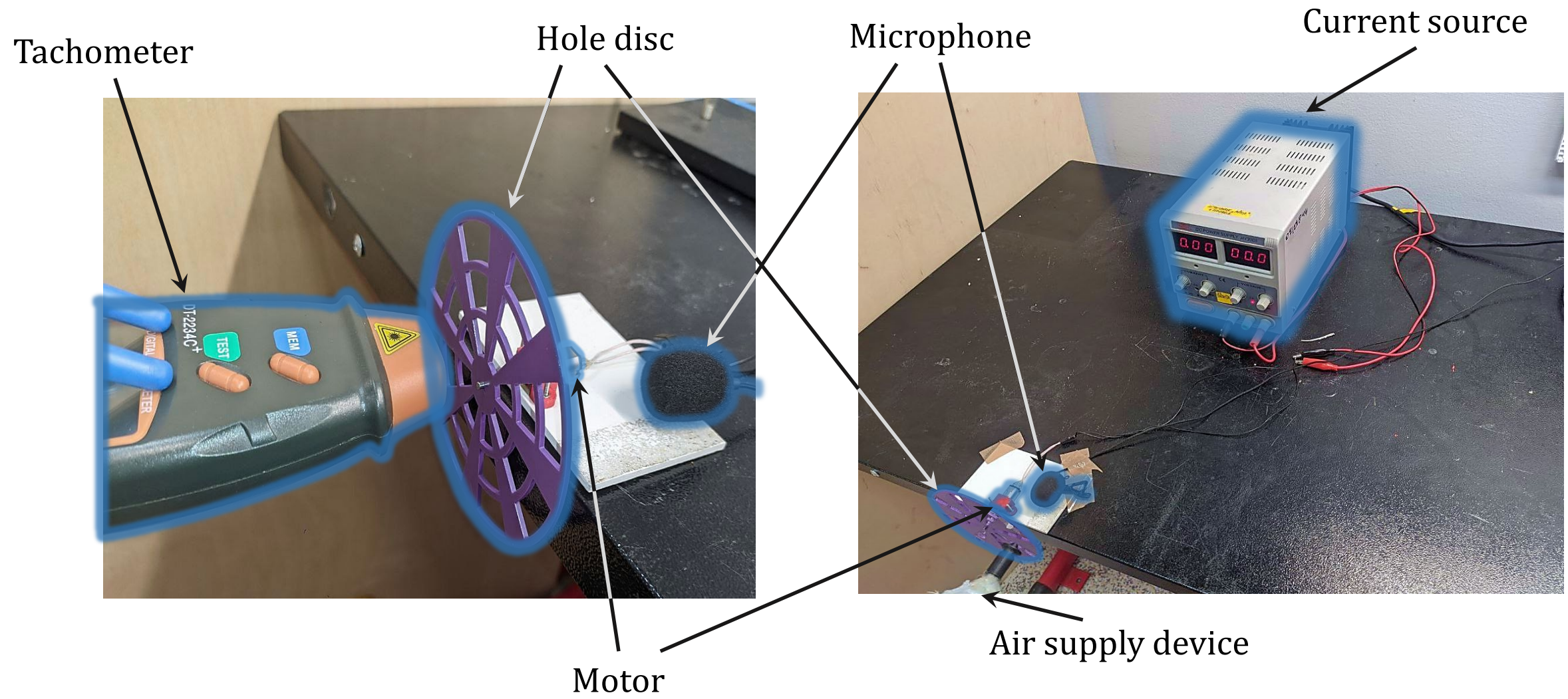
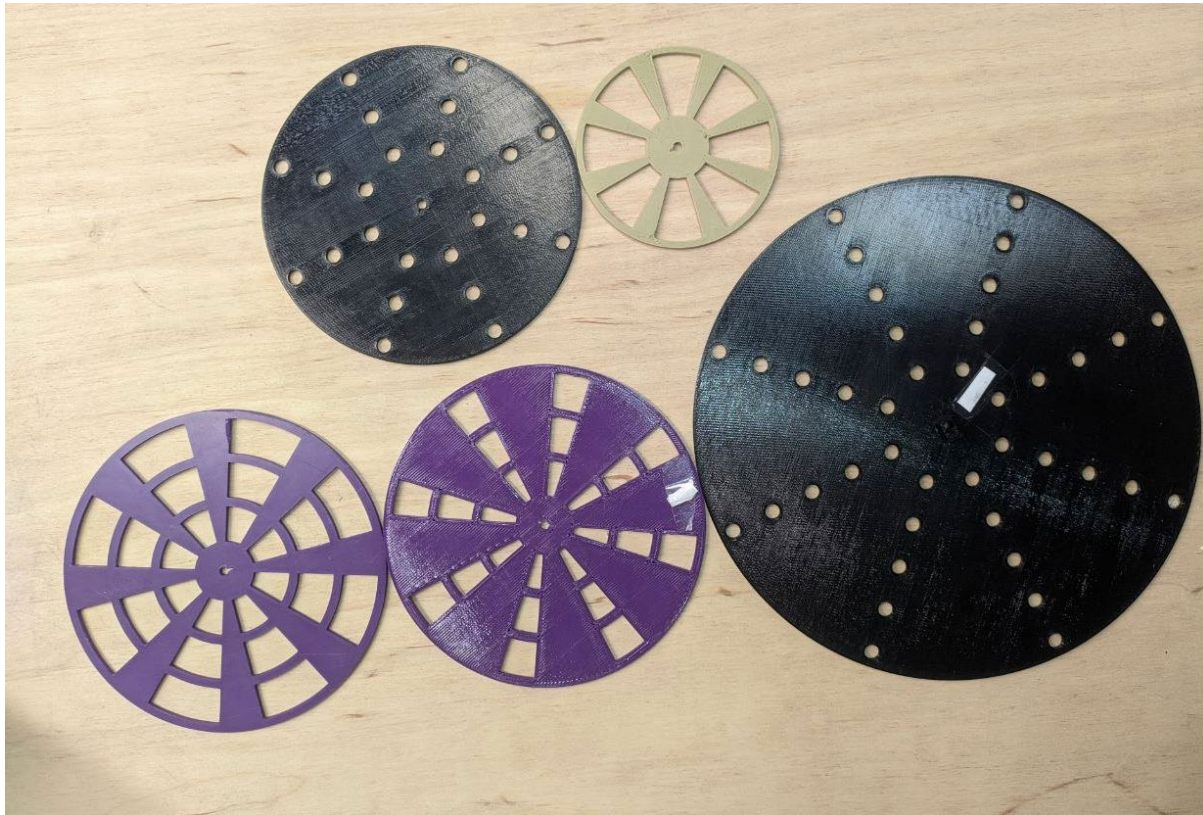


# Setup



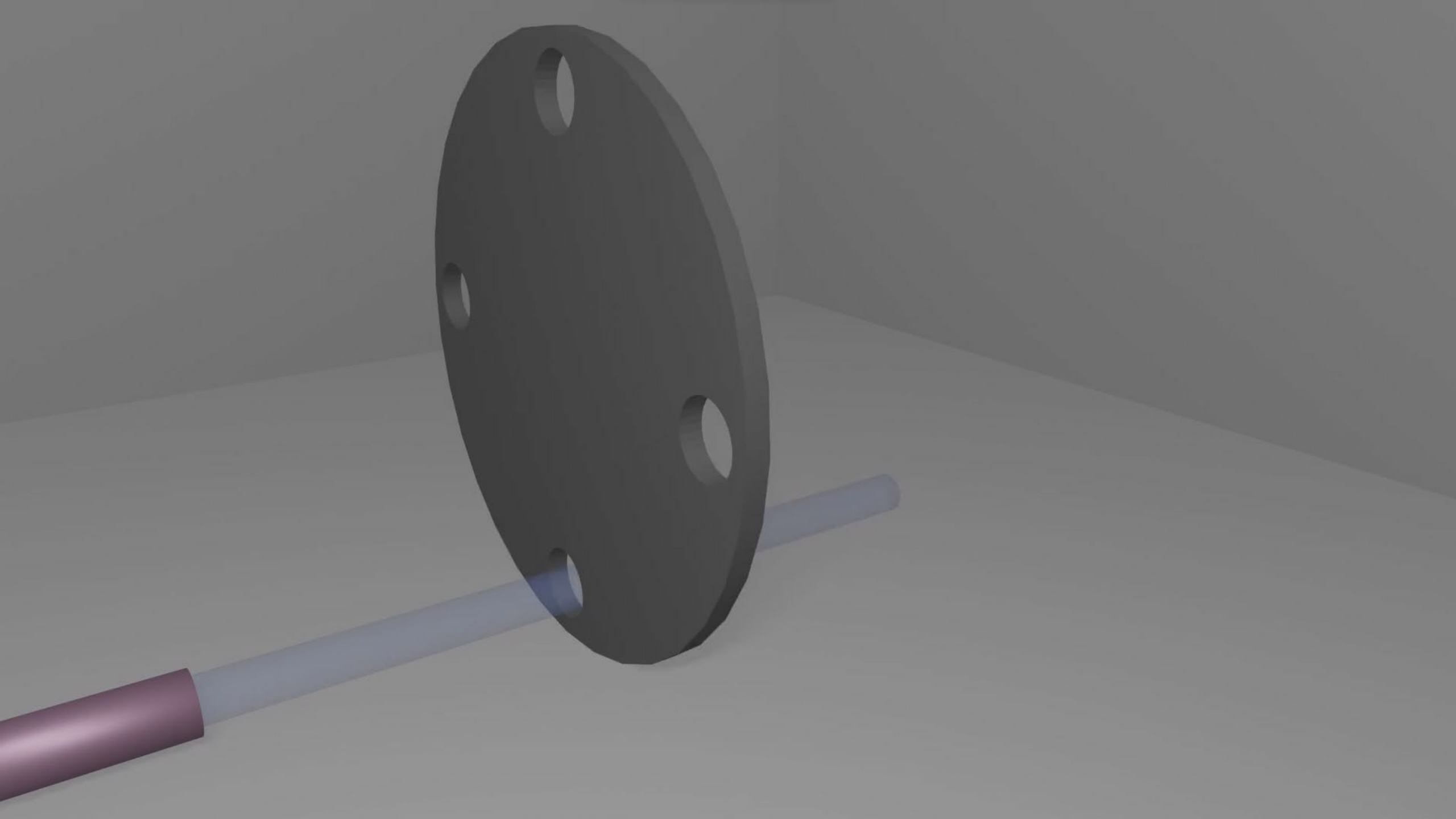
# Various disks & Air supply device



Various disks



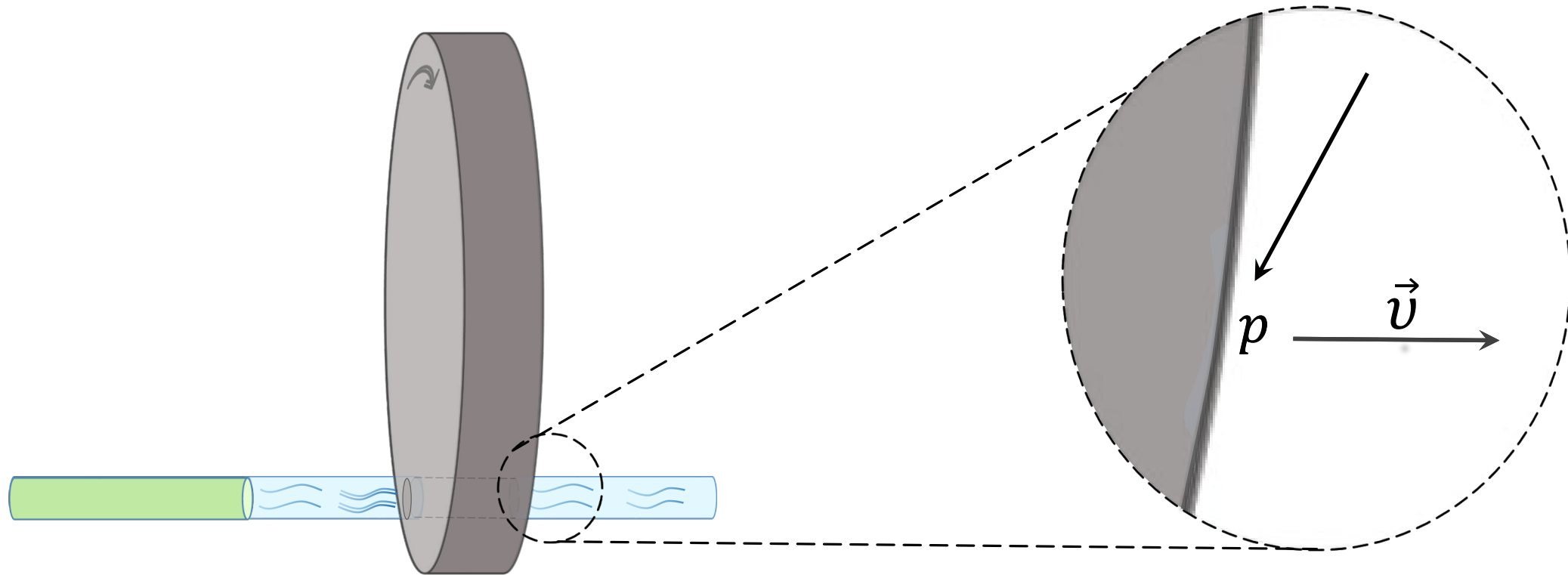
Air supply device

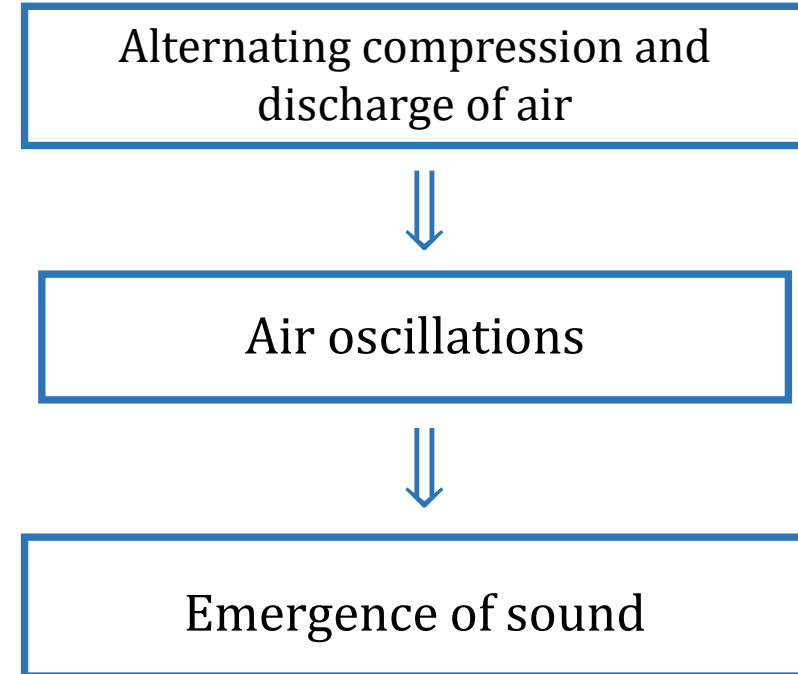
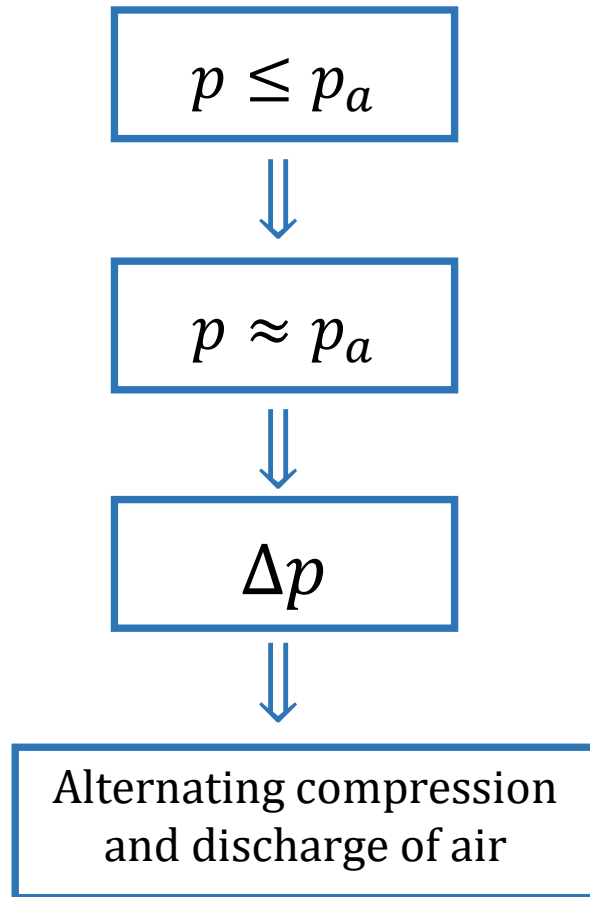


# A short explanation of the effect

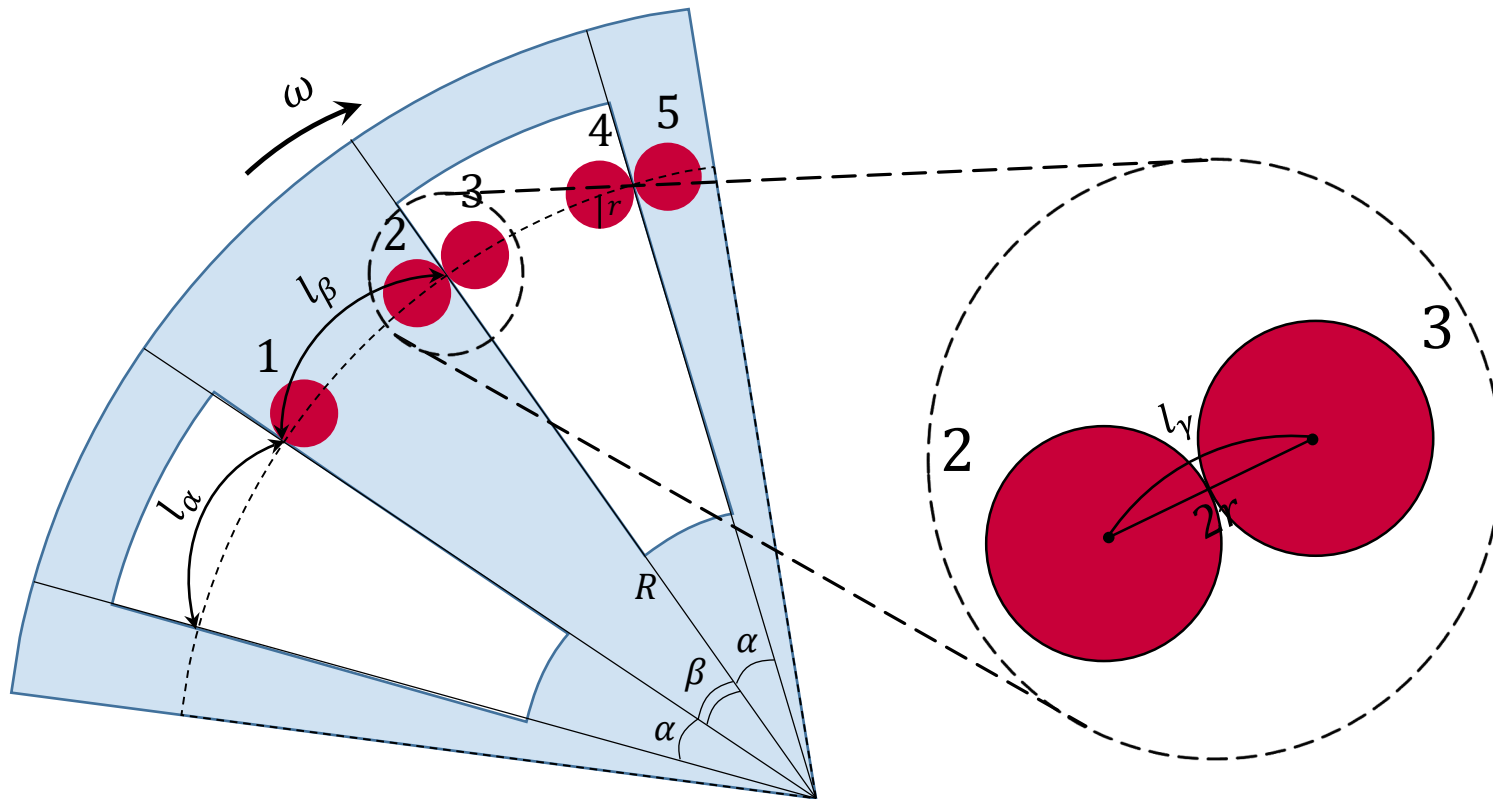
The air flow and the hole coincide

$$p \leq p_a$$





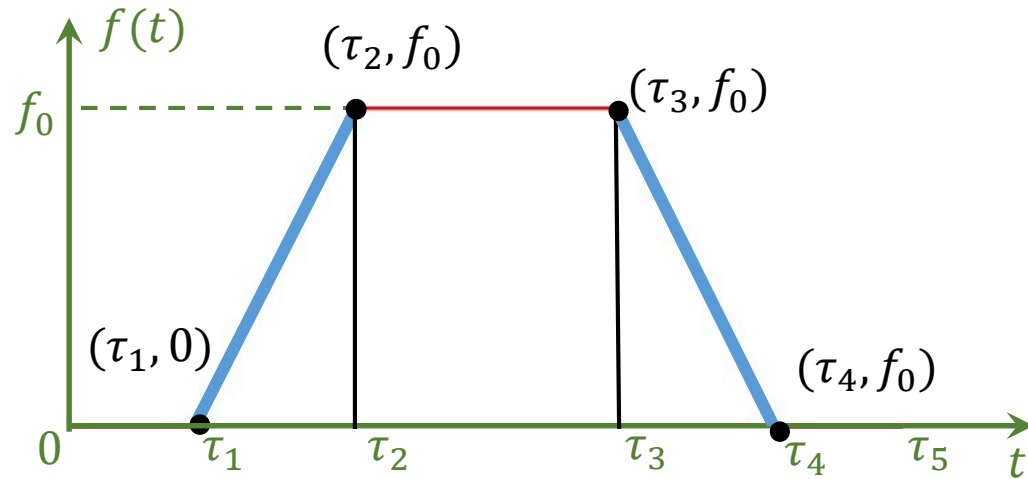
# Passing time



$$\left\{ \begin{array}{l} l_\alpha = R\alpha \\ l_\beta = R\beta \\ l_\gamma = 2R \cdot \arcsin \frac{r}{R} \\ t = \frac{l}{\omega R} \\ T = \frac{l_\alpha + l_\beta + 2l_\gamma}{\omega R} \end{array} \right.$$

$r$  – nozzle radius

# Driving force



$$\begin{cases} 0 = k\tau_1 + b \\ f_0 = k\tau_2 + b \end{cases}$$



$$f(t) = f_0 \frac{t - \tau_1}{\tau_2 - \tau_1}$$

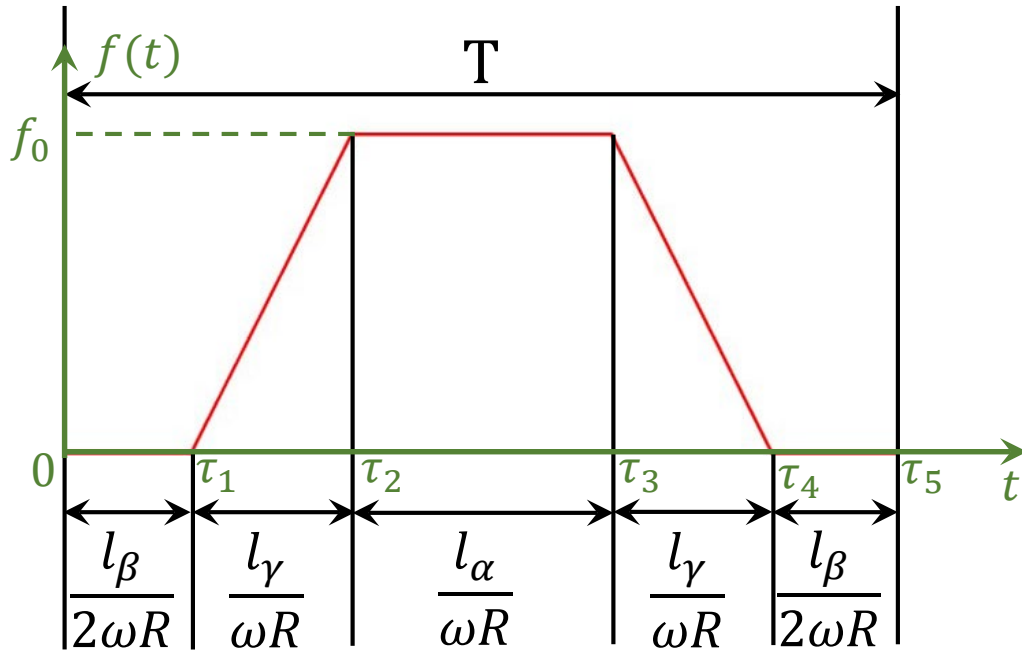
$$\begin{cases} f_0 = k\tau_3 + b \\ 0 = k\tau_4 + b \end{cases}$$



$$f(t) = f_0 \frac{t - \tau_4}{\tau_3 - \tau_4}$$

$$f(t) = \begin{cases} 0, & 0 \leq t < \tau_1 \\ f_0 \frac{t - \tau_1}{\tau_2 - \tau_1}, & \tau_1 \leq t < \tau_2 \\ f_0, & \tau_2 \leq t < \tau_3 \\ f_0 \frac{t - \tau_4}{\tau_3 - \tau_4}, & \tau_3 \leq t < \tau_4 \\ 0, & \tau_4 \leq t < \tau_5 \end{cases}$$

# Final Expression



$$\tau_1 = \frac{l_\beta}{2\omega R}$$

$$\tau_2 = \frac{l_\beta + 2l_\gamma}{2\omega R}$$

$$\tau_3 = \frac{l_\beta + 2l_\gamma + 2l_\alpha}{2\omega R}$$

$$\tau_4 = \frac{l_\beta + 4l_\gamma + 2l_\alpha}{2\omega R}$$

$$\tau_5 = \frac{l_\beta + 4l_\gamma + 2l_\alpha}{2\omega R}$$

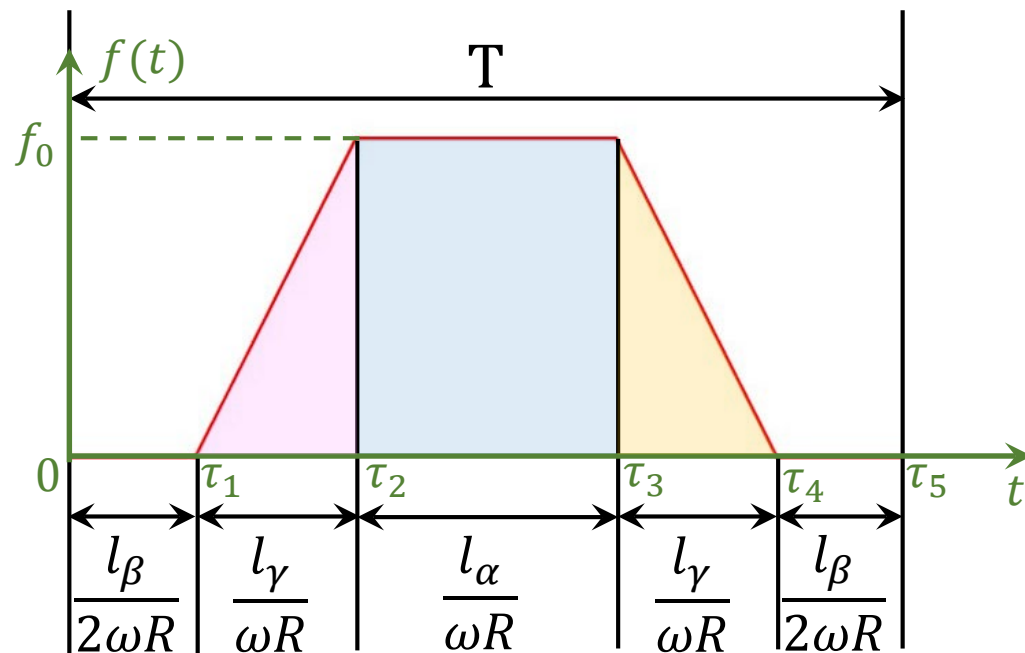


# Fourier series expansion

$$f(t) = \frac{a_0}{2} + \sum_{n=1}^{\infty} \left[ a_n \cos\left(\frac{2\pi n}{T} t\right) \right]$$

$$a_0 = \frac{2}{T} \int_0^T f(t) dt$$

$$a_n = \frac{2}{T} \int_0^T f(t) \cos\left(\frac{2\pi n}{T} t\right) dt$$



$$= \frac{2}{T} \left( \int_{\tau_1}^{\tau_2} f(t) \cos\left(\frac{2\pi n}{T} t\right) dt + \int_{\tau_2}^{\tau_3} f(t) \cos\left(\frac{2\pi n}{T} t\right) dt + \int_{\tau_3}^{\tau_4} f(t) \cos\left(\frac{2\pi n}{T} t\right) dt \right)$$

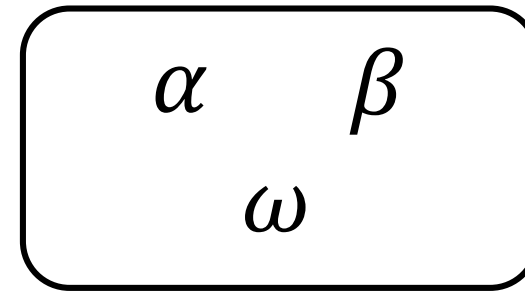
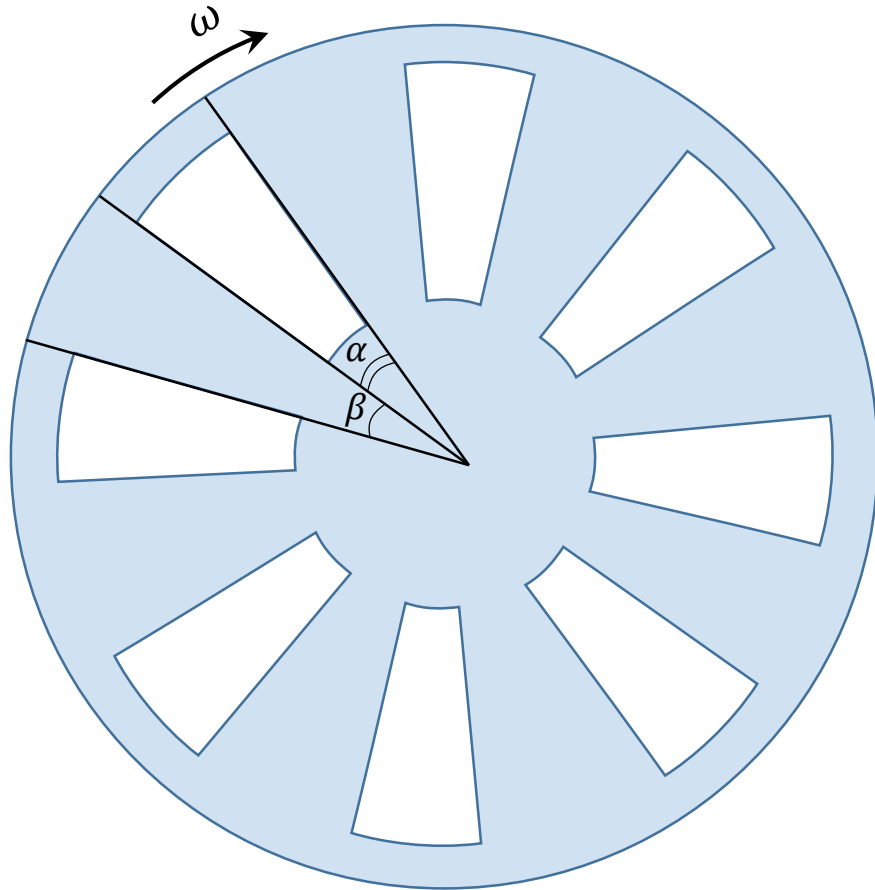
$T$  – period

$n$  – harmonic number

$a_n$  – intensity of the  $n$ th harmonic

$v_n$  – frequency of the  $n$ th harmonic

$$v_n = \frac{n}{T}$$

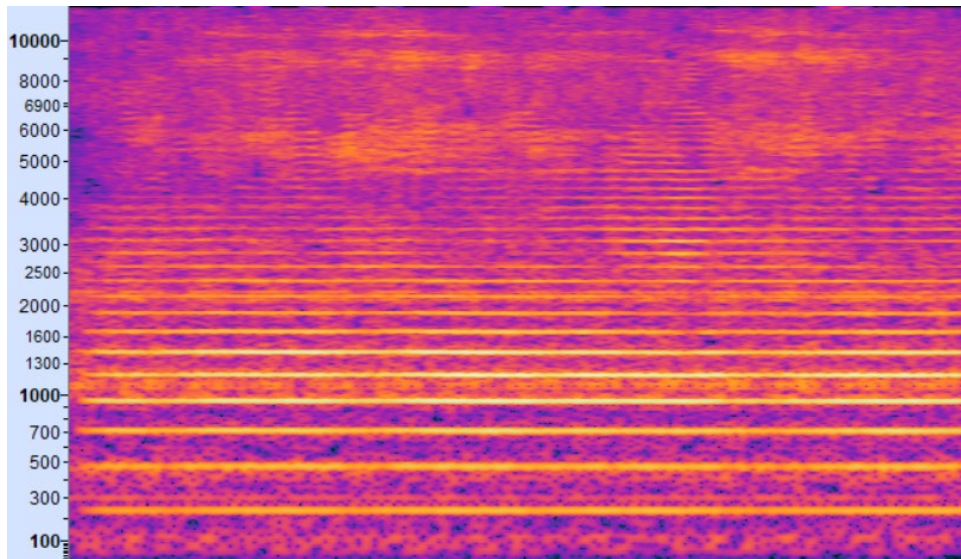


$\alpha$  — angle of hole

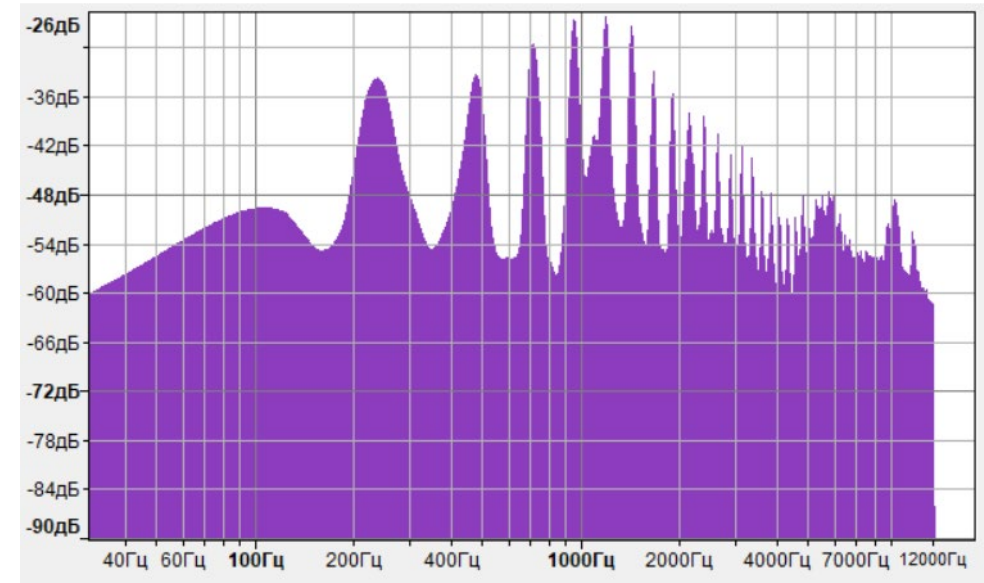
$\beta$  — filling angle

$\omega$  — angular speed of rotation

# Data receiving and processing



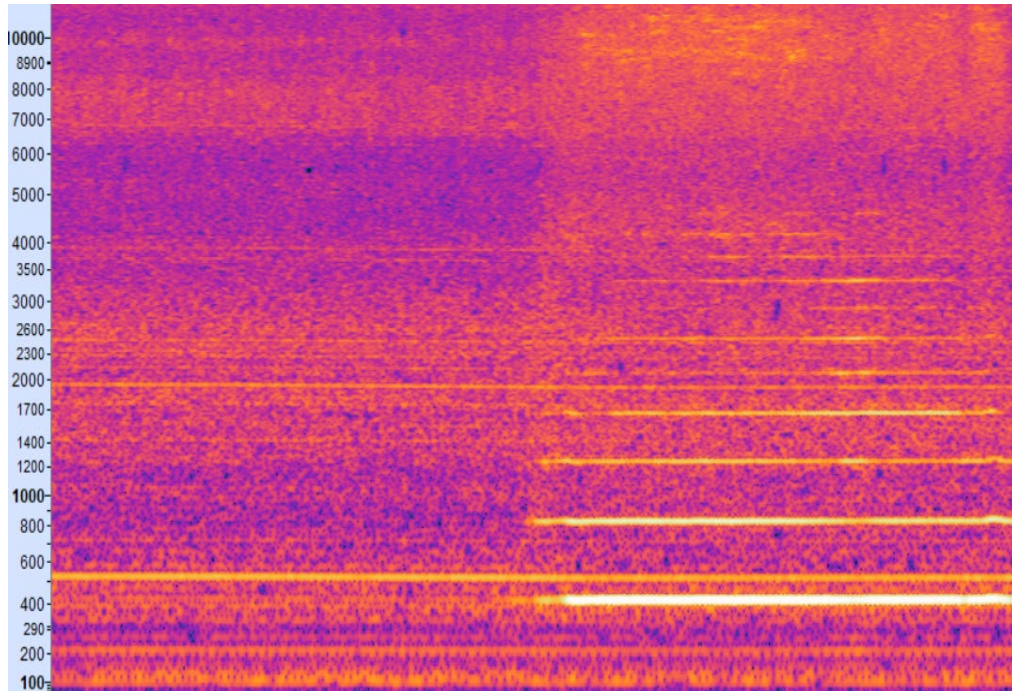
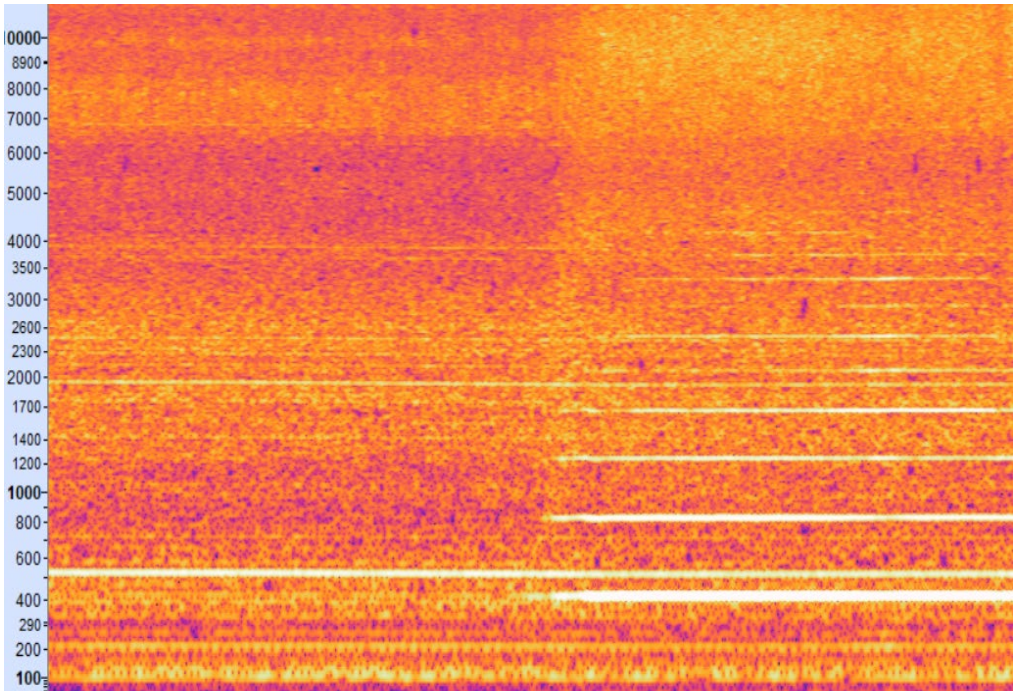
Spectrogram



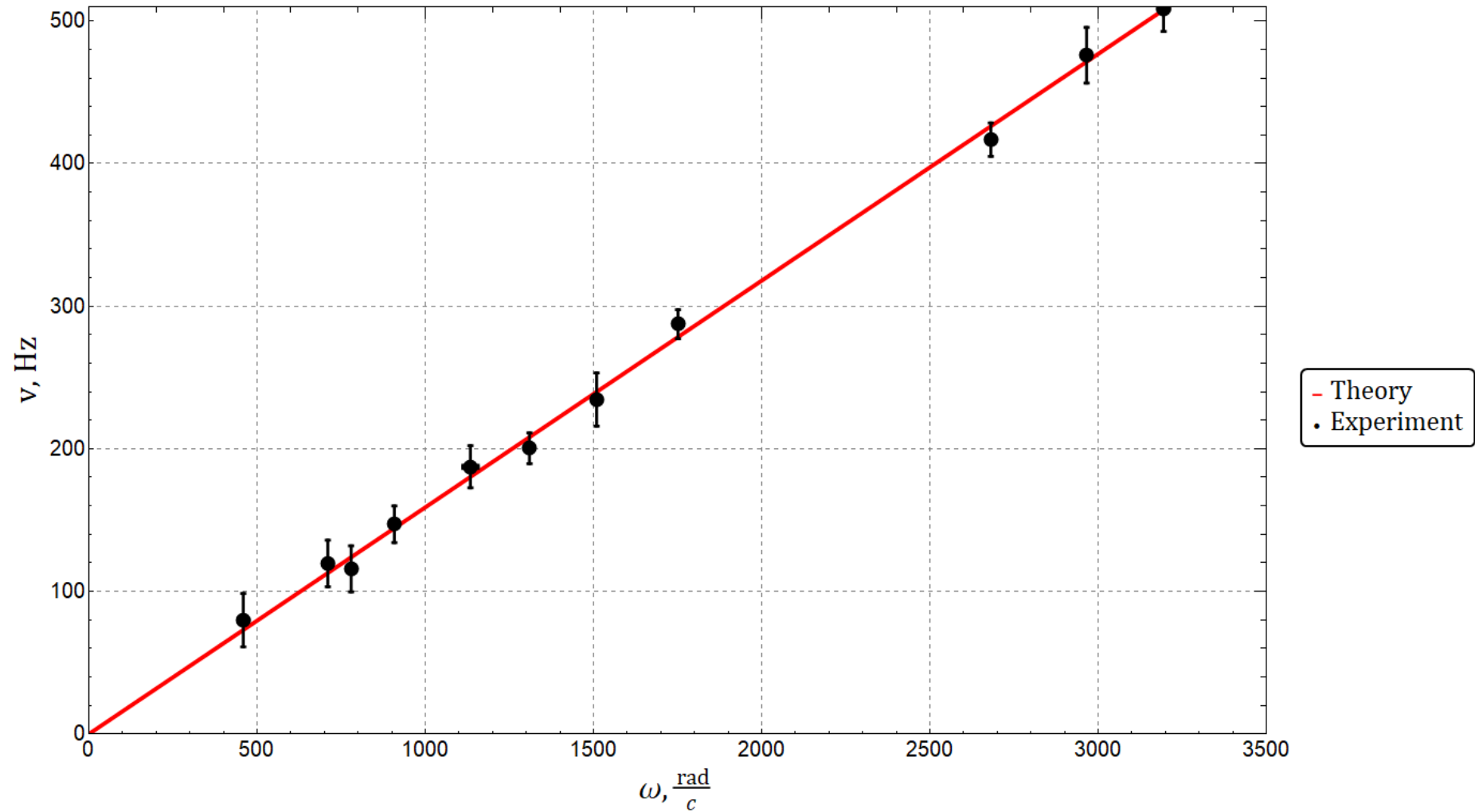
Amplitude-frequency response



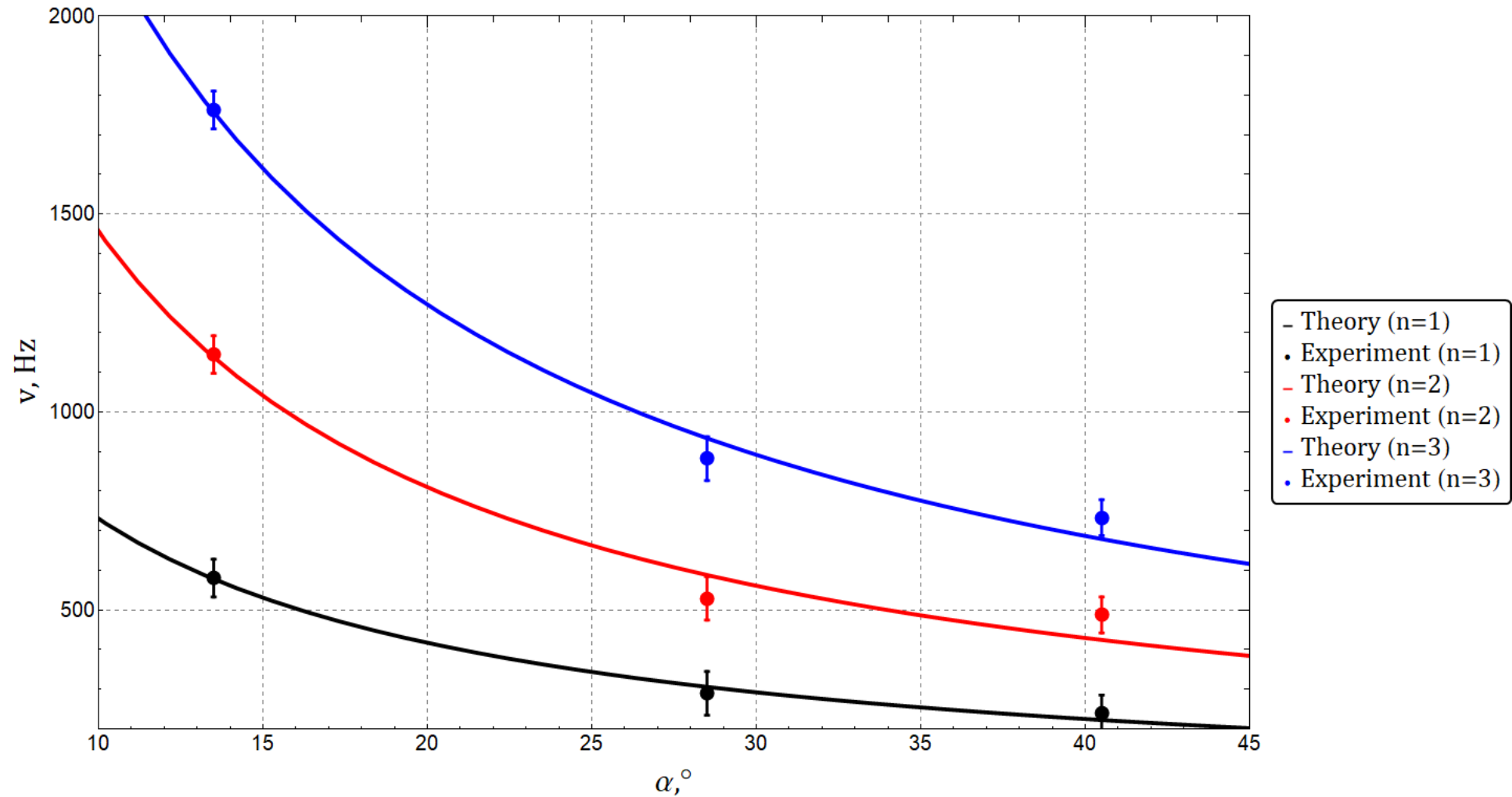
# Noise reduction



# Dependence $v(\omega)$



# Dependence $v(\alpha)$



# Dependence $v(\beta)$

