Historical Review of Japanese VLBI Correlation Processor

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2004.8.9
Correlator WS@Kashima

Contents

- K3 correlation processing system in Kashima (K3)
  - The first Japanese operational correlation processor
- The first NAO Correlation Processor (NAOCO)
  - The first Japanese astronomer's correlation processor
- The Near Real-time Fringe Detector (NRFD)
  - The first real-time correlation processor
- The VSOP FX Correlation Processor (VSOP/FX)
  - The first FX type processor
- The e-VLBI Correlation Processor
  - The first operational real-time processor

K3 Correlation System

The K3 correlator was developed by RRL in 1983.

Correlation Processor Tape Drives   CPU (HP1000/45F)

Two Tape Drives, One Baseline

Data
  BW=2MHz/ch
  1bit/sample
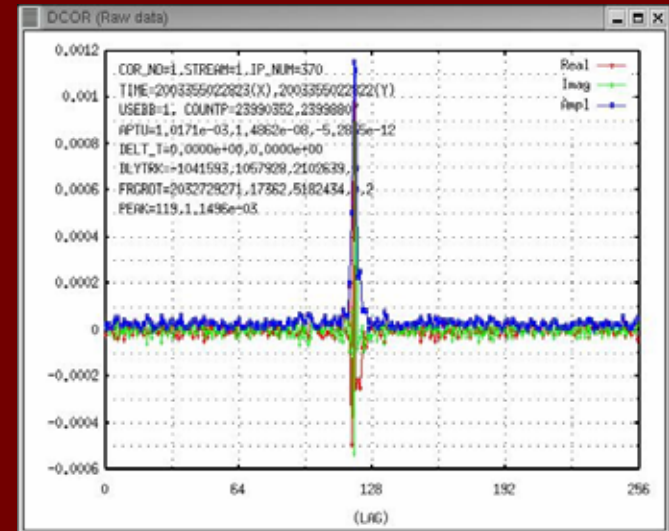 14ch
8 lags/ch
8 ch/unit
4 units in total
PP 1second

Fringe Example

"COARSE SEARCH"

Mojave-Kashima
3C345
X-band
2MHz/ch

Fringe Amplitude

7.5 psec/sec Delay Rate

1875 nsec
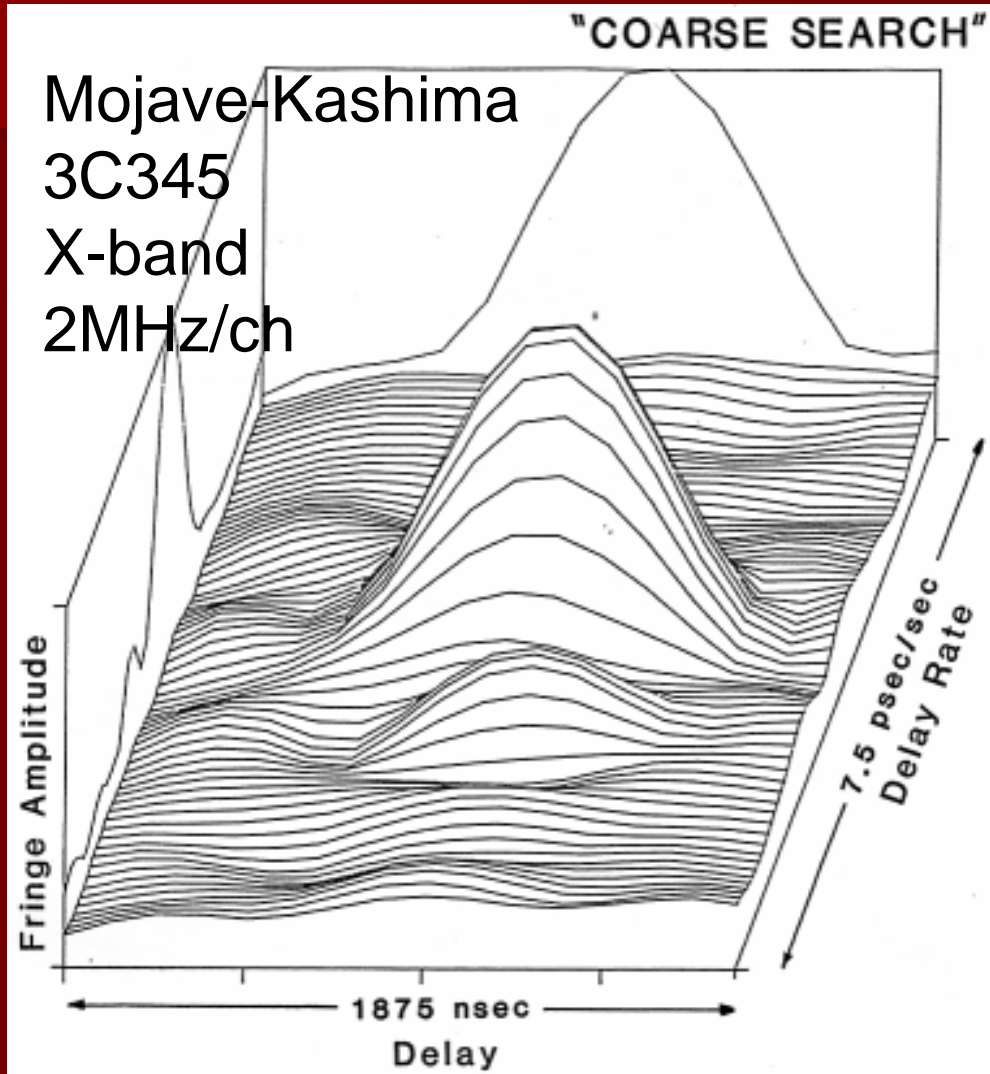
Delay
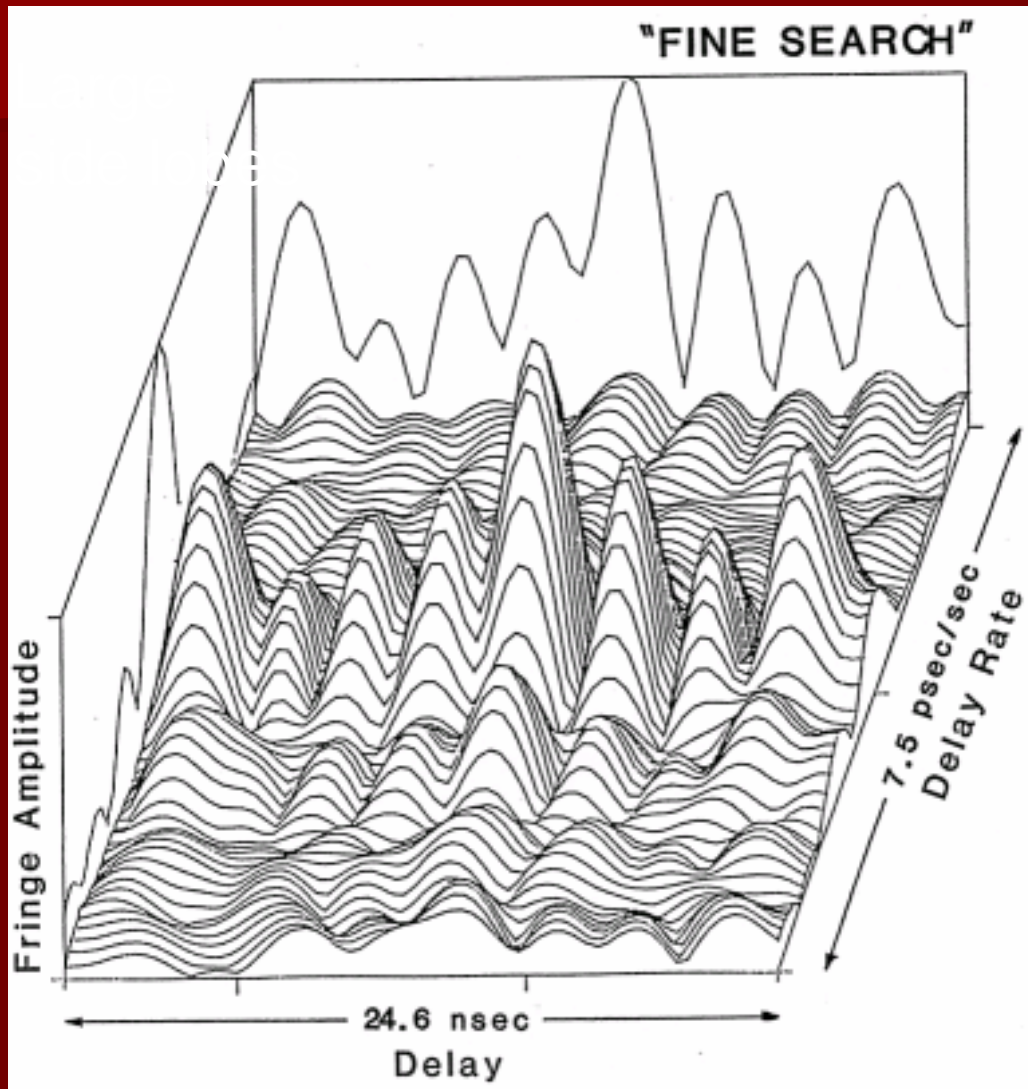
Current Output
of e-VLBI
512MHz/ch

256 nsec

Bandwidth Synthesizing

"FINE SEARCH"

Fringe Amplitude

7.5 psec/sec
Delay Rate

24.6 nsec
Delay

Current Output
of e-VLBI

8989,3478534,5000095,0
93184356,7301,13245084,1,2
5.5815e+00, SNR=1290.64
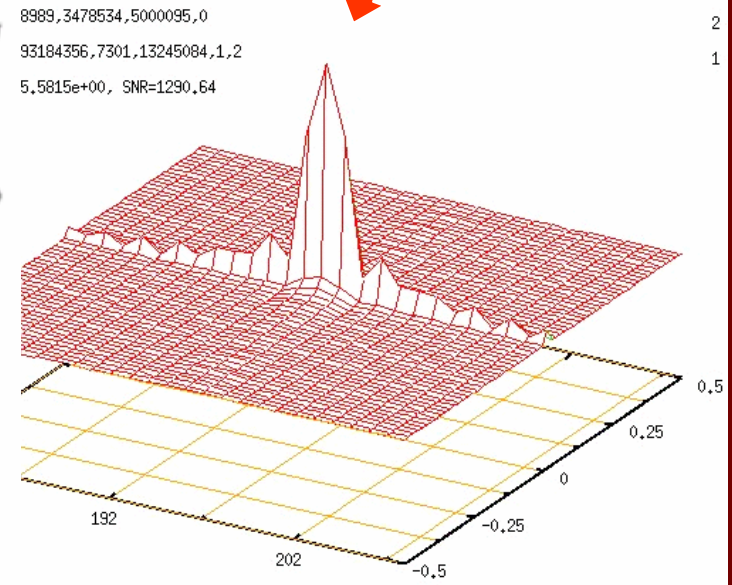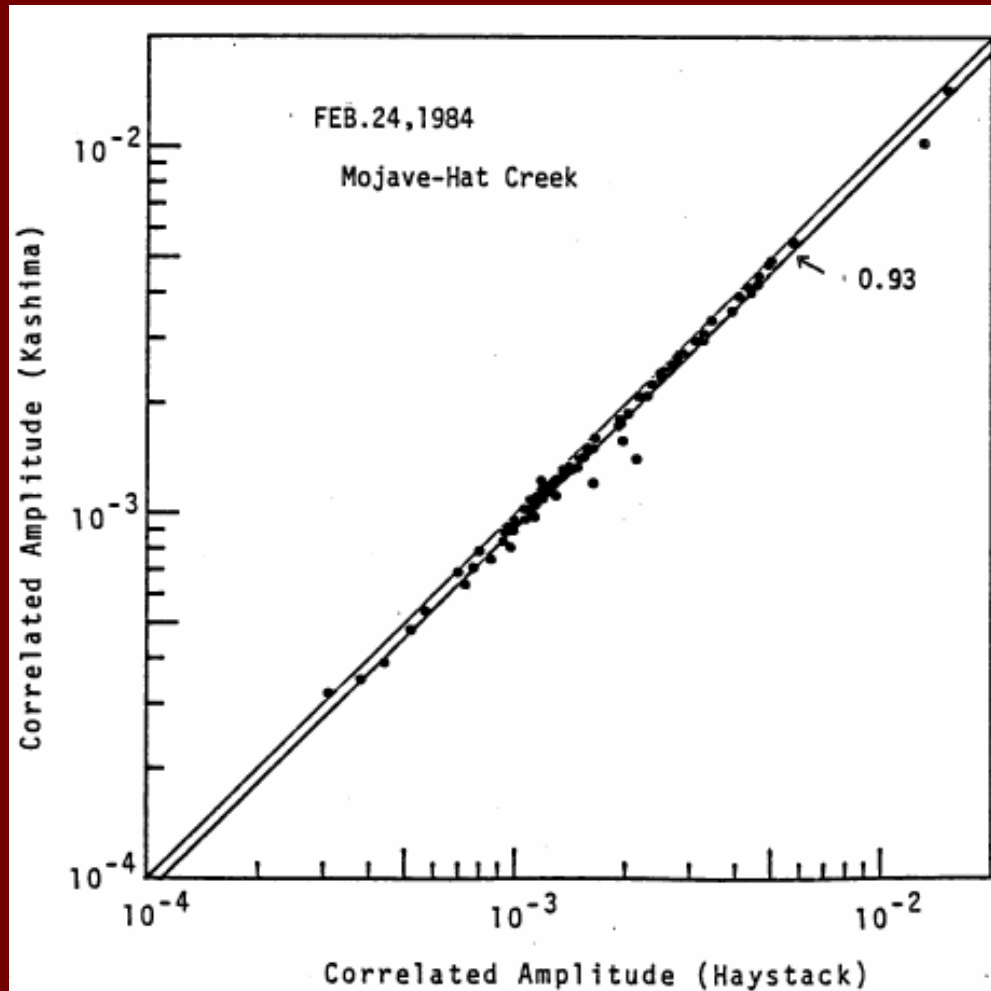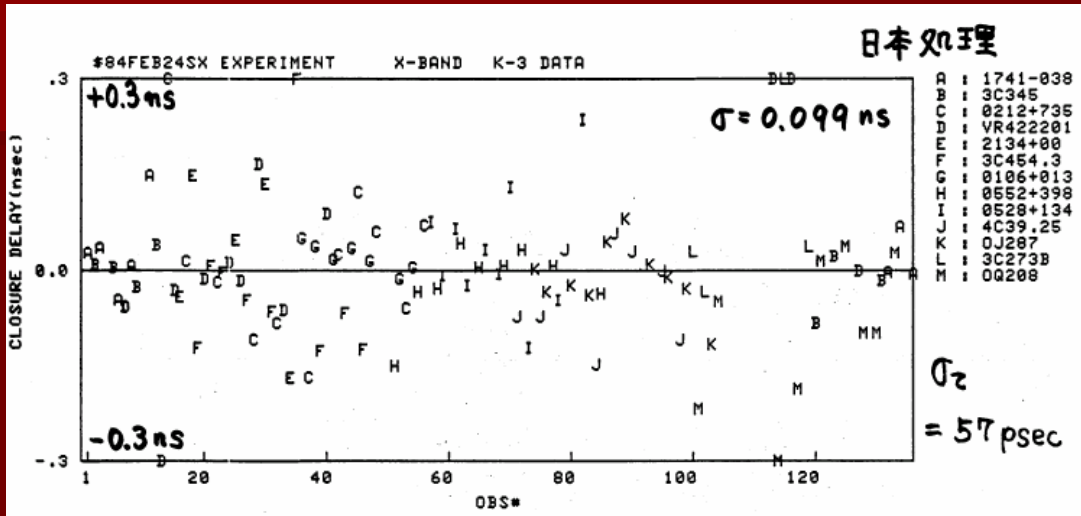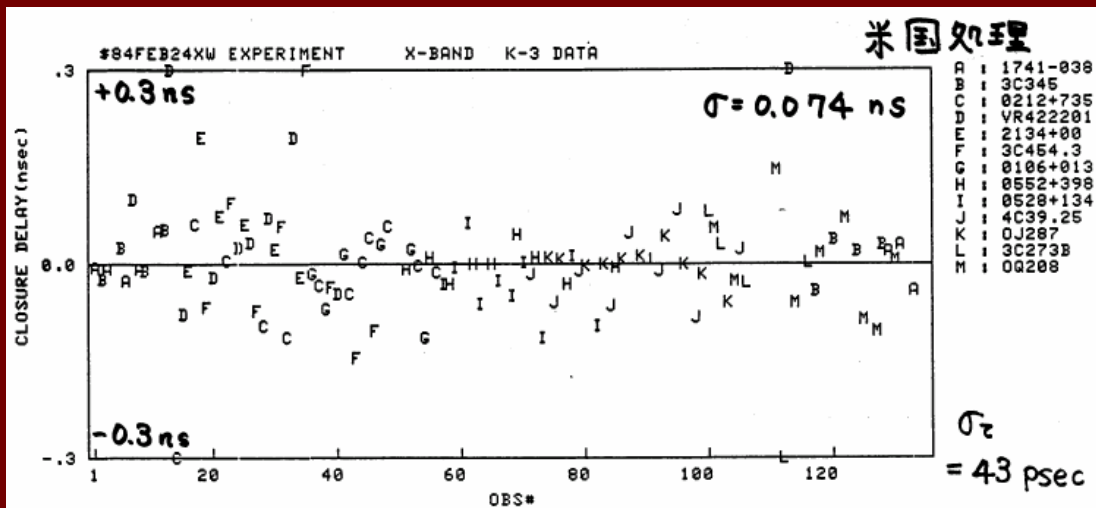
Correlation Amplitude Test

Comparison to the Haystack Correlation Processor

Closure Delay Test

K3 Correlator
=99 psec

Haystack Correlator
=74 psec

Other Correlation Processors

| Name	Developed by	Speed (Mbps)	Number of Lags	Maximum Number of Staions	Type	Year
Mark-III	Haystack	8	256	6	XF	1981
K-3	Kashima	8	128	2	XF	1983
Block-II	Cal Tech	8	448	4	XF	1987
NAOCO	NAO	128	512	5	XF	1991
VLBA	NRAO	512	1024	20	FX	1992
NRFD	NAO	512	4096	2	XF	1994
VSOP	NAO	512	16384	10	FX	1995
e-VLBI	NAO	2048	256	3	XF	2003

XF Chips (custom designed LSI)

Developer	Year	bit #	Speed (Msps)	Lag #	Imple-mented
A. Boss	1991	2	64	16	AT
B.V. Herzen	1991	2	250	12	
N. Kawaguchi	1992	2	128	8	NAOCO
N. Kawaguchi	1993	1	1024	32	UWBC
N. Kawaguchi	1994	2	64	128	NRFD

Towards a large number of lags

W3OH spectrum with 512 ch of NRFD

64ch
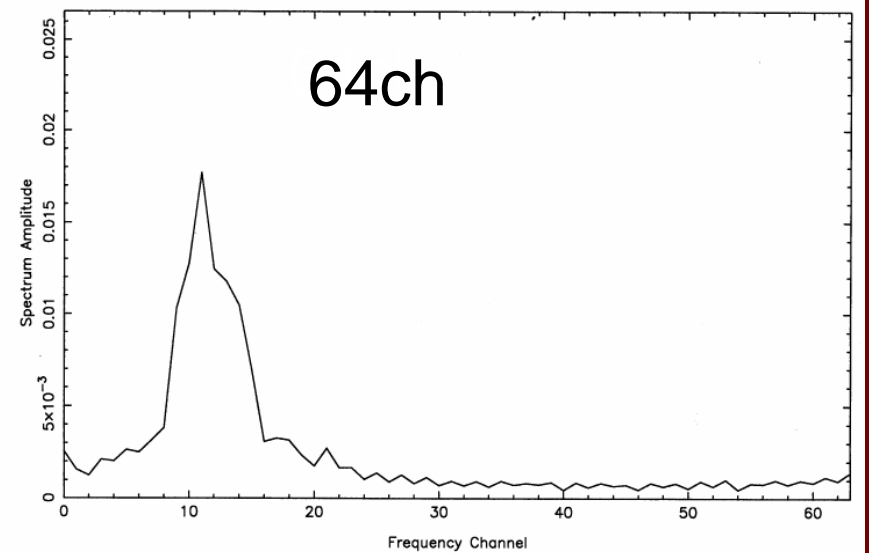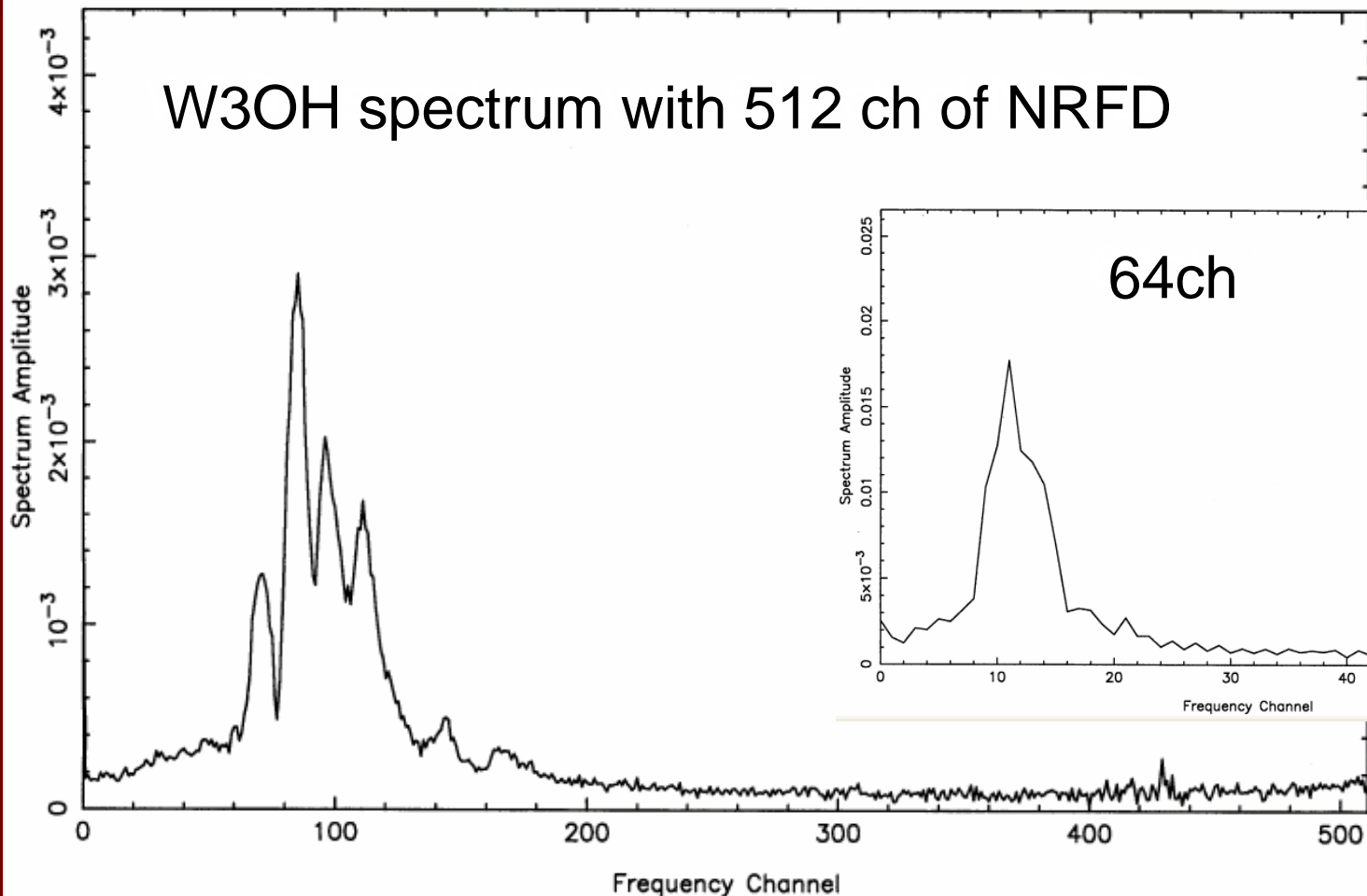
Towards Wider Bandwidth

256MHz

64MHz

16MHz

128MHz

32MHz

8MHz

VERA Digital Filter Response by Oyama
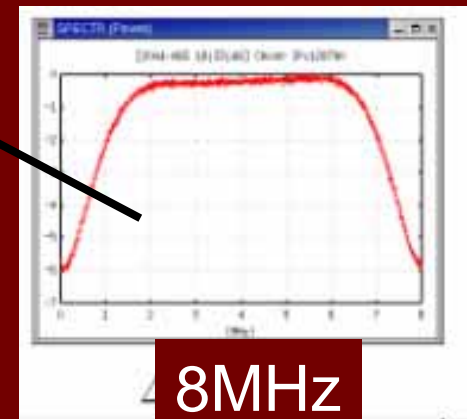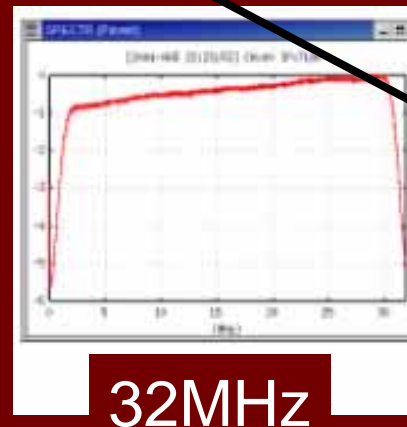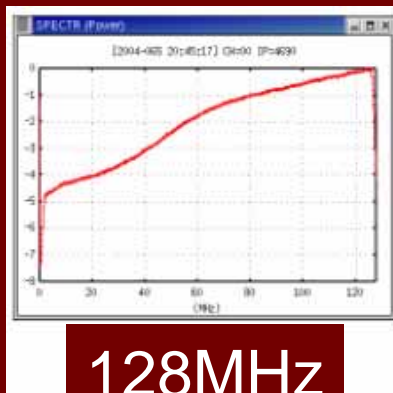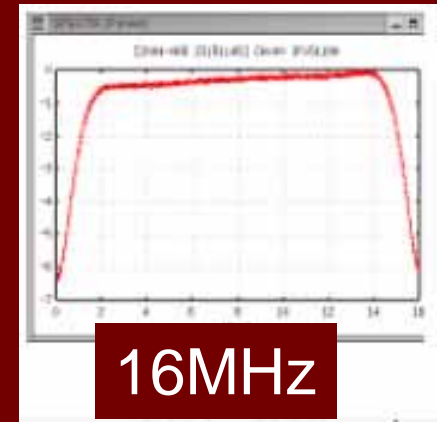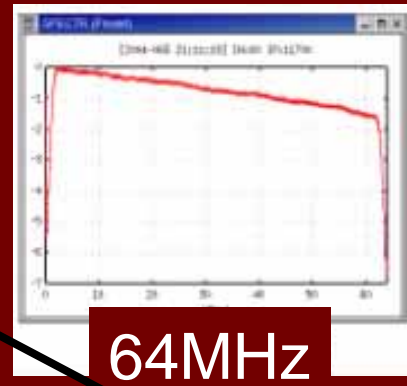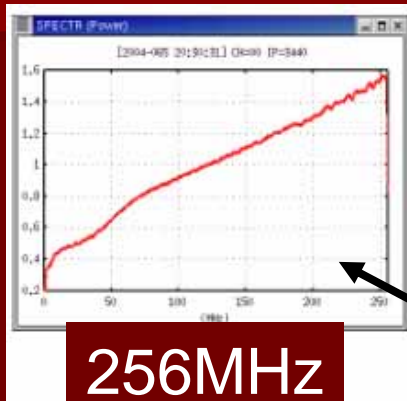
Concluding Remarks

- Japanese VLBI users started correlation works in 1983.

- XF type processor are working for VERA, BEARS, UWBC and e-VLBI.

- FX type processor is working for VSOP and VERA.