

**The ALMA Correlator 4 GHz  
Bandwidth  
FIR Digital Filter**

January 10, 2000

R. P. Escoffier

J. C. Webber

L. R. D'Addario

C. M. Broadwell

National Radio Astronomy Observatory

2015 Ivy Road

Charlottesville, VA 22903

## **FIR Filter Features**

- 128 taps at 1/2 bandwidth
- Double number of taps for each reduction  
X2 down to 1/32
- Low-pass filters permit use of 95% of  
bandwidth down to 1/32 reduction = 62.5  
MHz
- Bandpass filters permit use of 90% of  
bandwidth down to 1/32 reduction
- Complex bandpass shapes easily  
programmable
- Many simulations calculated
- Prototype board awaiting breadboard I/O  
experiments

# ALMA Digital FIR Filter

- Input:
  - 4 Gsamp/sec at 4-bit quantization
  - Demultiplexed to 32 4-bit streams @125 MHz
- Function:
  - Input state counters
  - Part of fractional bit delay
  - Tap weight multiply and add for  $1/2 \dots 1/32$  bandwidth
  - Resample to 2 bits
  - Output state counters
- Output:
  - 32 2-bit output streams, decimated samples

# **FIR Filter Implementation**

- Xilinx Virtex-E FPGA series adopted
  - 0.18 micron process
  - 1.8 V operation for low power consumption
- Input buffer, input state counters, PN test
  - Requires 2 XCV50-E chips (small)
- Tap weight multipliers and 10-bit adders
  - Requires 8 XCV400-E chips (intermediate size)
- 7-bit adders, resample, output state counters, output buffer
  - Requires 4 XCV50-E chips
- Board size 6U X 280mm