Stébla trávy

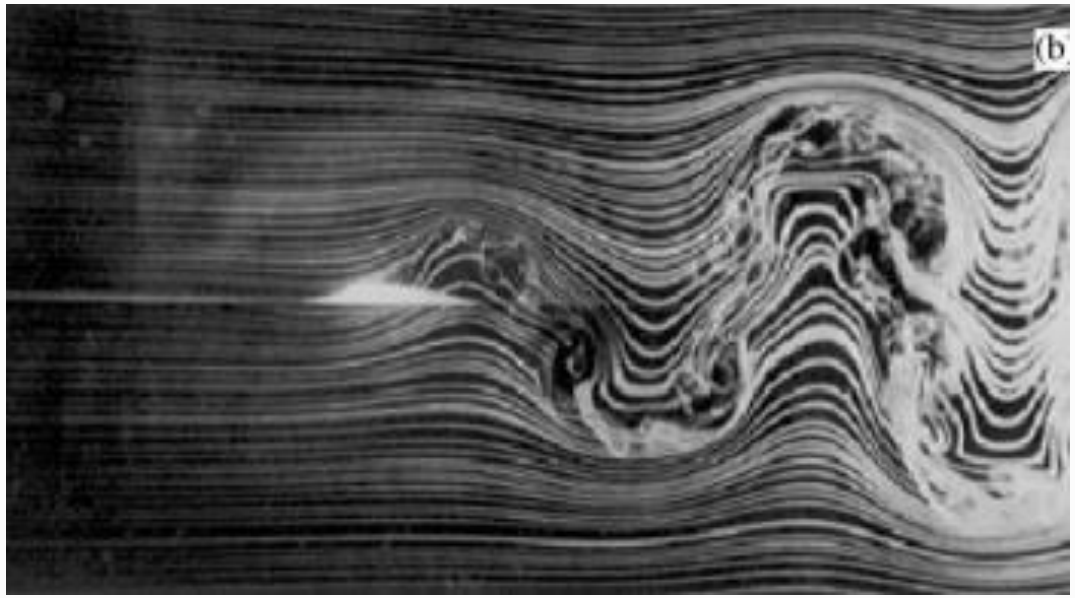
Pavla Bérešová

Abstrakt

Foukáním přes list trávy, proužek papíru nebo něco podobného lze vyvolat zvuk. Prozkoumejte tento jev.

Vznik zvuku

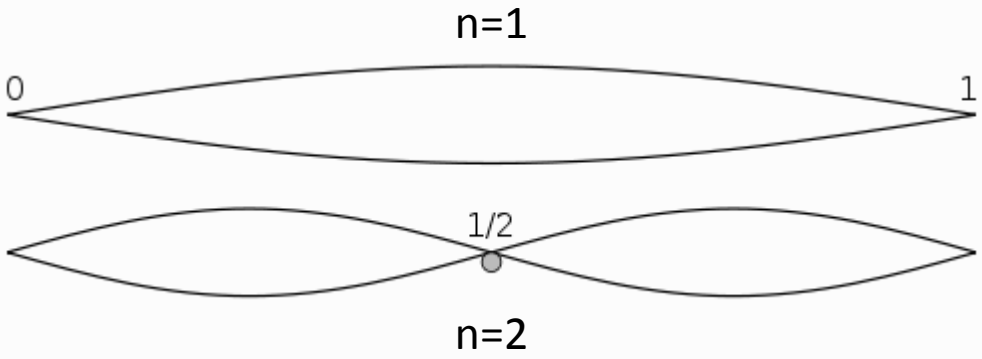
- Proudící vzduch
- Vznik malých vzdušných vírů rozrážením vzduchu o přední hranu
- Vibrování proužku



Y. Watanabe, S. Suzuki, M. Sugihara, and Y. Sueoka. An experimental study of paper flutter. J. Fluids Structures 16, 4, 529-542 (2002)

Frekvence zvuku

$$f = \frac{nv}{2L}$$



Parametry

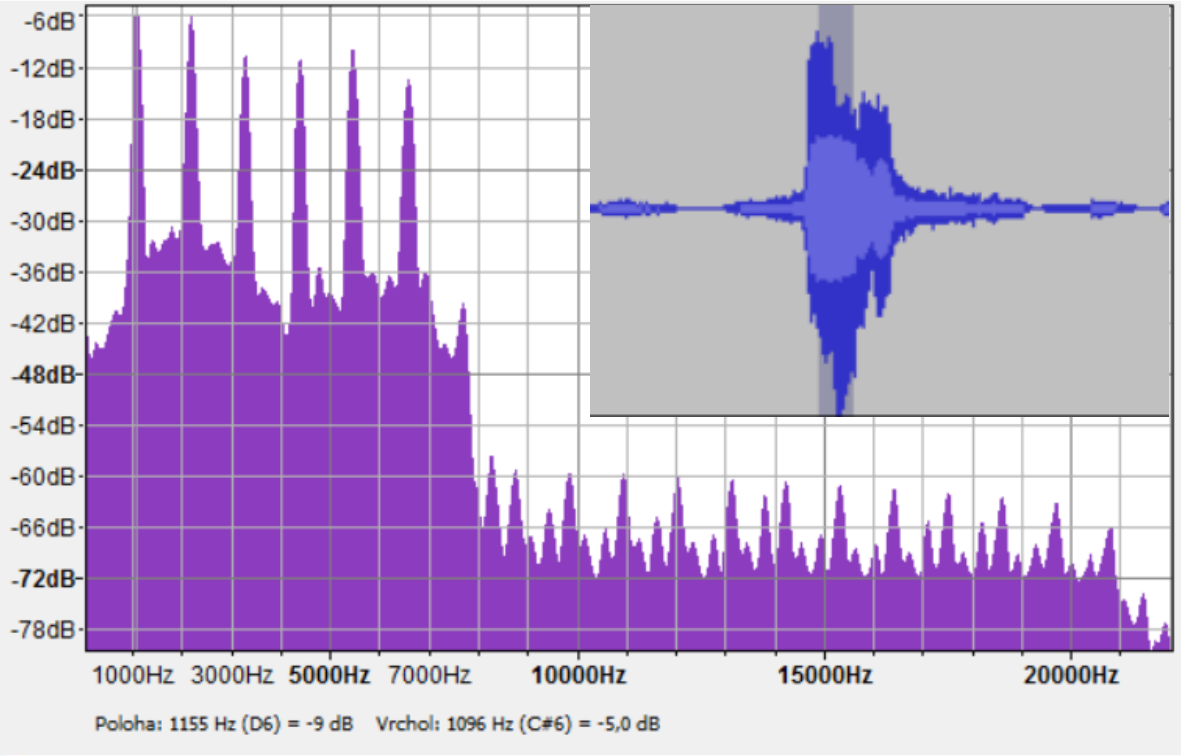
- Napětí (T)
- Délka (L)
- Hmotnost proužku (m)
- n – pořadí alikvoty
- v – rychlost šíření vlny

$$v = \sqrt{\frac{T}{m/L}}$$

$$\boldsymbol{f = \frac{n\sqrt{\frac{T}{m/L}}}{2L}}$$

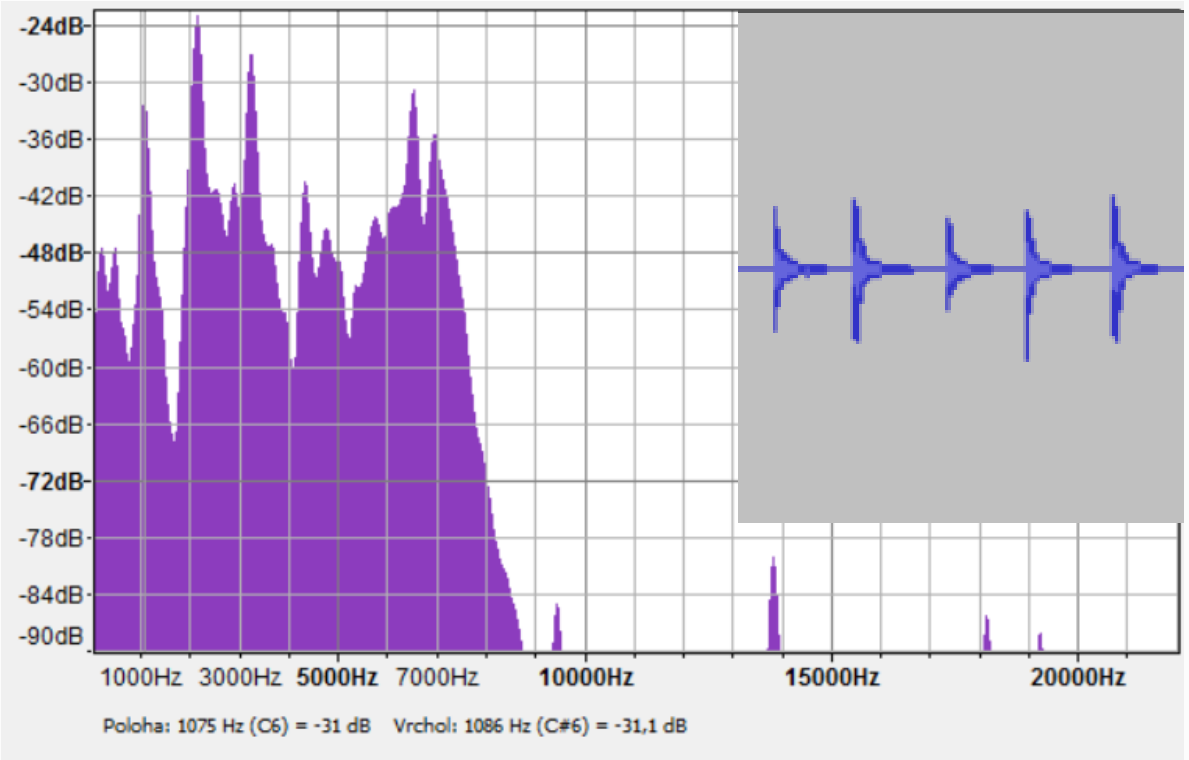
Foukání

f_1= 1086 Hz



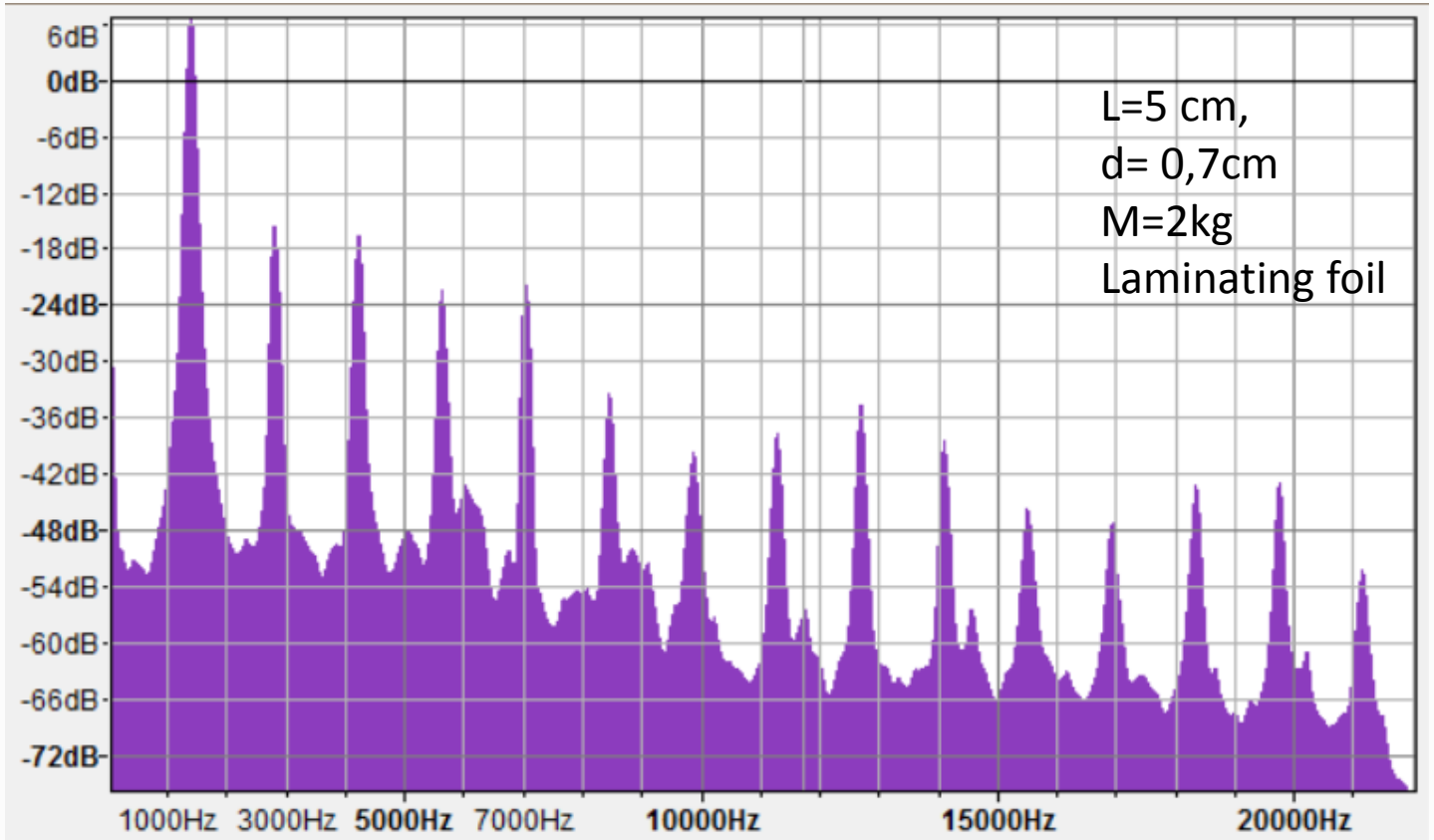
Brnknutí

- f_1=1096 Hz



Rezonance proužku

- Harmonické frekvence
- Nezávislost vrekvence na rychlosti proudění



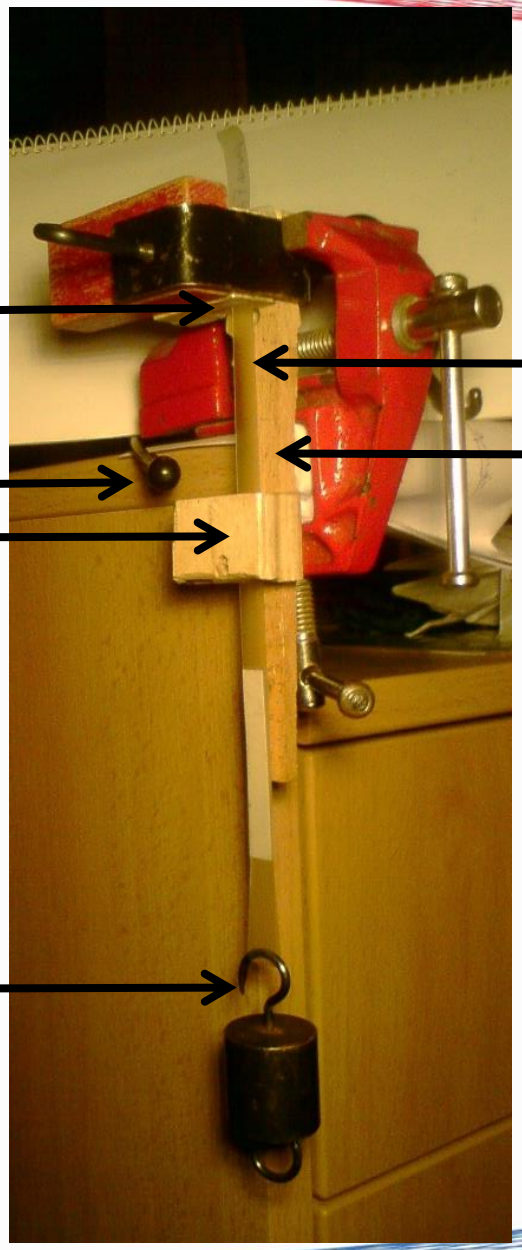
Použité proužky

- Tráva
  - Vroubkovaný povrch
  - Měnící se parametry
  - Trhání
- Papír
  - Absorbují vodu – mění hmotnost
- Folie
  - Stálé parametry

Aparatura

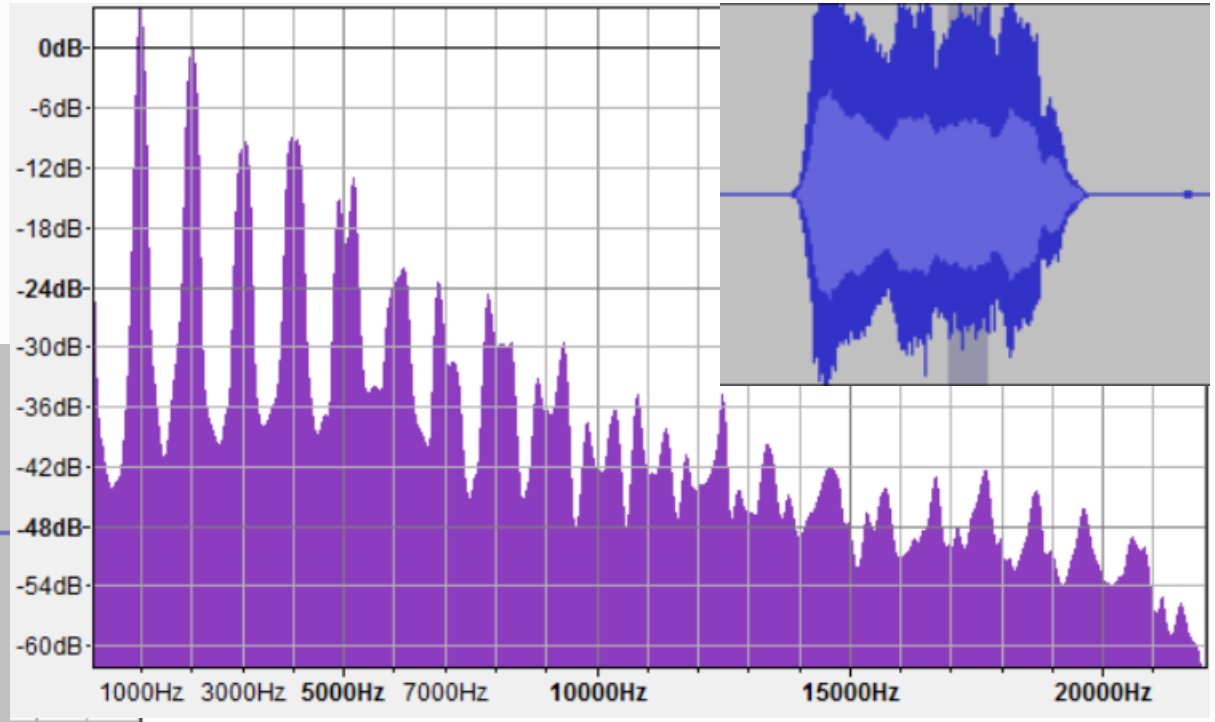
- Measured parameters
  - Napětí (T)
  - Závaží (M)
  - Délka (L)
  - šířka (d)
  - Tloušťka (h)

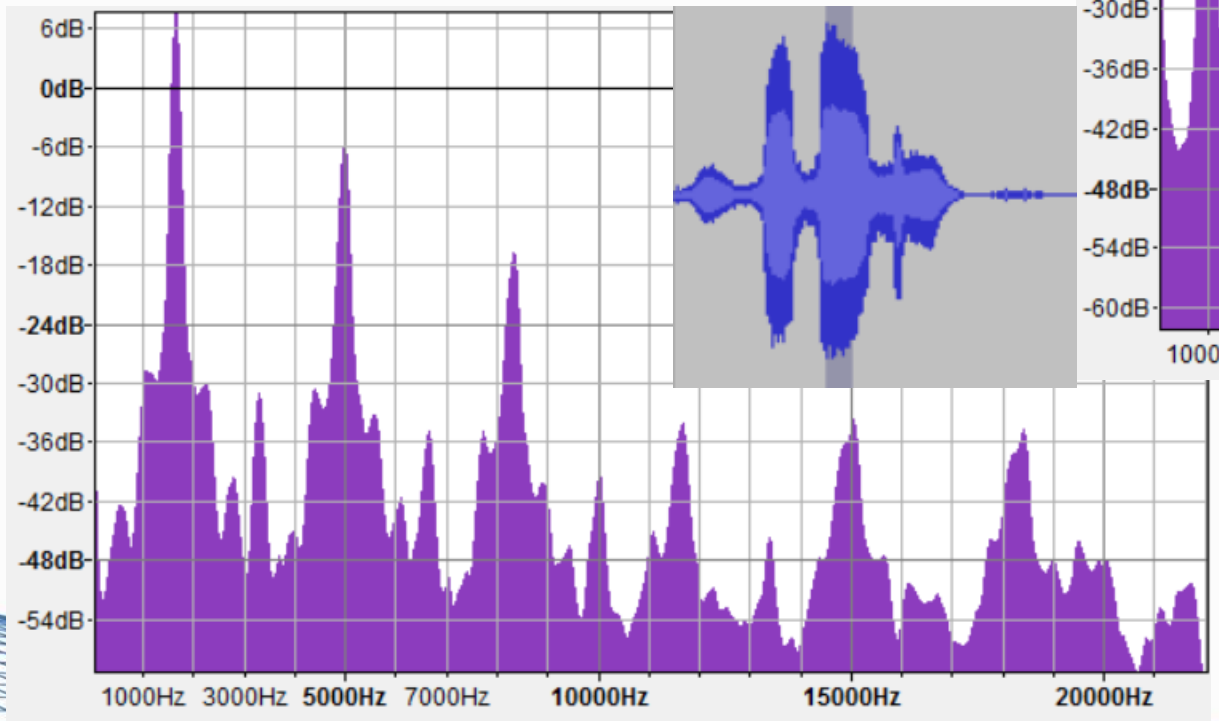
$$T = Mg$$



Spektra stébel trávy

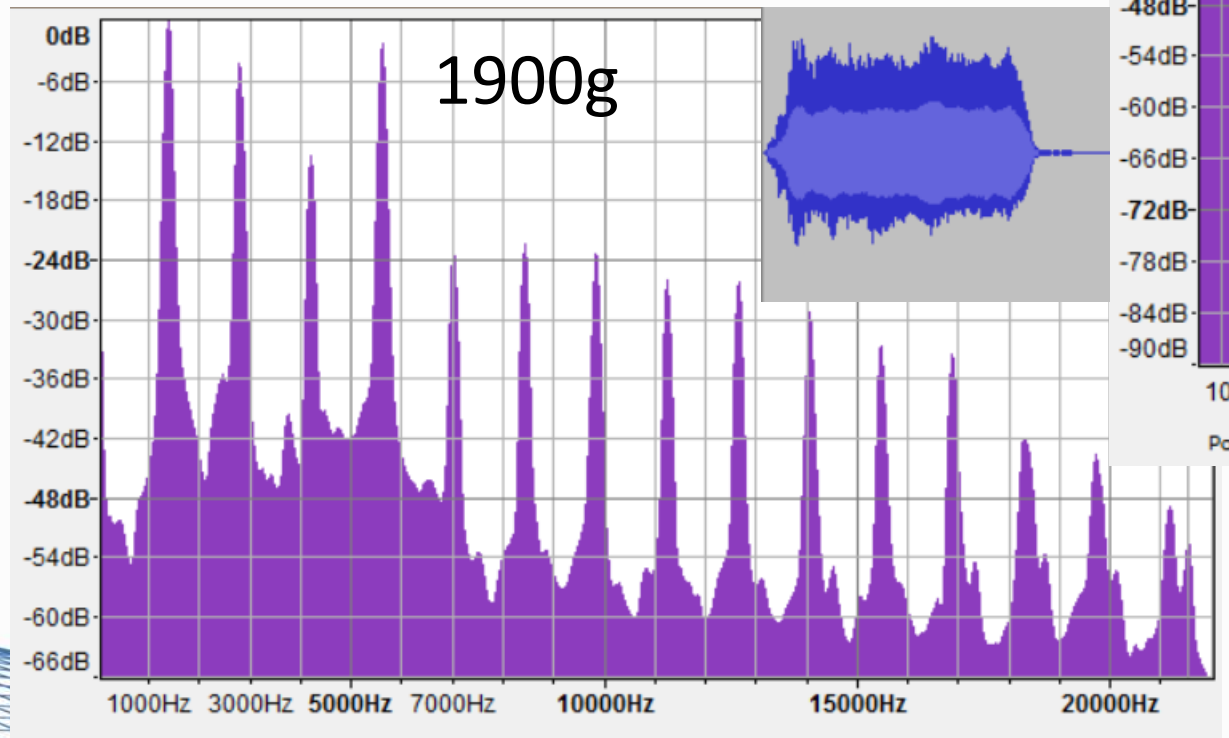
- Program Audacity

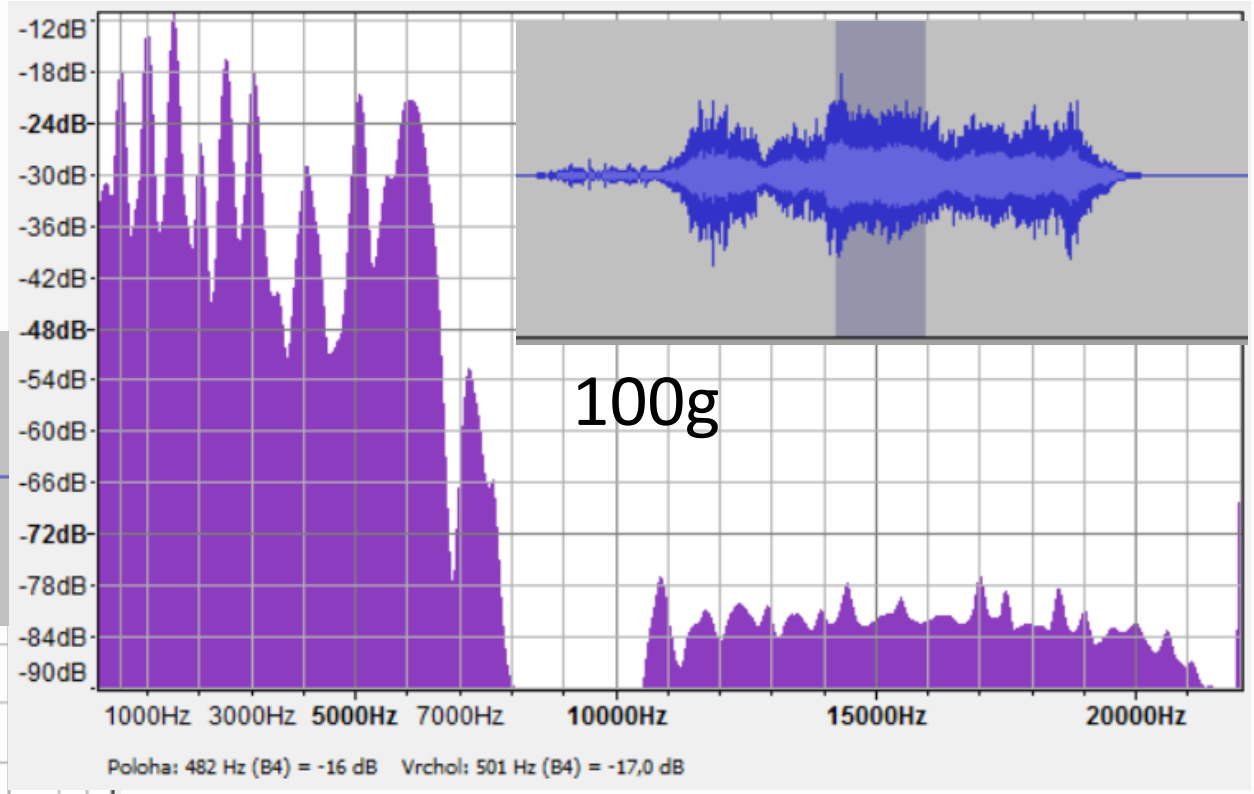




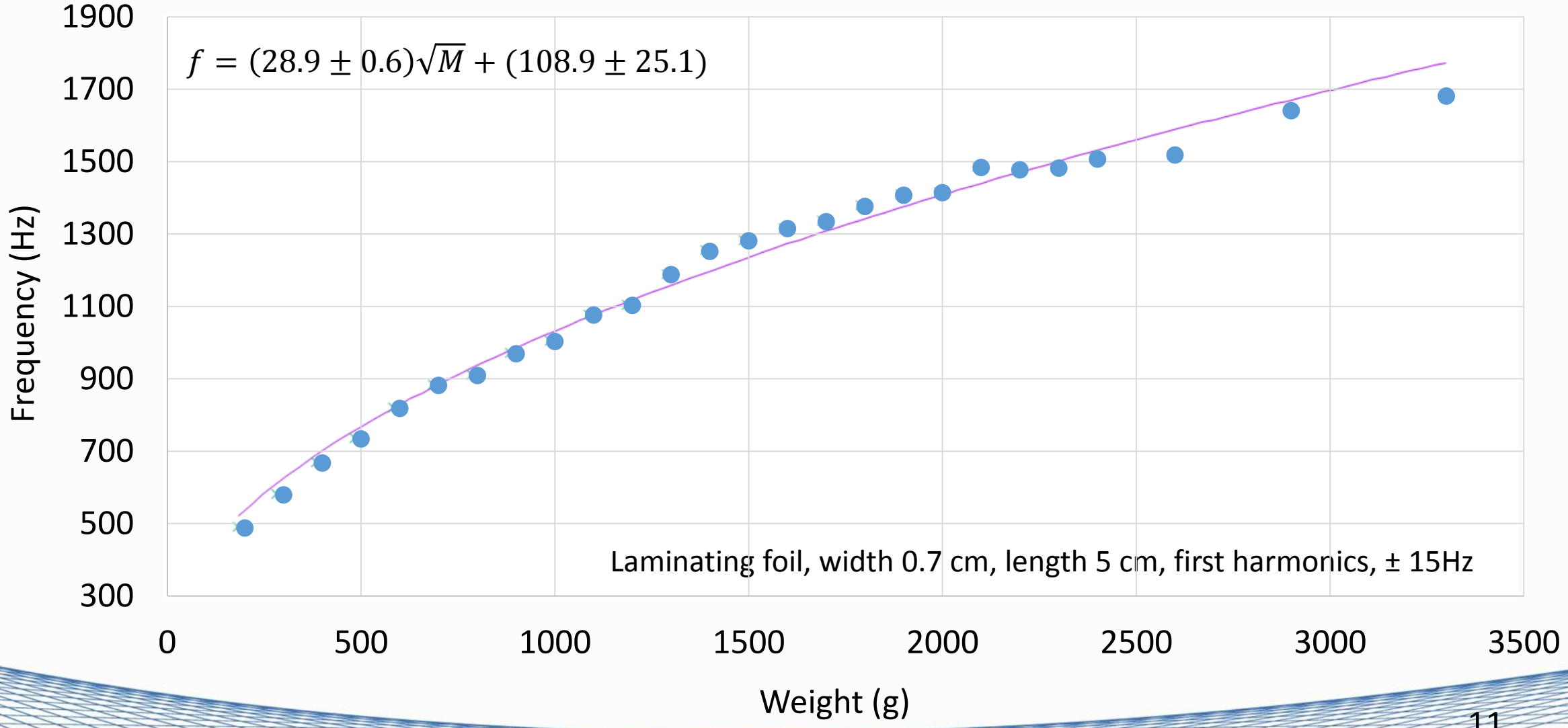
Spektrum folie

Lam. Foil
d=0,7 cm
L=5cm

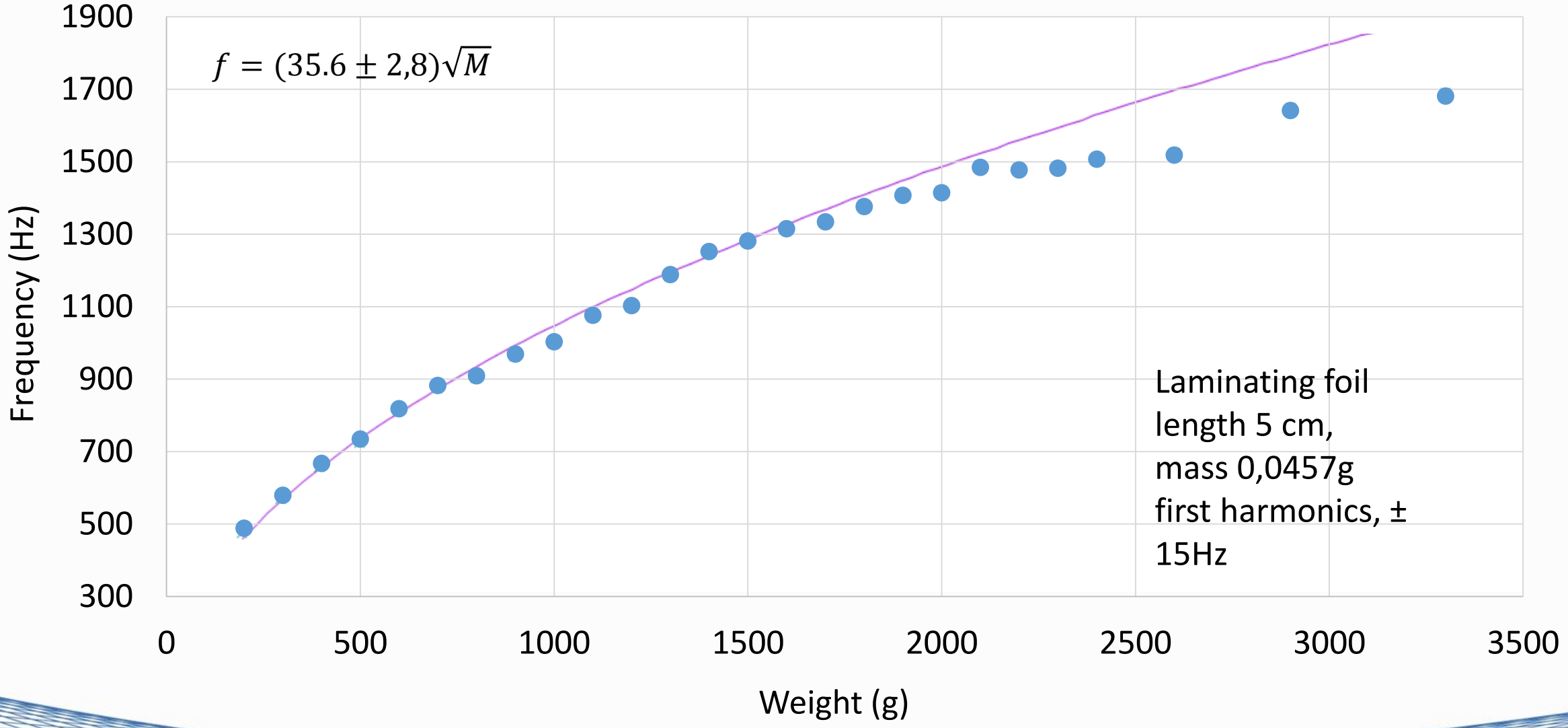




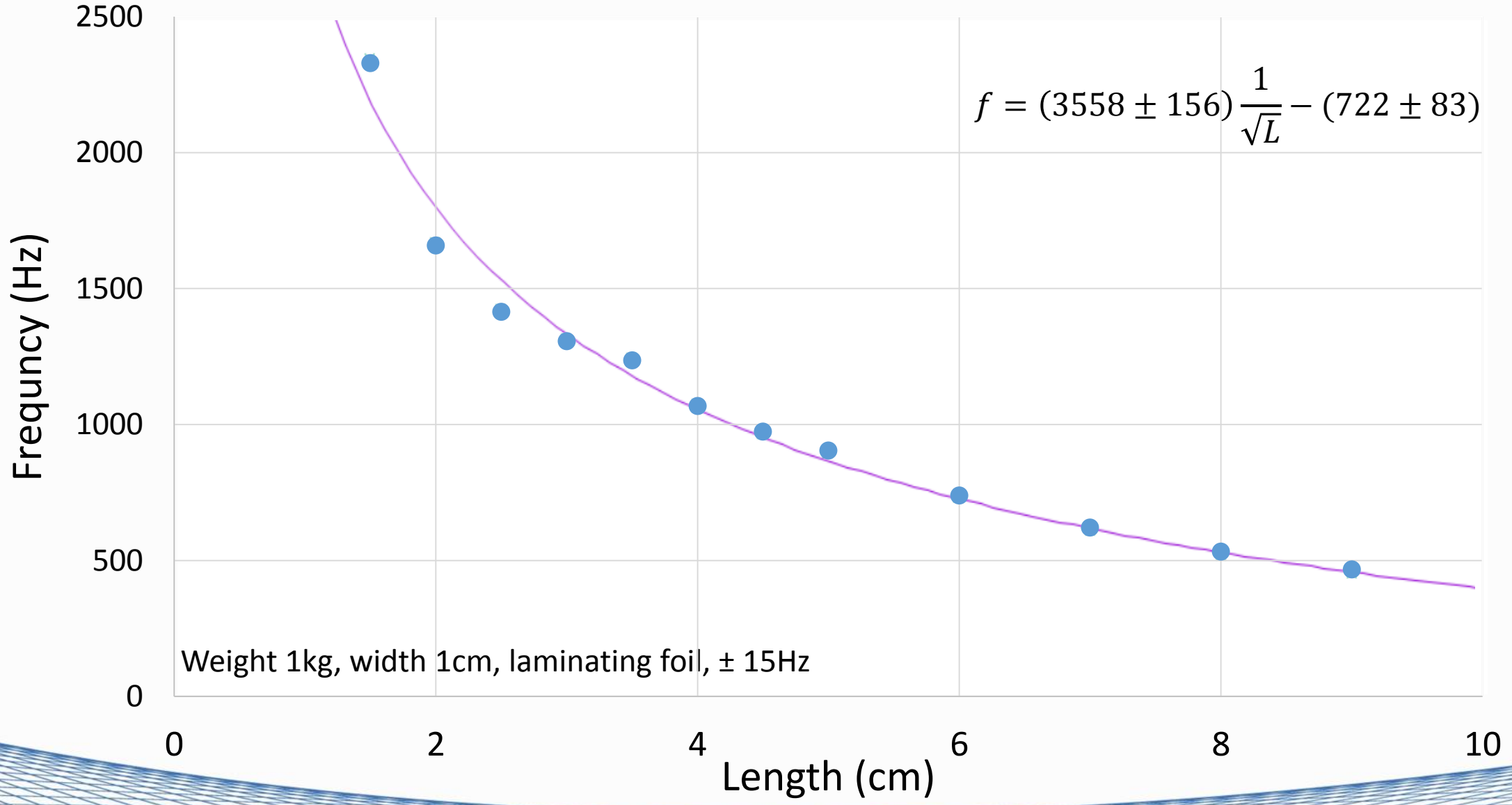
Napětí + fit


$f = (28.9 \pm 0.6)\sqrt{M} + (108.9 \pm 25.1)$
Laminating foil, width 0.7 cm, length 5 cm, first harmonics, ± 15Hz
Frequency (Hz)
1900
1700
1500
1300
1100
900
700
500
300
0
500
1000
1500
2000
2500
3000
3500
Weight (g)

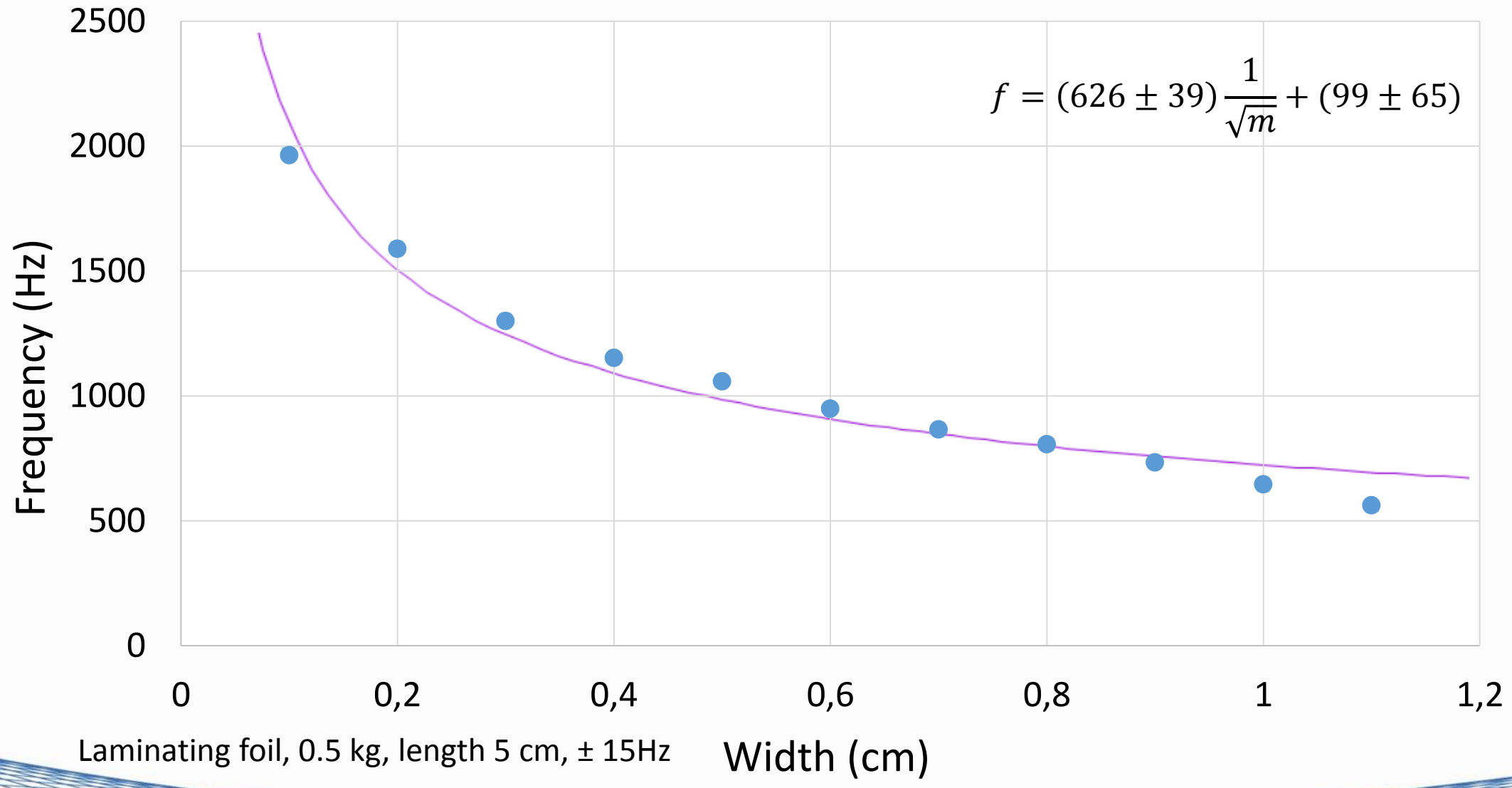
Napětí + Teoretická křivka



Délka

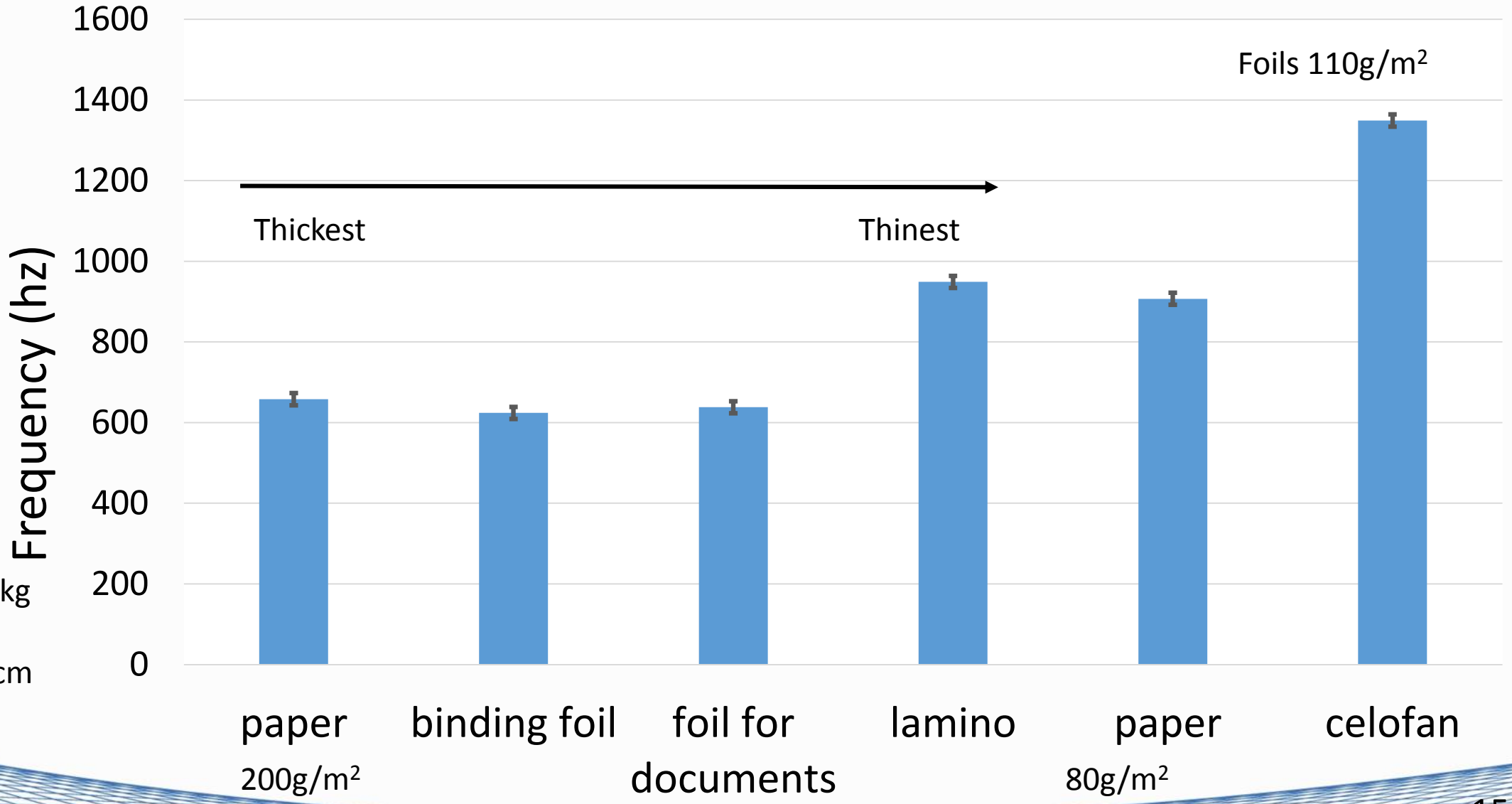

2500
2000
1500
1000
500
0
Frequncy (Hz)
0
2
4
6
8
10
Length (cm)
$f = (3558 \pm 156)\frac{1}{\sqrt{L}} - (722 \pm 83)$
Weight 1kg, width 1cm, laminating foil, ± 15Hz

Šířka



Laminating foil, 0.5 kg, length 5 cm, ± 15Hz

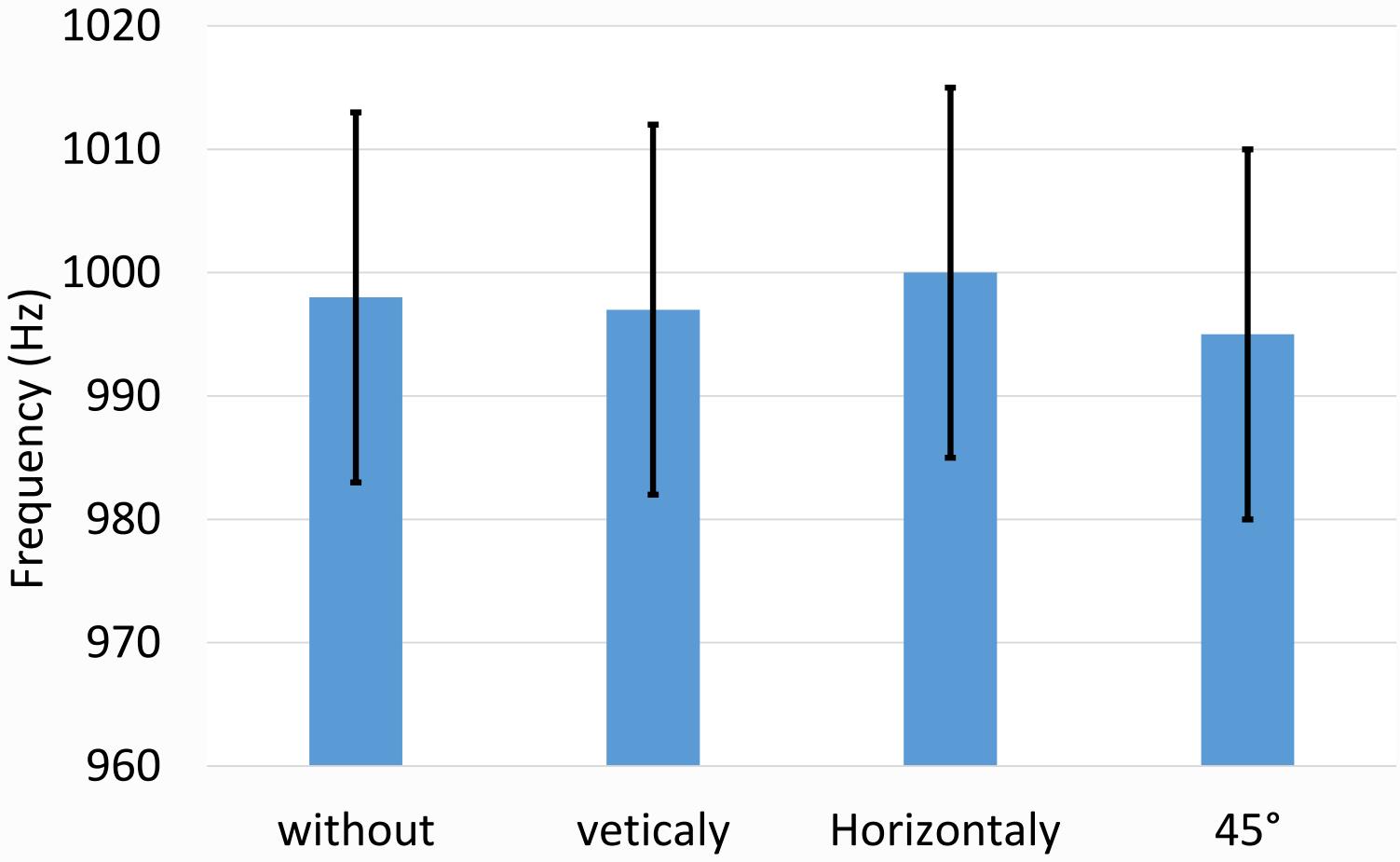
Tloušťka a materiál



M= 0.5 kg
L=5 cm
D= 0.6 cm
± 15Hz

Povrch

- Žádný dopad na frekvenci



d =0.7cm, Lamino, L = 5cm, M=1 kg

Závěr

- Frekvence je ovlivněna hmotností stébla
- Nejlépe regulovatelným parametrem je napětí
- Rychlost ovlivňuje pouze hlasitost zvuku
- Povrch nemá vliv na frekvenci

Thank you for your attention !

References

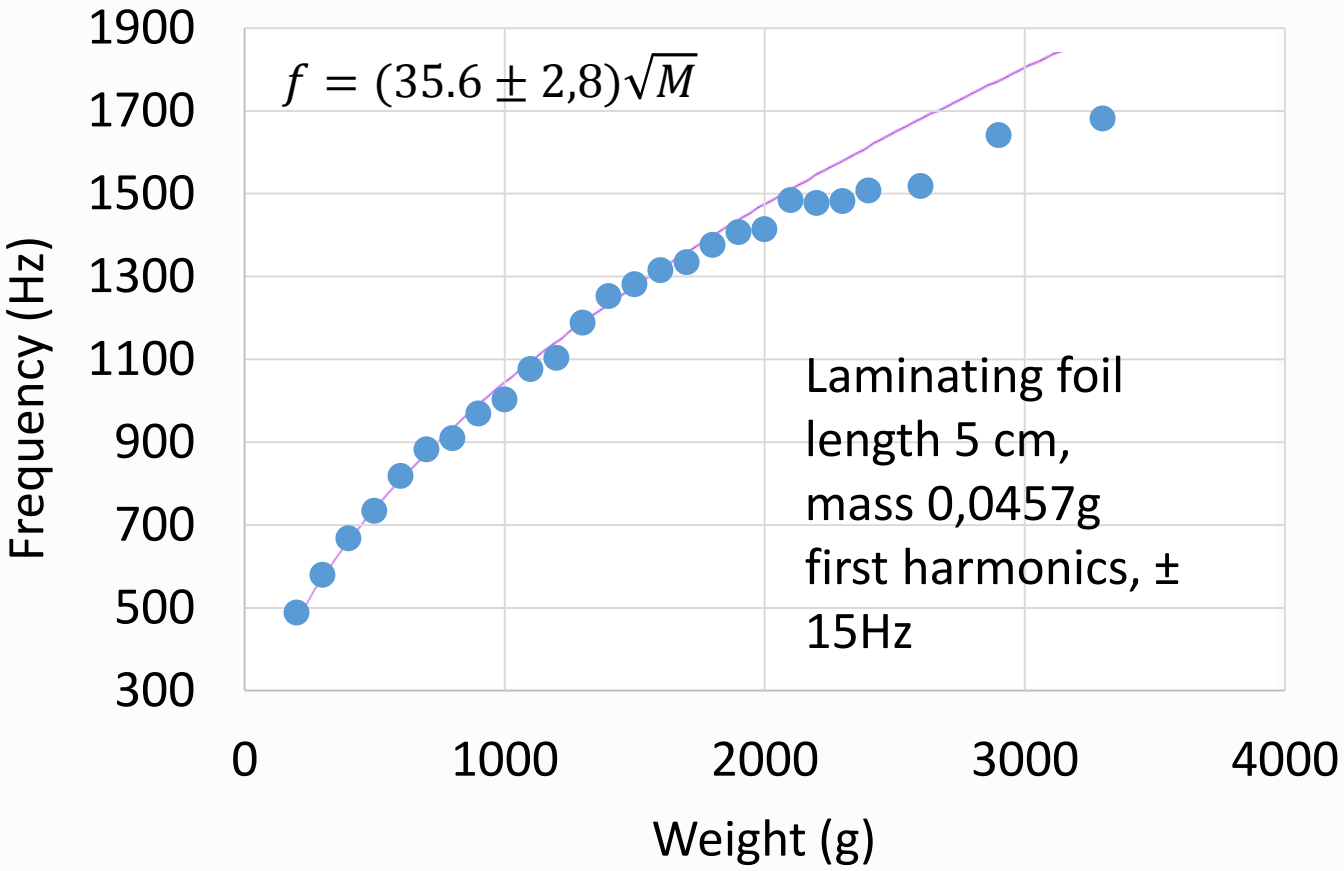
- Y. Watanabe, S. Suzuki, M. Sugihara, and Y. Sueoka. An experimental study of paper flutter. J. Fluids Structures 16, 4, 529-542 (2002)

- Vibrating string. In: *Wikipedia: the free encyclopedia* [online]. San Francisco (CA): Wikimedia Foundation, 2001- [cit. 2015-03-15]. Dostupné z: http://en.wikipedia.org/wiki/Vibrating_string

My measurement is in correspondence with the theory

Values for 0.7 foil strip – measured and calculated

- Fot biger tension strips starts to stretch… differrence grows



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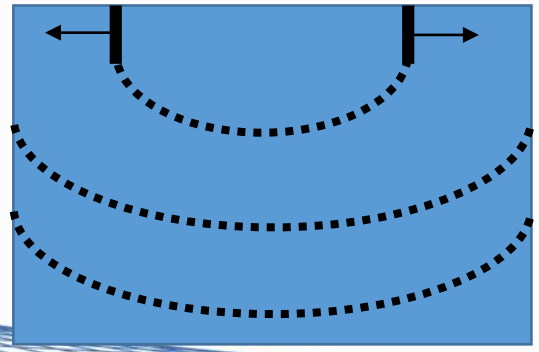
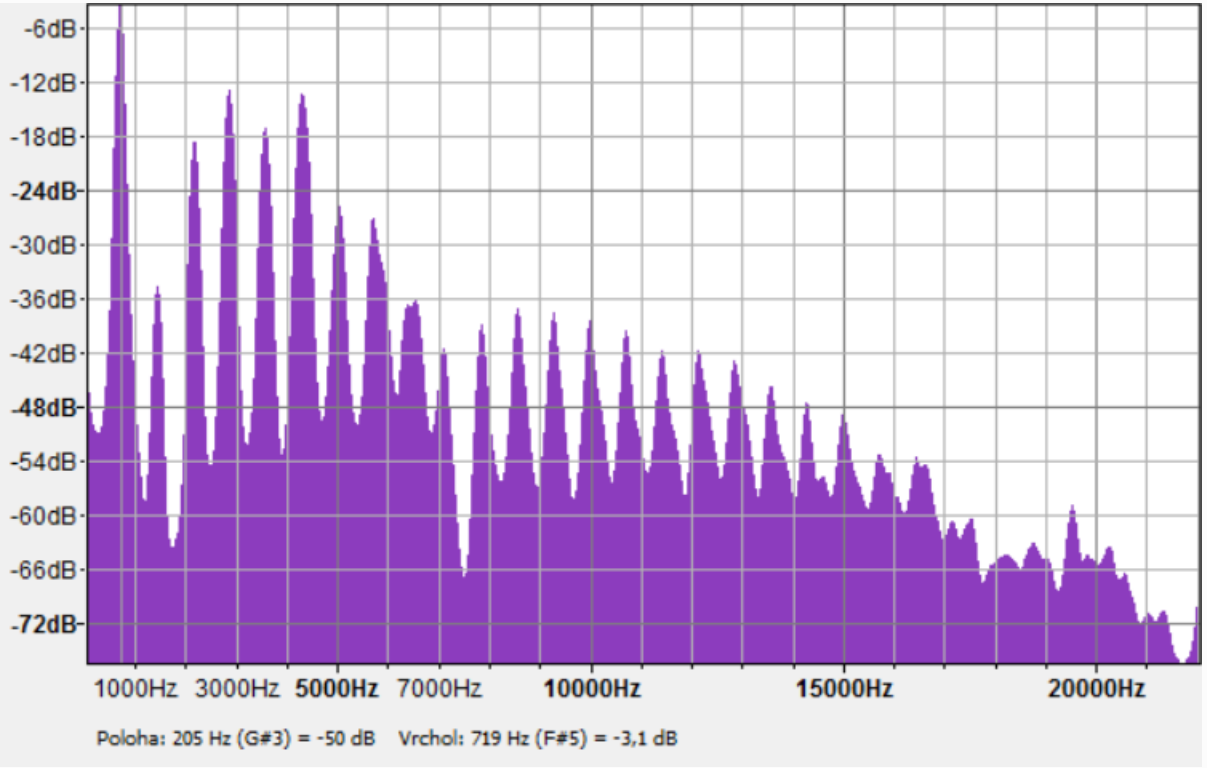
Appendix

- Wider strip than fingers
  - Normal looking spekter
  - No posible to describe mass
  - Inhibition of sound caused by not streched part