CORRELATION ANALYSIS OF NOISE GENERATION OF PLASMA RELATIVISTIC MICROWAVE SOURCES [[1]](#footnote-1)\*)

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The gain band and band of possible generation in plasma relativistic microwave sources (PRMS) is 1.5 – 2 GHz. The radiation is digitally recorded on a high-speed Tektronix oscilloscope in real time with a sampling step s = 16 ps. Registration bandwidth up to 4 GHz. Correlation analysis methods can be applied to evaluate the correlation properties of such signals using standard formulas for the autocorrelation function and correlation coefficients. The integration is carried out over a finite time interval, on which the results of calculations may depend. One waveform is analyzed and the correlation coefficients of two successive sections of the waveform with the same duration *τ* = *s* × *nτ* are calculated, where *nτ* is the number of waveform points in the integration interval *τ*. In this way, the entire waveform is viewed. The result consists of correlation coefficients. They are then squared and averaged. The result is a positive number corresponding to a given sample *τ* for the entire waveform. If we now change the sample duration and plot these values against the sample duration, then we get a correlation power vs. *τ* plot for the entire waveform. If the step with which the sample duration changes is small enough, then interference effects appear on the correlation power graph.



Fig. 1 Fig. 2

Figure 1 shows graphs for sampling durations in the range of 10 - 76 points (0.16 - 1.216 ns) for two waveforms - noise (Noise) and for an waveform containing sections of narrow-band generation (file 220921\_015). For noise generation, interference effects decay in the region of 0.6–0.7 ns. We can say that the correlation time for the Noise waveform is ~ 0.6 ns. For another file, these effects continue and we can only say that the correlation time is significantly greater than 1 ns.

It should be noted that the interference effects essentially depend on the step with which the duration of the samples changes. In Figure 1, the sample increment is two waveform points (0.032 ns). In Figure 2, the same waveform are processed with an increment of 10 points (0.160 ns) and in a wider range of 10 - 220 points (0.16 - 3.52 ns). From the last figure, it is obvious that the correlation time for file 220921\_015 is significantly higher than 3.5 ns, and for noise generation, the correlation time cannot be determined.

By choosing different time intervals, you can explore the correlation features of different parts of the waveform.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Pt/ru/GJ-Ivanov.docx) [↑](#footnote-ref-1)