

VLA correlator specification. Things to be specified, suggested specs, and remarks

CORRELATOR SIZE DETERMINING SPECIFICATIONS

Number of antennas: 40

[Or, 27 at full bandwidth, 40 at half bandwidth - a controversial spec at the moment]

Number Base Band pairs: 4

A Base Band pair is an independently steerable polarization pair, usually RHC and LHC.

Bandwidth: 2 GHz

In each Base Band of each Base Band pair. Total bandwidth processed: 16 GHz.

Number of channels per baseline

At maximum bandwidth, full polarization products: 256×4 . That is, 256 channels of four polarization products times four baseband pairs = 4096 complex correlations per baseline.

Maximum: 32,768 complex correlations per baseline.

Maximum output rate: 0.6 million complex correlations per second

Based on what is conveniently achievable to a permanent magnetic medium. Future expandability to faster media or multiple output streams should be considered.

OTHER CORRELATOR DESIGN SPECIFICATIONS

Minimum integrator dump time for a subset of integrators: 10ms

Flexible selection of the subset is desirable; selection of the autocorrelators only is necessary.

Maximum integration time: 60s or greater

Self-products (autocorrelations) and state counts for each sampler must be provided. This includes the products of the two polarization hands from the antenna.

Max baseline: 350 km

Max transmission delay: 3ms

Minimum channel width: 1 Hz

[Over sampling support: 2]

Modes:

There must be modes supporting efficient trading of polarization products for spectral channels, or bandwidth for spectral channels, up to the maximum number of channels per baseline. Trading should be independent for the baseband pairs used - for example, 256 products for 2 GHz for first pair, 1024 products for 0.5 GHz in second, etc.

Subarraying:

Up to three independent sets of modes (see above) and integration times must be supported. Masking of data outputs to correlations within 10 subarrays, and reasonably efficient use of the maximum output rate must be maintained. A delay resolution of 1/16 of the sample clock must be maintained, either as part of the sampler or as part of the correlator.

Timing:

Antenna from one subarray to another: no more than sum of integration times of the two subarrays.

Change mode of subarray: no more than 2 integration times

Change integration time: no more than 2 of longer integration times

Data logging:

It is the responsibility of the correlator to write the output data to a permanent medium. It must also accept ancillary inputs, for documenting the circumstances of the observation, to be logged contiguously with the correlation data.

Pulsar processing:

It should be possible to efficiently exchange bandwidth for pulsar timing bins, at least up to 32 bins.

Phased array output:

A phased array output must be provided, consisting of the digital sum of appropriately delayed data for all antennas and a D/A converter and appropriate filtering, for 8 basebands with a bandwidth of 64 MHz.

Interference suppression:

A mechanism must be supplied for the suppression of harmonics and aliased harmonics of an interfering sine wave by at least 45db, for bandwidths of at least 64 MHz in each BaseBand. [Not clear this is sufficient - under discussion at the moment.]

Gating:

External signal ports should be provided to suppress correlation, both effective immediately and clocked with short-term integrator cycles. Provision must be made to record the duty cycles.

Maintainability:

Diagnostic testing to localize failing board should be conveniently runnable, preferably without interfering with observing. Displays to show activity in the correlator, as well as failures, should be provided. If possible, boards should be hot-swappable.

Burst mode:

A burst mode is desirable, in which the correlator can be commanded to accumulate data at rates substantially higher than the output rate given above, with correlation stopped on command to allow output of the accumulated data.

Corrlator efficiency:

Loss of efficiency beyond that associated with two bit sampling (about 12%) is deprecated.

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