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# LOFAR ionospheric scintillation spectra - automatic analysis system

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## 1 Extended Abstract

Spectral index is a significant parameter describing ionospheric scintillation as well as the formation of ionospheric irregularities. Used in single station mode, LOFAR can be used as an excellent tool for measurements of the ionospheric scintillation in middle geomagnetic latitudes at a frequency range of 10-90 MHz. According to the theory of ionospheric scintillation [1], the spectra of measured scintillation have a power-law character that corresponds to the spectra of ionospheric irregularities. Figure 1 shows an example of spectrum computed using Welch algorithm for 1 hour of data. In Figure 1, three different frequency-dependent regions are clearly visible: 1) flat spectrum in the high frequency range is a result of noise, unrelated to scintillation, present in recorded data, 2) power-law region associated with ionospheric scintillation, 3) low frequency region effect of Fresnel cutoff. In order to au-

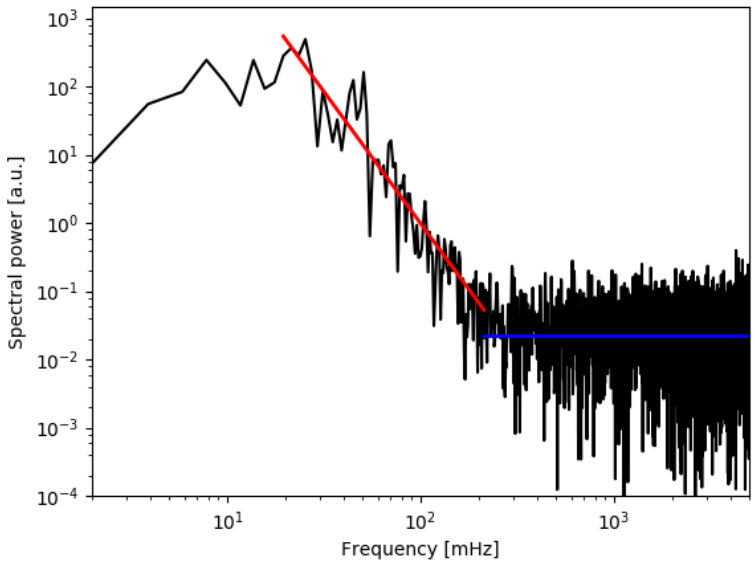


**Figure 1.** The plot of the signal spectrum, fitted noise floor, the curve is given by formula 1. Fitted parameters: noise floor 0.022 (fitting range 200 mHz - 5 Hz), spectral index $p = 3.86$ (fitting range 15 mHz -200 mHz).

tomatize the fitting process of the spectra, the level of observed noises is fitted. This allows the area to be removed to eliminate its impact on the calculation of the spectral index. Subsequently, the curve is fitted to the remaining part:

$$P = Cf^{-p} \tag{1}$$

where the frequency is defined as $f$, $C$ describes the scintillation intensity parameter, and $p$ is a spectral index. The spectrum is fitted only to the points below Fresnel frequency and enables obtaining the spectral index in the power-law part. Figure 1 presents the fit of the base of the noise and the spectral index. There are several spectral parameters: spectral index $p$, scintillation intensity parameter $C$, noise level, and fitting range. All of them are saved to the database for further parameters analysis.

## References

[1] C.L. Rufenach, "Power-Law Wavenumber Spectrum Deduced from Ionospheric Scintillation Observations", *Journal of Geophisical Research*, vol. 77, no. 25, September 1, 1972