

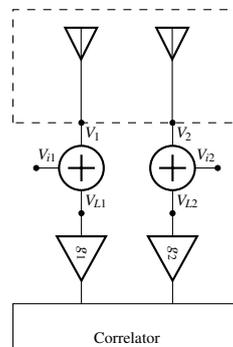
## Antenna and Amplifier Noise Considerations for a Closely-Spaced Two-Element Interferometer

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A closely-spaced two-element interferometer (Fig. 1) is useful for observing highly diffuse radio sources [1] such as the Milky Way and Cosmological signals [2, 3]. The primary argument for the closely-spaced interferometer over the single element radiometer is that the former only senses the desired external signal while the self noise due to the low-noise amplifiers (LNAs) is uncorrelated. However, research in the phased array community [4] has shown that the LNA self noise may be coupled in an array environment and should be accounted for in the analysis. This is an important aspect to consider, in particular due to the demand of extreme precision in Cosmological signal detection.



**Figure 1.** The block diagram of a two-element interferometer. The antennas are spaced less than one wavelength from each other.  $V_{i1}, V_{i2}$  are the additive internal noise sources due to the LNAs. The LNA noise couples through the antennas, which leads to noise correlation at the correlator output.

We have carefully analyzed the contributions of both external and self-noise signals due to LNA noise coupling in a two-element interferometer. Using an equivalent circuit based on radiophysics and antenna theory, we explore the interactions between key design parameters such as the antenna self and mutual impedance and noise parameters of the LNAs. The calculation results show that it is possible to design an interferometer with a smooth spectral response to diffused external noise using two dipole antennas over a 2:1 bandwidth (50-100 MHz) which is of interest in cosmology. However the results also show that the LNA noise is correlated to a non-negligible level as a result of near-field electromagnetic coupling between the two antennas. This suggests that the LNA noise must be inherently considered in the design of the interferometer.

## References

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