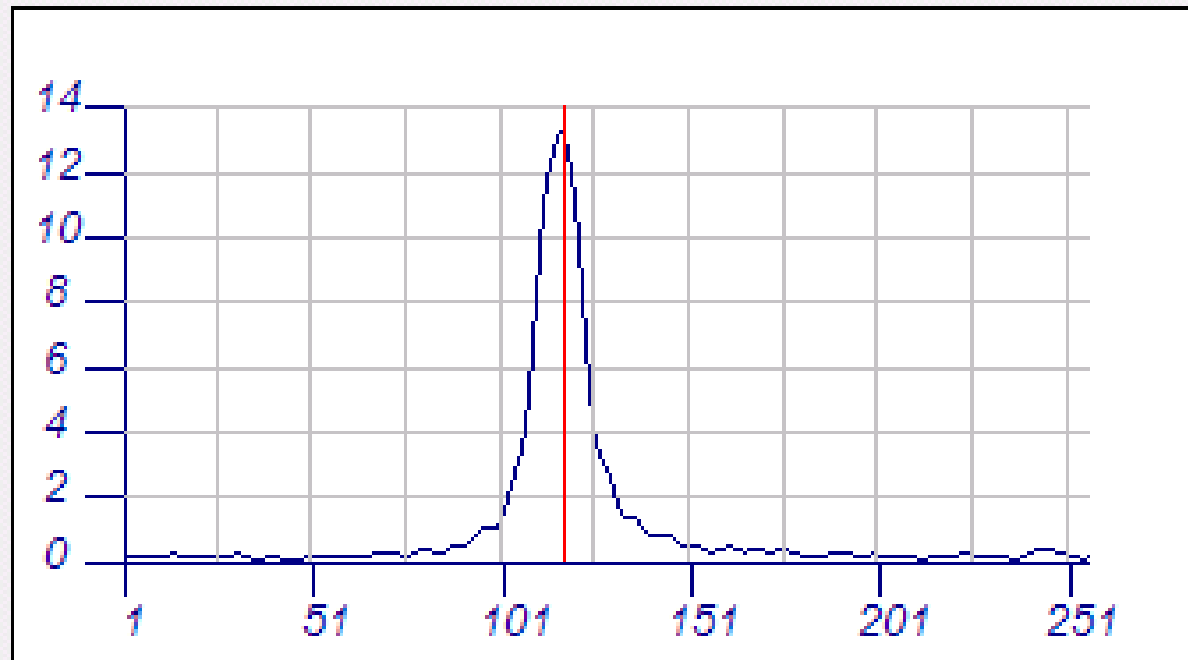


PREV

GATE 1

NEXT

NOISE SPECTRUM FOR 10,000 SHOT SUMMATION

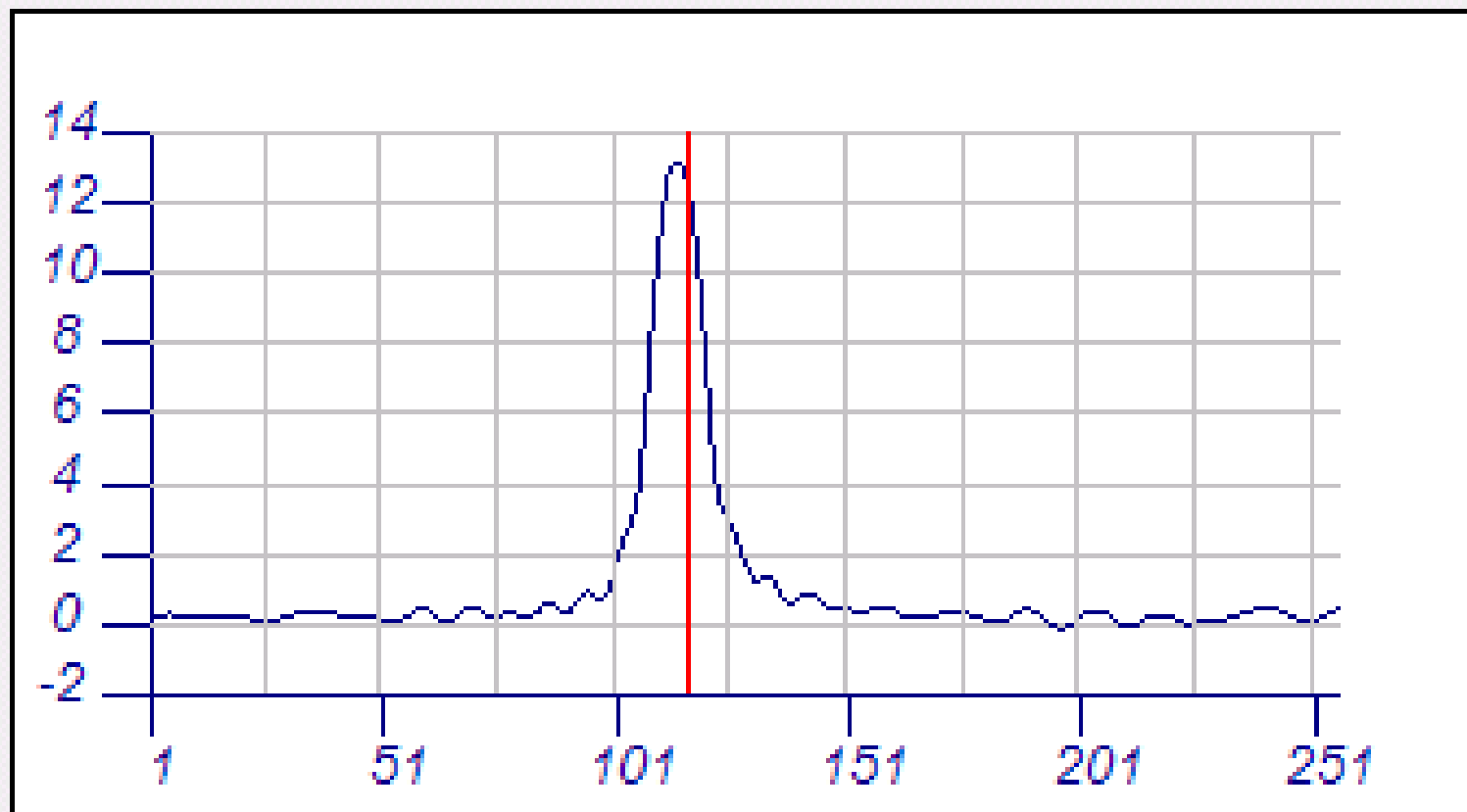


PREV

GATE 20

NEXT

SPECTRUM, GATE 20, 10,000 SHOT SUMMATION

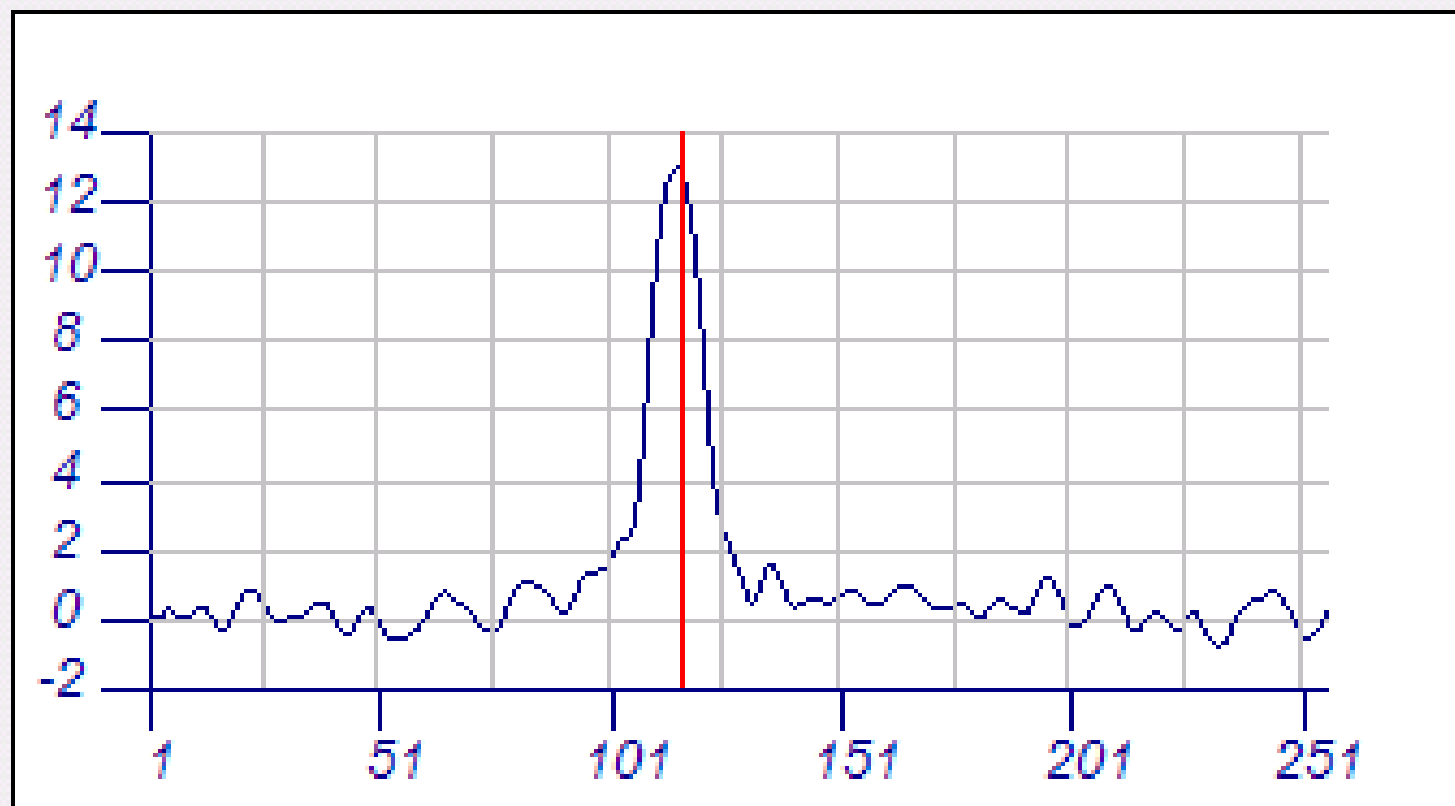


PREV

GATE 20

NEXT

1000 shot accumulation

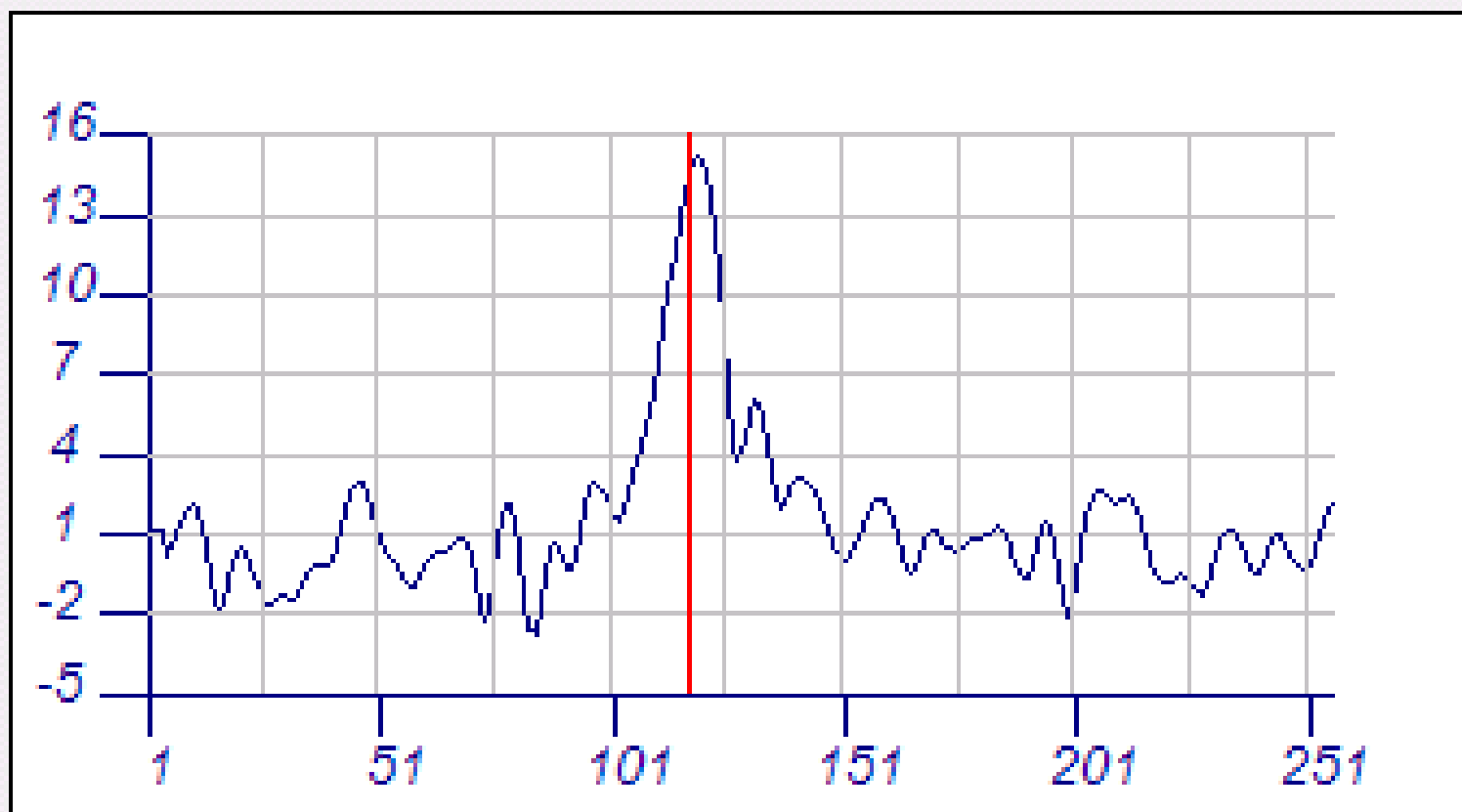


PREV

GATE 20

NEXT

SPECTRUM, GATE 20, 100 SHOT SUMMATION

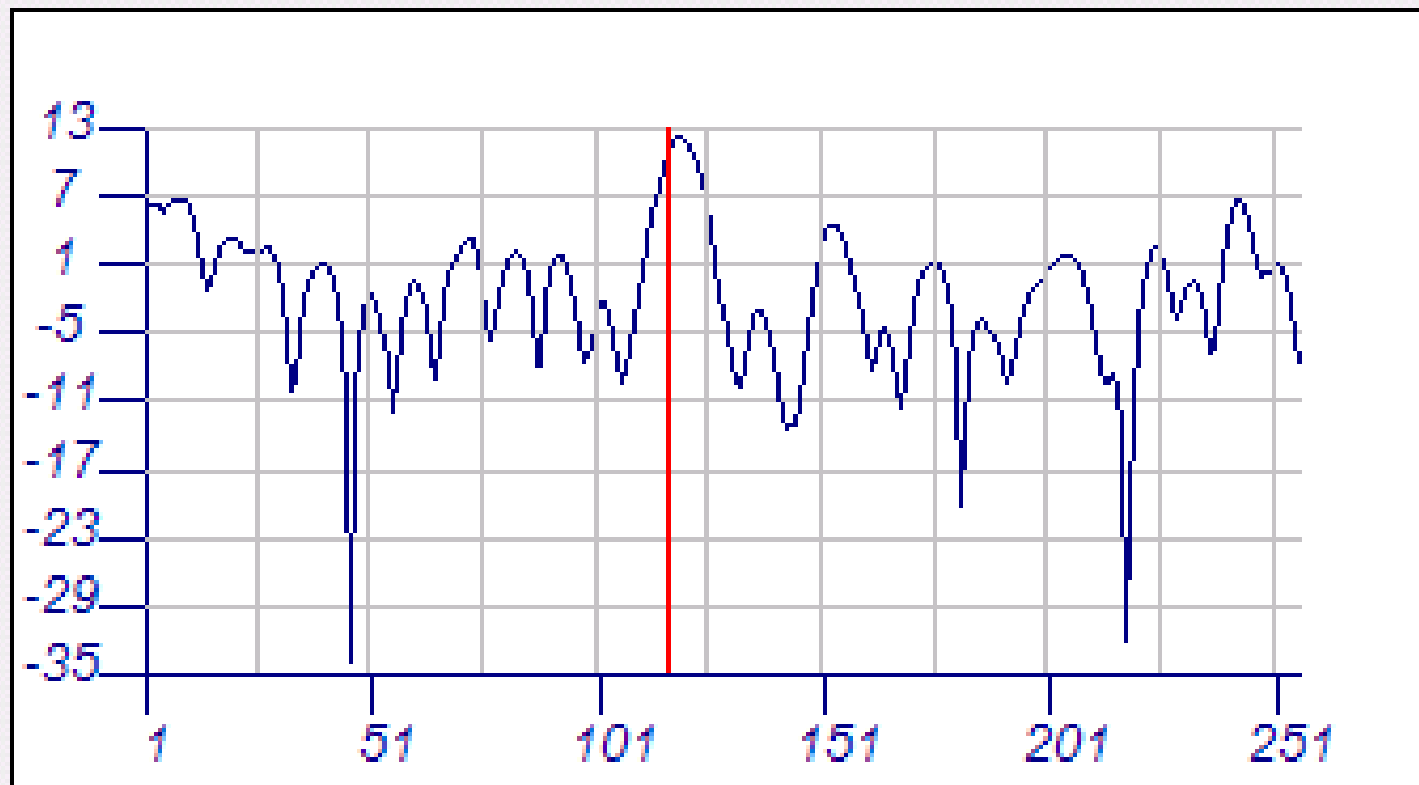


PREV

GATE 20

NEXT

SPECTRUM, GATE 20, 10-SHOT SUMMATION

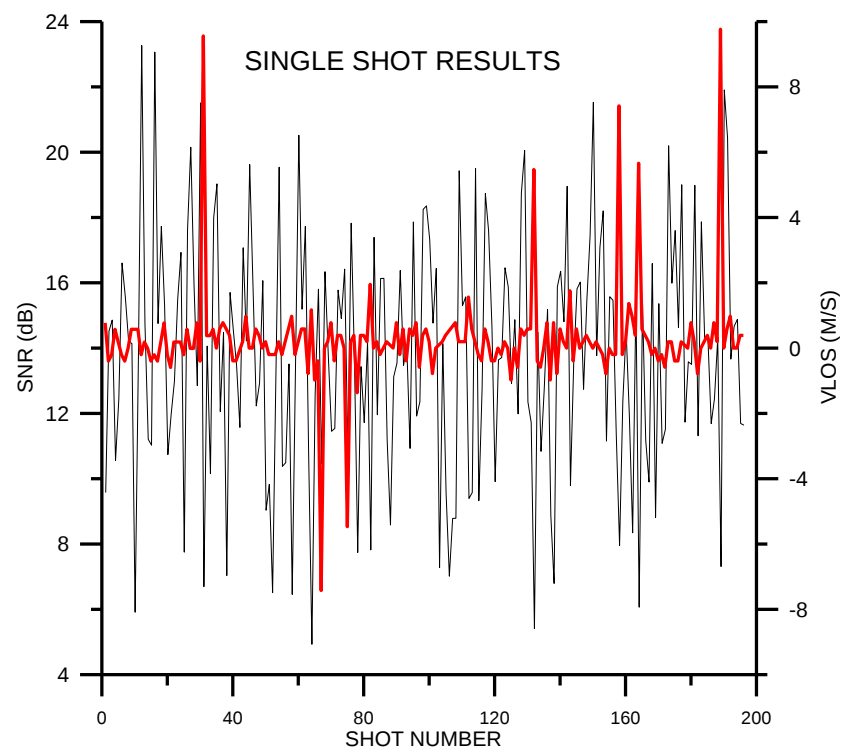


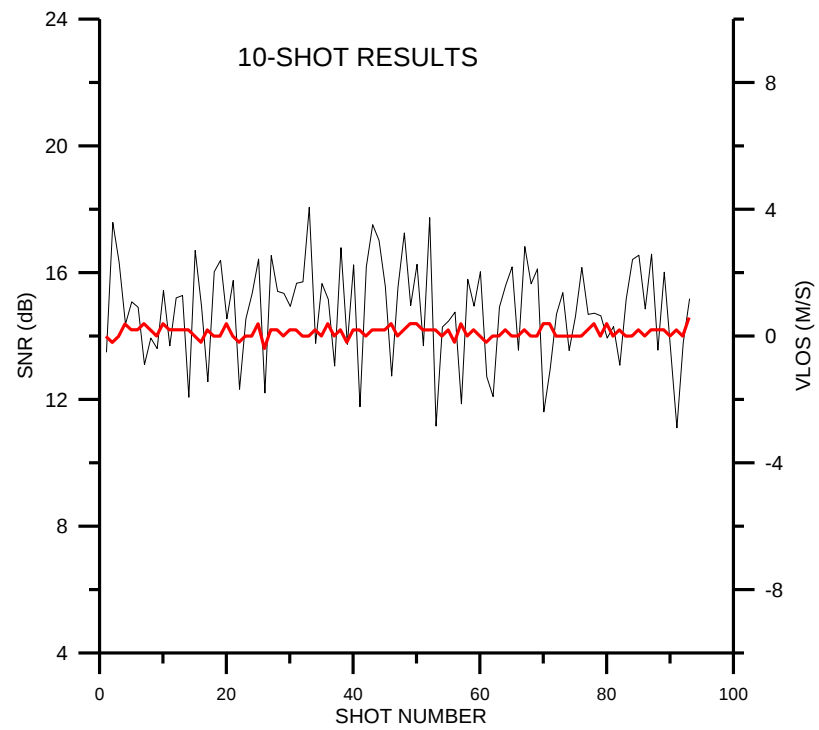
PREV

GATE 20

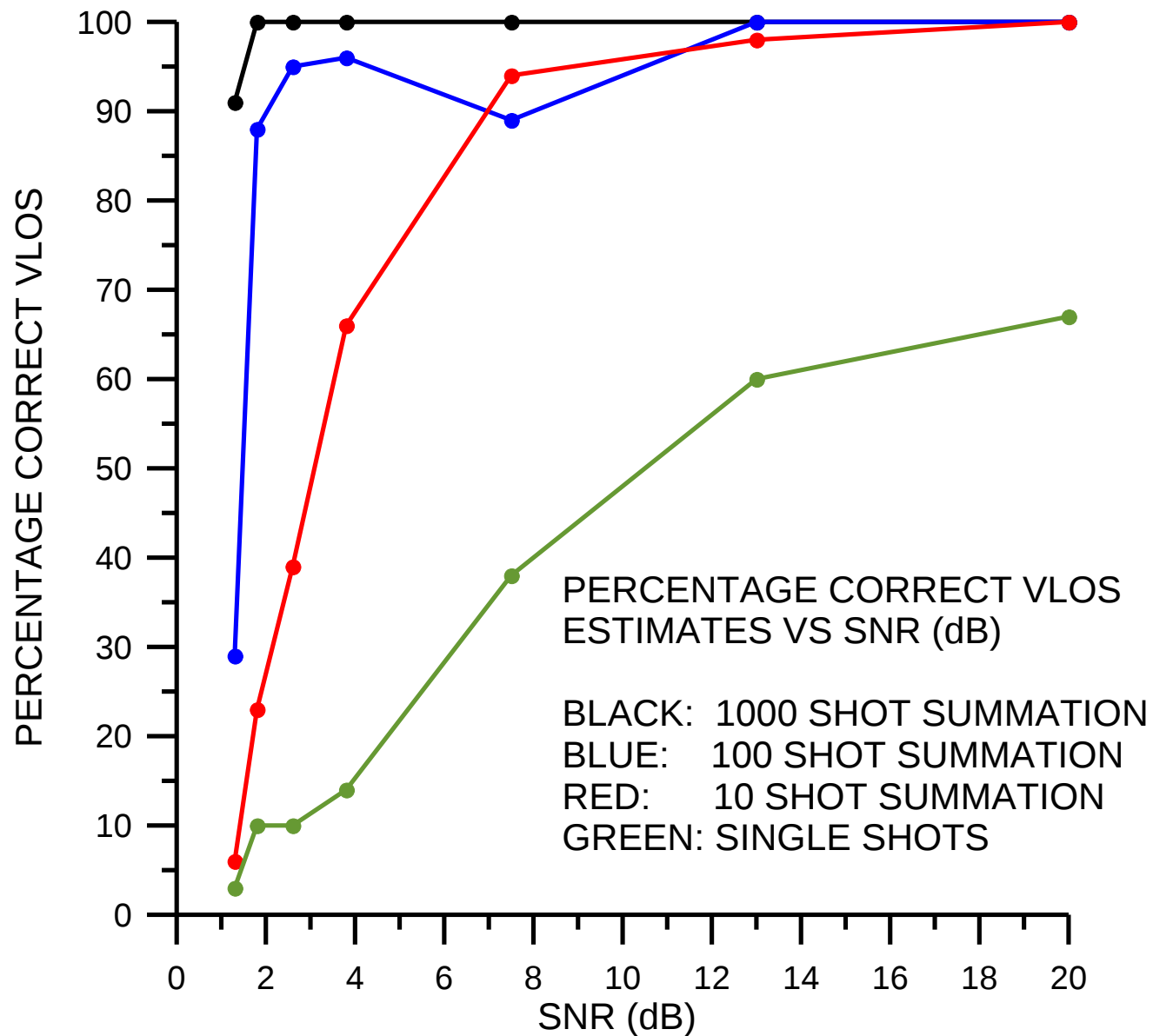
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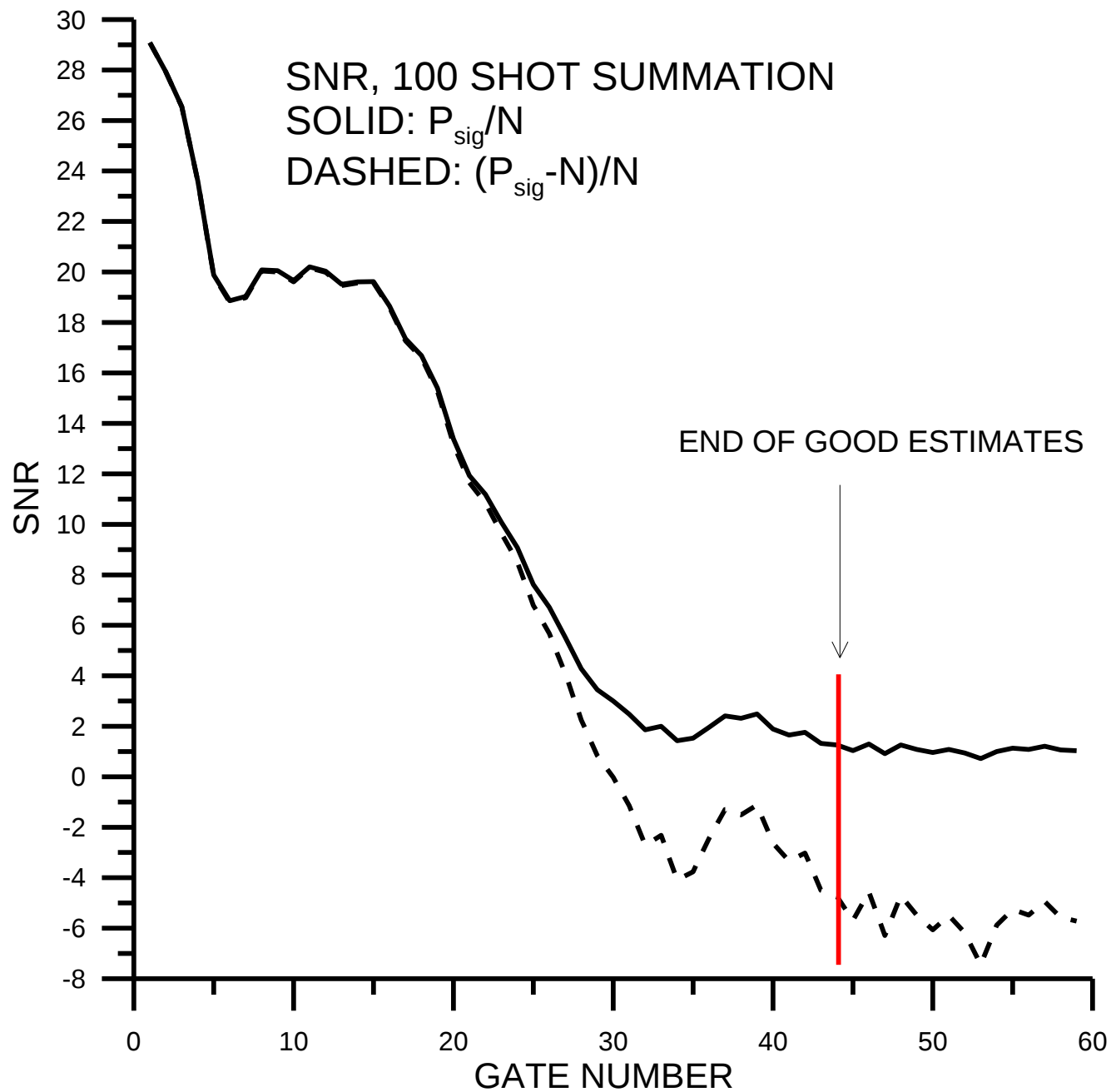
GATE 20 SPECTRUM, SINGLE SHOT

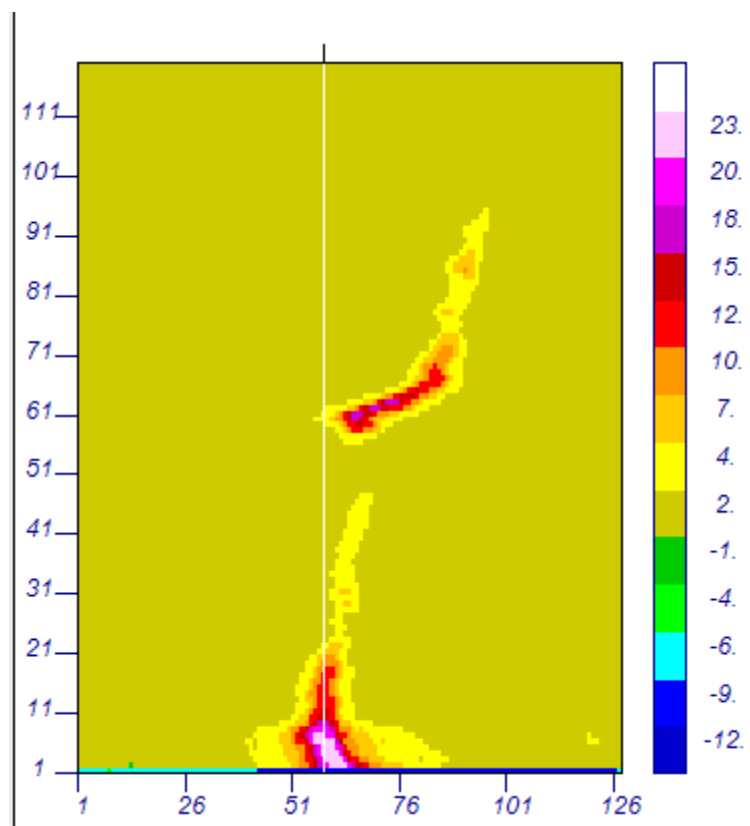


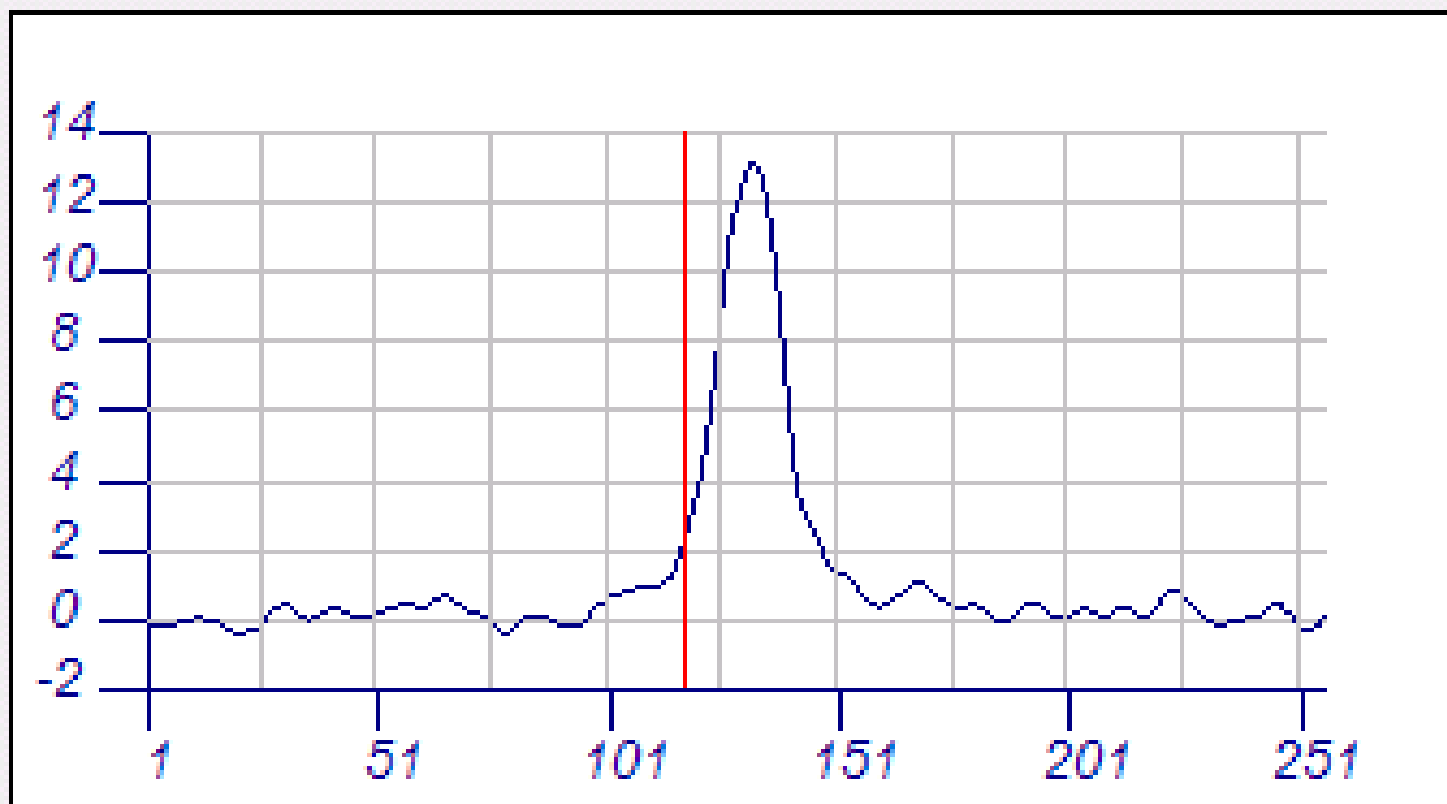


SNR (gate)	1000 Shots	100 Shots	10 Shots	1 Shot
20.0 (10)	100%	100%	100%	67%
13.0 (20)	100%	100%	98%	60%
7.5 (25)	100%	89%	94%	38%
3.8 (28)	100%	96%	66%	14%
2.6 (30)	100%	95%	39%	10%
1.8 (40)	100%	88%	23%	10%
1.2 (46)	91%	29%	6%	3%
Sample Size	11	110	185	294
Below 50% Gate	49	46	30	24





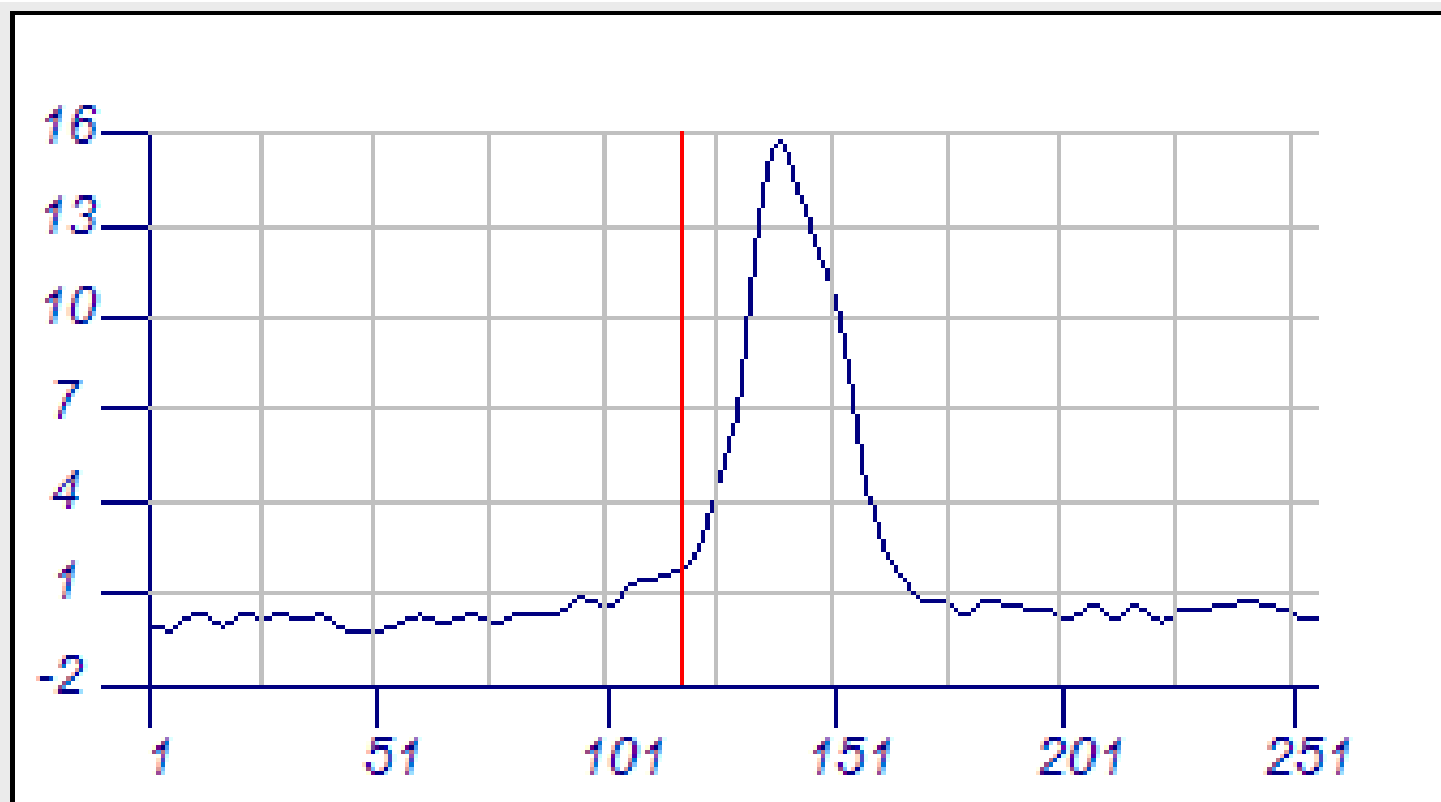




PREV

GATE 59

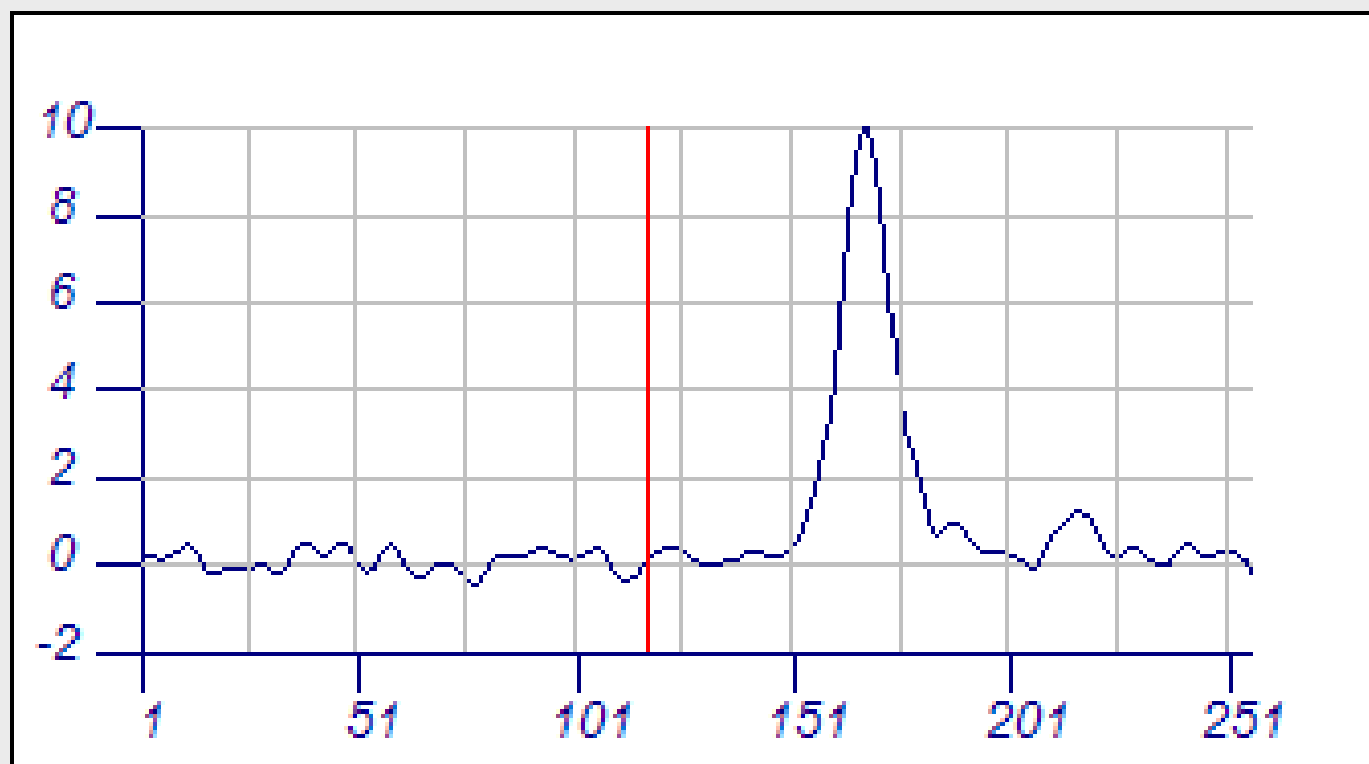
NEXT



PREV

GATE 62

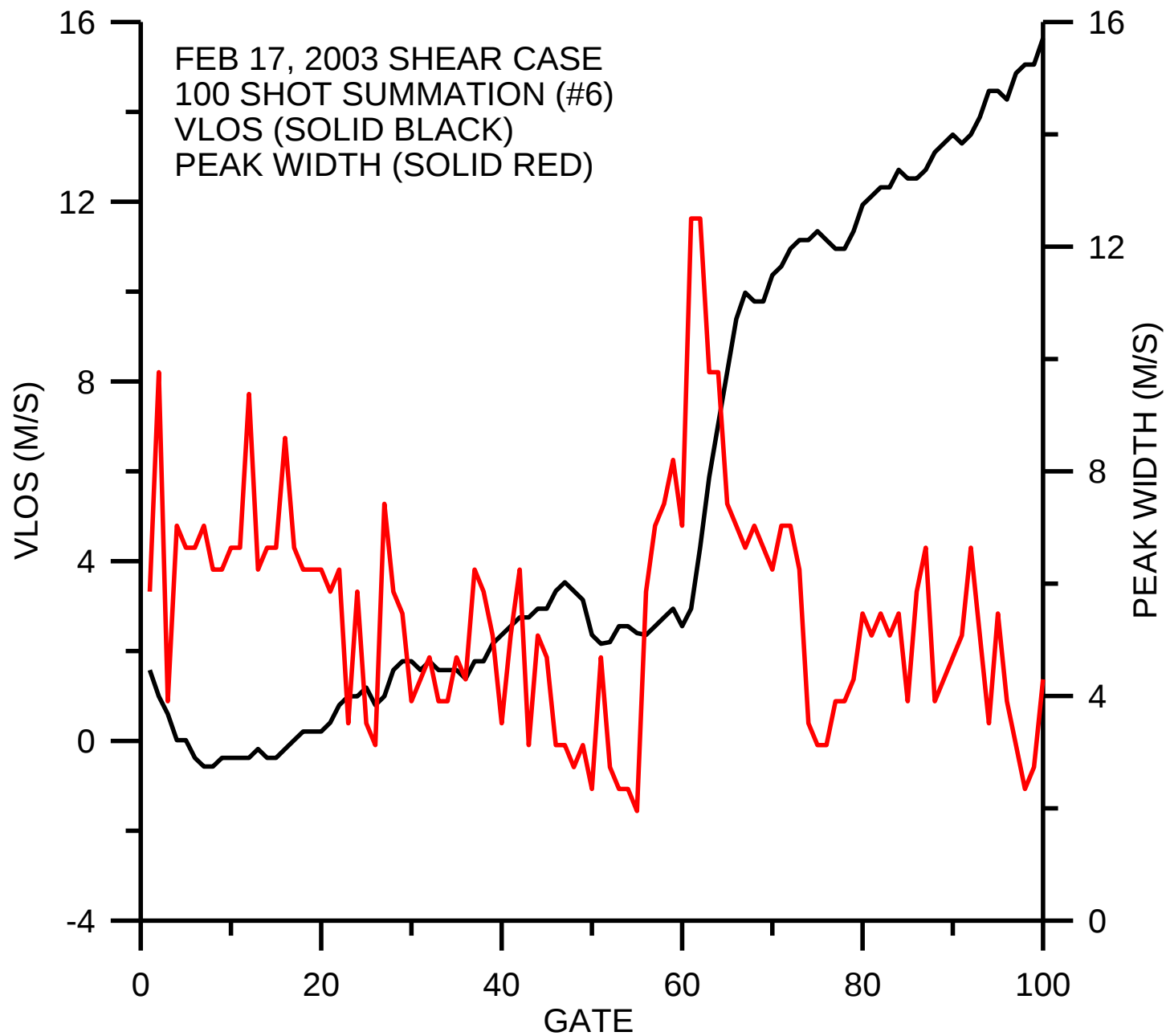
NEXT

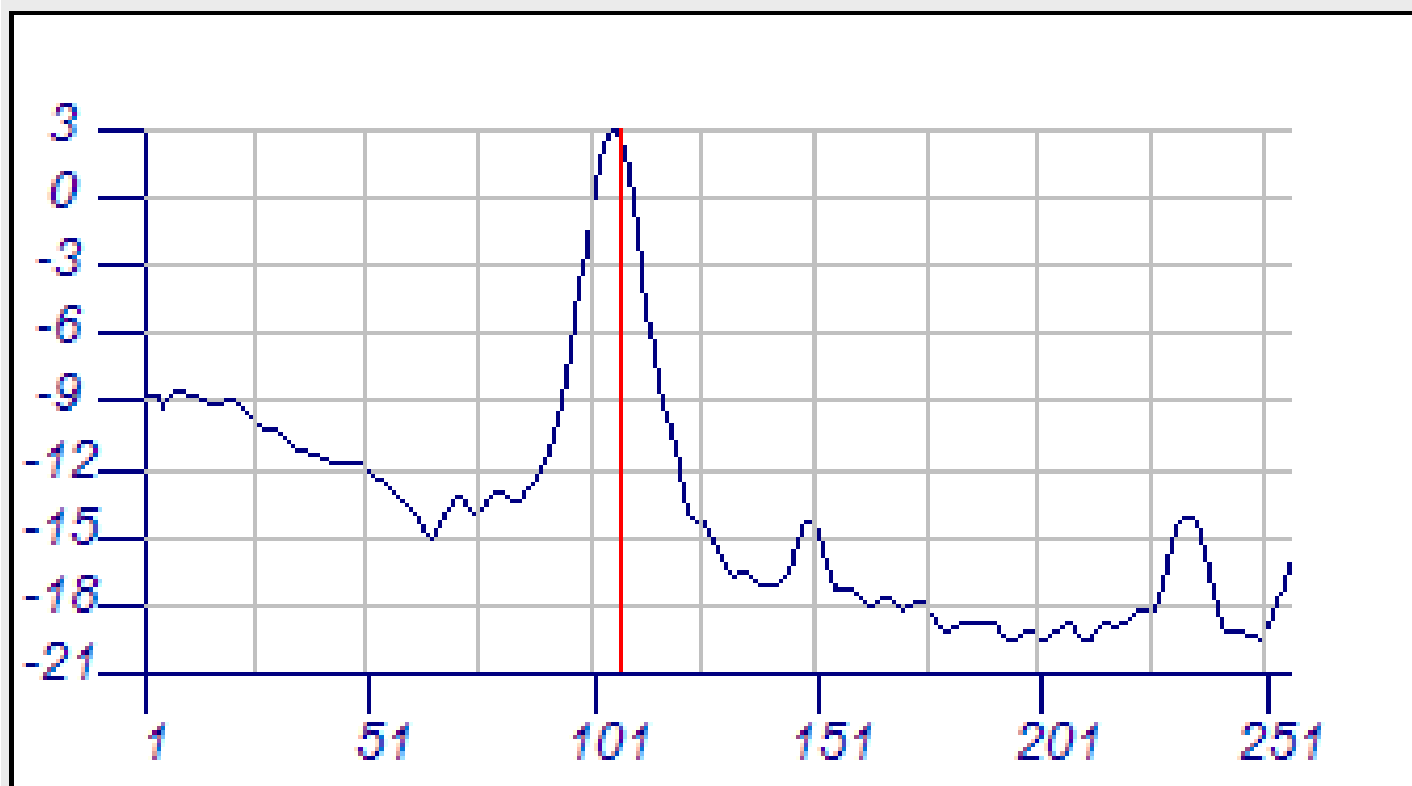


PREV

GATE 69

NEXT

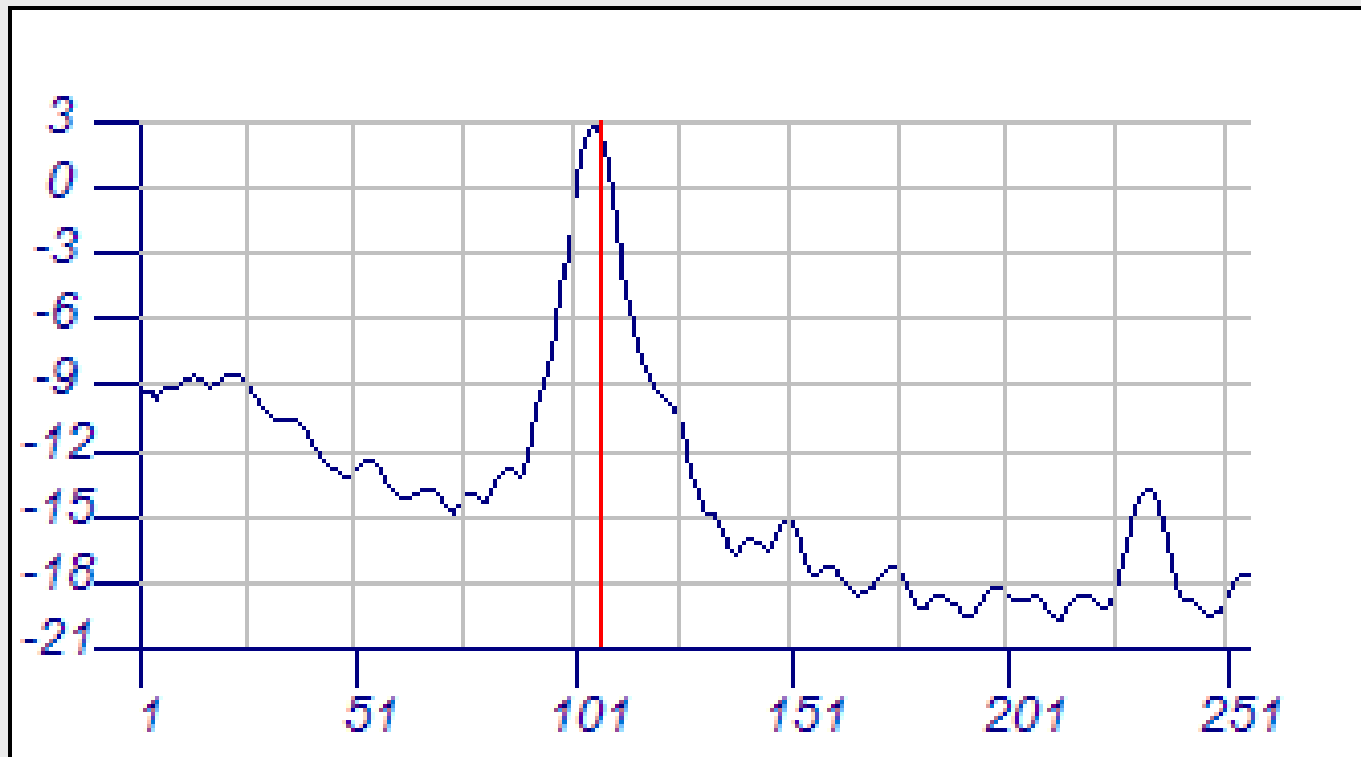




PREV

GATE 33

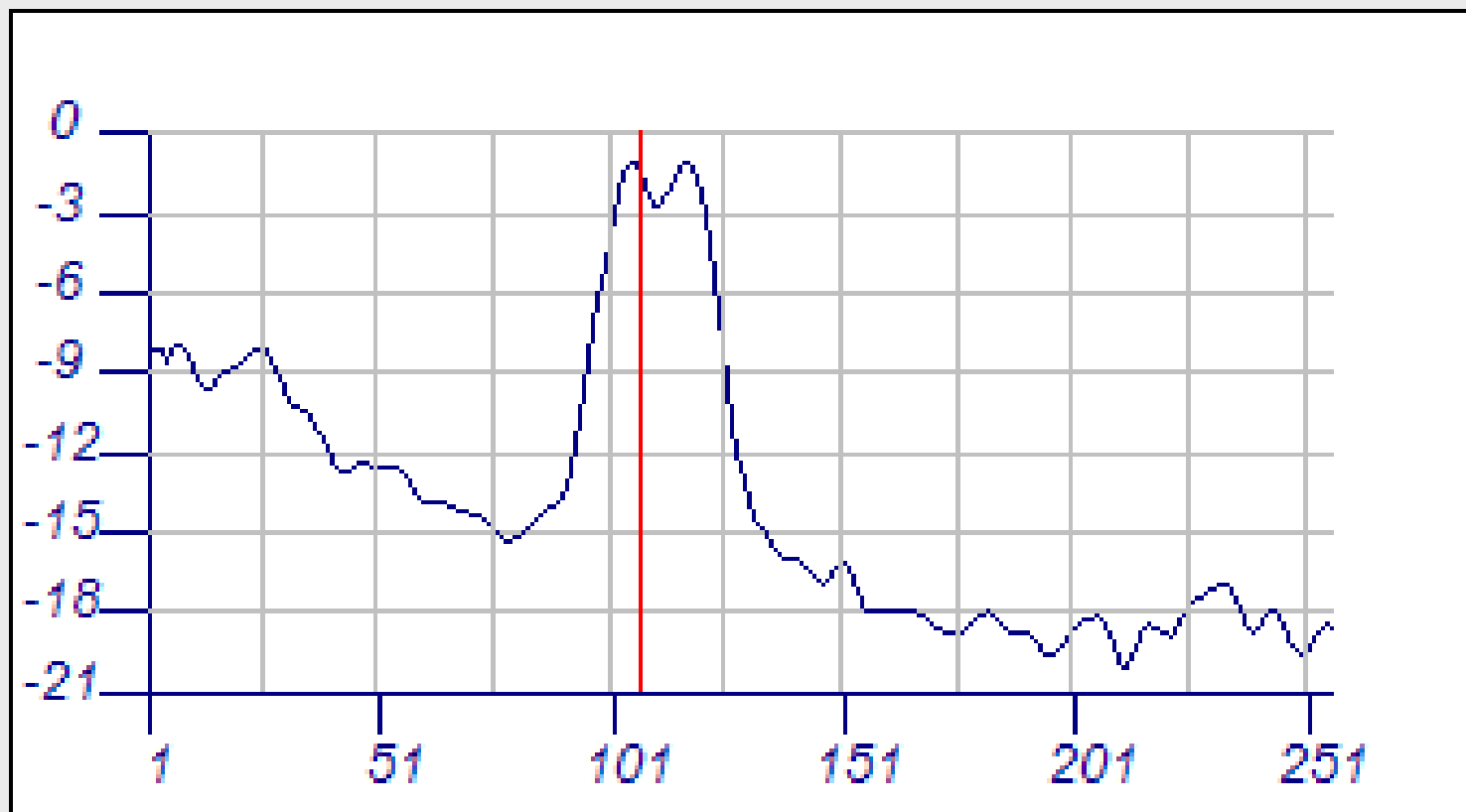
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PREV

GATE 35

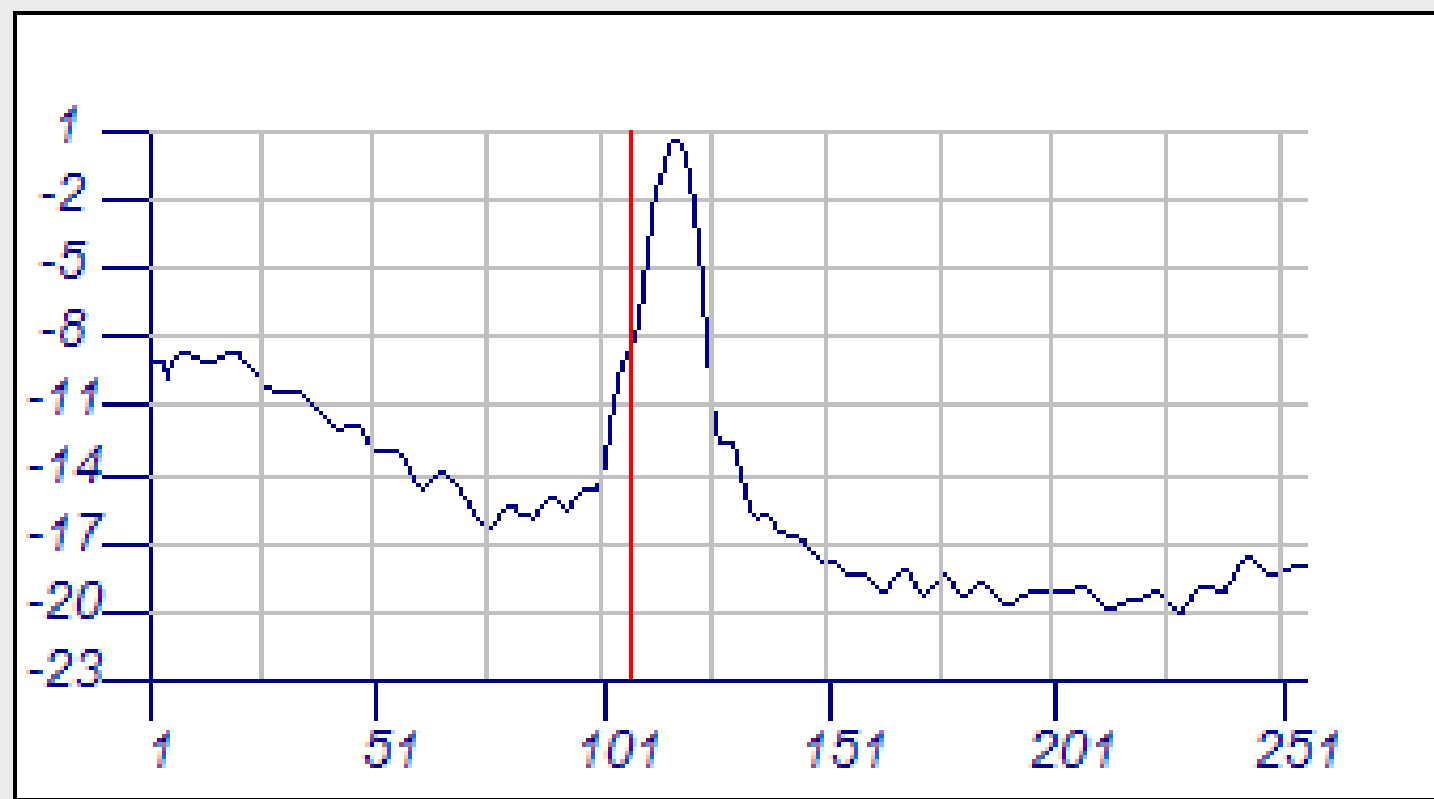
NEXT



PREV

GATE 37

NEXT



PREV

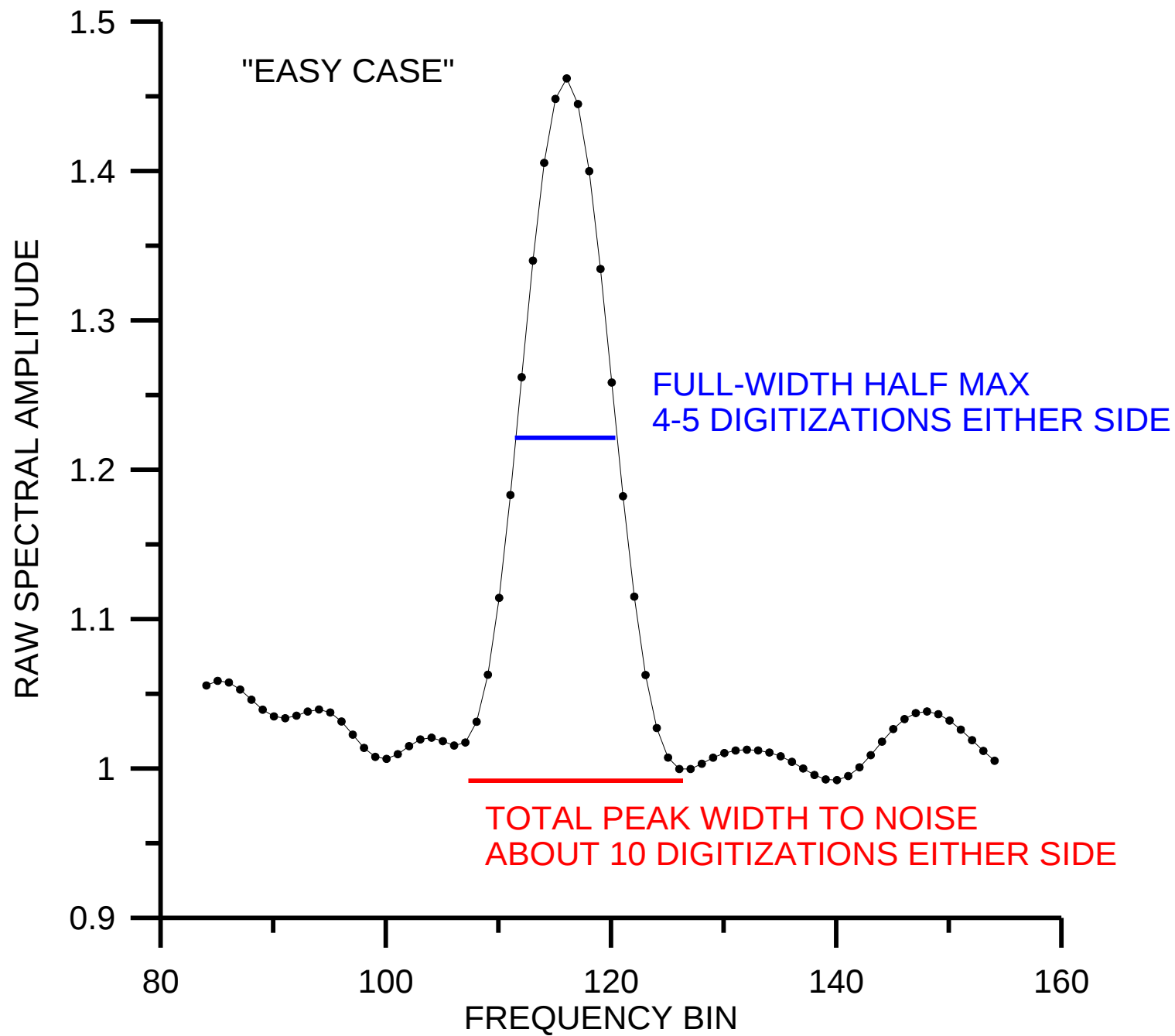
GATE 39

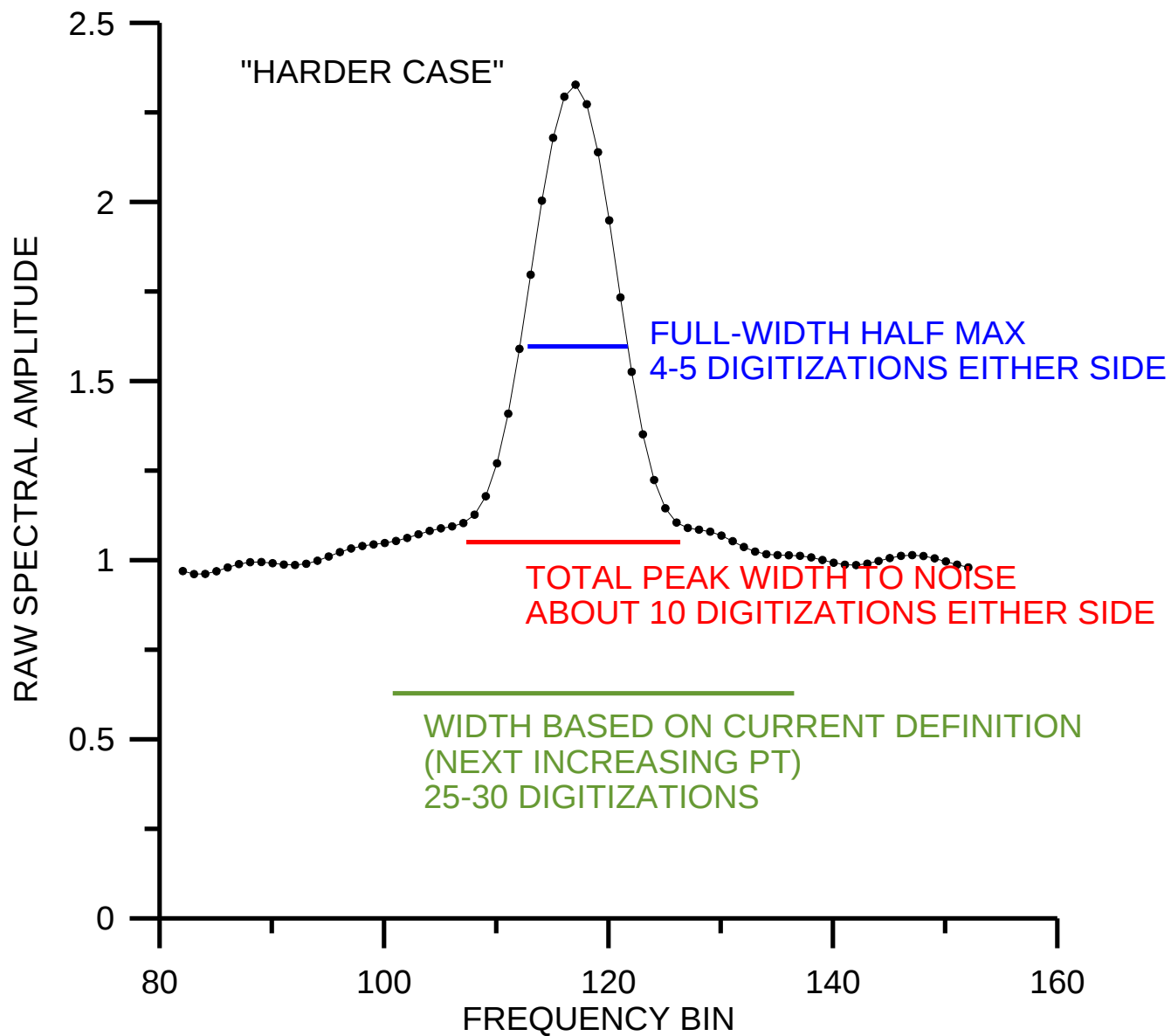
NEXT

Questions?

- How does feature broadening lower threshold of signal detection?
- How can we get independent measure of beta on experiment days?

Backup slides





Summed	Amp	SD (Noise)	Amp/SD (Noise)	Err (0.5)	Err (1.0)	Err (5.0)
Gate 40						
1000	1.54	0.03	46.23	0	0	0
100	1.57	0.10	15.91	11.8	1.8	0.9
10	2.07	0.31	6.69	76.8	67.1	53.5
1	5.53	0.96	5.85	90.8	82.7	66.8
Gate 35						
1000	1.52	0.03	48.07	0	0	0
100	1.55	0.10	15.15	12.7	7.3	5.5
10	2.08	0.31	6.84	76.2	67.0	55.7
1	5.39	0.95	5.86	94.4	90.3	68.8
Gate 20						
1000	21.22	0.06	340.56	0	0	0
100	21.33	0.12	181.74	0	0	0
10	22.16	0.35	64.35	1.6	0	0
1	27.75	1.09	26.79	37.2	11.2	8.2
Gate 10						
1000	105.99	0.27	398.97	0	0	0
100	106.39	0.29	365.47	0	0	0
10	108.81	0.48	226.49	0	0	0
1	124.29	1.36	91.00	37.7	8.2	0.5

Key:

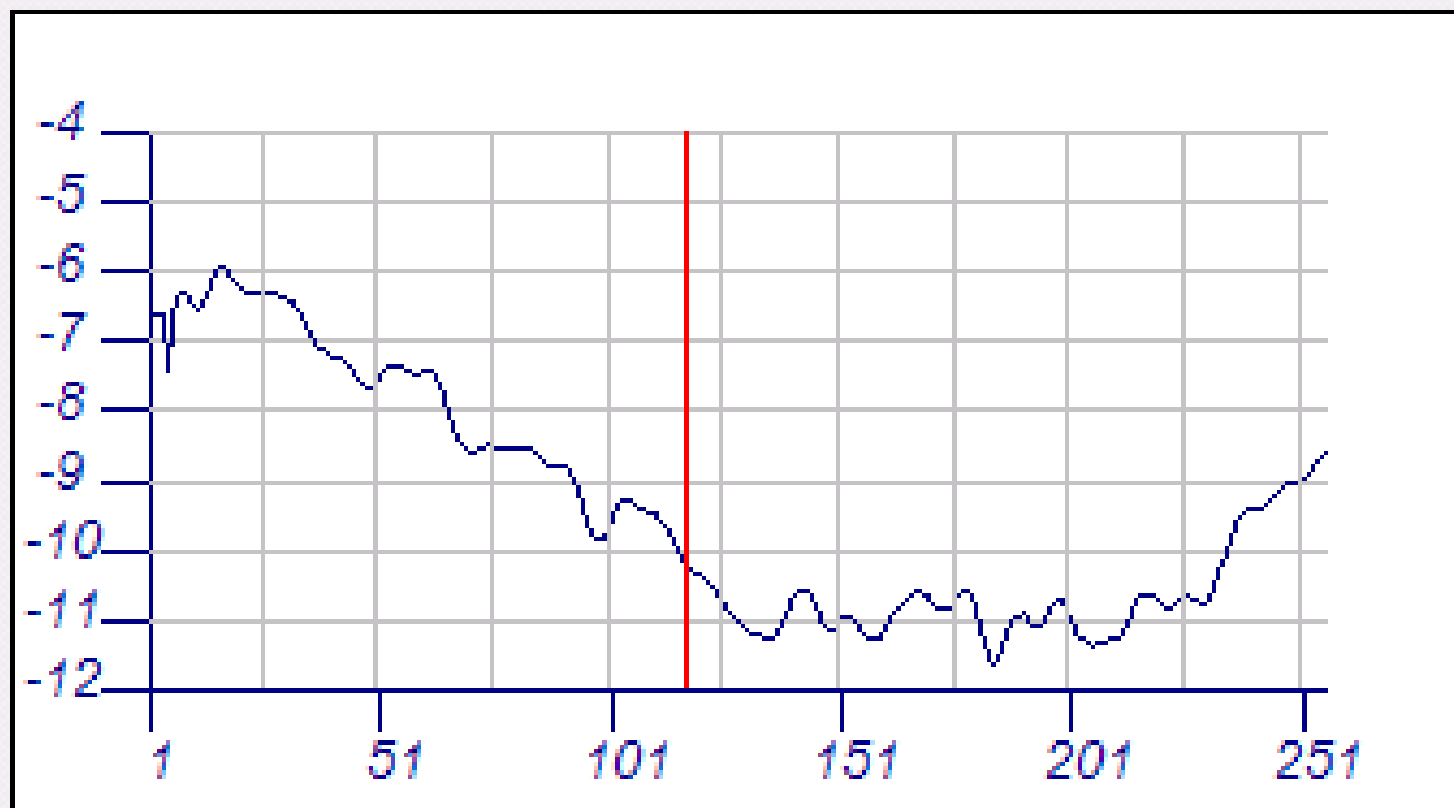
Summed: number of shots summed.

Amp: Average amplitude of peaks (raw power units). NOT IN DB!

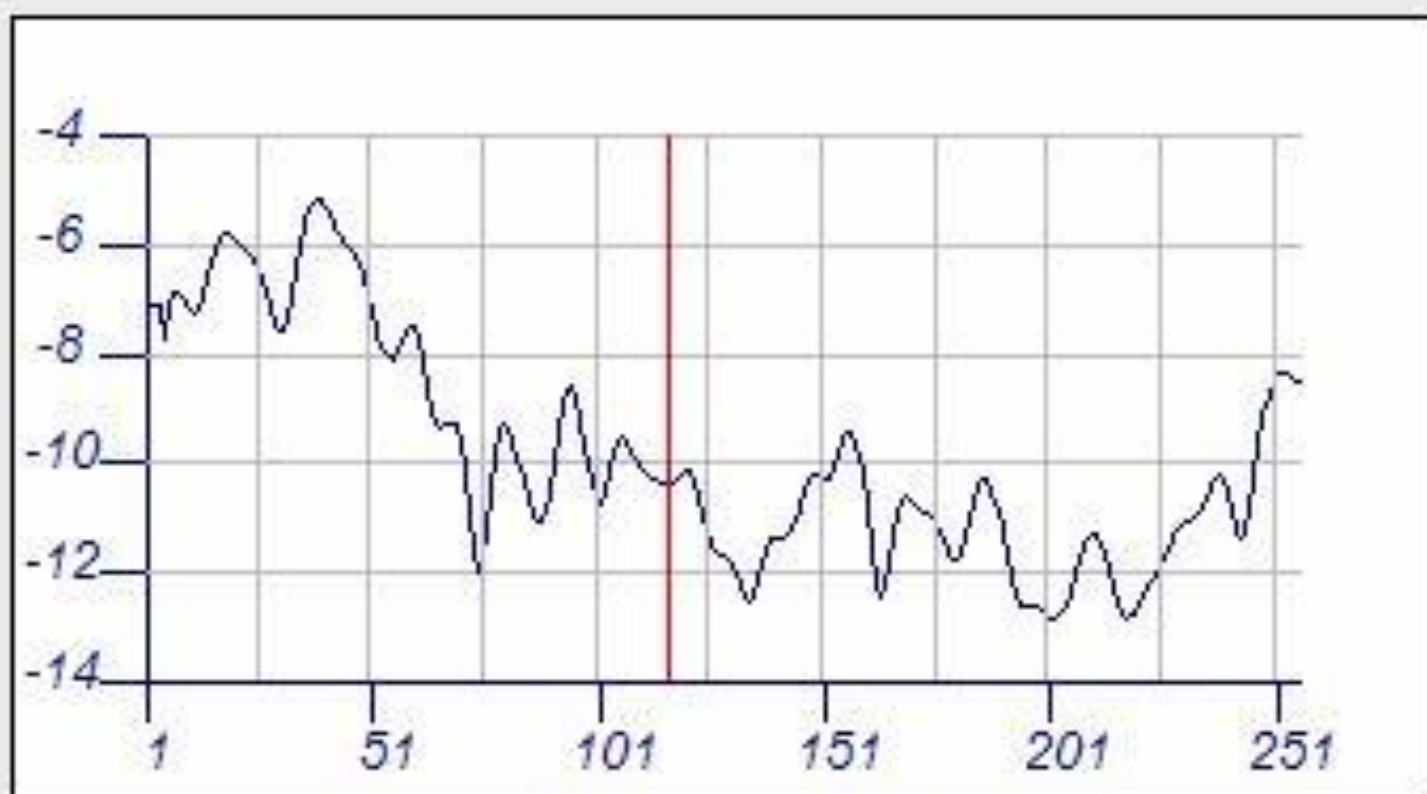
SD (Noise): Average standard deviation of noise (raw power units).

Amp/SD (Noise): Amp divided by noise standard deviation.

Err(N): Percentage of velocity estimates whose error (relative to 0 m/s) exceeds the value of N



NOISE SPECTRUM FOR 10 SHOT SUMMATION



NOISE SPECTRUM, SINGLE SHOT