

## Time - frequency analysis of Schumann resonance signals

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**Abstract:** We present results of time - frequency analysis of the transient events in the vertical electrical field component of Schumann resonance signals based on the measurements at the Astronomical and Geophysical Observatory (AGO) operated by the Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava.

We prepared a pseudo-randomly database of 22 transient events in the ELF band. Selection was made on the base of the Q-burst criteria in the time domain. Common patterns of transients in the time domain were investigated and the events were sorted into 3 groups: „normal transients“, „peculiar transients“ (Ondrášková et al., 2008) and „double-bursts“.

For the time-frequency (TF) decomposition we used continuous wavelet transform (CWT) method with the analyzing Morlet wavelet, which are frequently used method and type of wavelet in the time - frequency analysis in various physical and technical applications. CWT method was applied in two ways: with and without additional modification of the reassignment method. The TF decomposition of Schumann resonance signals using the CWT method was computed using the programme package TF-SIGNAL developed by Kristekova (2006).

We found a characteristic common pattern in the time - frequency domain for each group of transient events. Results obtained by CWT method supported the assumption presented in the paper (Ondrášková et al., 2008), that „peculiar

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transients“ are generated by two cloud-to-ground flashes, but these kinds of events need further investigations.

**Key words:** Schumann resonances, ELF transients, time - frequency analysis, continuous wavelet transform

## References

- Ondrášková A., Bór J, Ševčík S, Kostecký P., Rosenberg L., 2008: Peculiar transient events in the Schumann resonance band and their possible explanation. *J. Atmos. Sol.-Terr. Phys.*, **70** (6), 937-946.
- Kristekova M., 2006. Time-frequency Analysis of Seismic signals. PhD. Thesis, Geophysical Institute, Slovak academy of sciences, Bratislava.