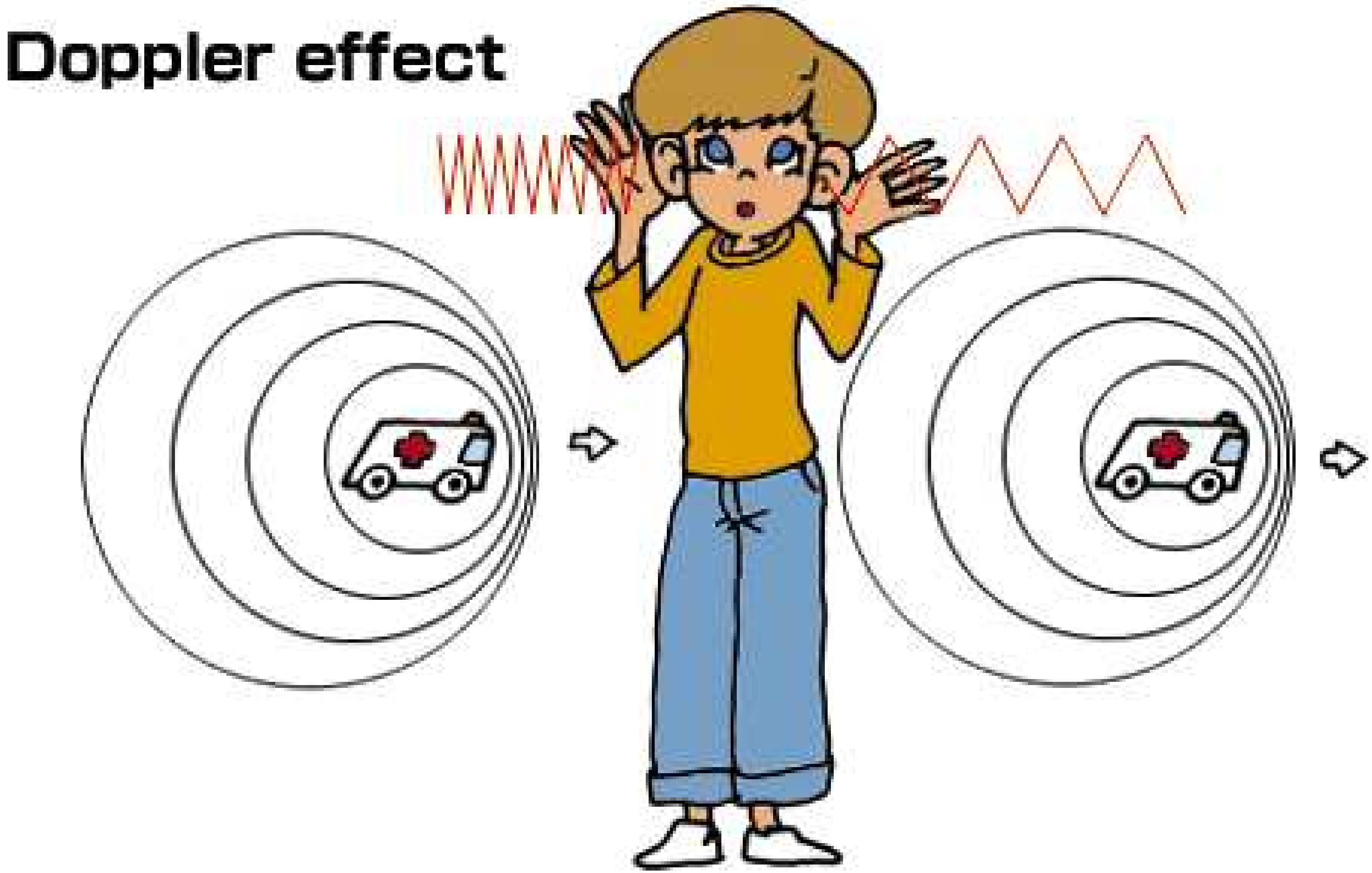
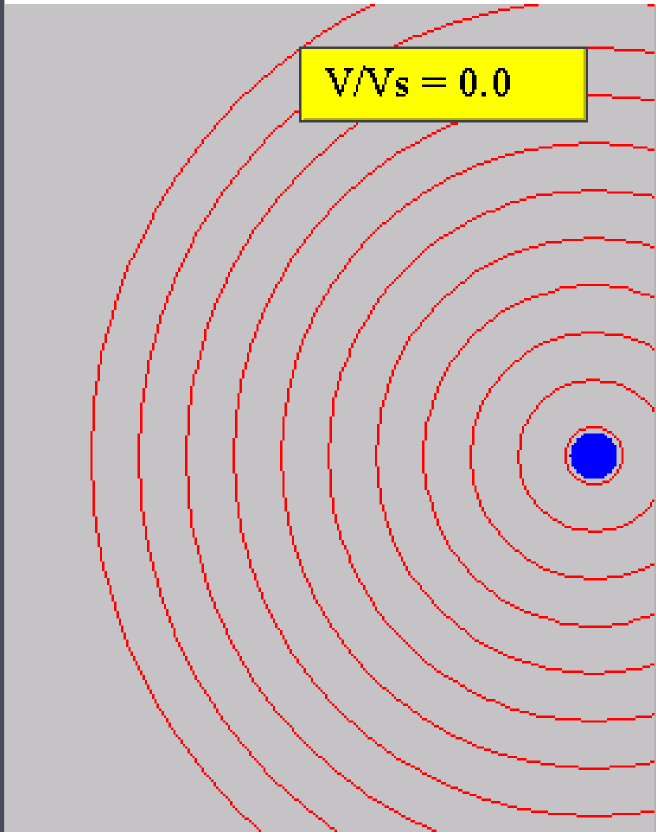
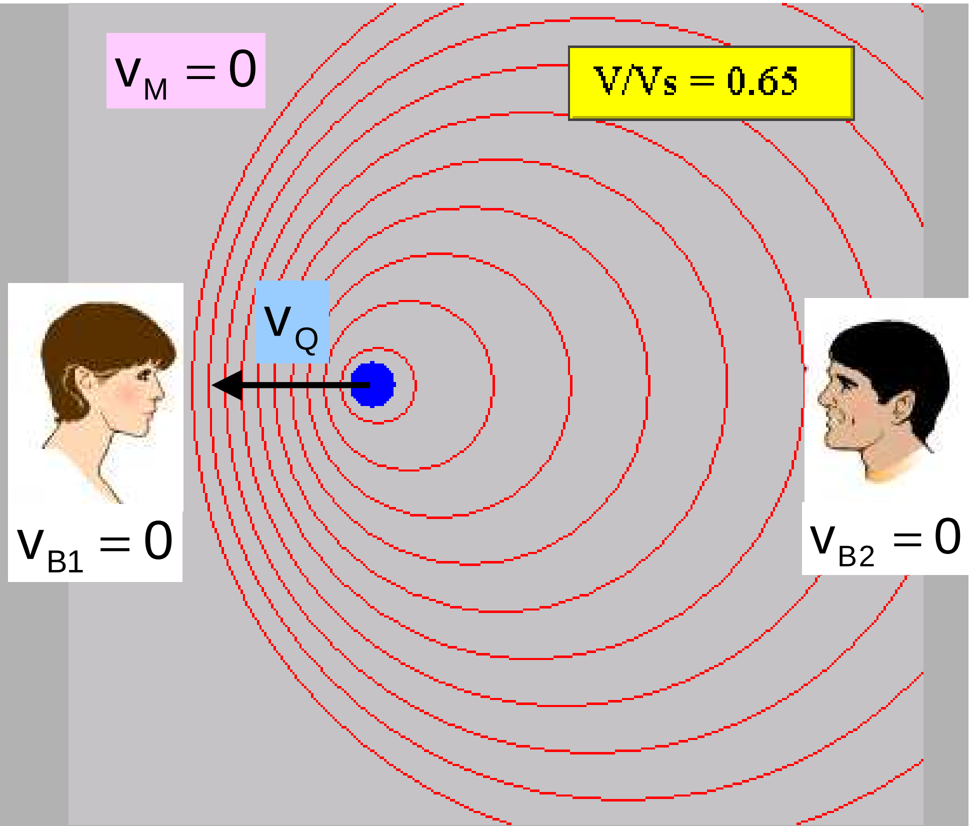
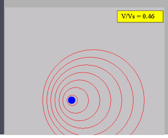
Dopplereffekt



Dopplereffekt Bewegte Quelle-Ruhender Beobachter







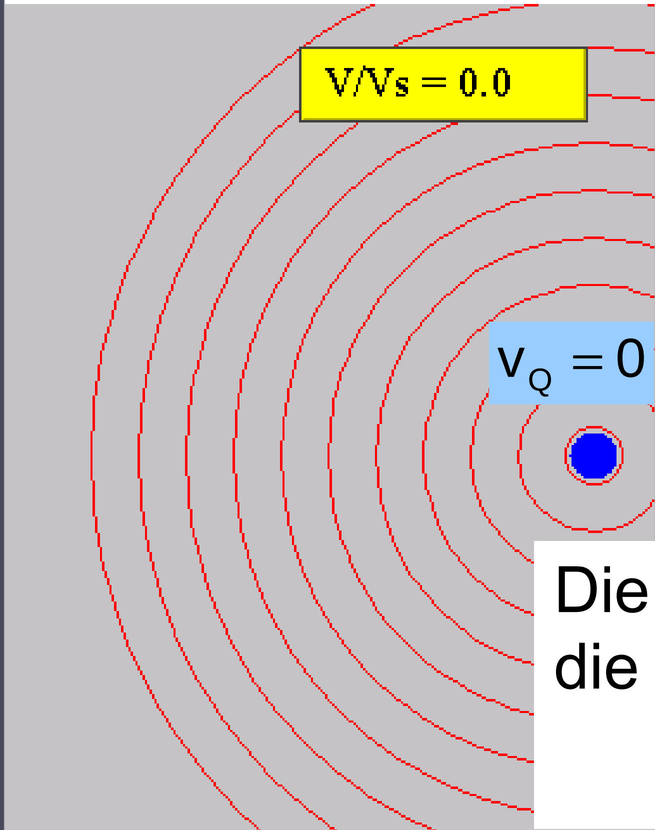
Wellenlänge	λ
Frequenz	f
Ausbreitungs – geschwindigkeit :	c

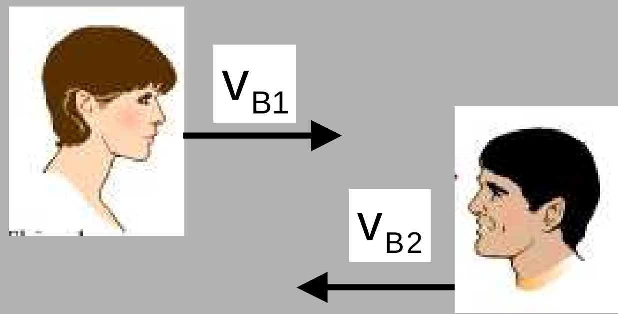
Wellenlänge $\lambda_1' = \lambda - v_Q \cdot T \quad \lambda_2' = \lambda + v_Q \cdot T$

Frequenz $f_1' = \frac{1}{1+\frac{v_Q}{c}} \cdot f \quad f_2' = \frac{1}{1-\frac{v_Q}{c}} \cdot f$

Ausbreitungs – geschwindigkeit : c

Dopplereffekt   Ruhende Quelle – Bewegter Beobachter



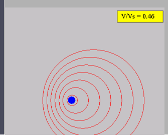


Die Welle besitzt relativ zum Beobachter die Ausbreitungsgeschwindigkeit

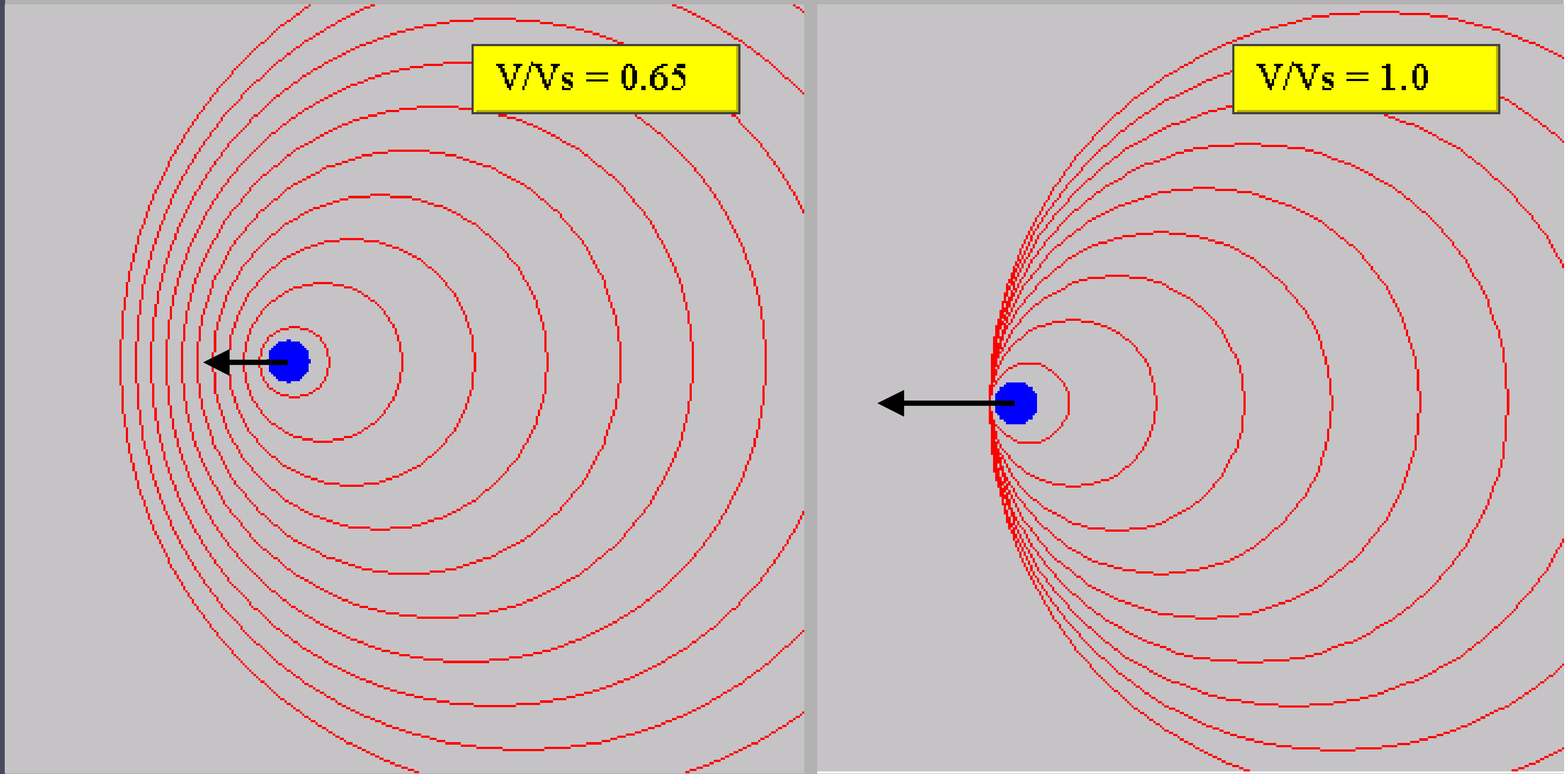
$$c_1' = c - v_{B1} \qquad c_2' = c + v_{B2}$$

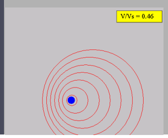
Frequenz
$$f_1' = \frac{c - v_{B1}}{\lambda} = f \cdot \frac{c - v_{B1}}{c} = f \cdot \left(1 - \frac{v_{B1}}{c}\right)$$

$$f_2' = \frac{c + v_{B1}}{\lambda} = f \cdot \frac{c + v_{B1}}{c} = f \cdot \left(1 + \frac{v_{B1}}{c}\right)$$



Dopplereffekt - Schallmauer





Schallmauer

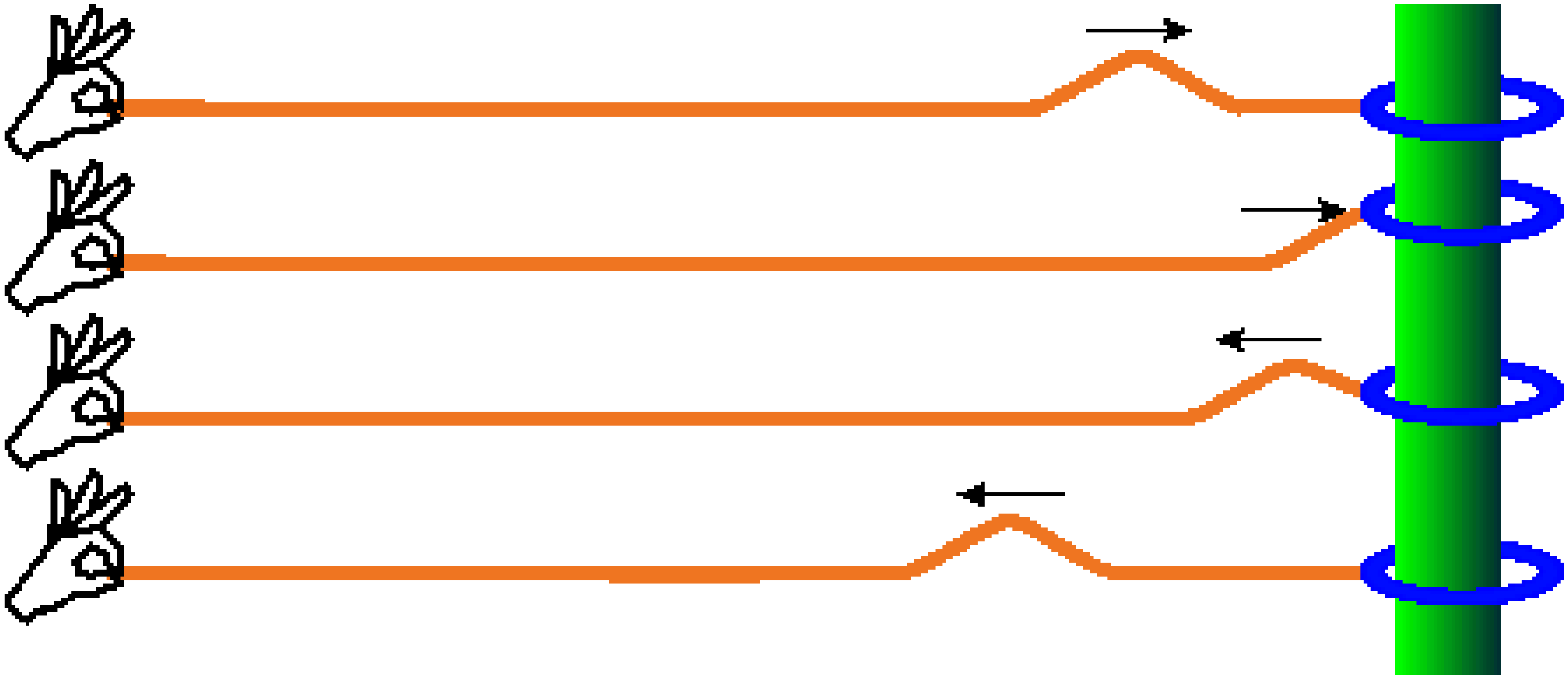
Reflexion von Wellen

Reflexion einer Seilwelle wenn das Ende an der Wand eingespannt ist

Hin- und Rücklaufende Welle haben eine Phasendifferenz

von π „“Phasensprung π“

Reflexion von Wellen

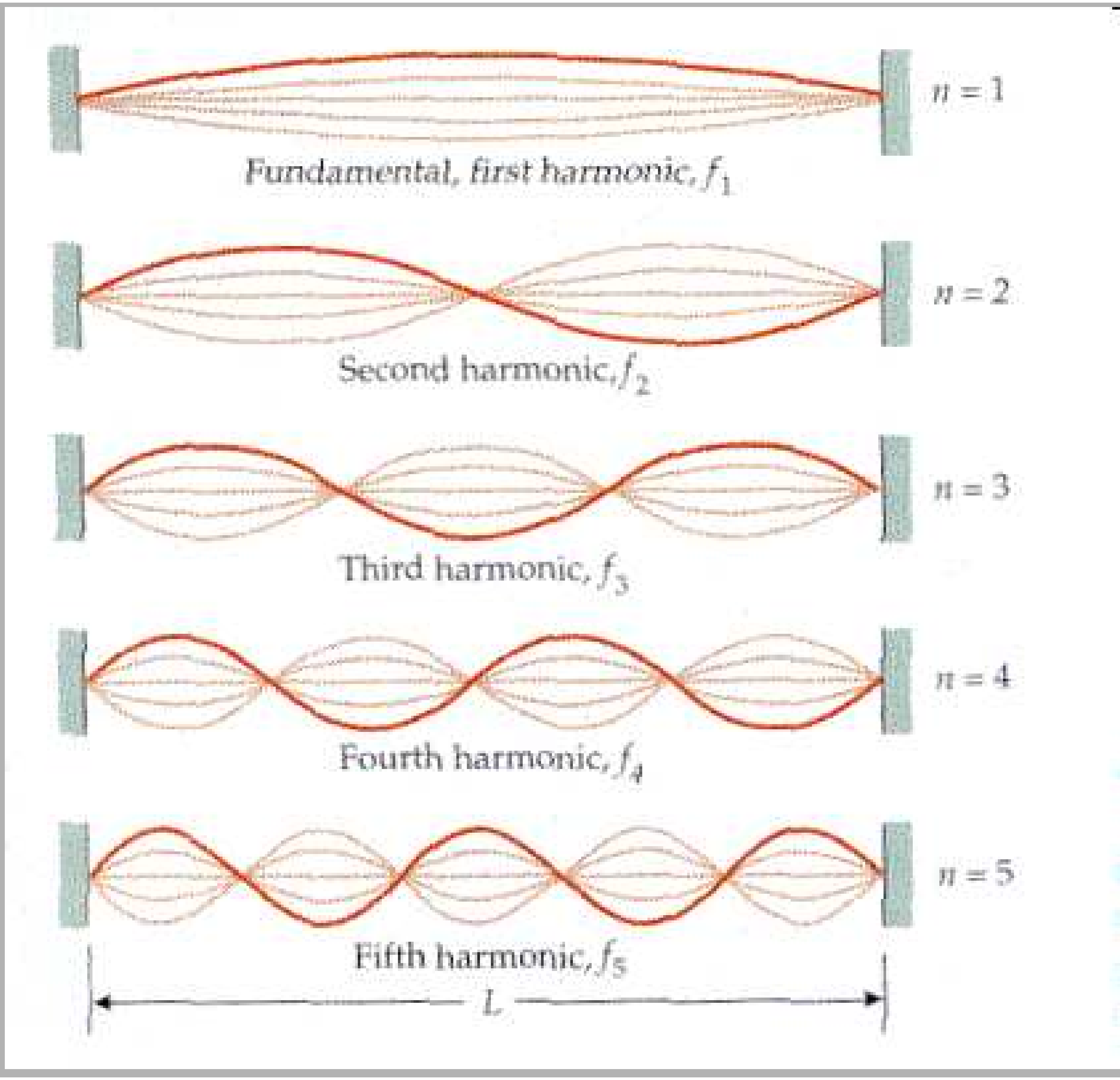


Reflexion einer Seilwelle wenn das Ende lose befestigt ist.

Hin- und Rücklaufende Welle haben keine Phasendifferenz

von π „kein Phasensprung “

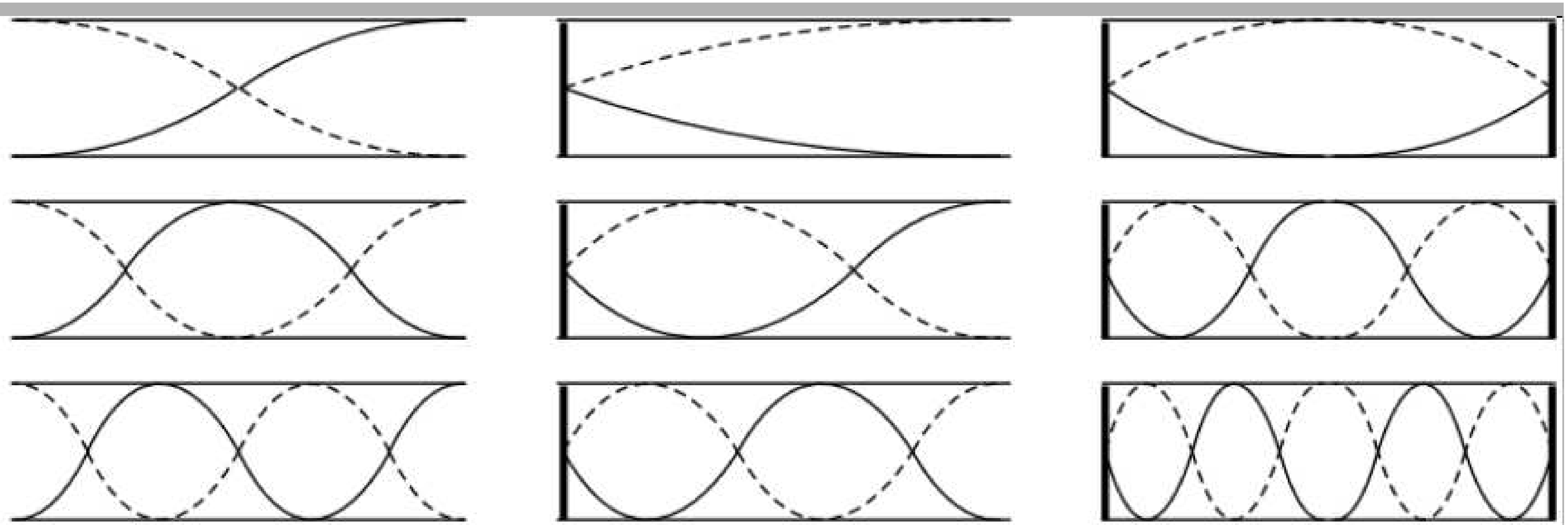
Stehende Wellen -beide Enden fest-



Stehende Seilwellen

Stehende Wasserwellen

Stehende Wellen



$$\lambda_n = \frac{2}{n+1}L \Rightarrow f_n = (n+1)\frac{c}{2L}$$

Beide Enden offen

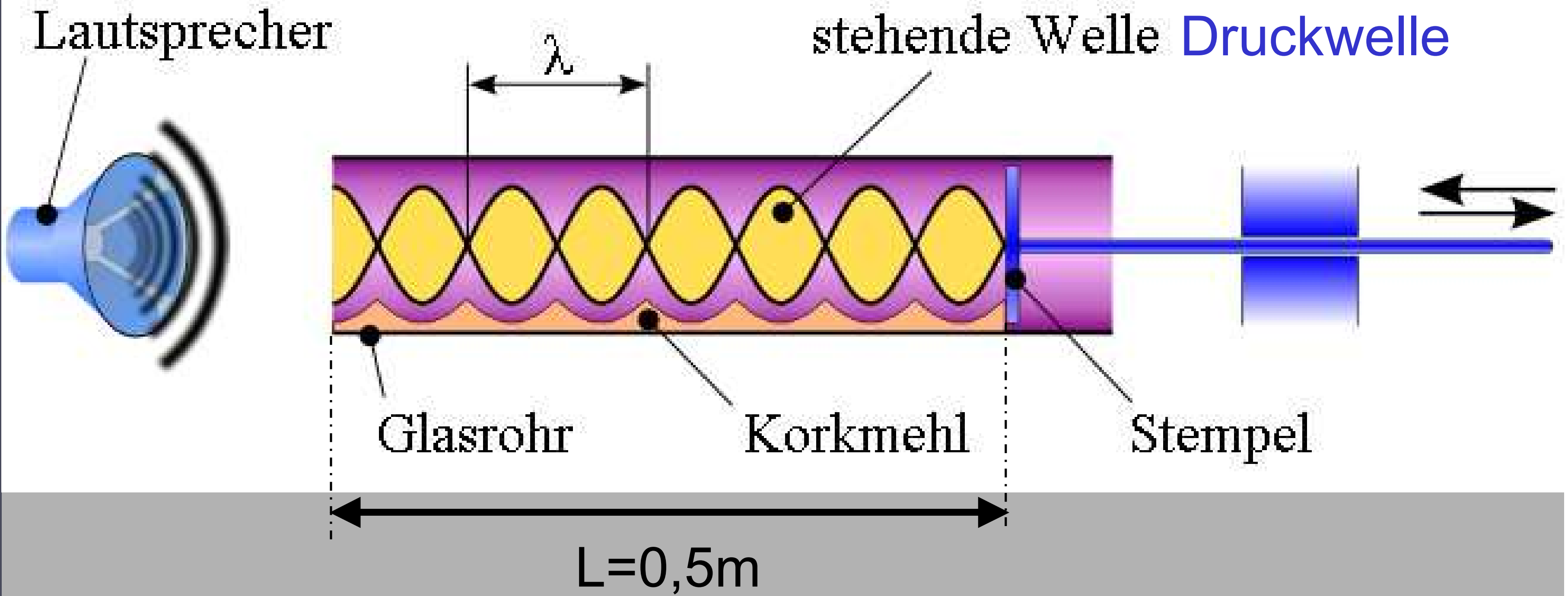
$$\lambda_n = \frac{4}{2n+1}L \Rightarrow f_n = (2n+1)\frac{c}{4L}$$

Ein Ende offen

$$\lambda_n = \frac{2}{n+1}L \Rightarrow f_n = (n+1)\frac{c}{2L}$$

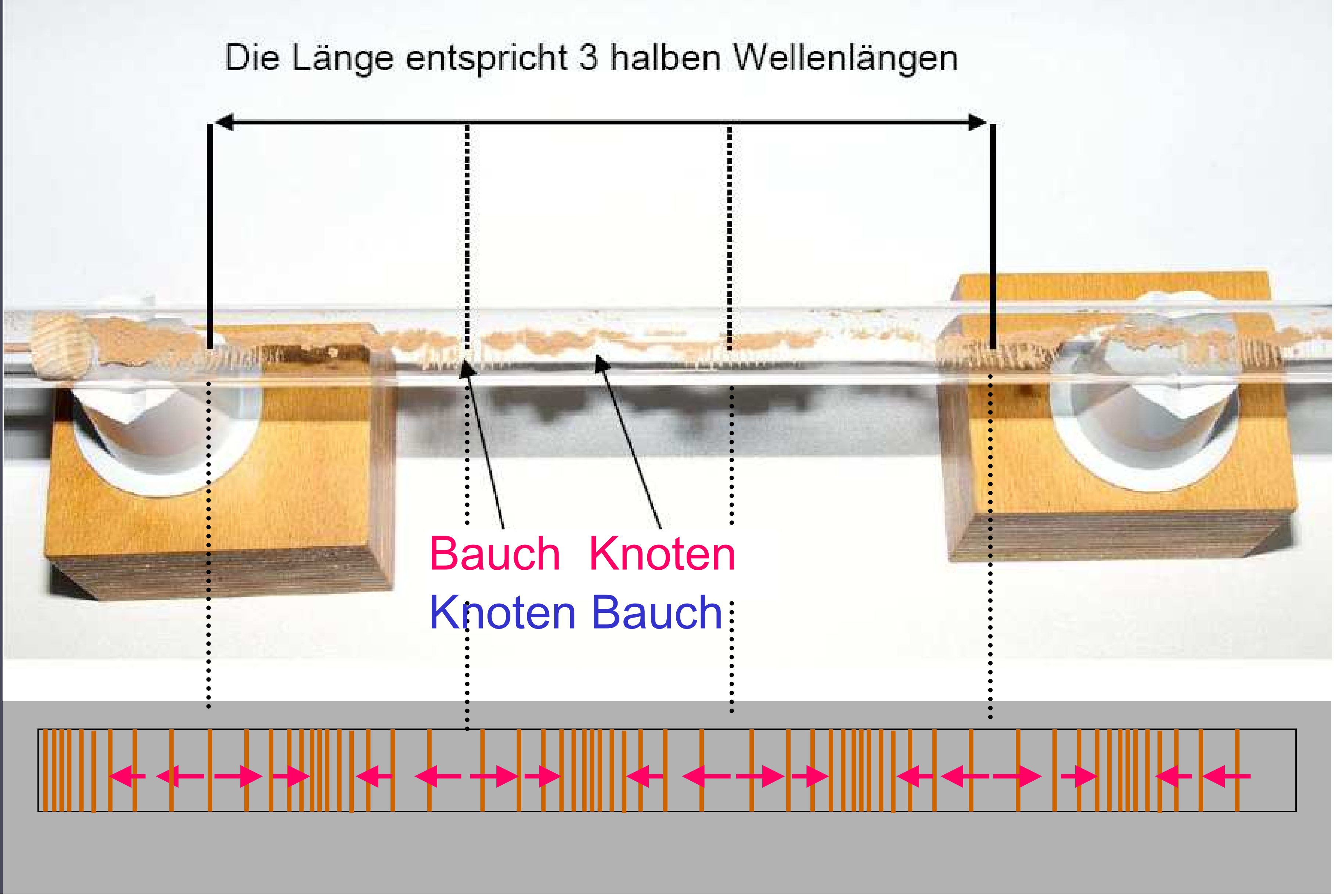
Beide Enden geschlossen

Kundtsches Rohr (Ein Ende offen, das andere geschlossen)

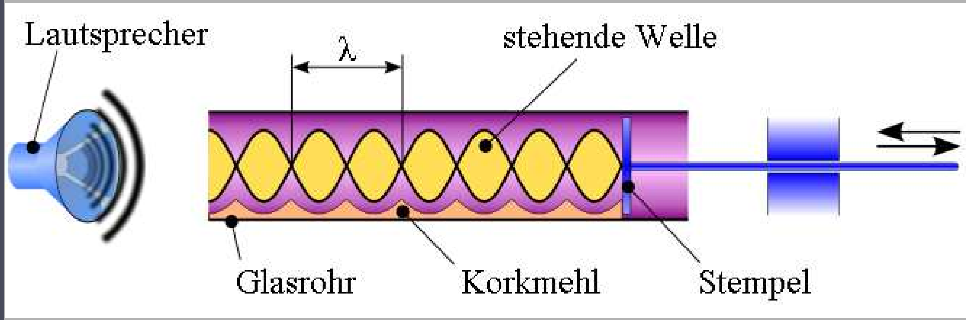


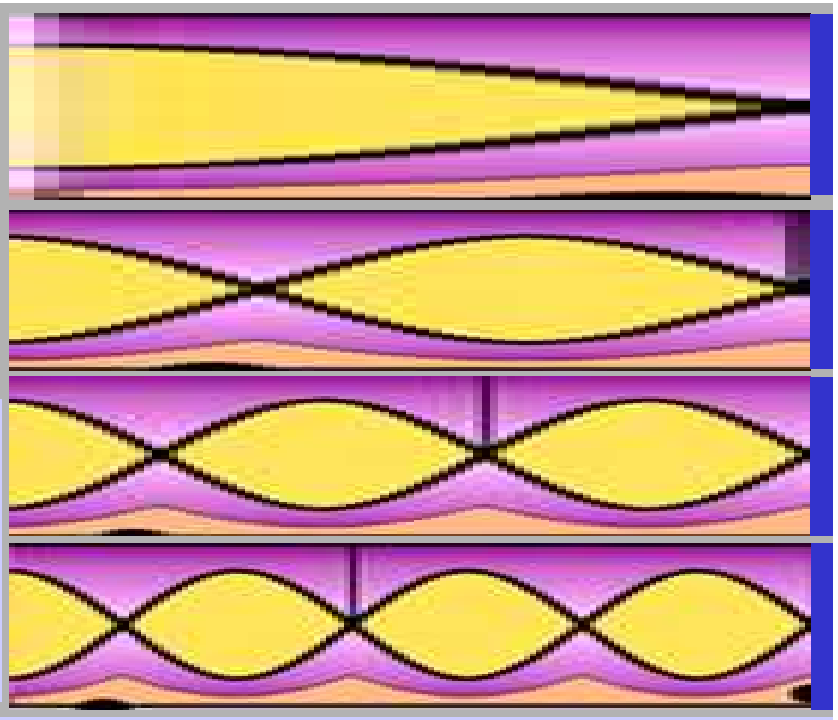
$$c_{\text{Luft}} \approx 331{,}5 \frac{\text{m}}{\text{s}} \sqrt{1 + \frac{\vartheta / {}^\circ\text{C}}{273{,}15}}$$

Kundtsches Rohr Schnellewelle Druckwelle



Kundtsches Rohr - Ein Ende geschlossen

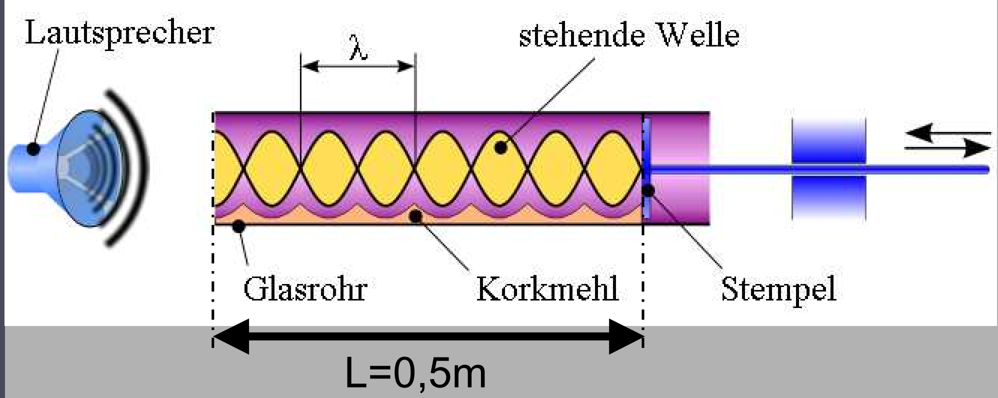




$$L = (2n+1)\cdot\frac{\lambda_n}{4}$$

$$\lambda_n = \frac{4}{2n+1}L \Rightarrow f_n = (2n+1)\frac{c}{4L}$$

Kundtsches Rohr - Ein Ende geschlossen



$$\lambda_n = \frac{4}{2n+1}L \Rightarrow f_n = (2n+1)\frac{c}{4L}$$

$$f_0 = \frac{c}{4L} \approx \frac{340}{2}\frac{1}{s} = 170\text{Hz}$$

$$f_1 = 3\frac{c}{4L} \approx 3\cdot\frac{340}{2}\frac{1}{s} = 510\text{Hz}$$

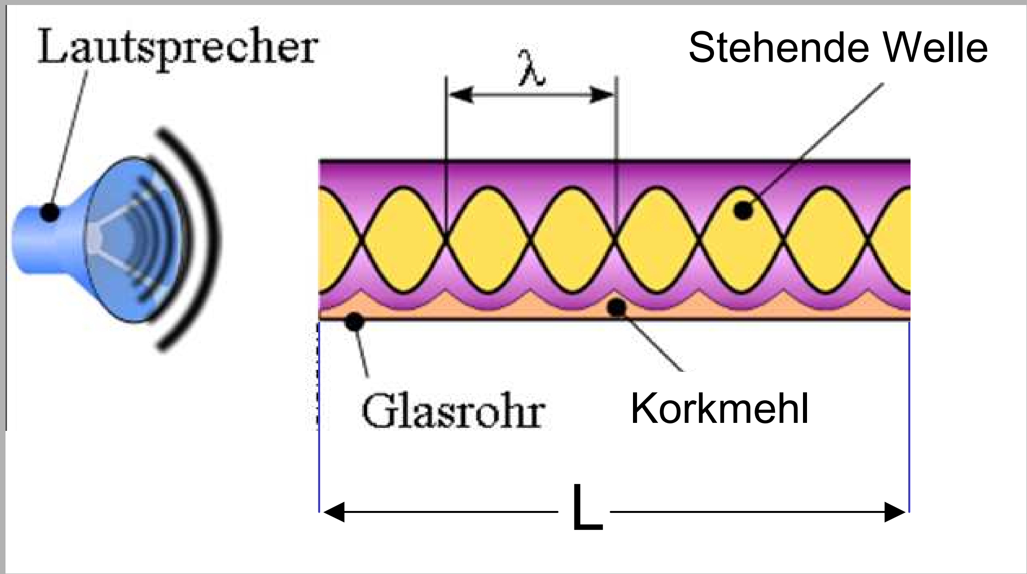
$$f_2 = 5\frac{c}{4L} \approx 5\cdot\frac{340}{2}\frac{1}{s} = 850\text{Hz}$$

$$f_3 = 7\frac{c}{4L} \approx 7\cdot\frac{340}{2}\frac{1}{s} = 1190\text{Hz}$$

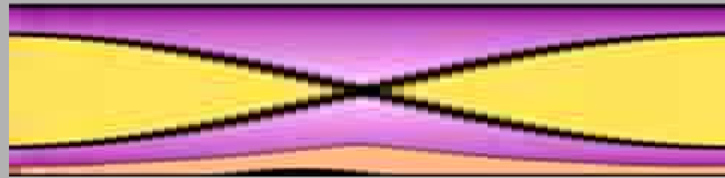
$$f_4 = 9\frac{c}{4L} \approx 9\cdot\frac{340}{2}\frac{1}{s} = 1530\text{Hz}$$

$$f_5 = 11\frac{c}{4L} \approx 11\cdot\frac{340}{2}\frac{1}{s} = 1870\text{Hz}$$

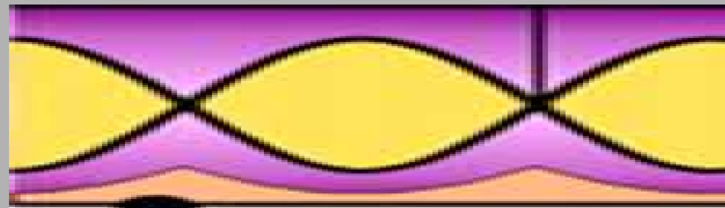
Kundtsches Rohr (beide Enden offen)



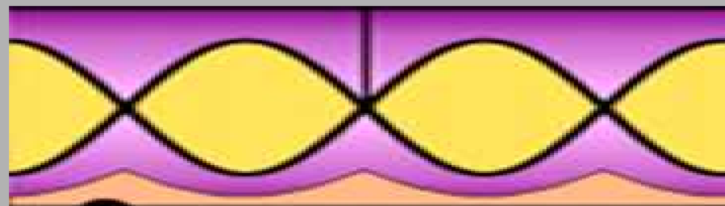
$$\lambda_n = \frac{2}{n+1} L \Rightarrow f_n = \frac{n+1}{2} \cdot \frac{c}{L}$$



$$\frac{1}{2}\lambda_0 = L \Rightarrow \lambda_0 = \frac{2}{1} L \Rightarrow f_0 = \frac{1}{2} \cdot \frac{c}{L}$$



$$\frac{2}{2}\lambda_1 = L \Rightarrow \lambda_1 = \frac{2}{2} L \Rightarrow f_1 = \frac{2}{2} \cdot \frac{c}{L}$$



$$\frac{3}{2}\lambda_2 = L \Rightarrow \lambda_2 = \frac{2}{3} L \Rightarrow f_2 = \frac{3}{2} \cdot \frac{c}{L}$$