

Goods, bads and the akwards

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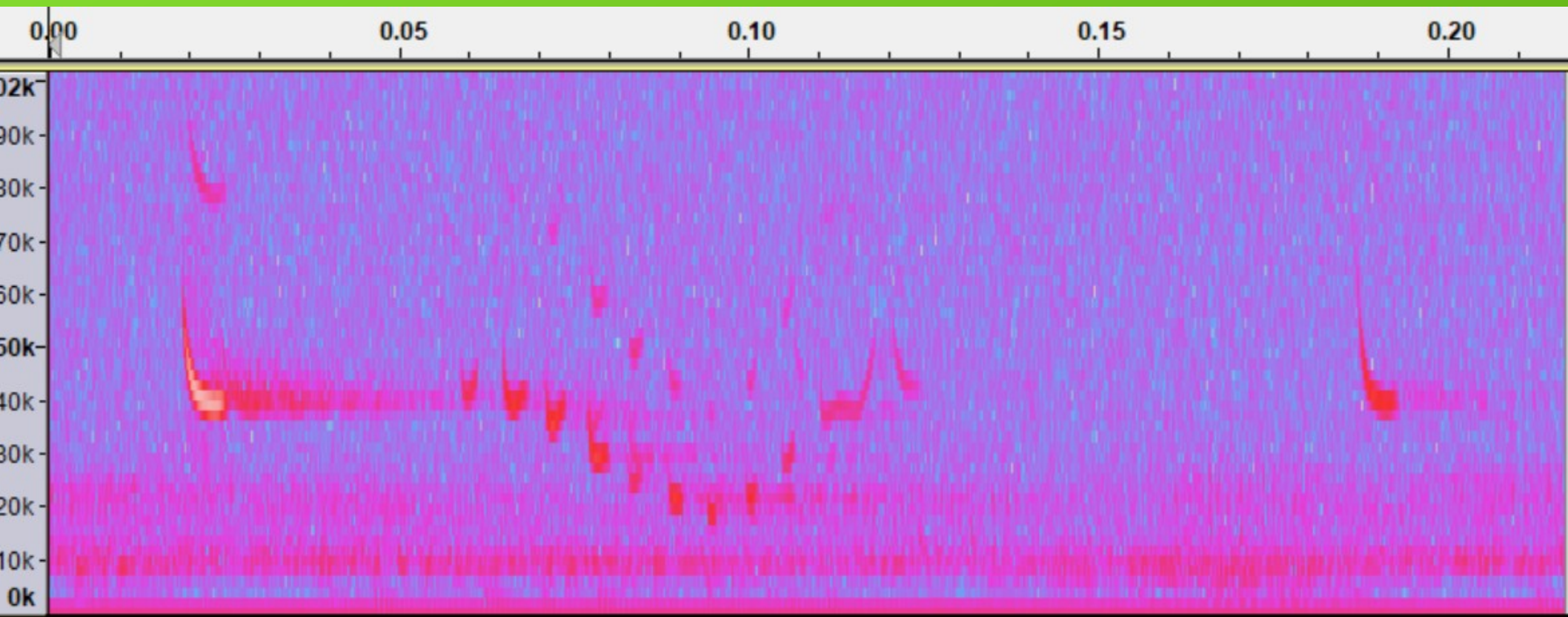
Turun yliopisto
University of Turku



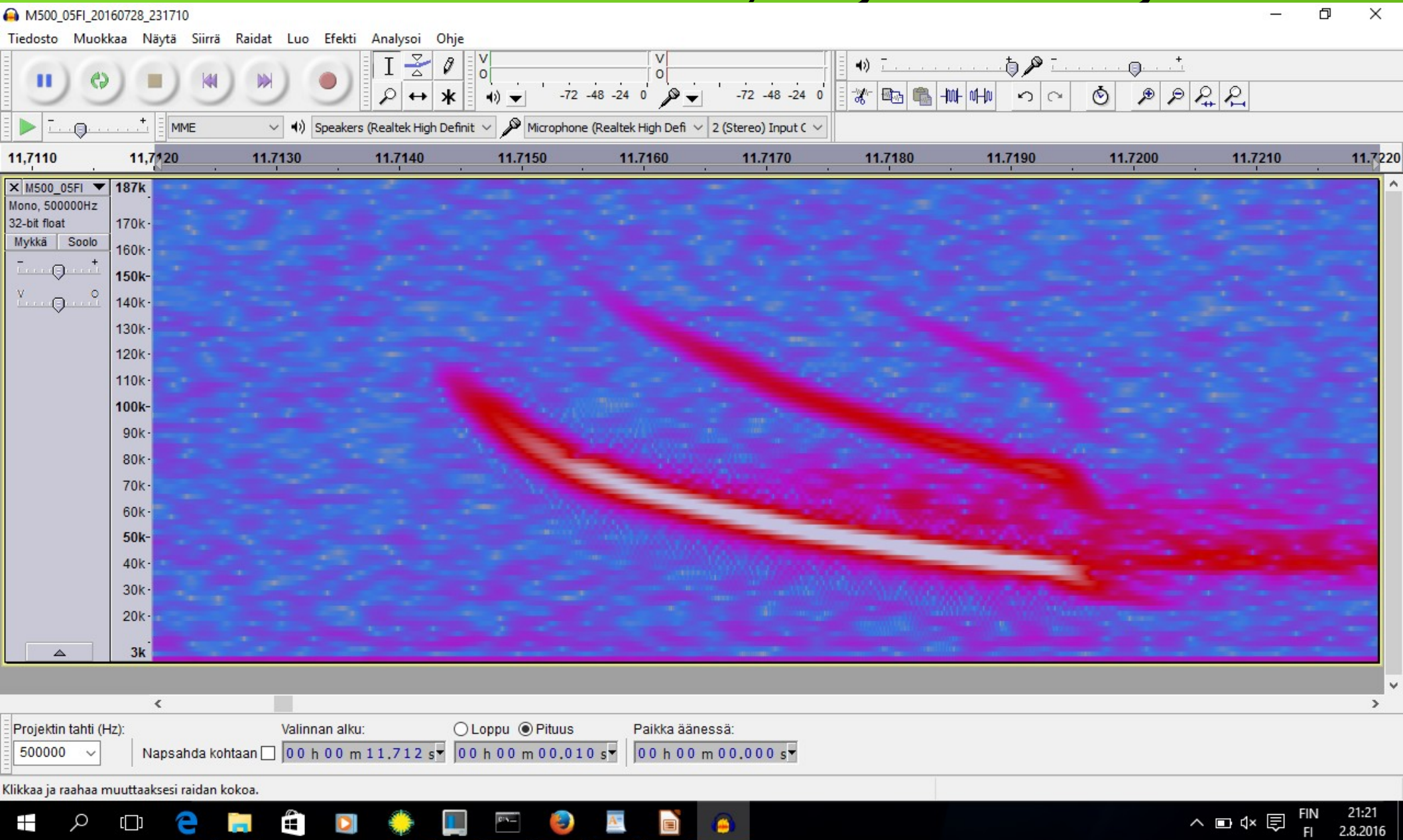
My background

- First **Fourier transforms** with a TI-58 calculator in 1975
- B.Sc. (Luk) 1980, M.Sc (FM)1982, Ph.D. 1989 (all in Astronomy)
- >100 scientific publications in time series analyses including various FTs & similar methods and their mathematical modelling.
- Since Jun 2006 bird sound recordings. Since May 2007 **bat recordings** - all full spectrum and good equipment.
- REASON FOR THE TALK quite a few bat people lack the deep understanding of their recordings. Some experienced bat recorders tell that they believe fully in what the fft shows them. They should be more cautious !

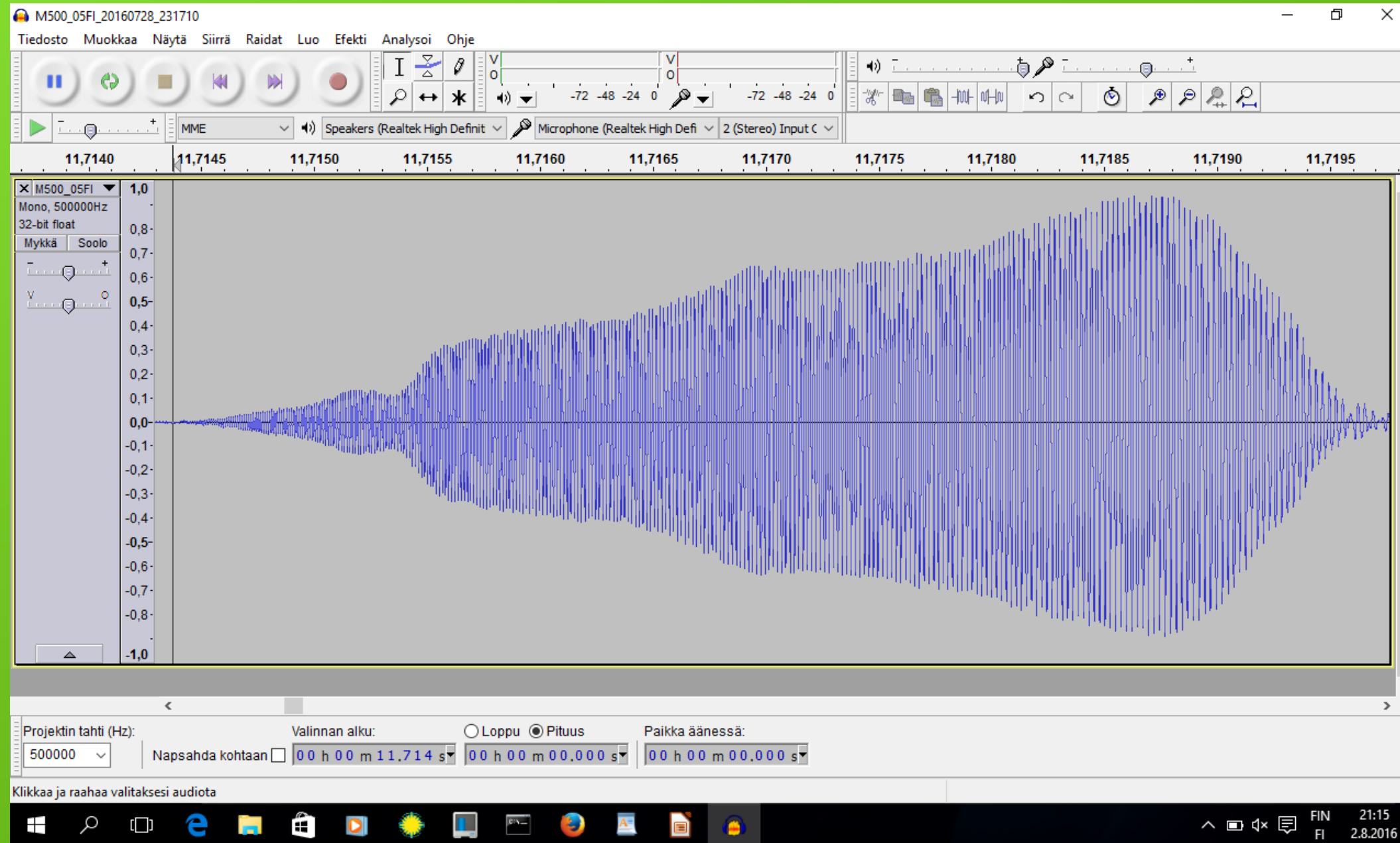
Good



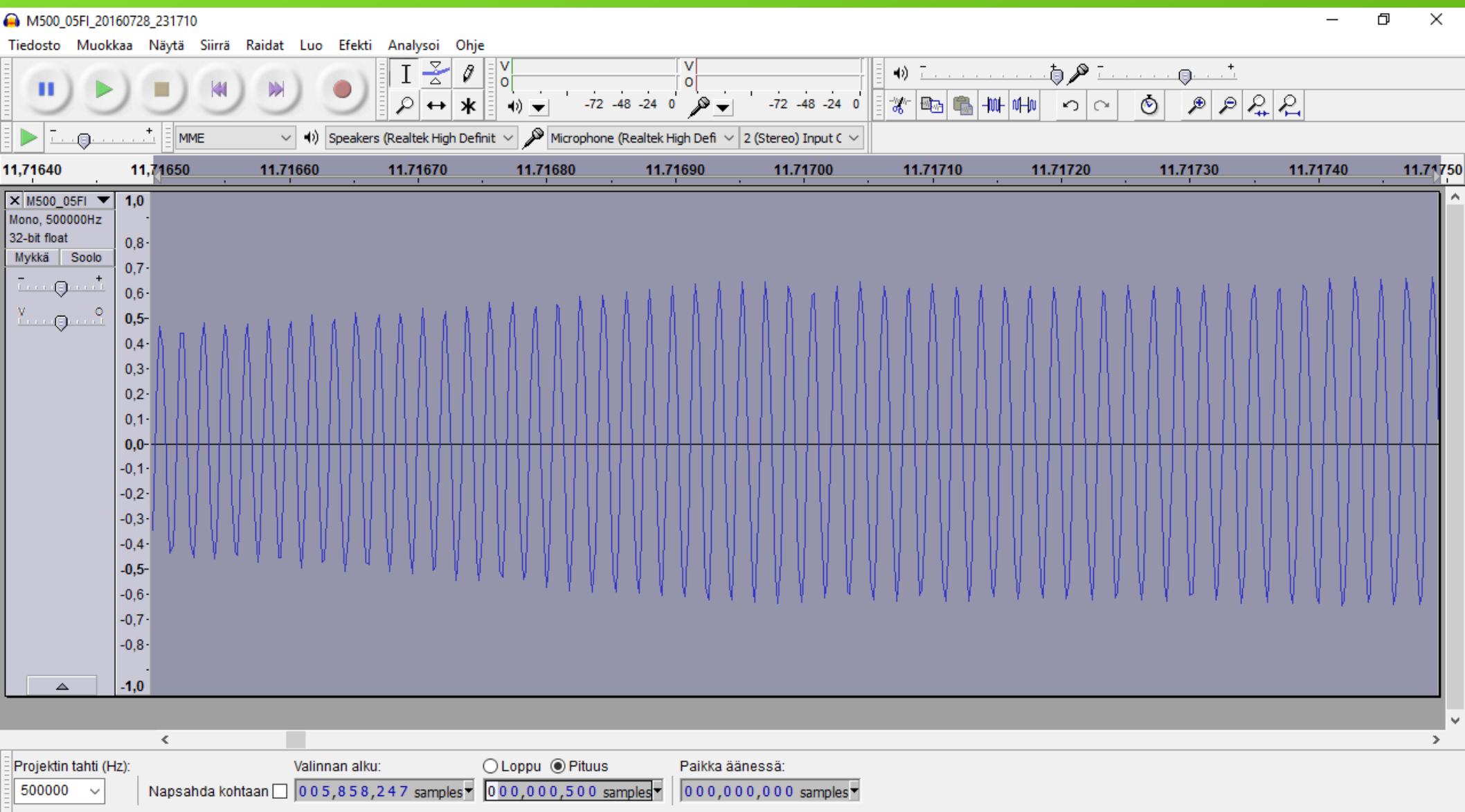
Spektrogram, sonogram, sonagram Petterson M500, Myobra/mys



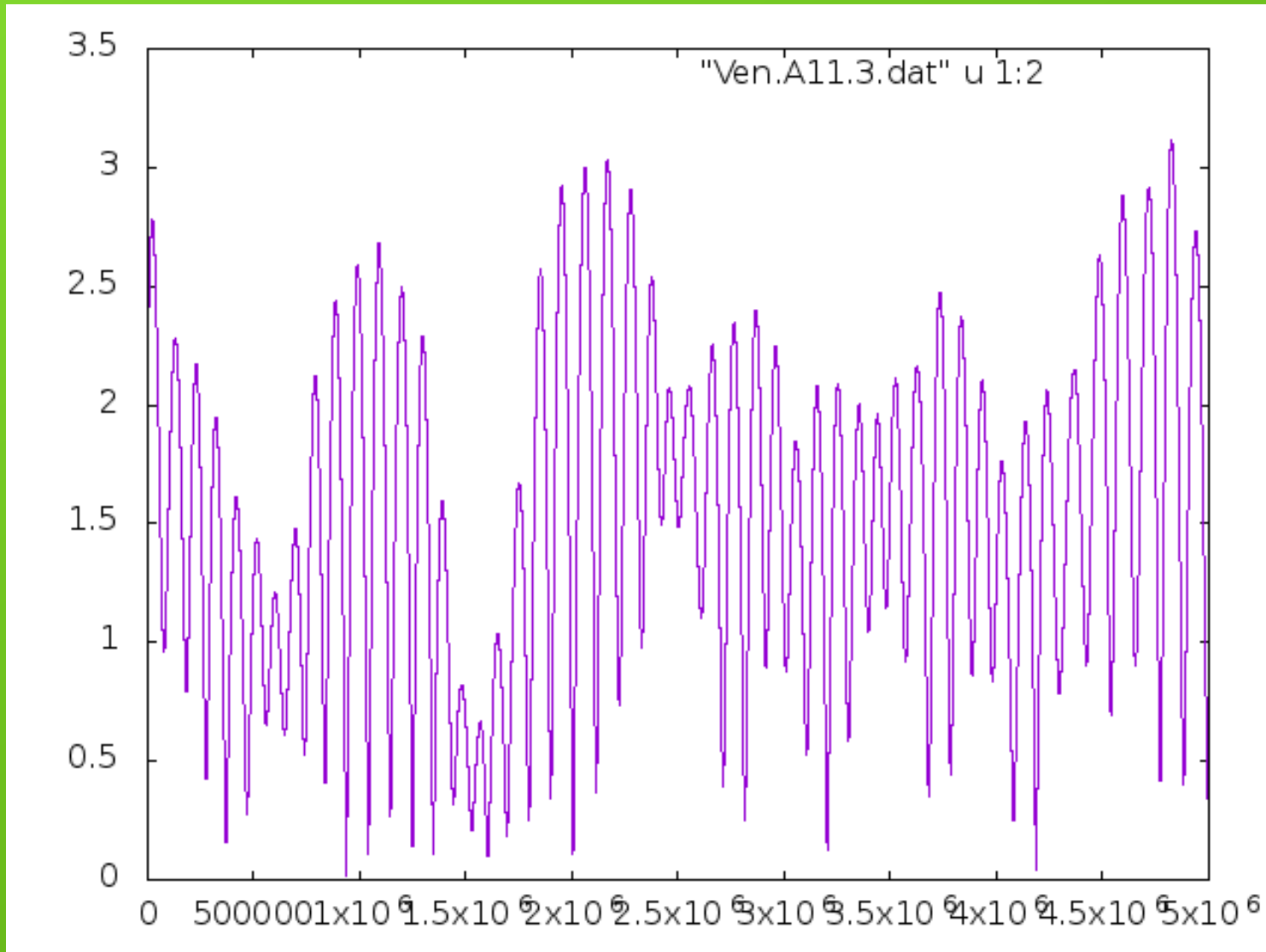
Oscillogram, 5 milliseconds



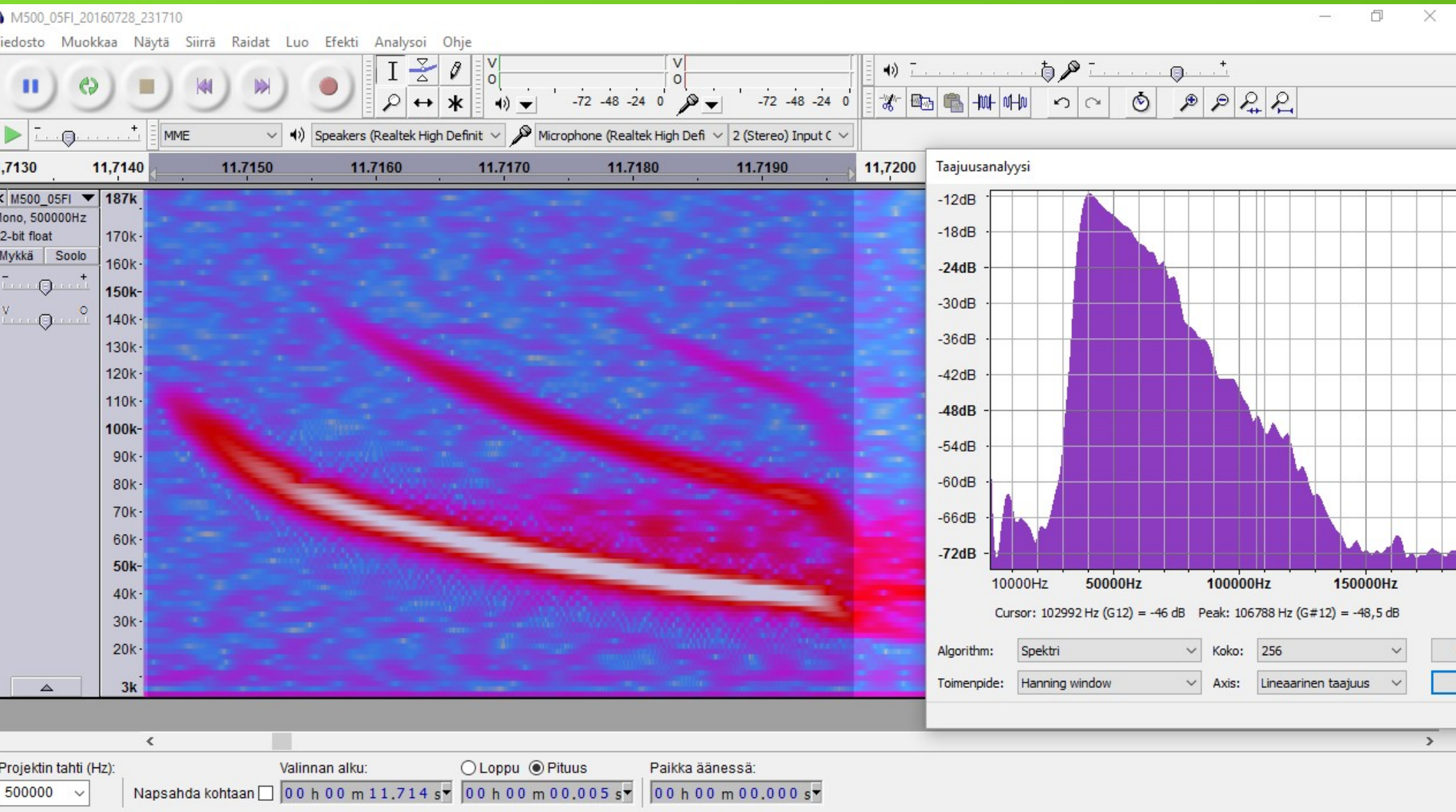
Oscillogram 1 millisecond



Tilt of planet Venus' orbit , 5 million years



Related to powerspectrum



Summary of goods!

- The Spectrogram is fast to calculate with FFTs (Fast Fourier transforms).
- And convenient with olSTFTs (over lapping Short time Fts). Length of the STFT can be from e.g. 256 to 2028 data points.

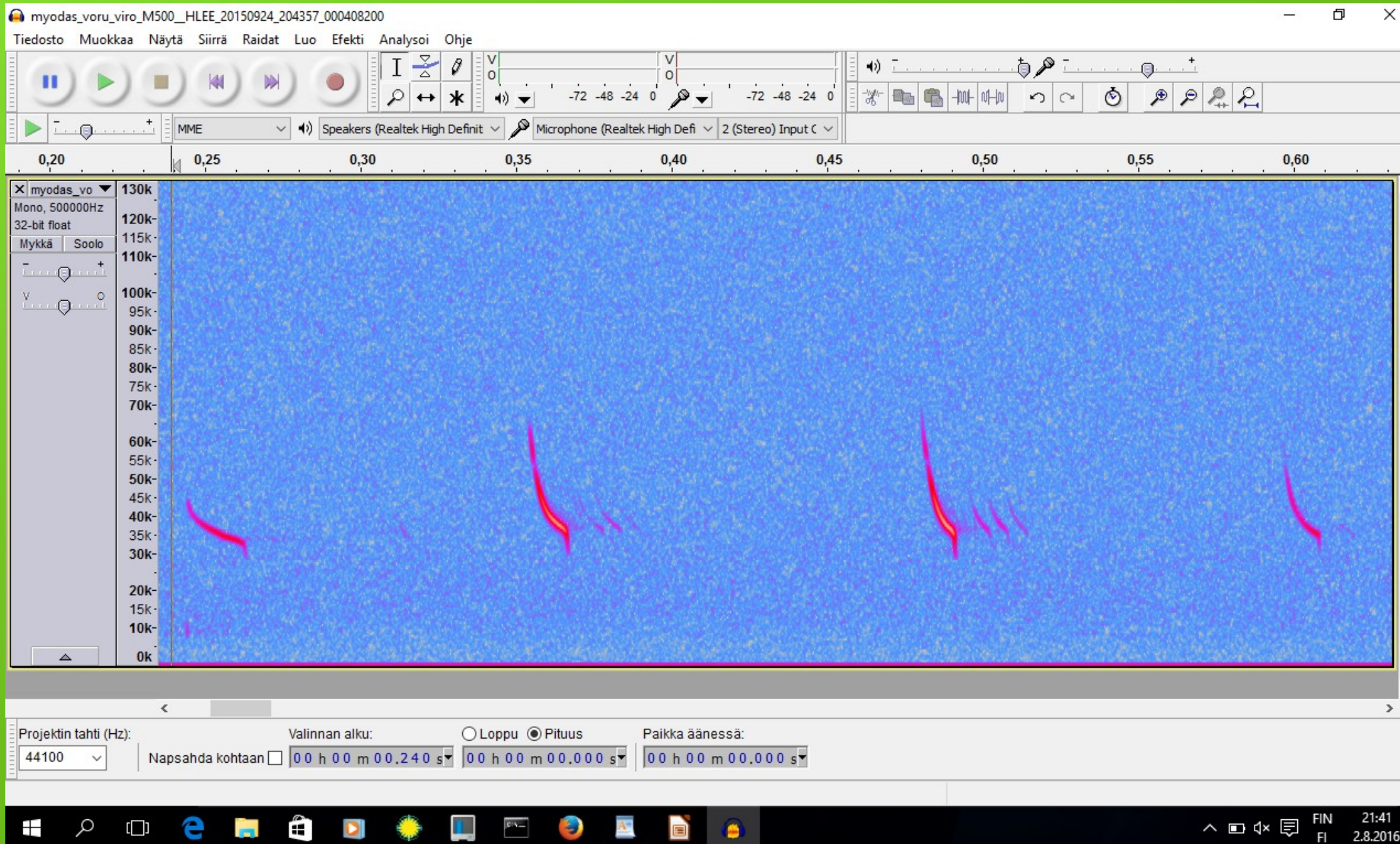
FFT resolution (bad) for
sampling of 500 000 KHz

$$\Delta t \Delta f = 1/2$$

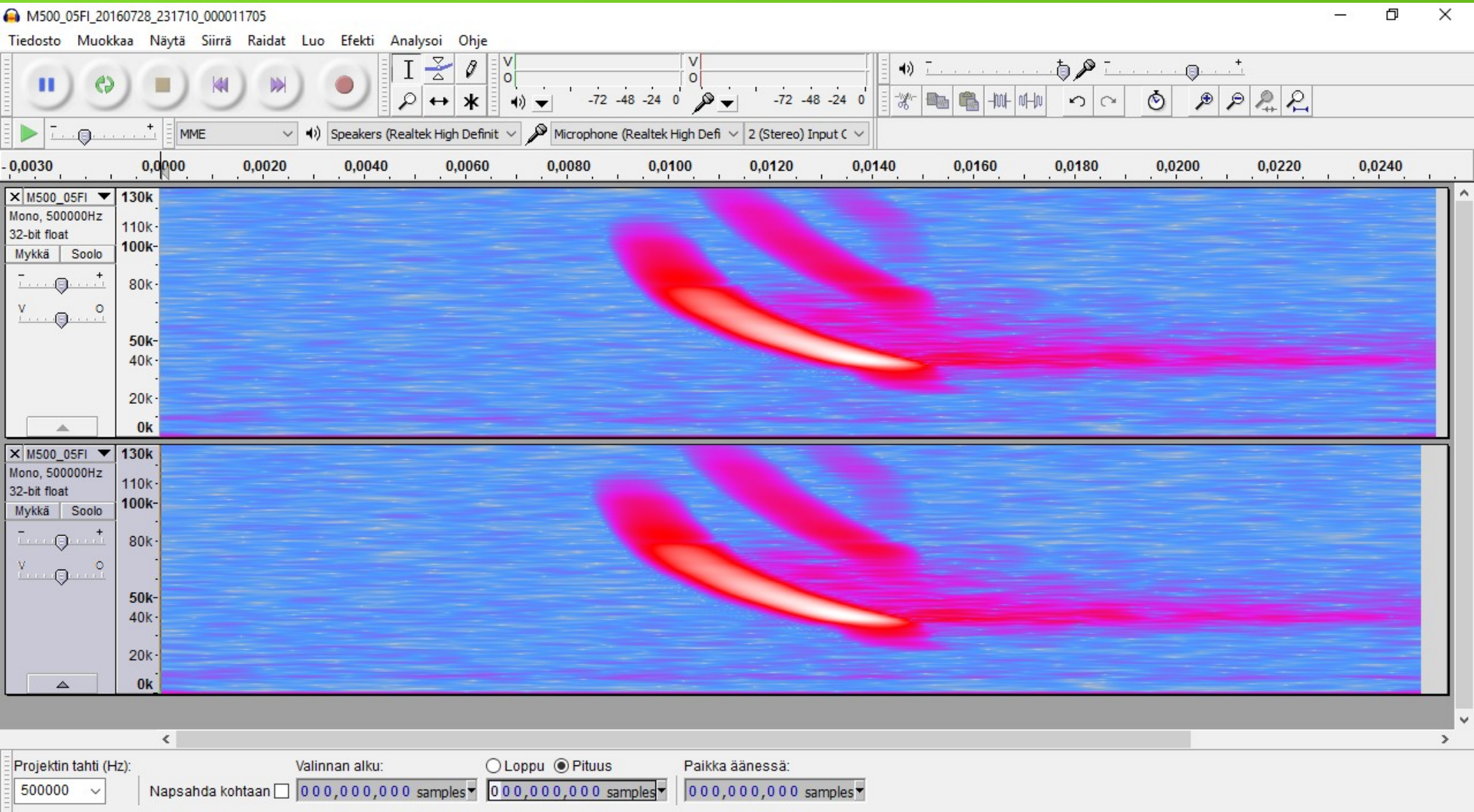
FTF	dt	df
2048	4.1msec	0.12kHz
256	0.52msec	1.0KHz

How meaningful is it to express bat
sound properties to $\pm 0.1\text{KHz}$?

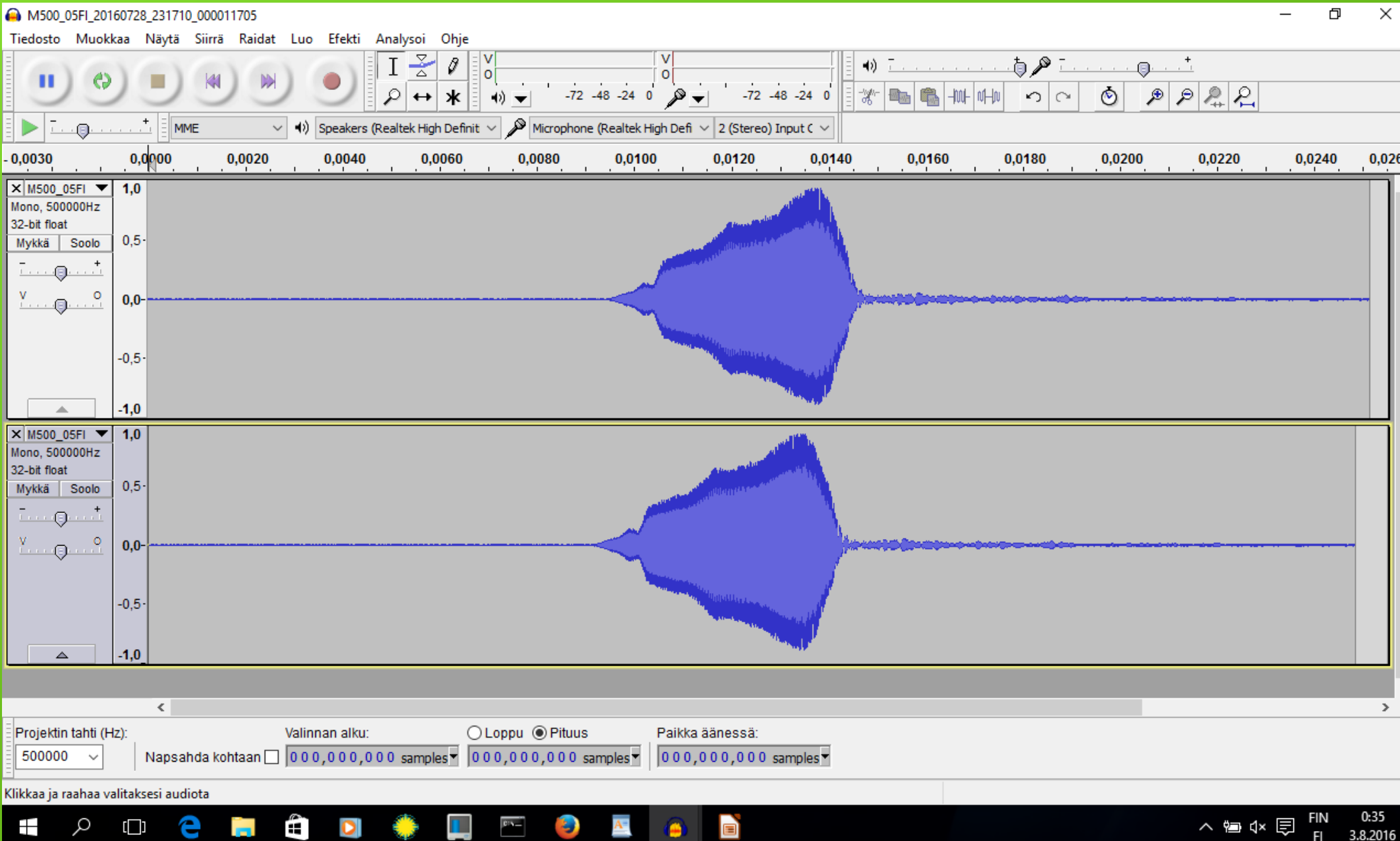
Dammfladdermus *Myotis dasycneme* no interference, because mic at water surface



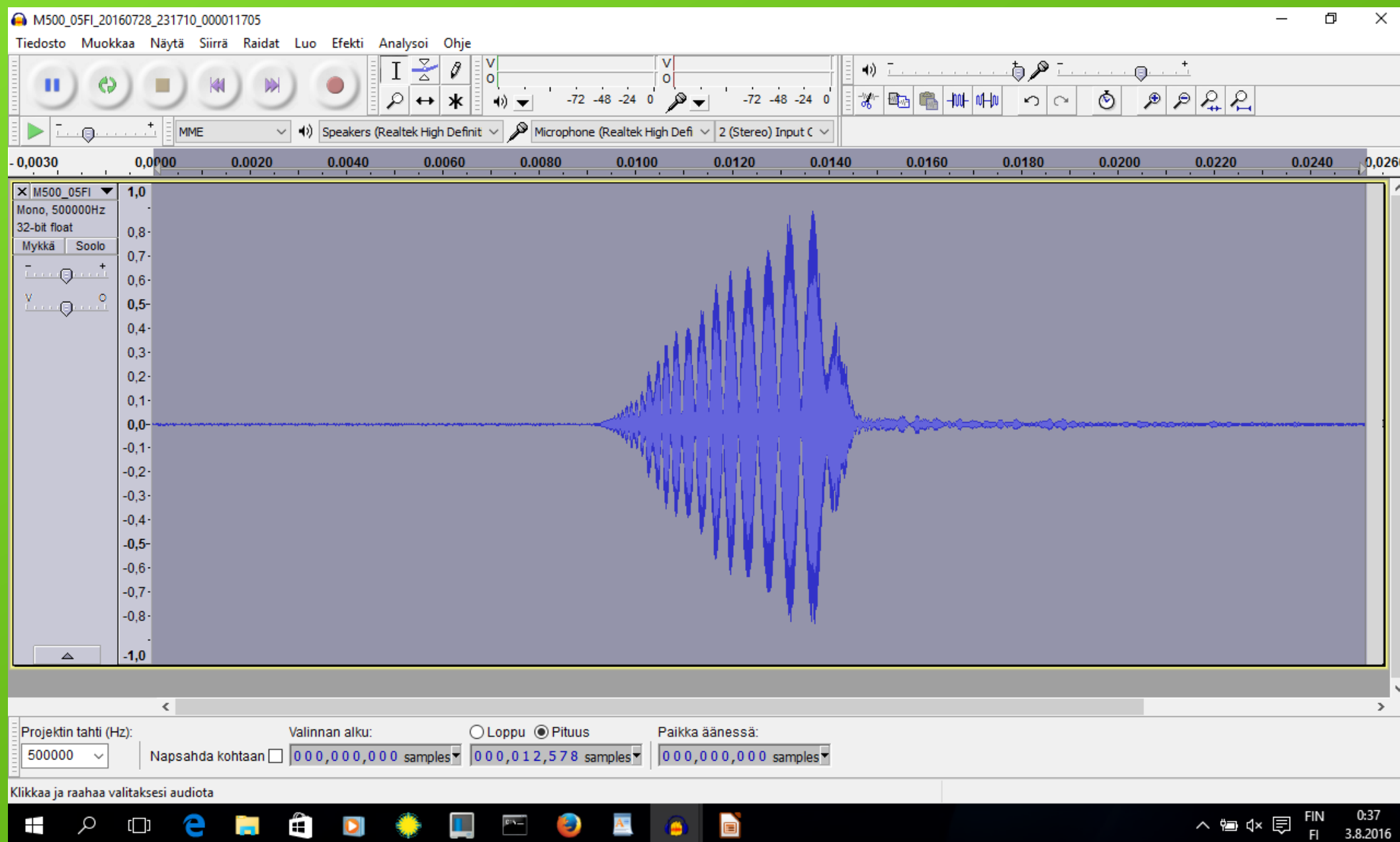
Two sounds (a 0.3ms shift = 1.0m)



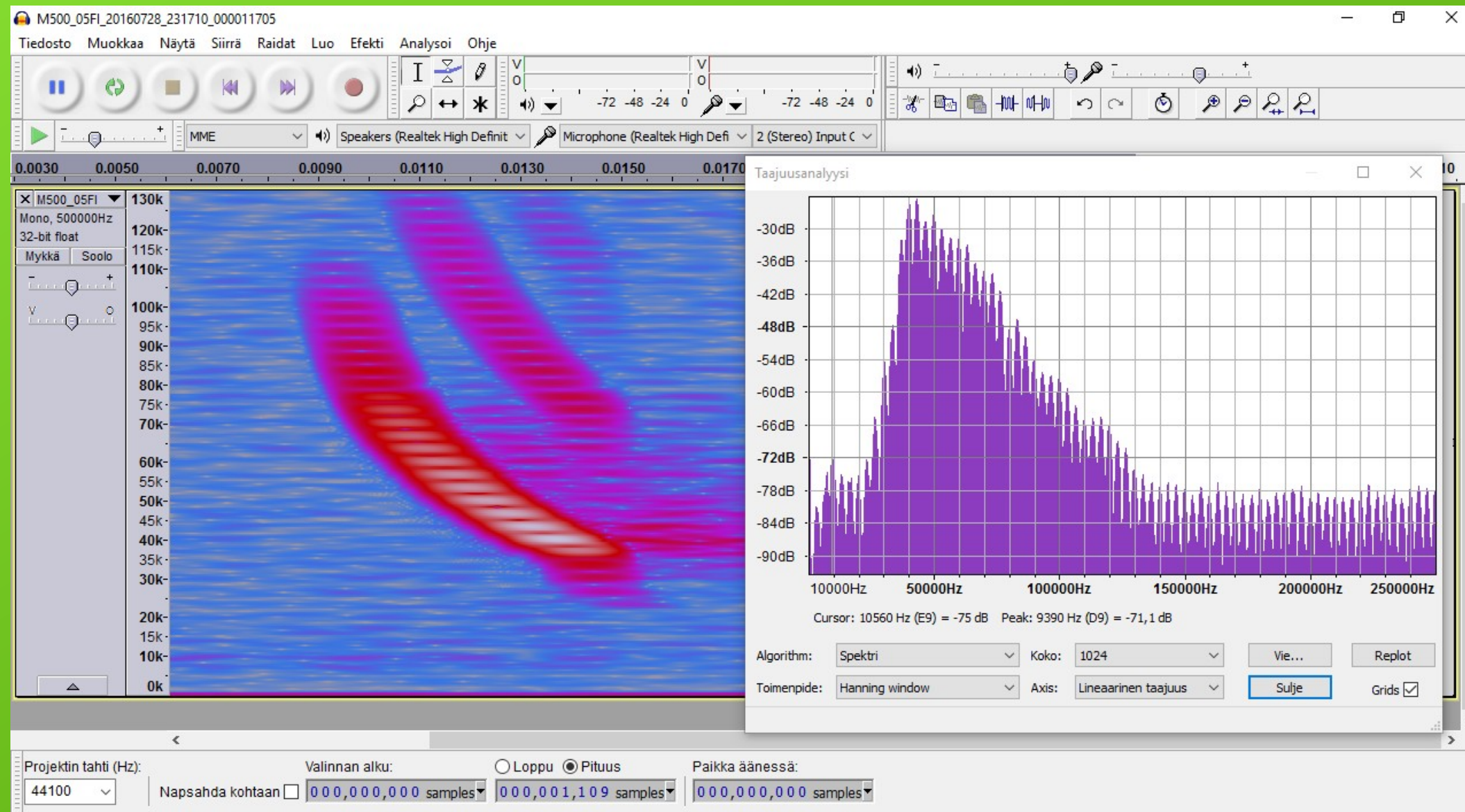
oscillograms (0.3ms shift)



Sum of the two sounds



Spectrogram long (1024) FFT



Spectrogram short (256) FFT

The image shows a screenshot of the Audacity audio editing software interface. The main window displays a spectrogram for a mono audio file named 'M500_05FI'. The spectrogram's vertical axis represents frequency from 0k to 130k Hz, and the horizontal axis represents time from 0.0020 to 0.0140 seconds. A prominent diagonal band of high-intensity energy is visible, indicating a signal with a frequency that increases over time.

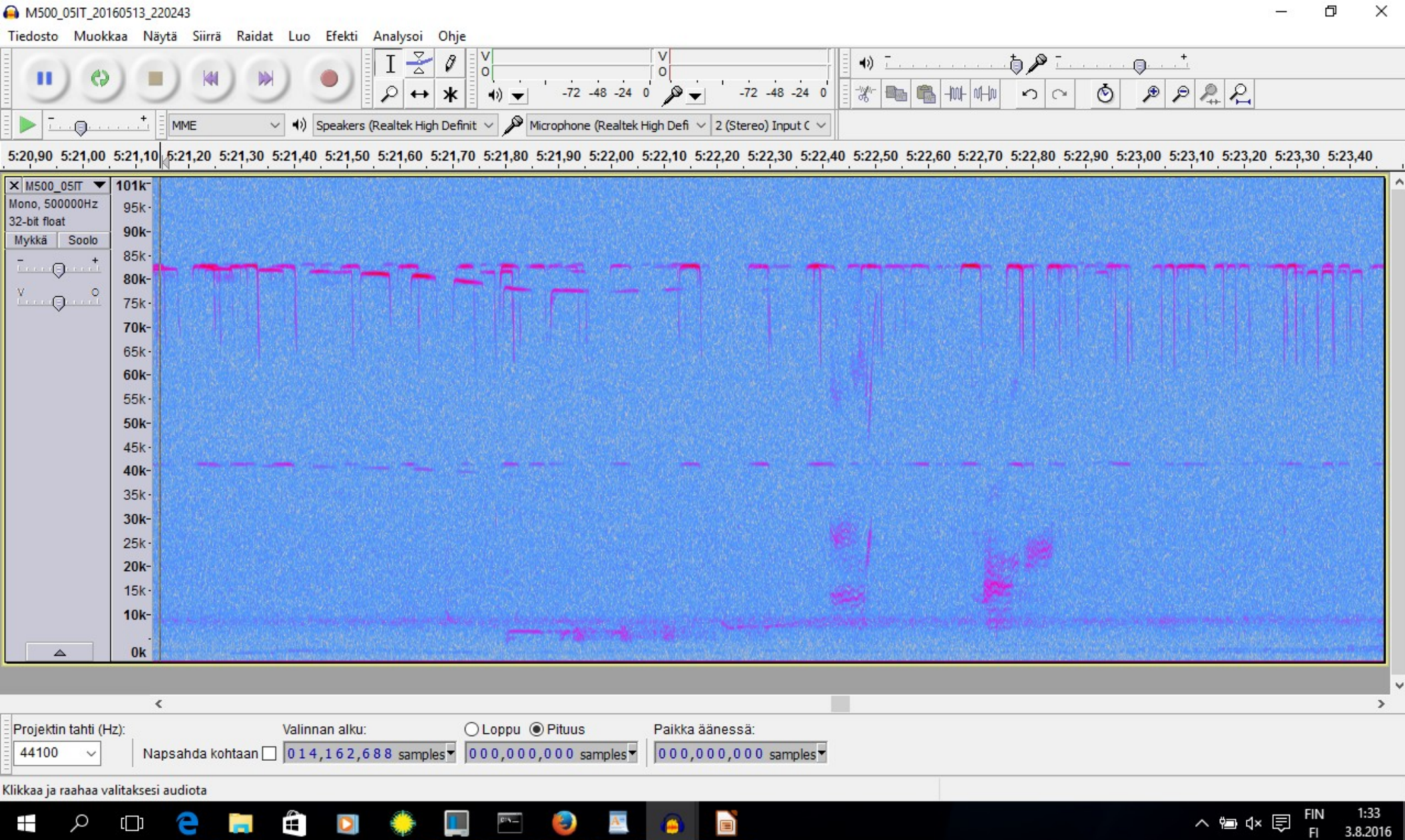
An inset window titled 'Taajuusanalyysi' (Frequency Analysis) is open, showing a purple-filled spectral plot. The vertical axis of this plot ranges from -75dB to -24dB, and the horizontal axis ranges from 10000Hz to 250000Hz. The plot shows a peak in intensity around 40,000 Hz. Below the plot, the analysis settings are displayed: Algorithm: Spektri, Koko: 256, Toimenpide: Hanning window, and Axis: Lineaarinen taajuus.

At the bottom of the Audacity window, the 'Projektin tahti' (Project Rate) is set to 44100 Hz. The 'Valinnan alku' (Selection Start) is at 000,000,000 samples, and the 'Paikka äänessä' (Position in audio) is also at 000,000,000 samples.

Doppler

(bigger effect in kHz at high frequencies)

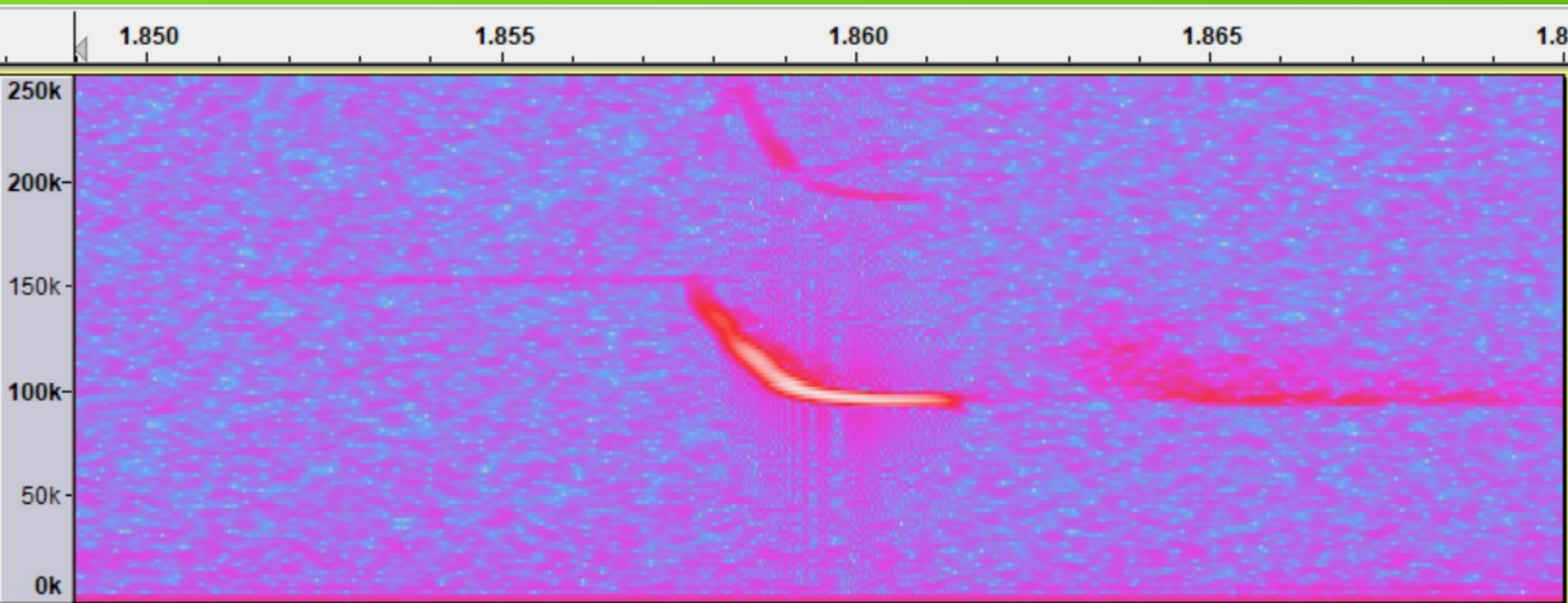
Rhinolophus ferrumequinum, Italia



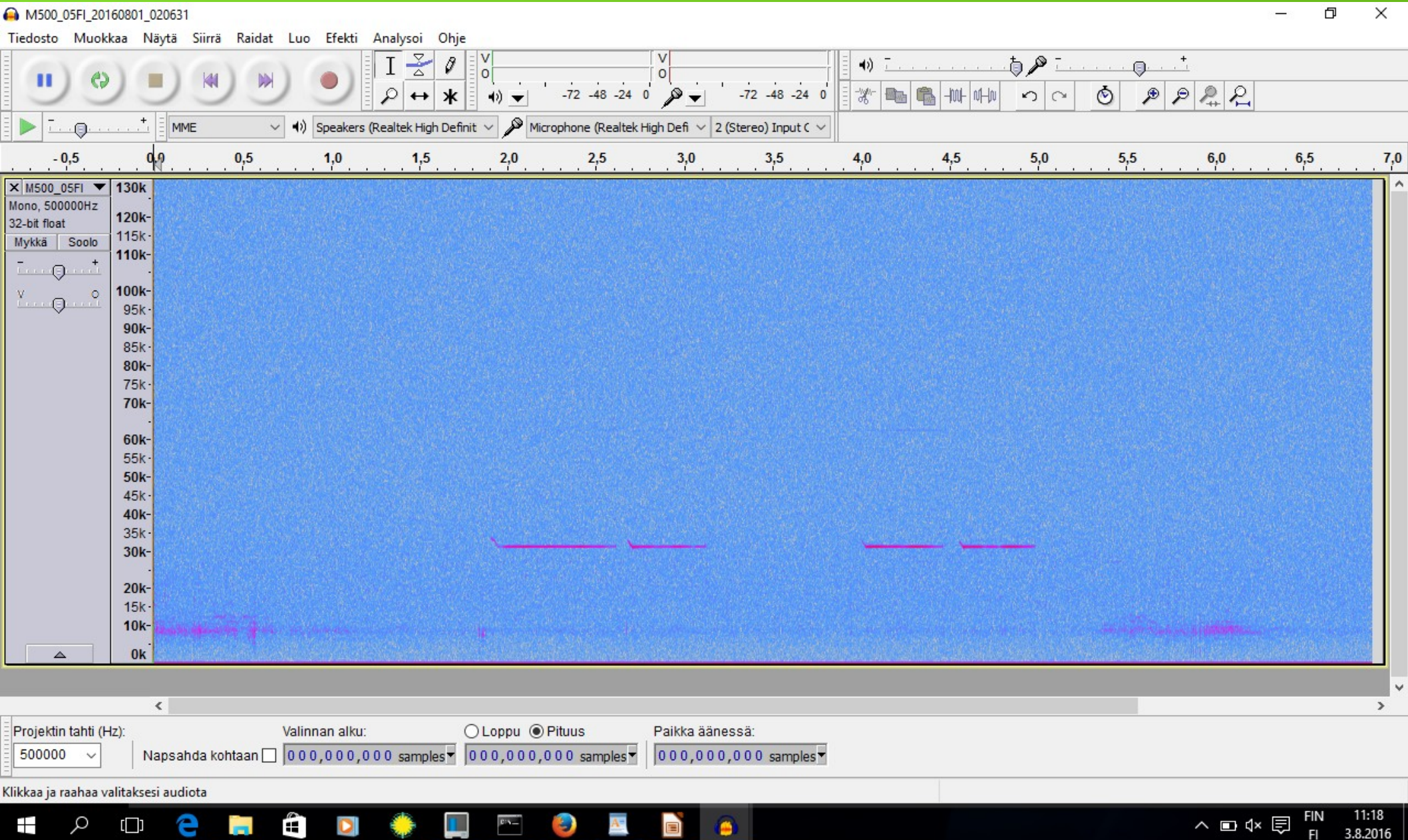
FT Akwards/outside disturbance

- From FTs
 - Interference, aliasing, harmonics, sharp edges
- Outside disturbance
 - Walking on sand/dirt road, door hinges, Breaking twigs, Keys, clothes
 - Insects (vårtbitare), tropical frogs, mammals
 - Brathing, wind, rain
- Electronics
 - Car electronics, street lamps, flash powering, image stabilization, autofocus, [kompaktlysrör(good for checking your detector)]
- Quiet discussion is ok, but avoid loud giggling

Aliasing, echo, harmonics, highest frequency (*Asellia tridens*, gambia)

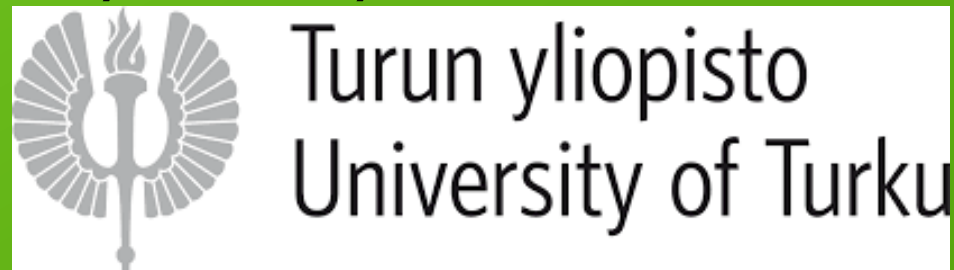


Kameran elektronics – test it



Conclusions

- Fourier-based spectrograms are the best way to identify bat sounds, but note the problems
- Detectors are now reasonably priced (audiomoth, about 100€, not as good as Petterson 200-300€ detectors)
- Thank you, tack, kiitos



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