Electro-oscillator

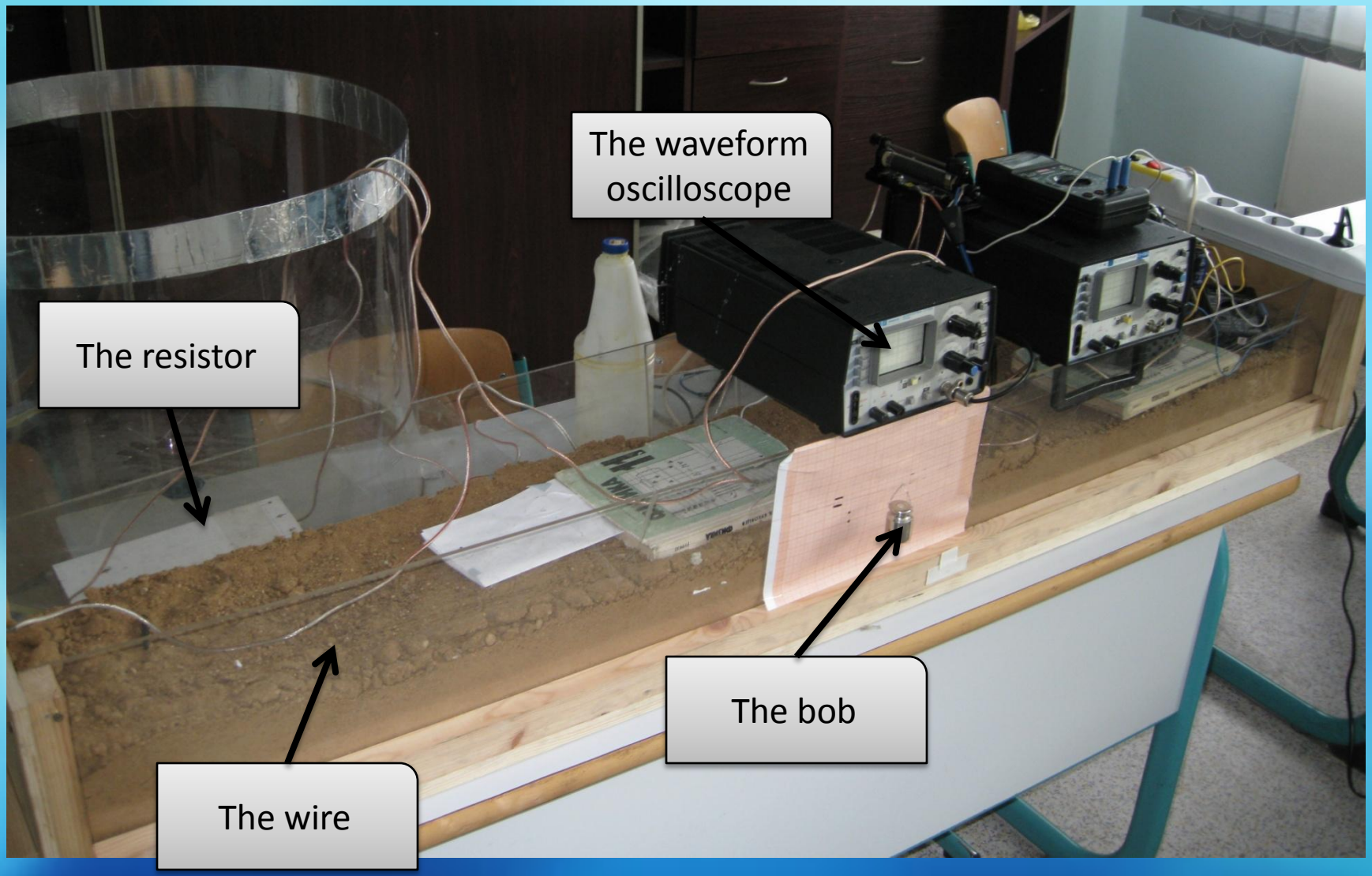
Republic of Belarus

Tianjin 2009

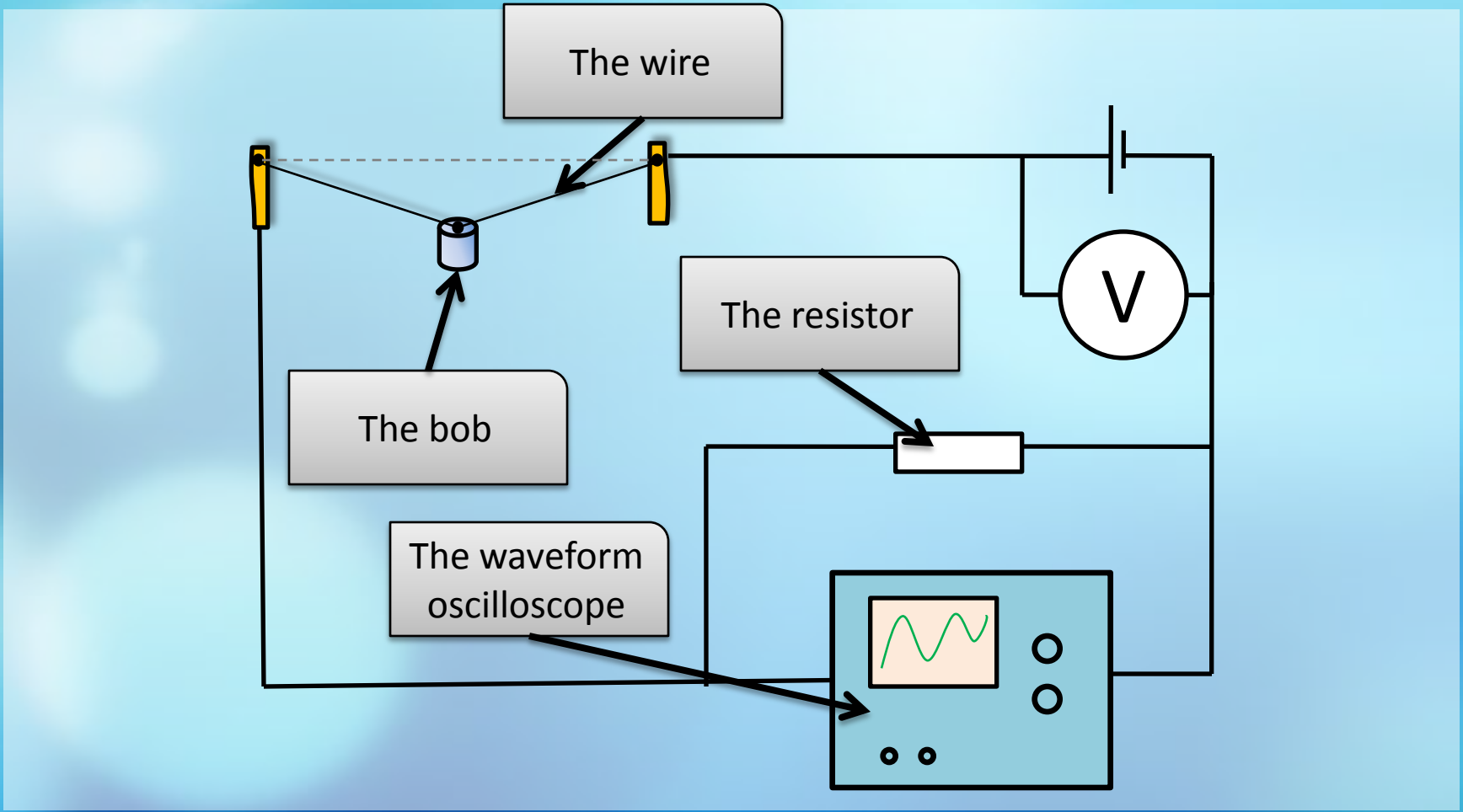
Statement of the problem

A mass is hung from the middle of a horizontal wire. When a current is passed through the wire, the mass may start to oscillate. Describe and explain this phenomenon.

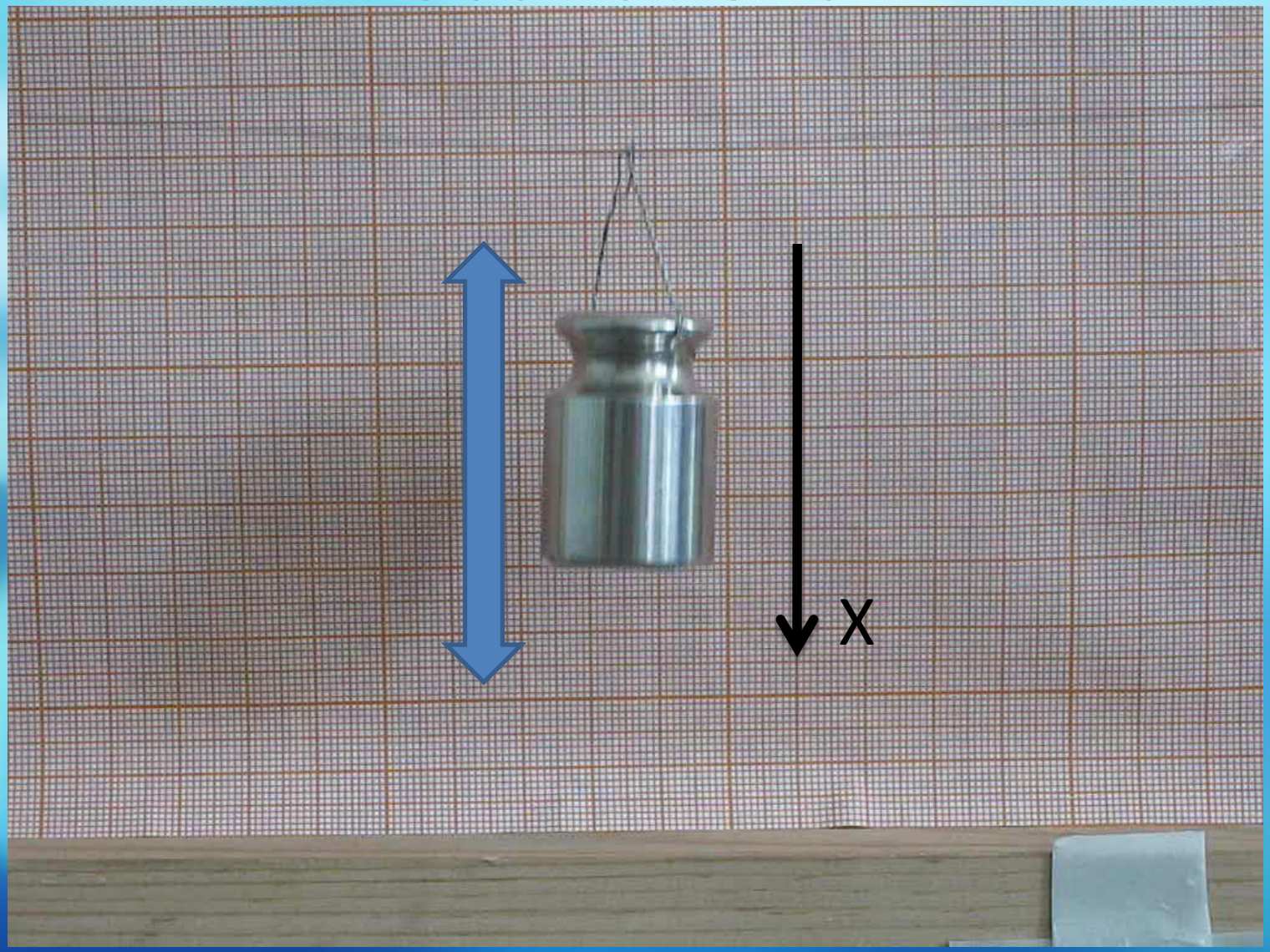
Experimental setup



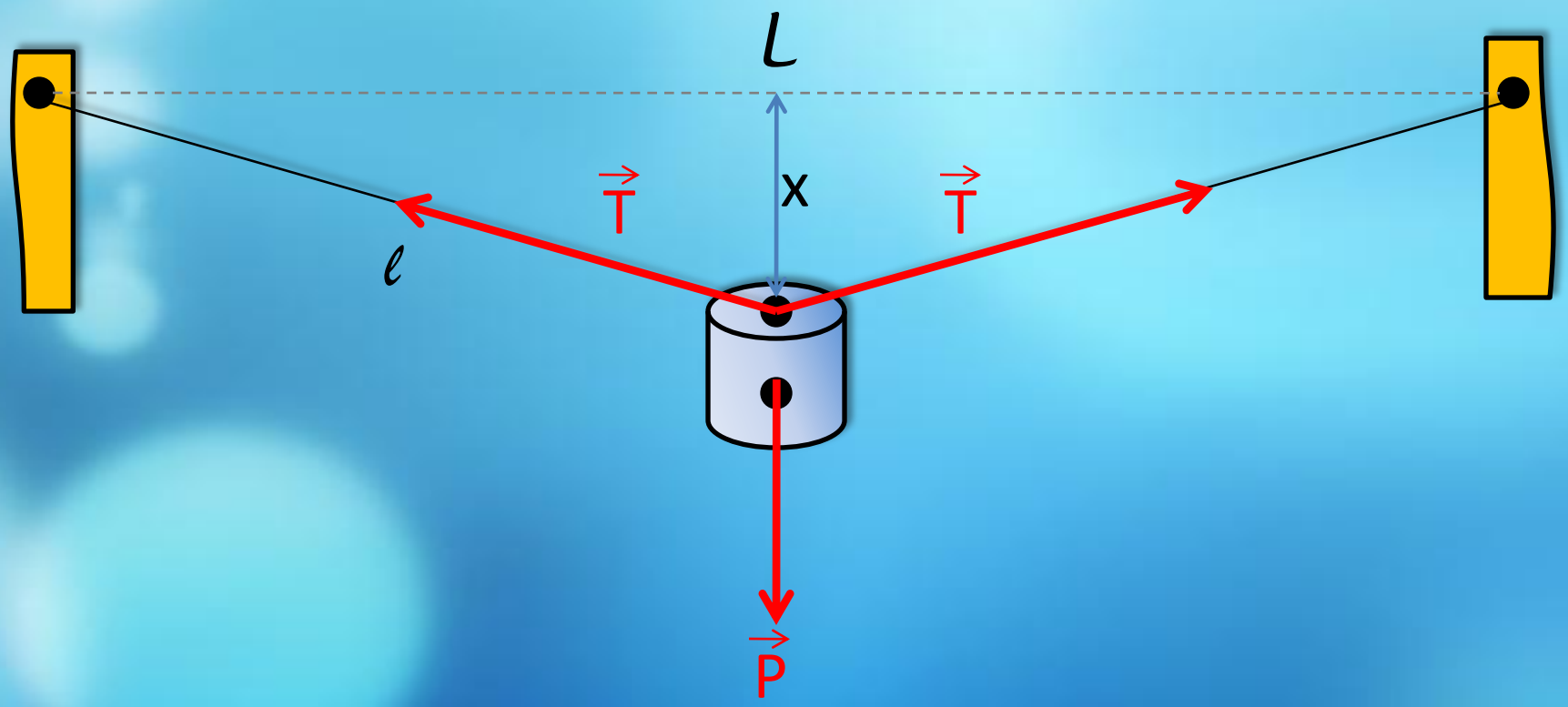
Experimental setup



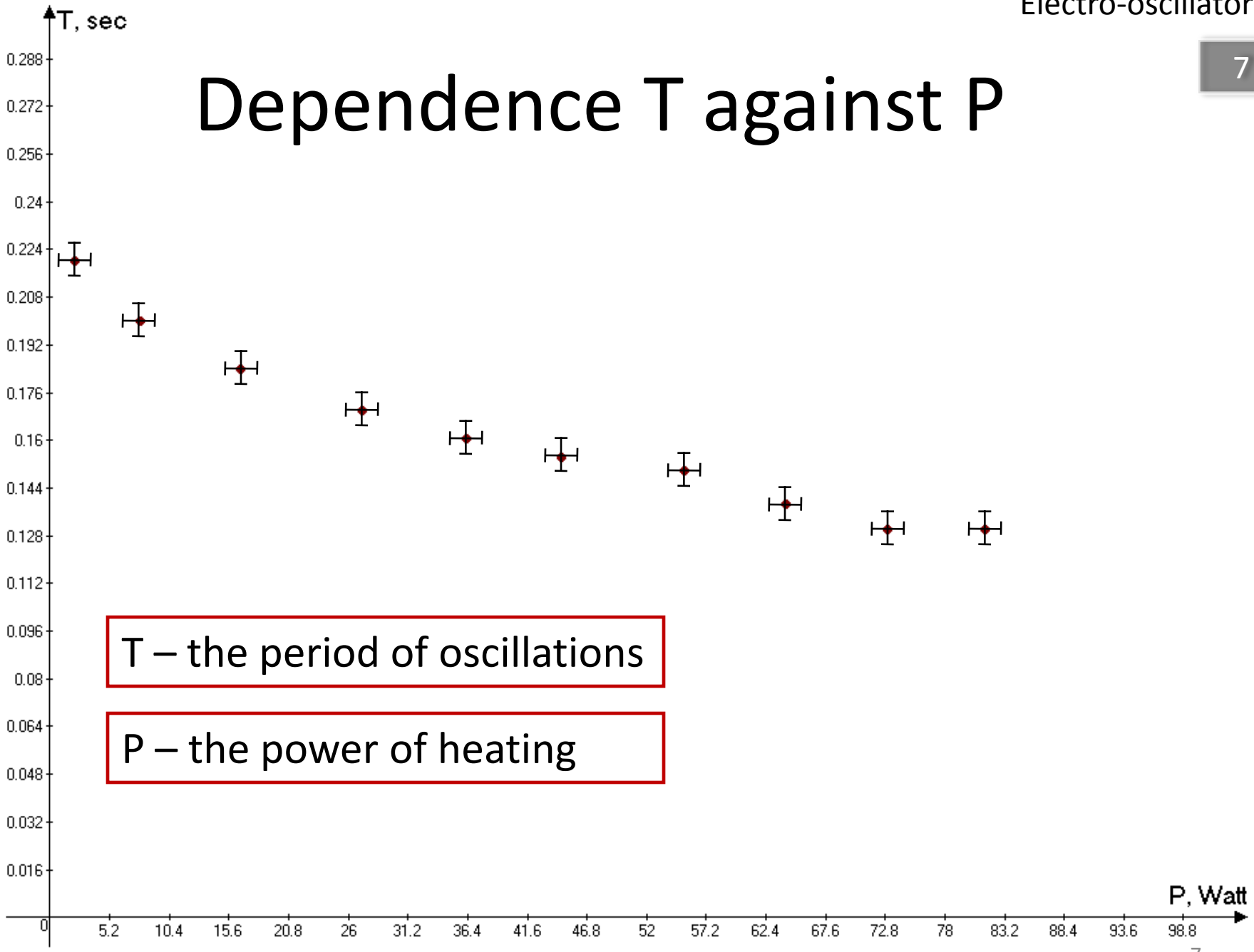
Oscillations



Experimental setup



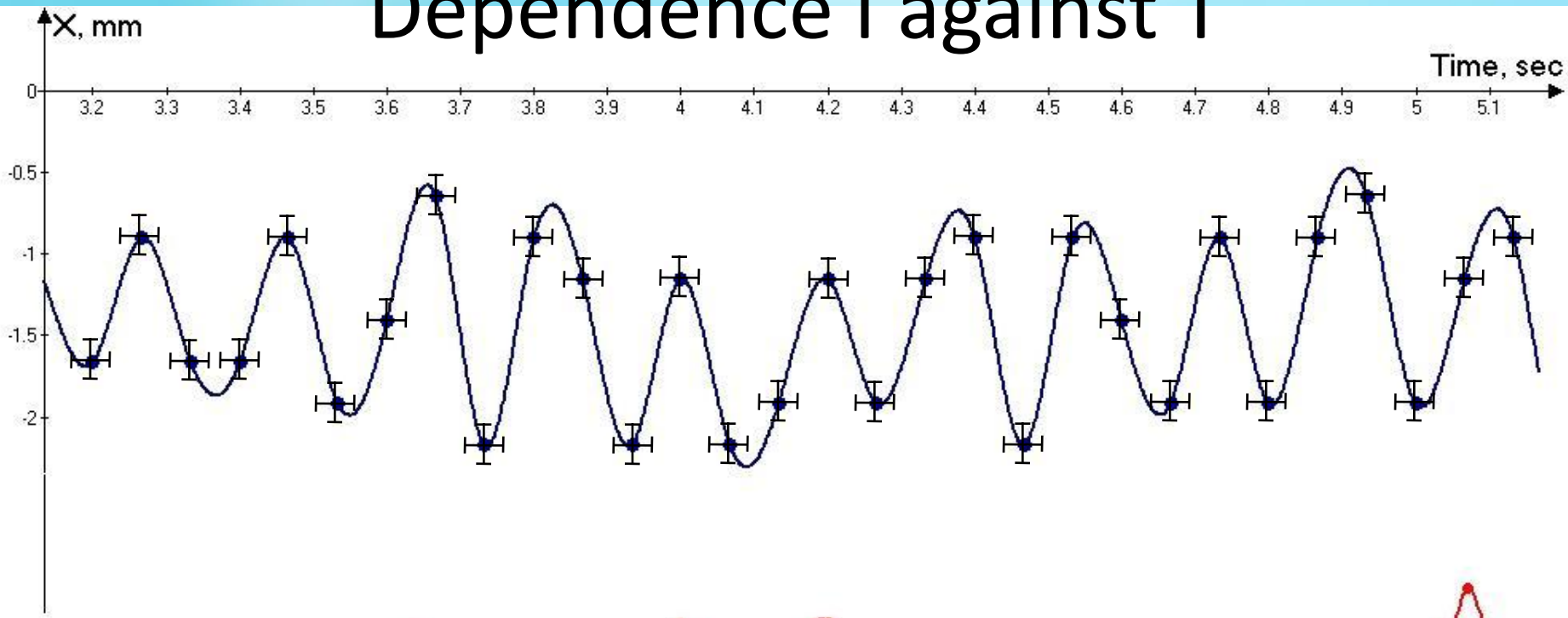
Dependence T against P

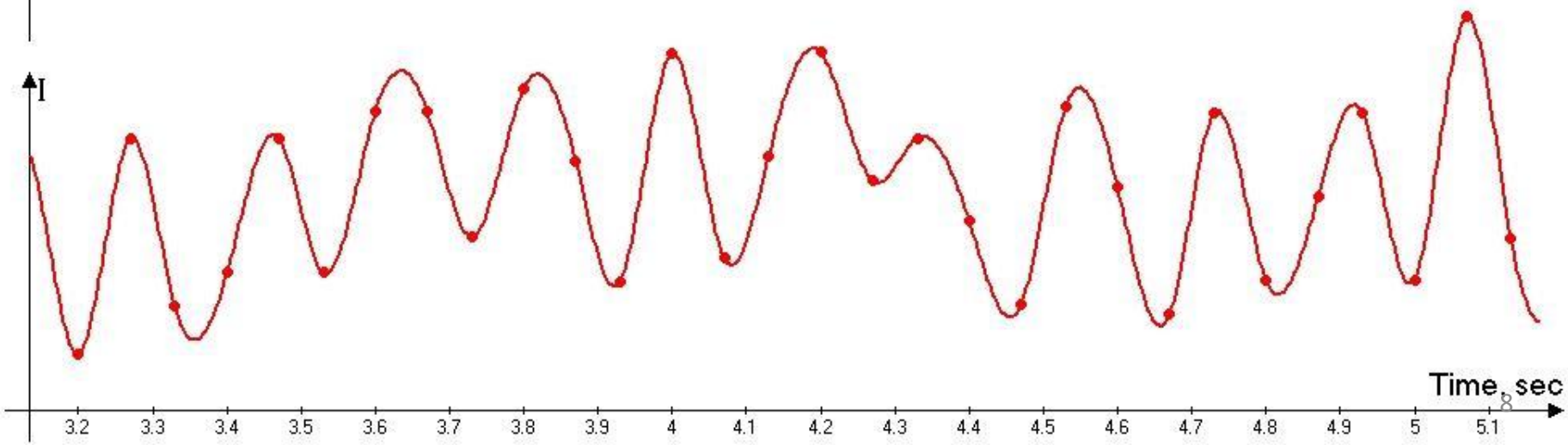


T – the period of oscillations

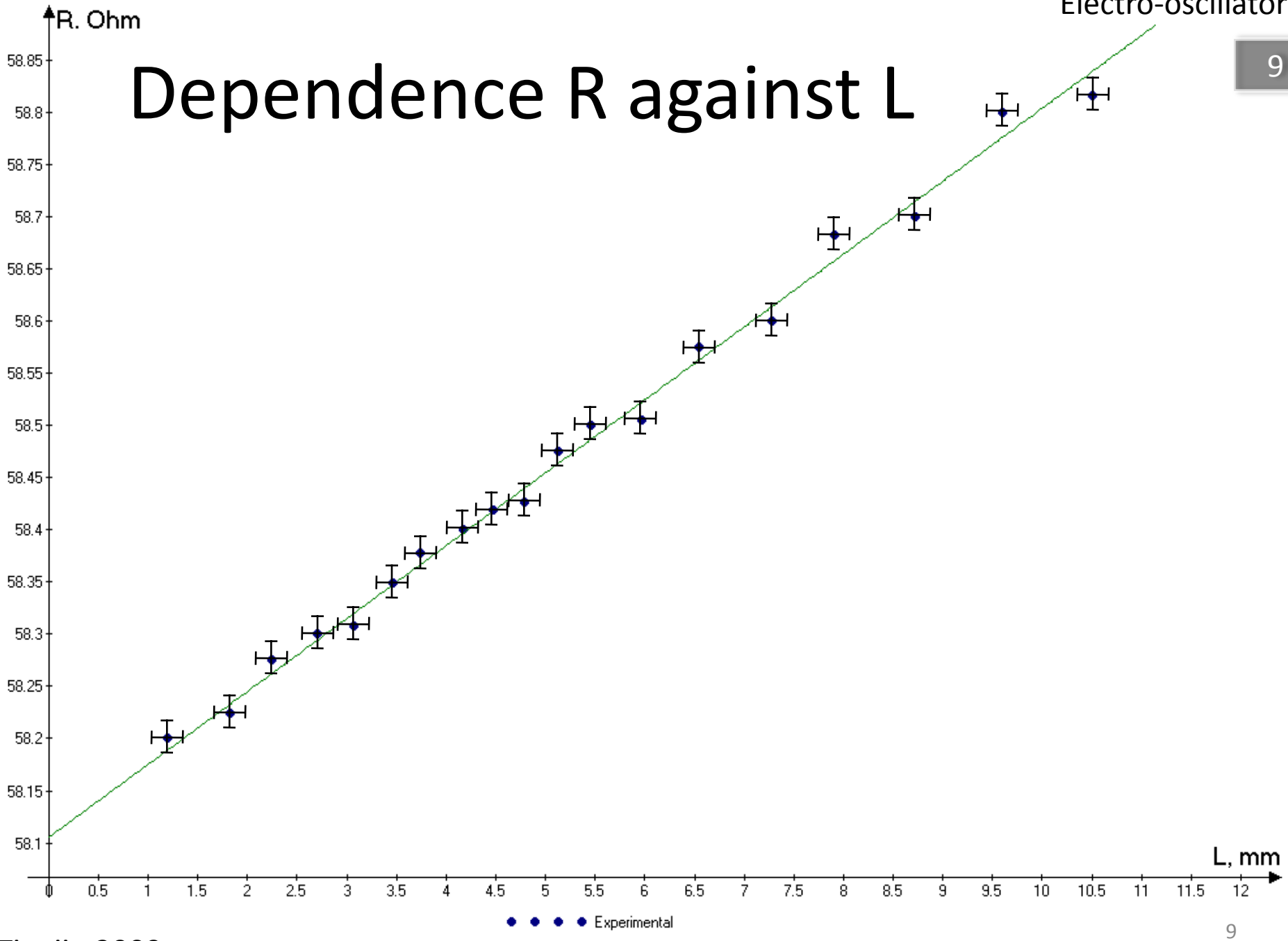
P – the power of heating

Dependence X against T & Dependence I against T

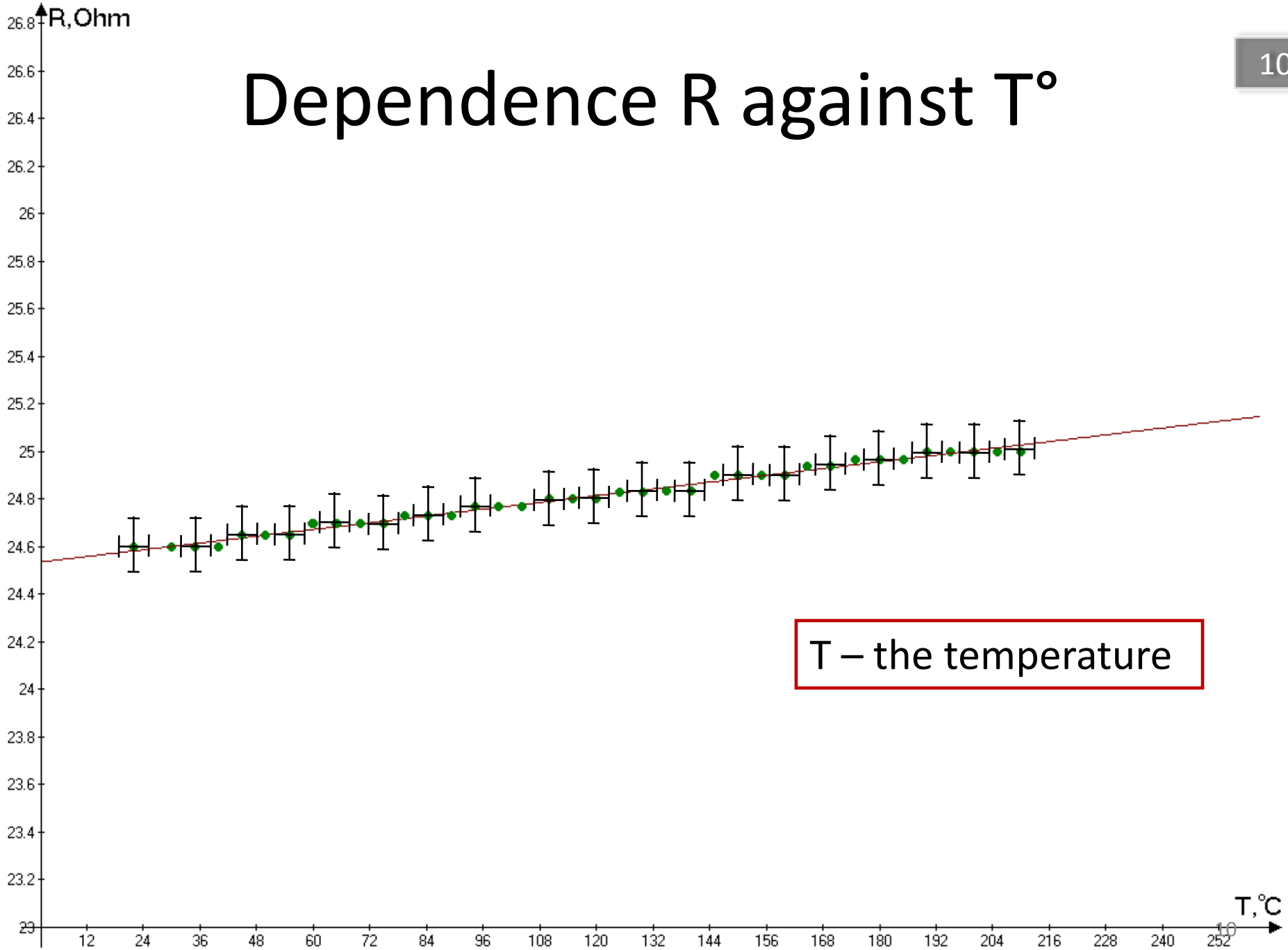




Dependence R against L

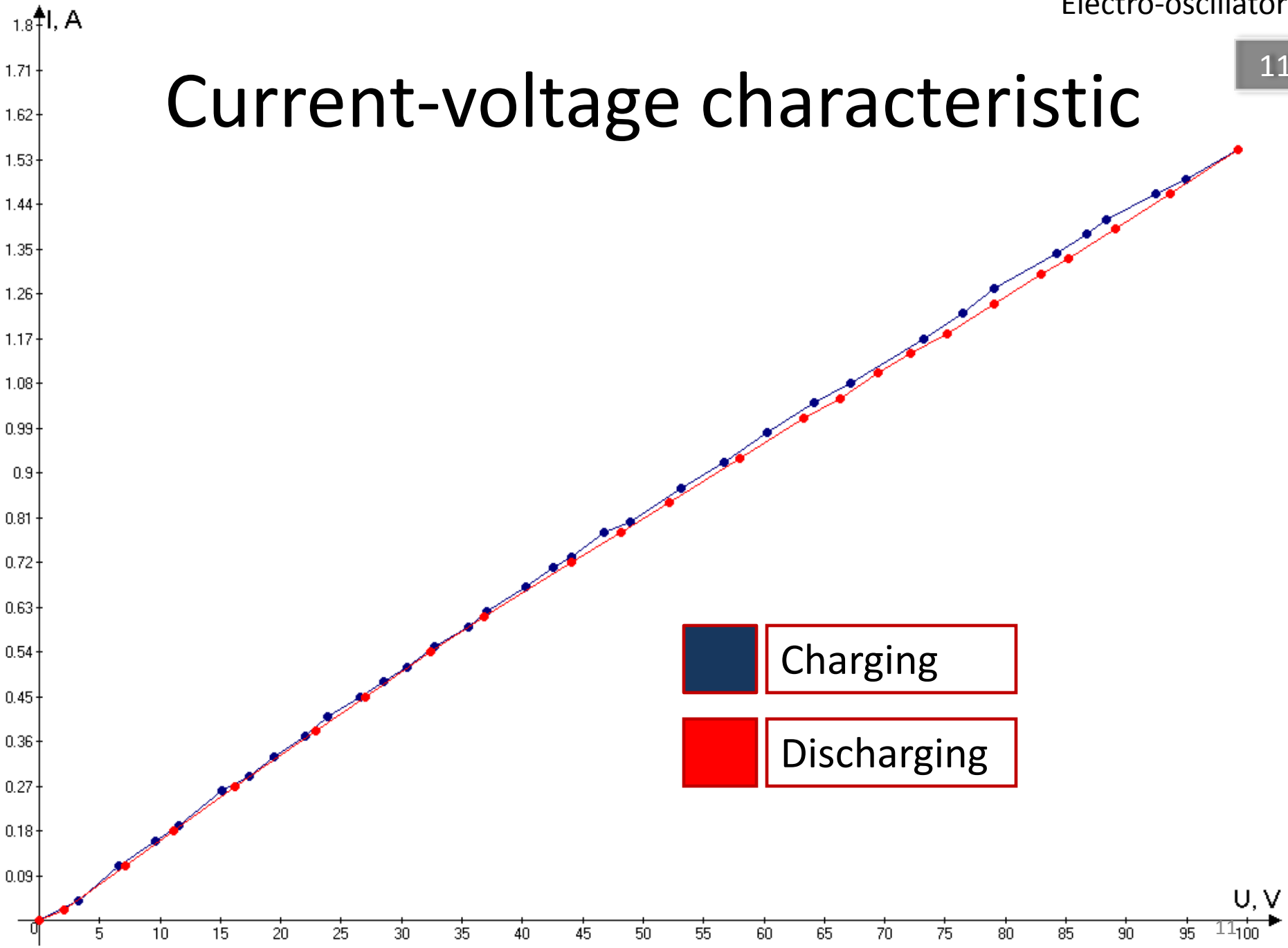


Dependence R against T°



T – the temperature

Current-voltage characteristic



Stimulate force

$$L = L_0(1 + \alpha \Delta T)$$

Stimulate force

$$P = \frac{U^2}{R(T)}$$

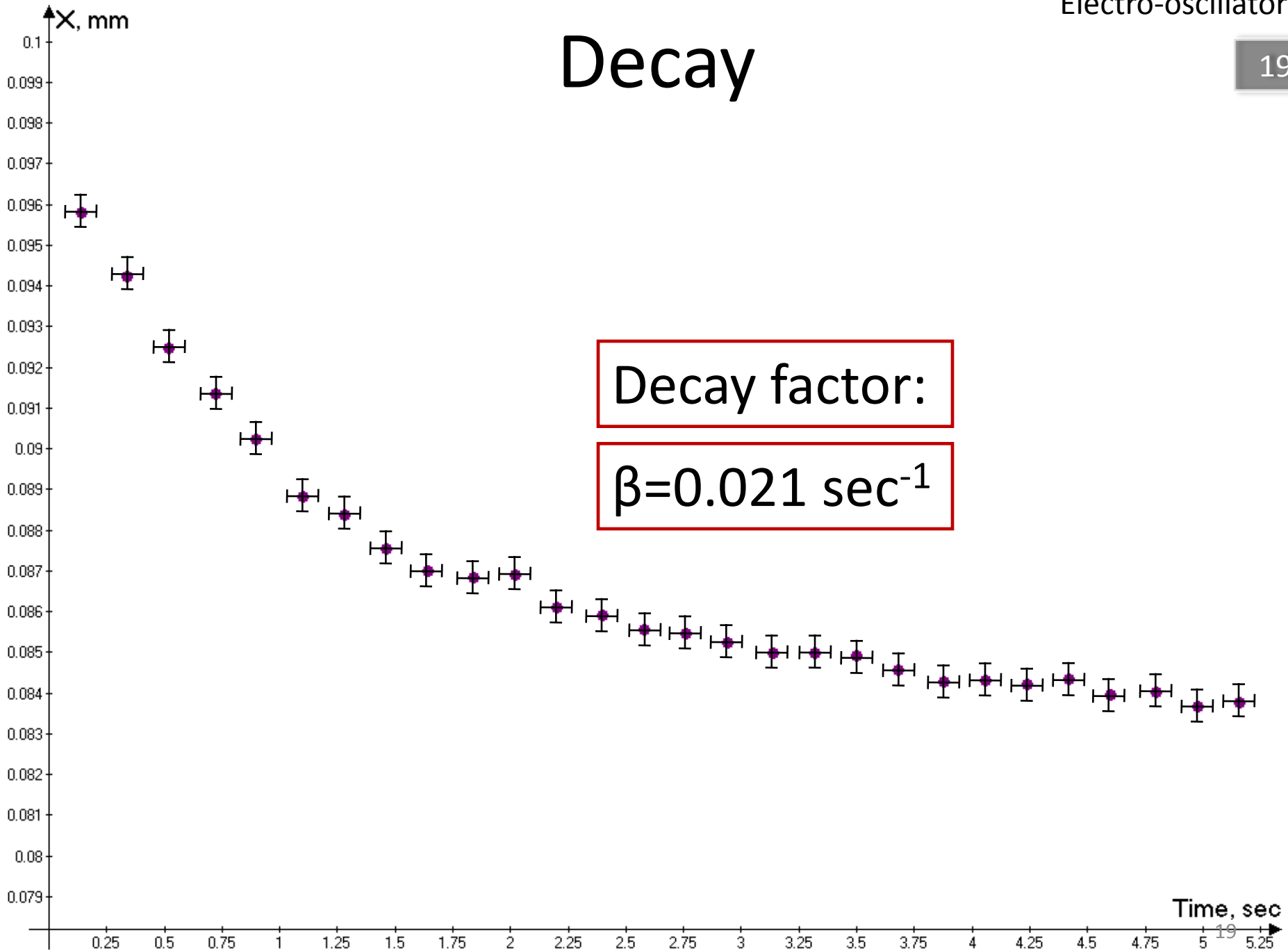
$$R(T) = \rho_0 (1 + \beta \Delta T) \frac{L(T)}{S}$$

Stimulate force

$$F_r = \frac{E(T)S}{L(T)} dL$$

$$E(T) = E_0(1 - \gamma \Delta T)$$

Decay



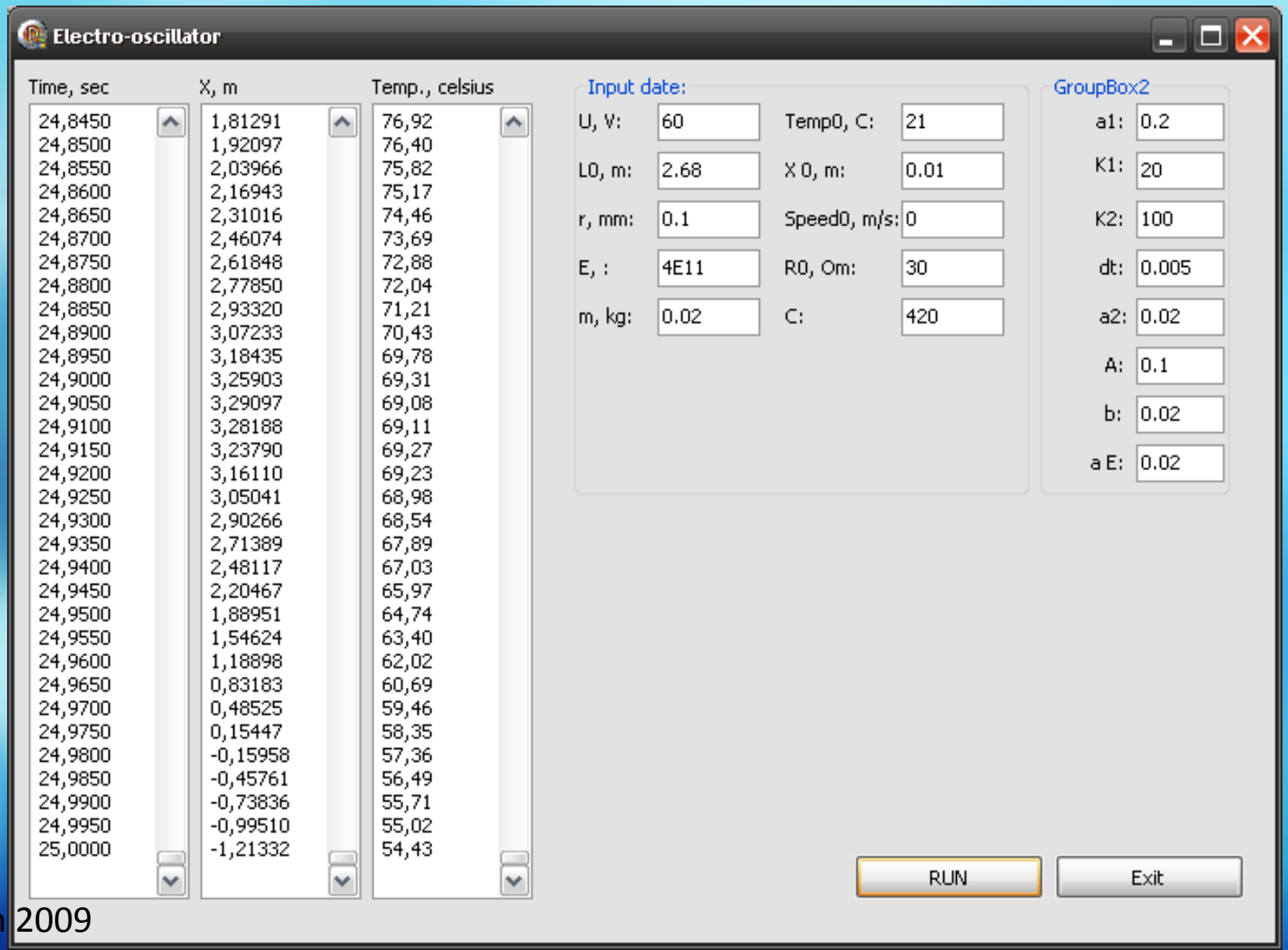
Decay factor:

$\beta = 0.021\ sec^{-1}$

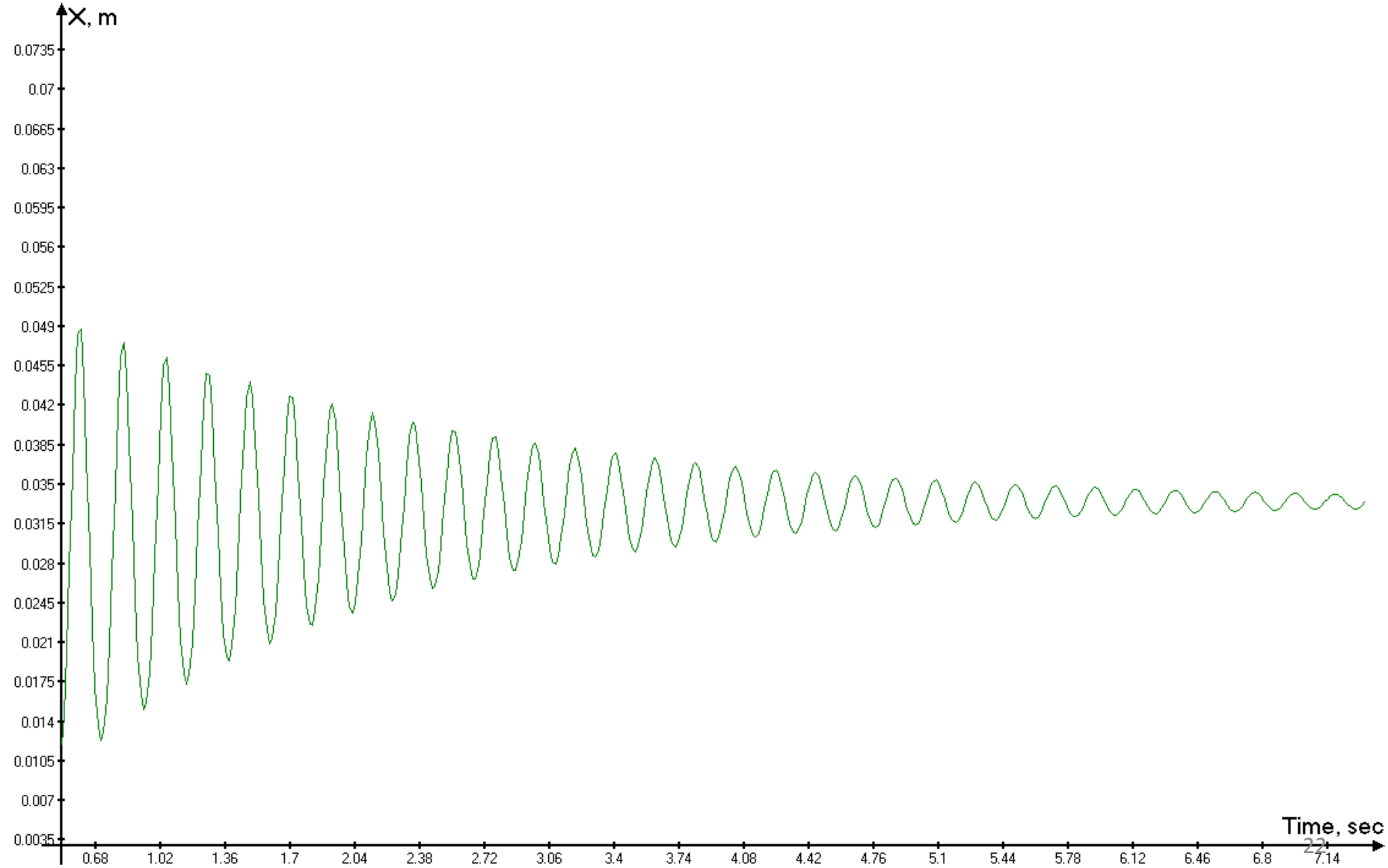
Heat loss

$$P_l = 2\pi r L(T)[\underbrace{K_1(T - T_0)}_{\text{Doesn`t depend on speed}} + \underbrace{K_2 V(T - T_0)}_{\text{Depend on speed}}]$$

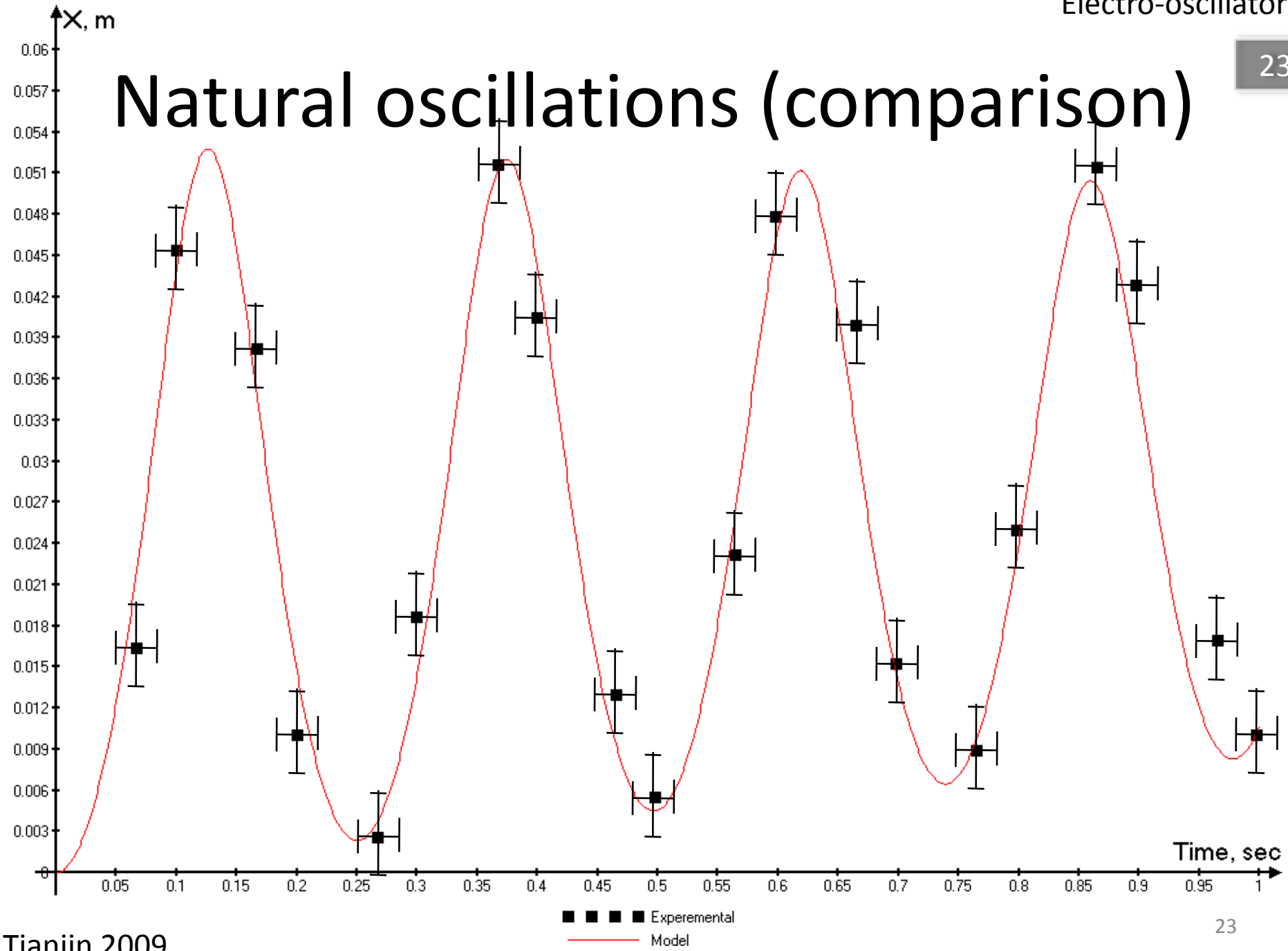
Computer model



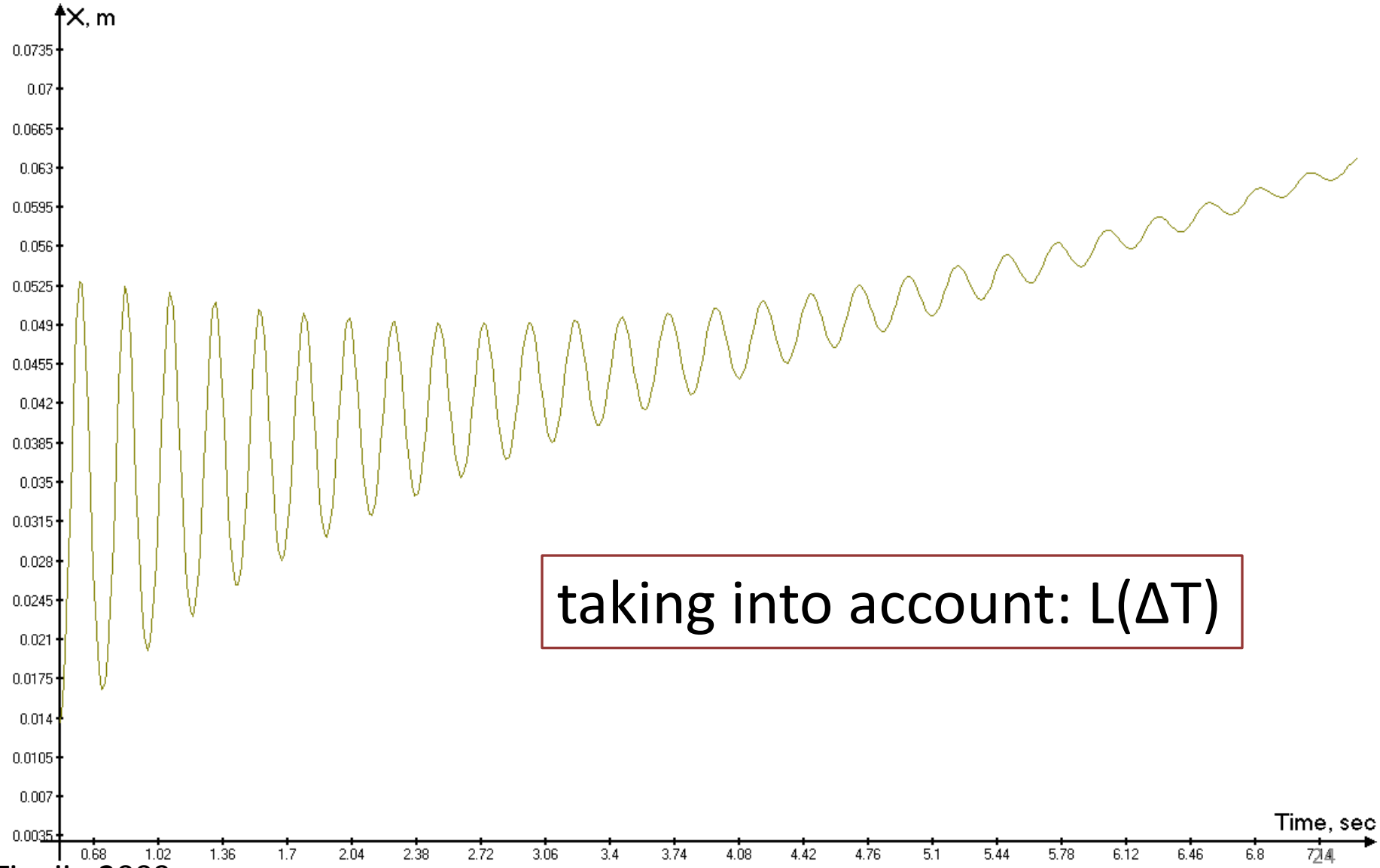
Natural oscillations (model)



Natural oscillations (comparison)

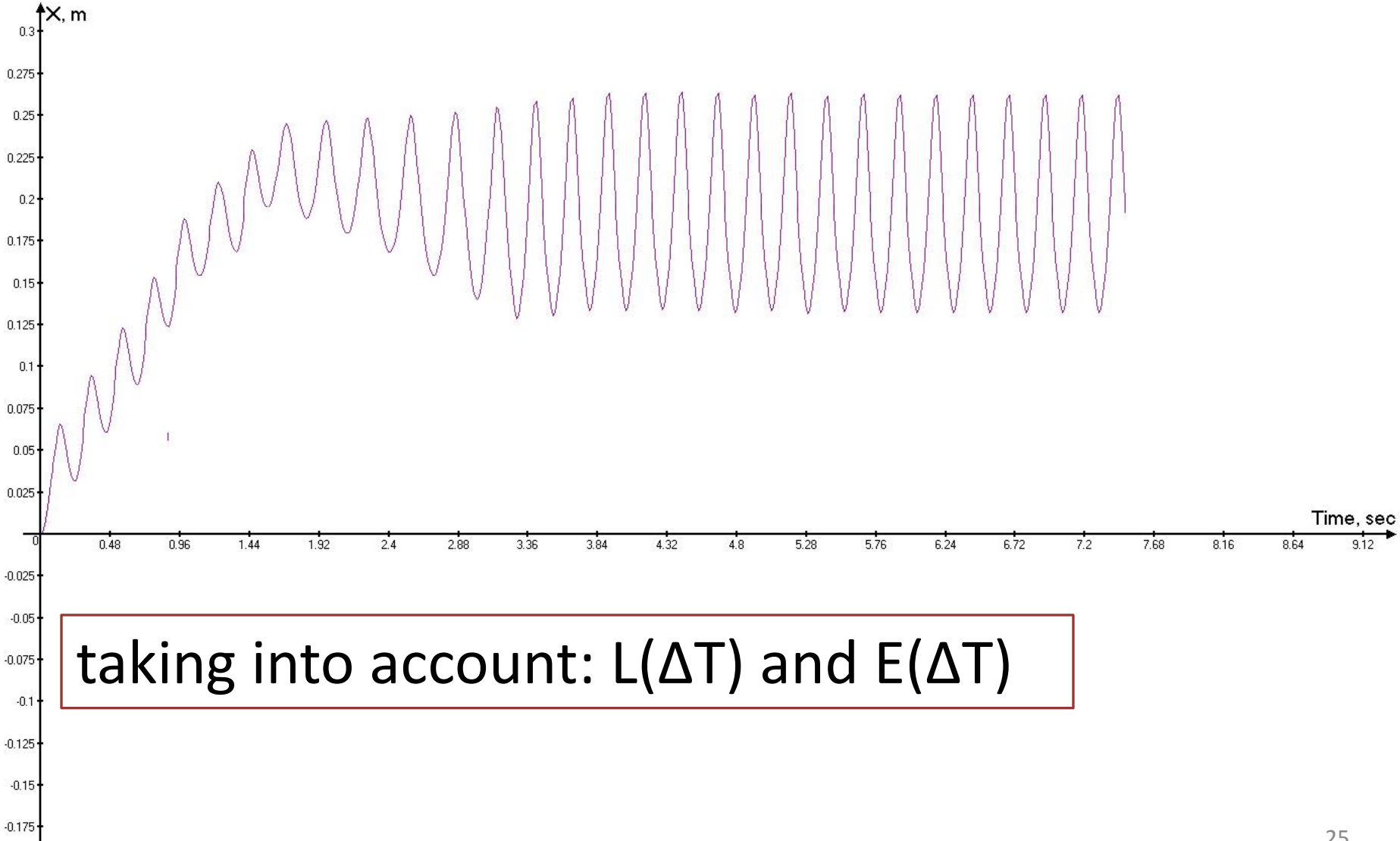


Oscillations (model)



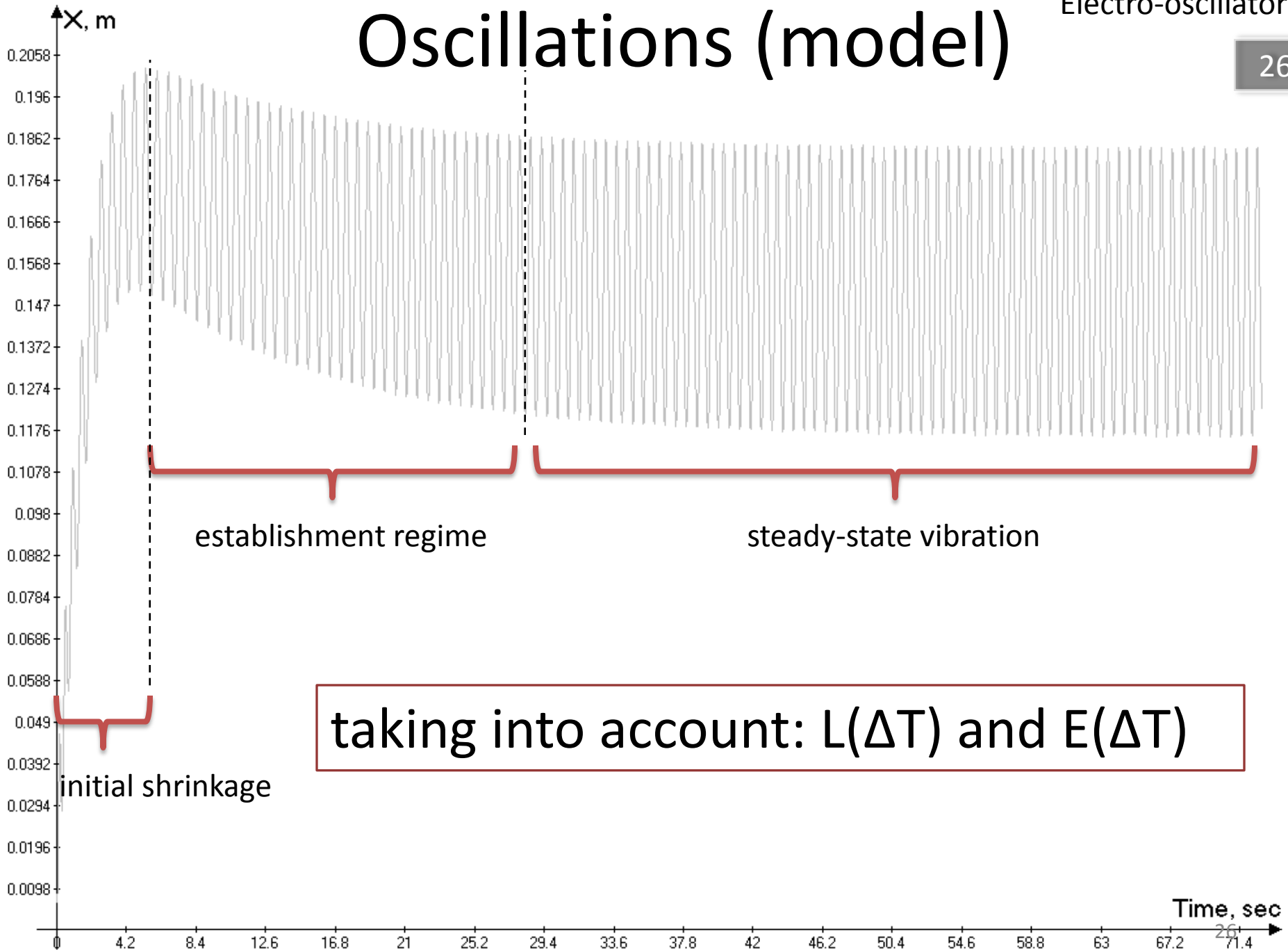
taking into account: L(ΔT)

Oscillations (model)+L(ΔT) and E(ΔT)



taking into account: L(ΔT) and E(ΔT)

Oscillations (model)



taking into account: L(ΔT) and E(ΔT)

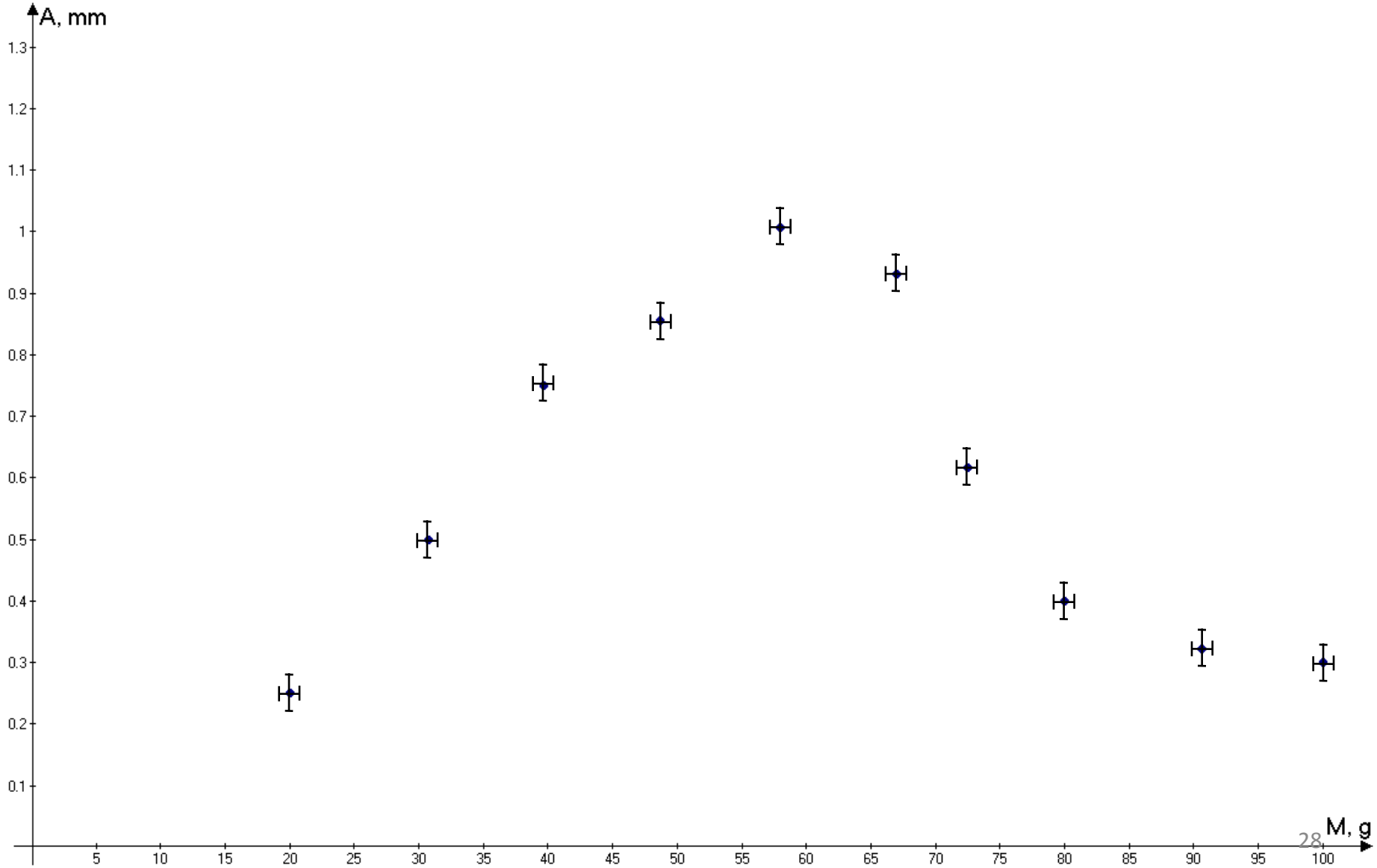
Resonance

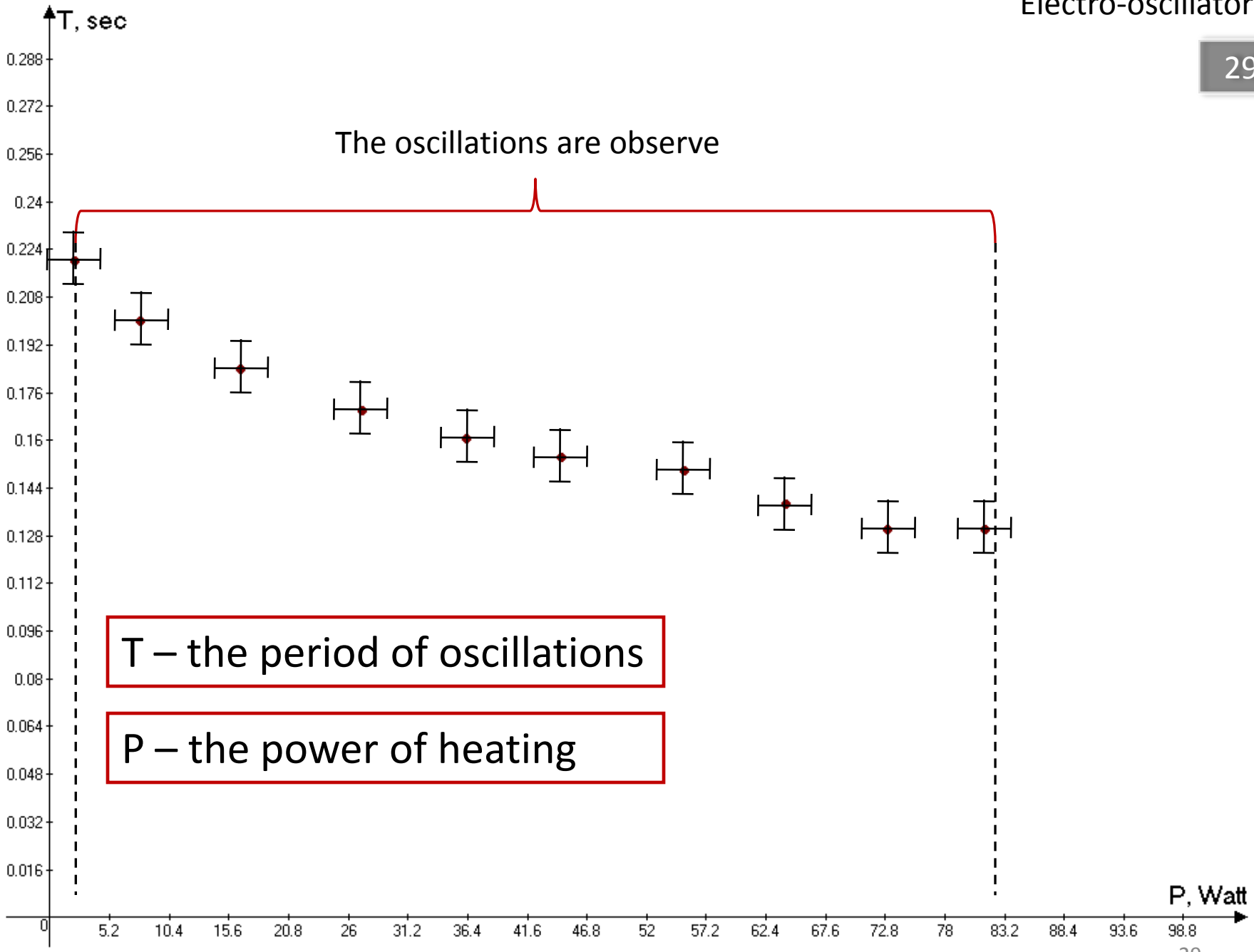
- Max oscillations if:

$$\nu_{natural} = k\nu_{forced}$$

$$k \in N$$

Dependence Amplitude against m




T, sec
0.288
0.272
0.256
0.24
0.224
0.208
0.192
0.176
0.16
0.144
0.128
0.112
0.096
0.08
0.064
0.048
0.032
0.016
0
5.2
10.4
15.6
20.8
26
31.2
36.4
41.6
46.8
52
57.2
62.4
67.6
72.8
78
83.2
88.4
93.6
98.8
P, Watt
The oscillations are observe
T – the period of oscillations
P – the power of heating

Total

- We detected main dependences for oscillations: $L(\Delta T)$, $\rho(\Delta T)$, $E(\Delta T)$;
- We should be take into account what all dependences are important for electro-oscillations.

Results

- Max oscillations was condition of resonance;
- All dependences are important for oscillation;
- We made the computer model for oscillations.

THANKS FOR ATTENTION

References

- Savljev “General physics course”;
- A. I. Slobodianuk “Mehanics”;
- R. P. Feynman “The Feynman Lectures on Physics”.