



# Active Noise Reduction for Several Fans in Tunnel

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# AGENDA

- » TUNNEL VENTILATION
- » ADDING SOUND PRESSURE FROM SEVERAL SOUND SOURCES
- » SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)
- » SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (ELECTRICAL CHANGE)

# TUNNEL VENTILATION

- » Often several fans standing near each other
- » Fans are usually used in case of fire
- » Fans sound levels are very important for safety

! In this work only local sound pressure levels were considered.

! Silencer will not be considered, because it is not changing general character of fan sound emission



## ADDING SOUND PRESSURE FROM SEVERAL SOUND SOURCES

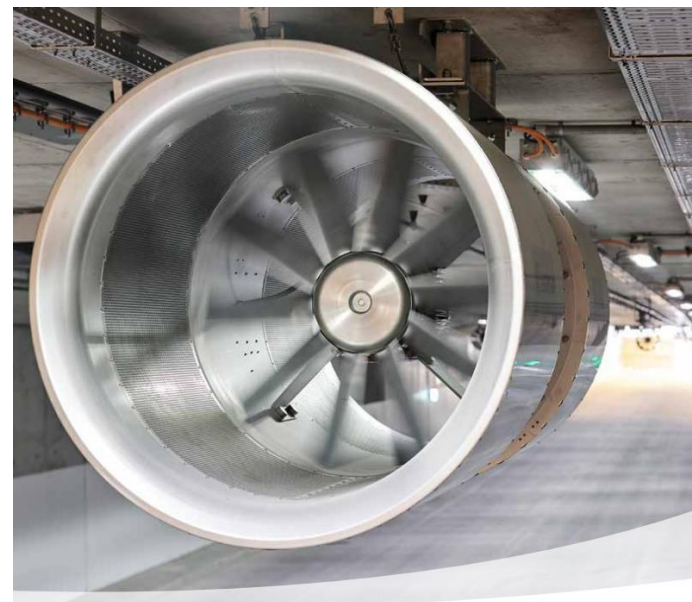
» Usually, sound levels for fans during tunnel design are calculated, considering fans as incoherent sources:

$$p_{t\_rms}^2 = p_{1\_rms}^2 + p_{2\_rms}^2$$

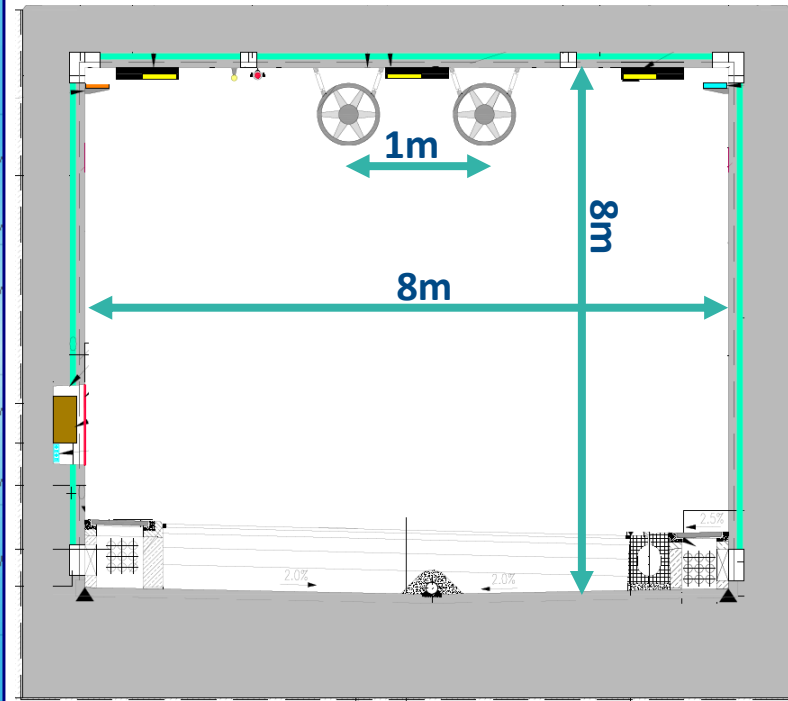
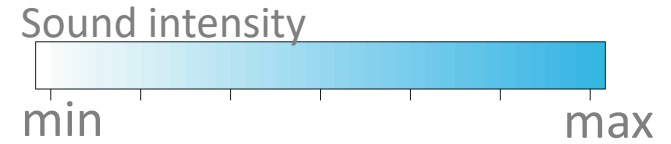
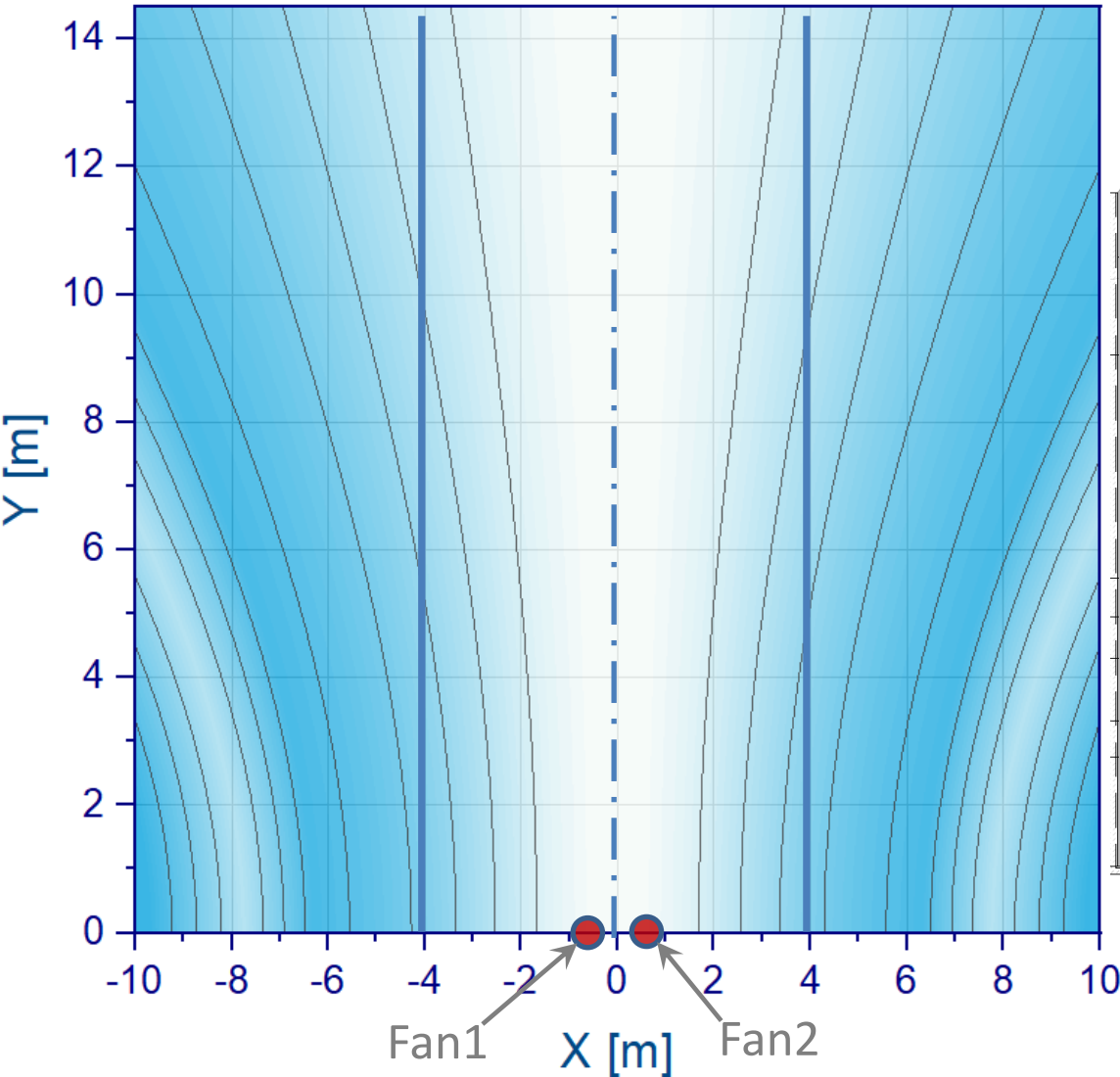
» Sound levels on blade passing frequency (BPF) are making the main input in total fan sound power

» When two identical fans are working near each other, sound waves on BPF can be considered as coherent:

$$p_{t\_rms}^2 = p_{1\_rms}^2 + p_{2\_rms}^2 + 2p_{1\_rms}p_{2\_rms}\cos(\beta_1 - \beta_2)$$



# ADDING SOUND PRESSURE FROM SEVERAL SOUND SOURCES IN TUNNEL (220 Hz)



$$I(x) = 2I_0 \cdot (1 + \cos(\beta_1 - \beta_2))$$

Walls influence is not considered

# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)

» Change of mutual impeller blade position for two identical fans, standing near each other can help reducing sound levels on BPF and therefore sum sound levels

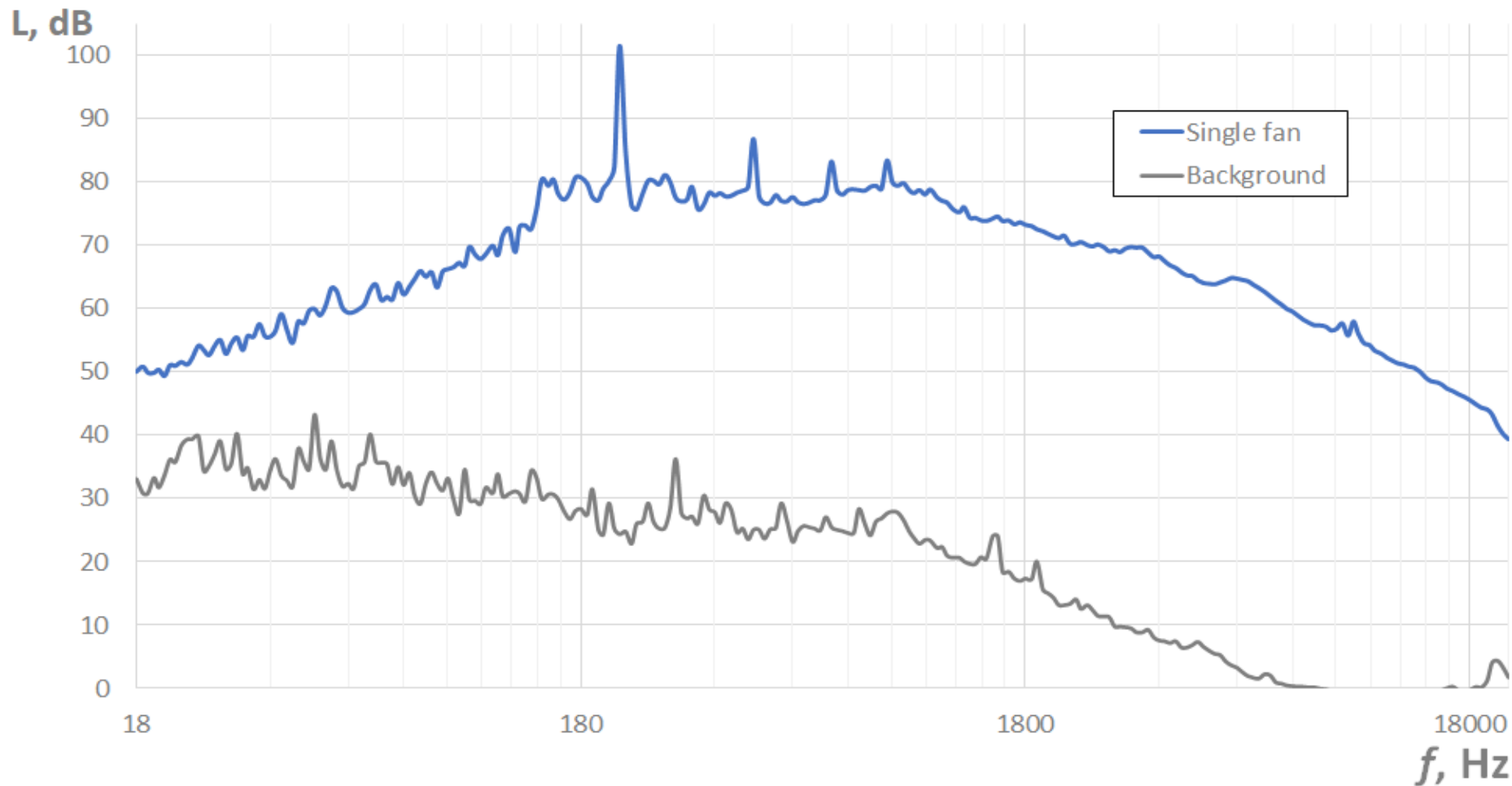
» At first, physical change of position was made by changing of the angular position of the taper lock on the impeller hub.

Examined fan AXC 800-9/29°-4 (7.5 kW): 1465 rpm, 9 blades, 800 mm diameter.

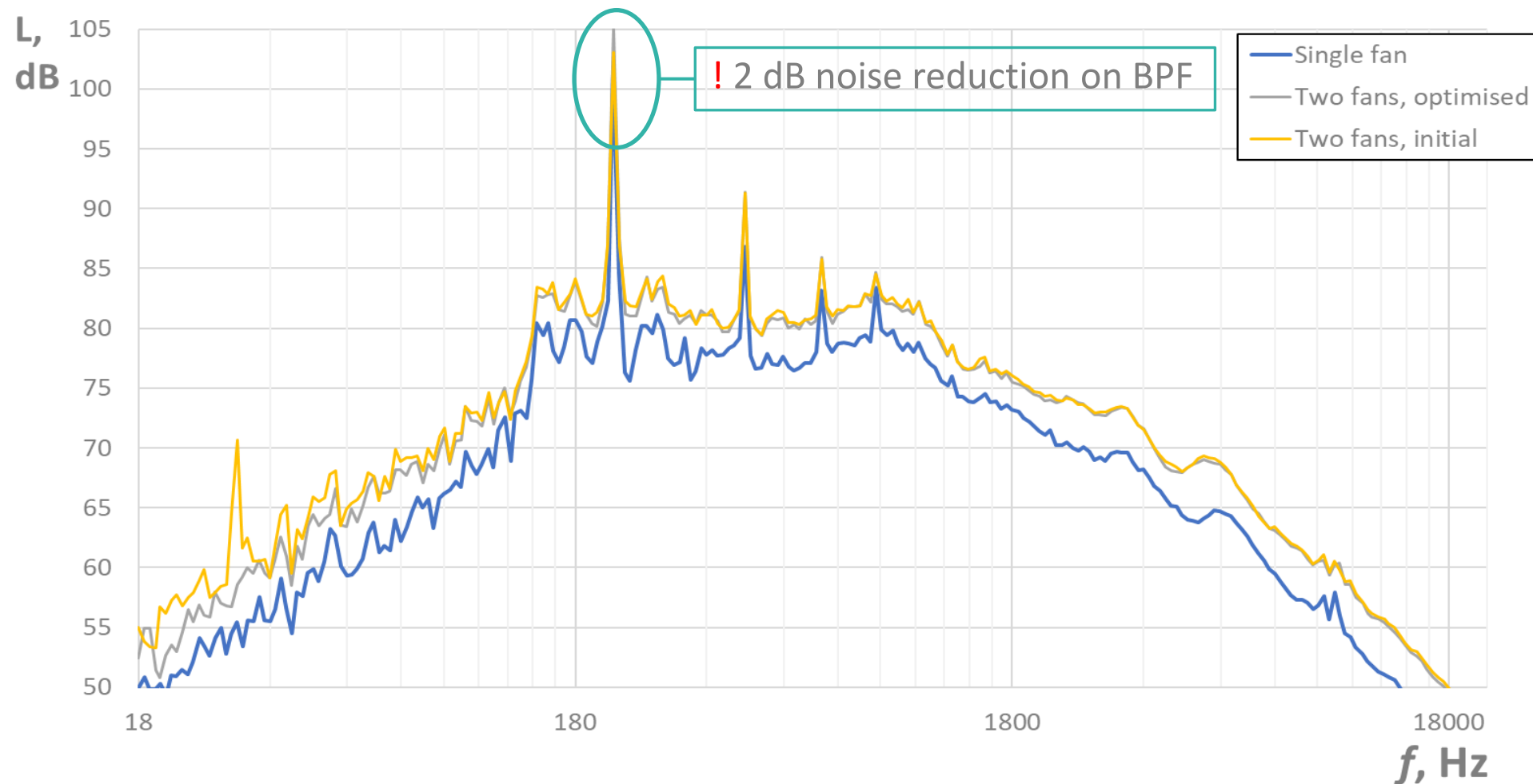




# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)

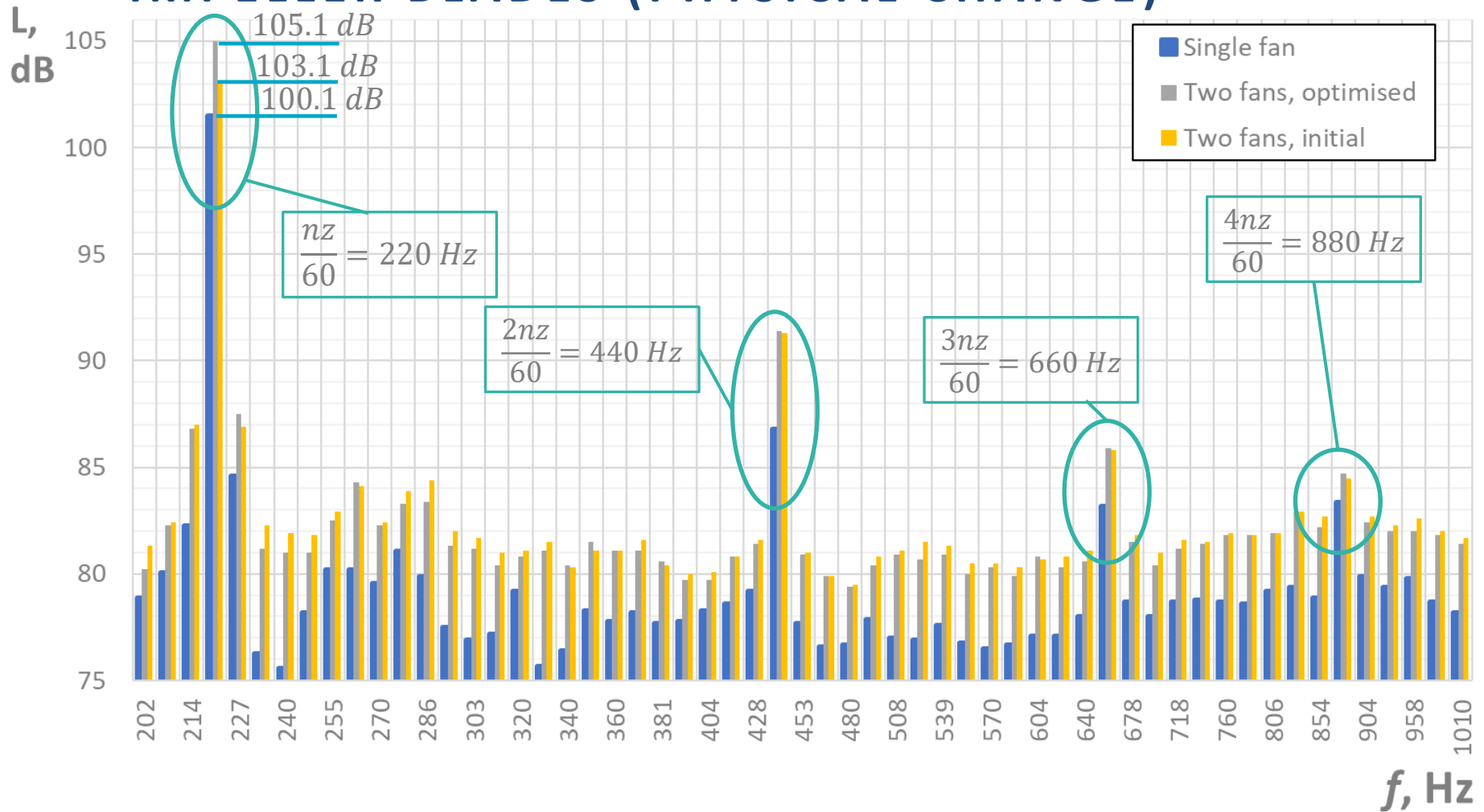


# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)



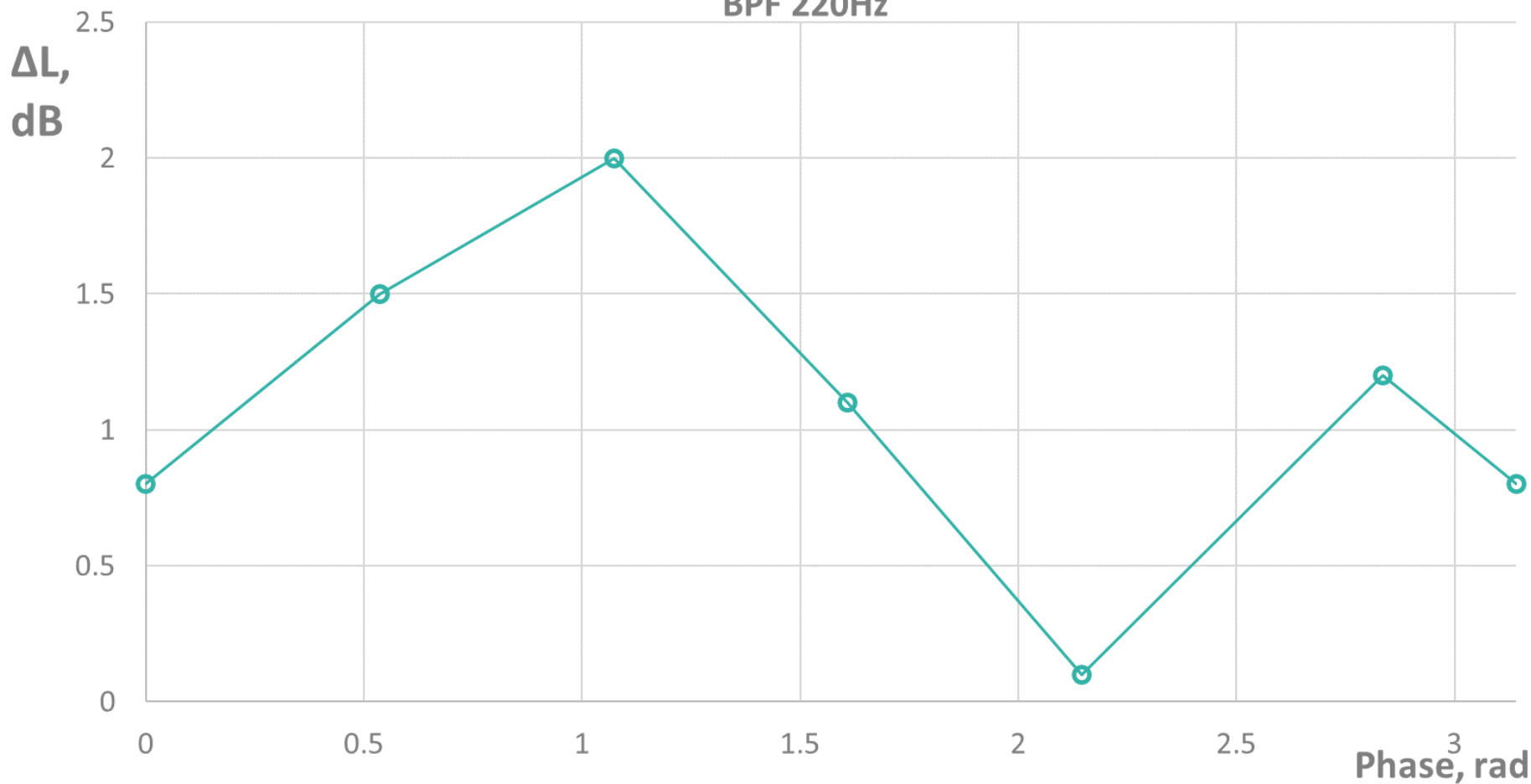


# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)

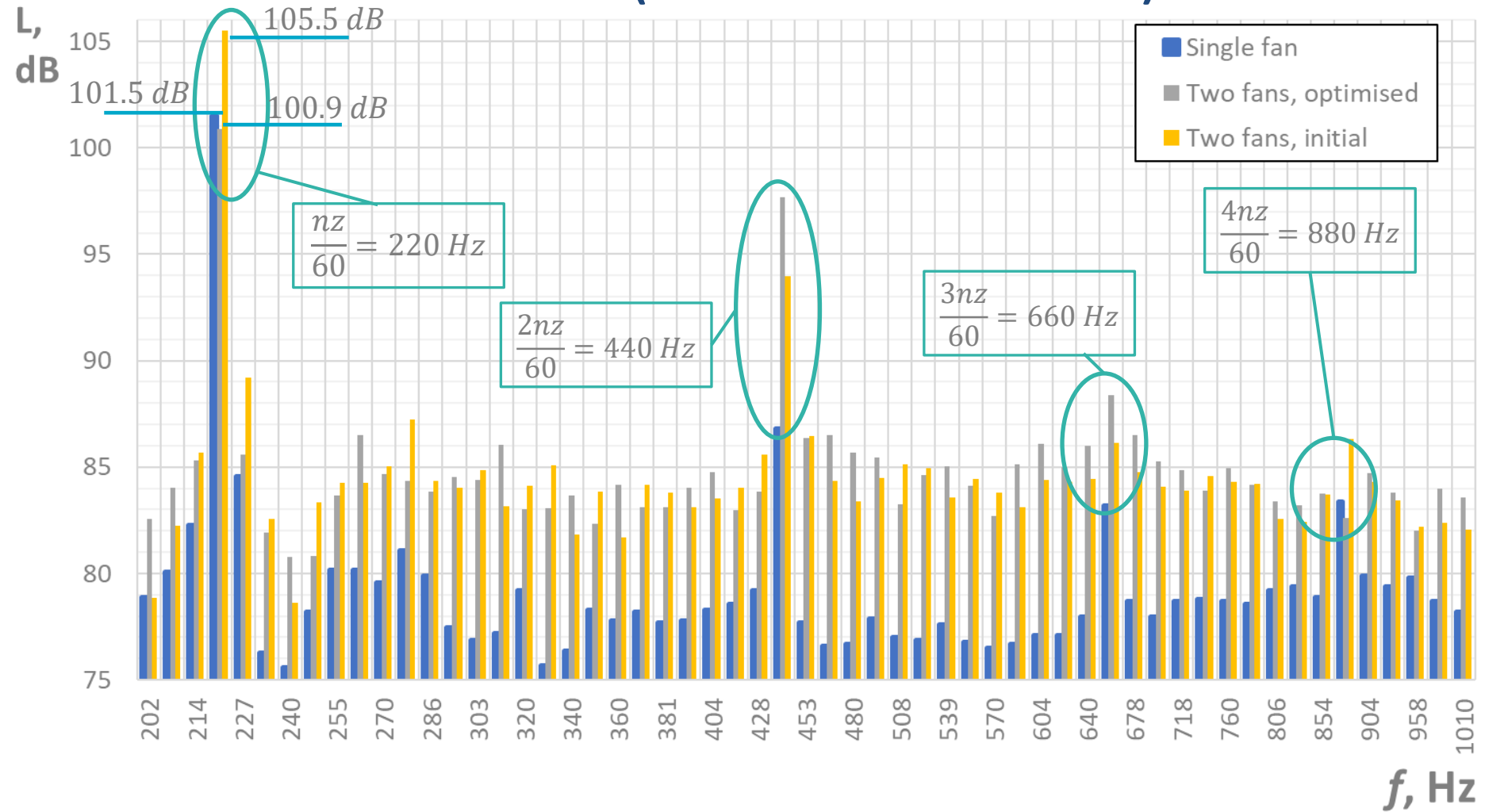


# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)

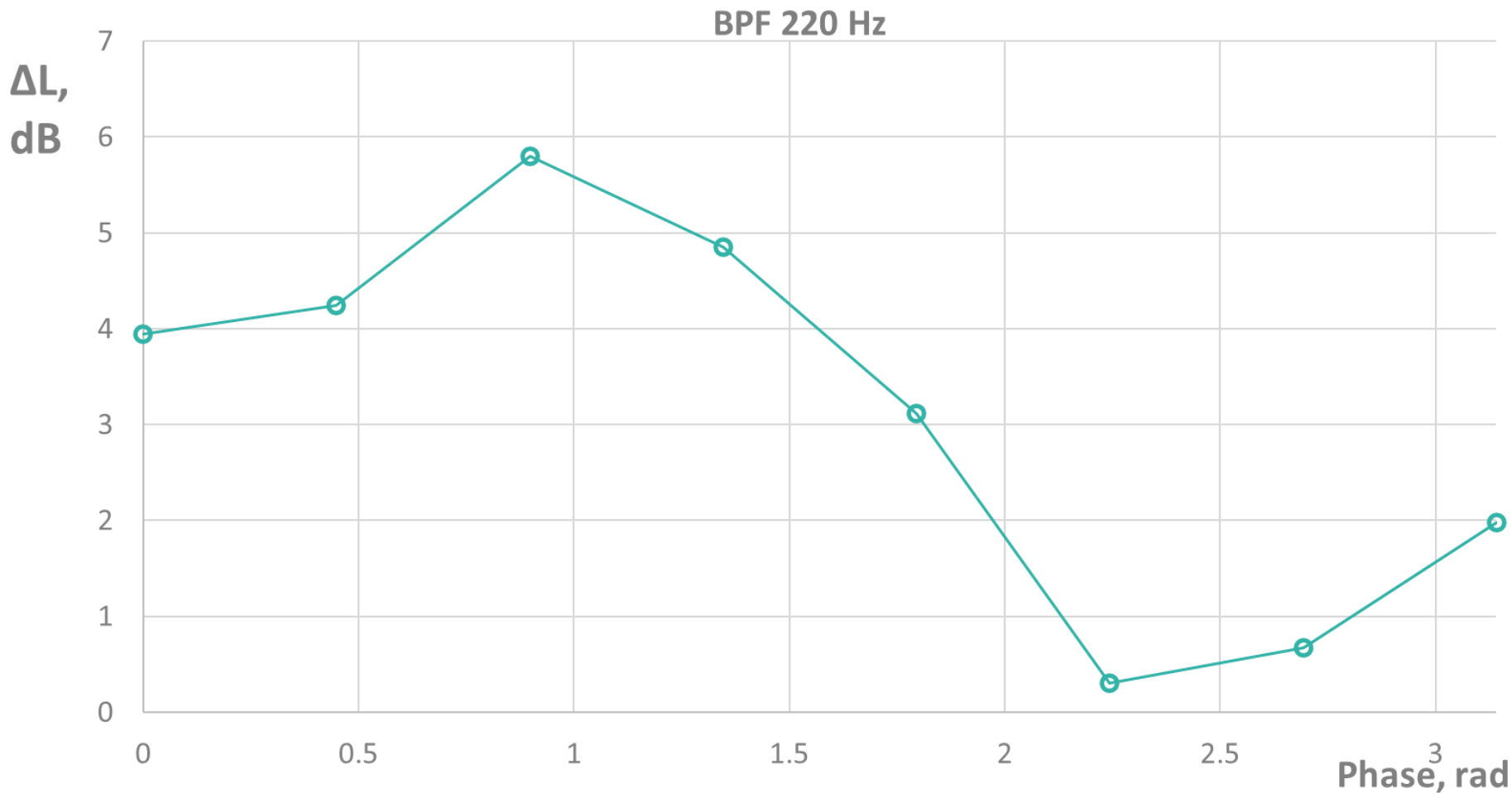
BPF 220Hz



# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (PHYSICAL CHANGE)



# SOUND LEVELS FOR TWO IDENTICAL FANS, WITH DIFFERENT MUTUAL POSITION OF IMPELLER BLADES (ELECTRICAL CHANGE)



# POSSIBLE IMPLEMENTATION

- » Better to use synchronous motors
- » Could be used also for more than two sound sources
- » Best option to implement will be – several centrifugal fans standing together, which are used often for renovation in our days.



# QUESTIONS?



**THANK YOU FOR  
YOUR ATTENTION!**