


Advanced ATNF Correlators

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Increased RF Bandwidth

- > NOW : 128MHz 2-bit data 32..128 channels
Future: 2048MHz 2..8-bit data 4096 channels
- > Continuum
 - Sensitivity $\propto \sqrt{BT}$; $\sqrt{B2/B1} = 4$
 - Quantising Noise: 2-bit $\rightarrow T_{sys} * 1.14$, 8-bit $\rightarrow T_{sys} * 1.001$
 » Net gain ≈ 4.5 , equivalent to 20° observing time.
- > Spectral Line @ 100GHz
 - Features $\propto f_0$, 4MHz+4096chans \rightarrow 128MHz+4096chans
 - Density $\propto f_0^2$ (lines \rightarrow forests), 4MHz \rightarrow 4GHz
- > Imaging
 - $(u, v) \leftrightarrow \frac{d}{\lambda} = \frac{B}{\lambda} \frac{f}{c}$. Smearing $\leftrightarrow \frac{\delta f}{f} \leq \frac{D}{d} \Rightarrow \frac{B}{\delta f}$ chans
 - 2GHz \rightarrow baselines (u-v tracks) *60 at X-band
 - MFS or BWS (Bob sault tomorrow).


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Increased RF Dynamic Range

- > " $\rightarrow f d s c d d s v f$
 $\rightarrow dd s d c d s$
- > s d y d s s, y () s s
 $\rightarrow d s s \rightarrow s s$
- > $\leftrightarrow R d c s s, P(c) \ll P(s)$
 $q s P(f) \ll P(s) \& c s P(s)$
- > " f c " (o, V) d s ' y s! d s
 $d s s \rightarrow v d y s c s s ()$
 $s s \rightarrow s, d, s c$
 $c s d s!$

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New Samplers/Digitisers

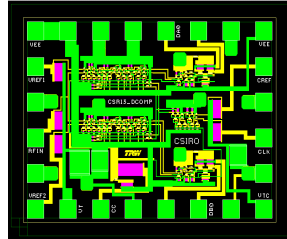
- > (BW) f y s, d v << 's c s ~ \$! W
- > $\rightarrow P d s s$
 $x dB s \rightarrow P \rightarrow s s$
- > P c s s s s c s
 - Physically separates sampling and digitising
 - Combines photonic bandwidths (huge) with available electronics
 - Ideal for SKA?, possibly developed on ATCA
- > c c d s s d s s

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InP Sampler/Digitiser



- Operation up to 8 Giga-Samples/s
- Contains no demux
- 119 transistors, 57 resistors and 3 capacitors
- 350 mw on a 1.6mm x 1.2mm die



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New 2GHz Correlator



- 2GHz IF \rightarrow 4k 0.5MHz complex channels \rightarrow correlation.
 - Delay function and fringe rotation incorporated.
- Key process is splitting input spectrum, ie filterbank.
 - Ideal channel shape
 - Flat top \rightarrow efficient correlation
 - Steep sides, nonoverlapping \rightarrow independent data streams
 - Deep stopbands \rightarrow avoid aliased noise and interference.
 - Technology choices
 - Analog: passive filters impractical, bccs too expensive
 - Naked FFT: crude, fails on all criteria
 - DSP: good match to objectives, proven at lower bandwidths

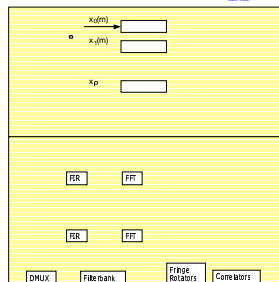
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Correlator Architecture



- Equivalent to 4k BBCs
 - Two filters per BBC
 - 64k taps per filter
 - Clocked at 4GHz
 - only one filter as 4k*16
 - Oscillator matrix = DFT
 - Clocked at 0.5MHz * 256
 - Fractional sample delay
- Massive grunt per \$
 - design circuit, not chip
 - more chans, bw, d-range
 - Endlessly reconfigurable



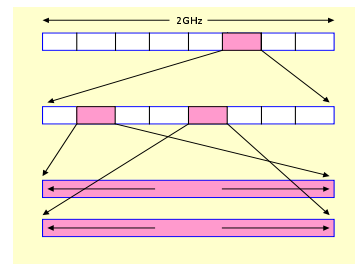
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Zoom!



- 2GHz
 - Z
 - *Z
 - Z A



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More Info



> // f cs / s c / c cs