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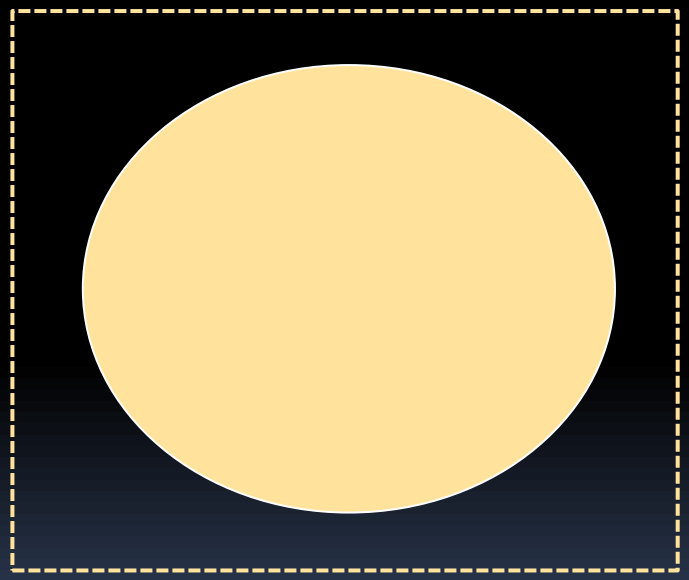
Stage acoustics

ORCHESTRA CANOPIES

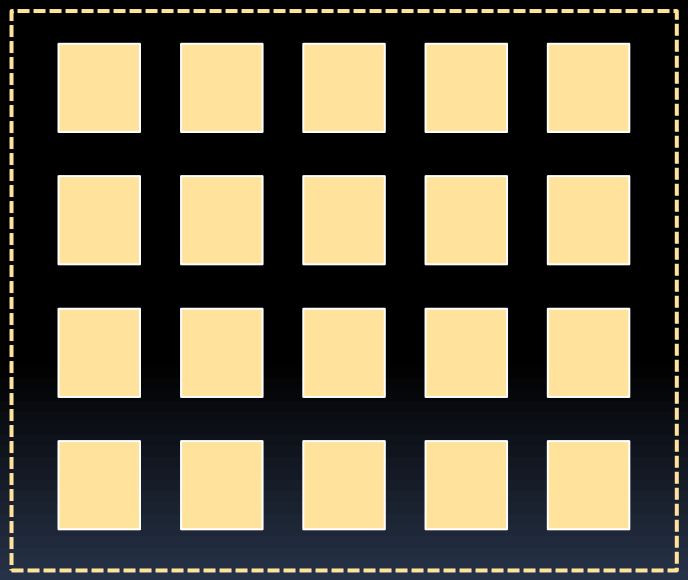
162nd Meeting of the Acoustical Society of America, 2 November 2011, 3aAA1

What is an orchestra canopy?

- Horizontal, sound reflecting device
- Suspended above orchestra



Single element



Element array, μ=50% density

These two have equal total surface area

Vienna, Boston, Amsterdam

Orchestra canopies

Orchestra canopies

Orchestra canopies

Panel array canopies

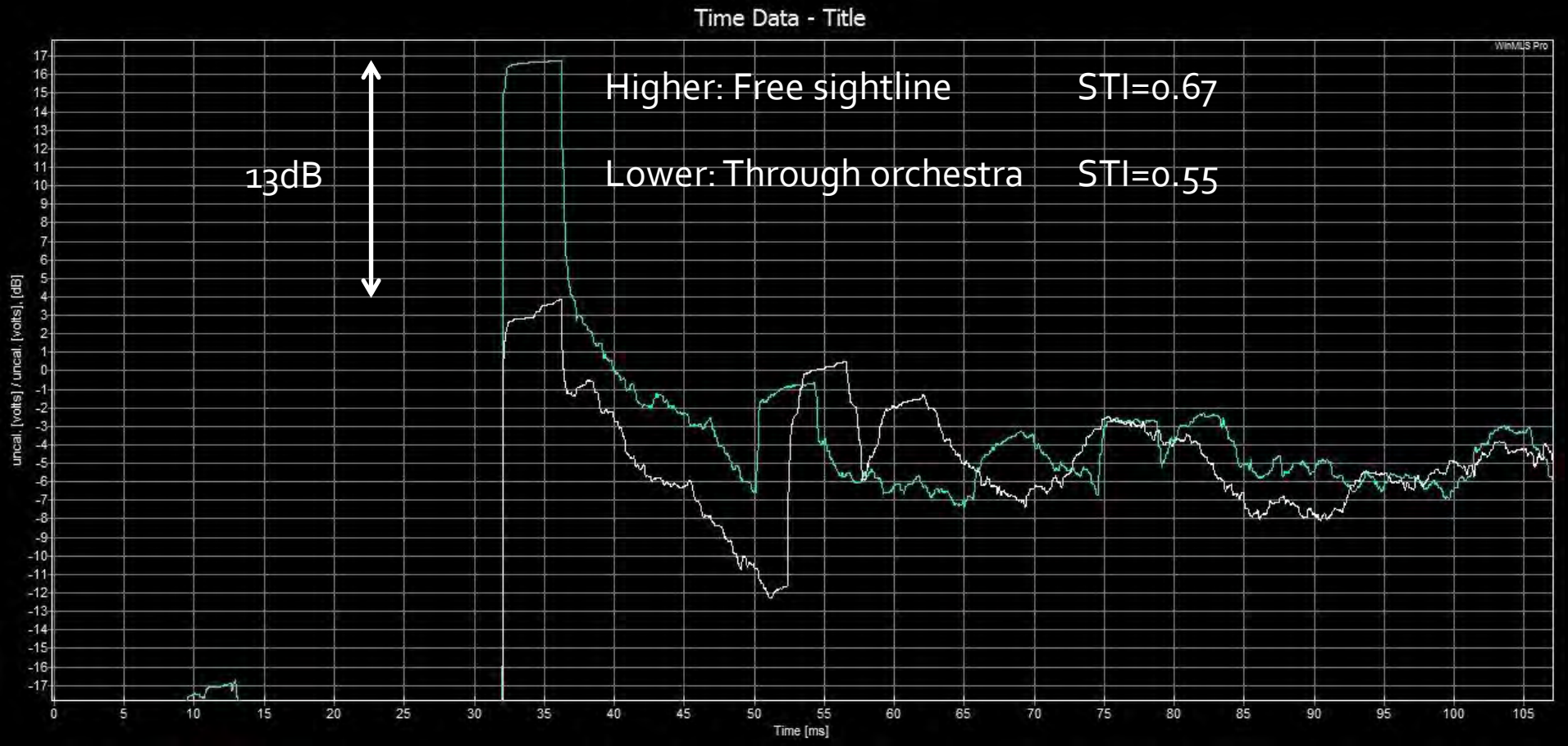
Orchestra, acoustic needs

- Hearing others, notes, pitch, ques, intonation
  - Direct sound path obstructed , alternative sound paths beneficial
  - Transmission quality measure demanded
- Early low frequency response, $G_{early,\ 63\text{-}125Hz}$
  - Bass pulse, Beat, to play in sync
  - Heavy walls close to orchestra
- Hearing the hall acoustics, performers reverberance
  - Proper ST_{late} , G_{late} and C on stage
  - Stage not separated from auditorium, no low stage ceiling
- No echoes
  - no specular ceiling reflection

Attenuation through orchestra

Transmission IR from 1st Violin to Basson, distance 11m

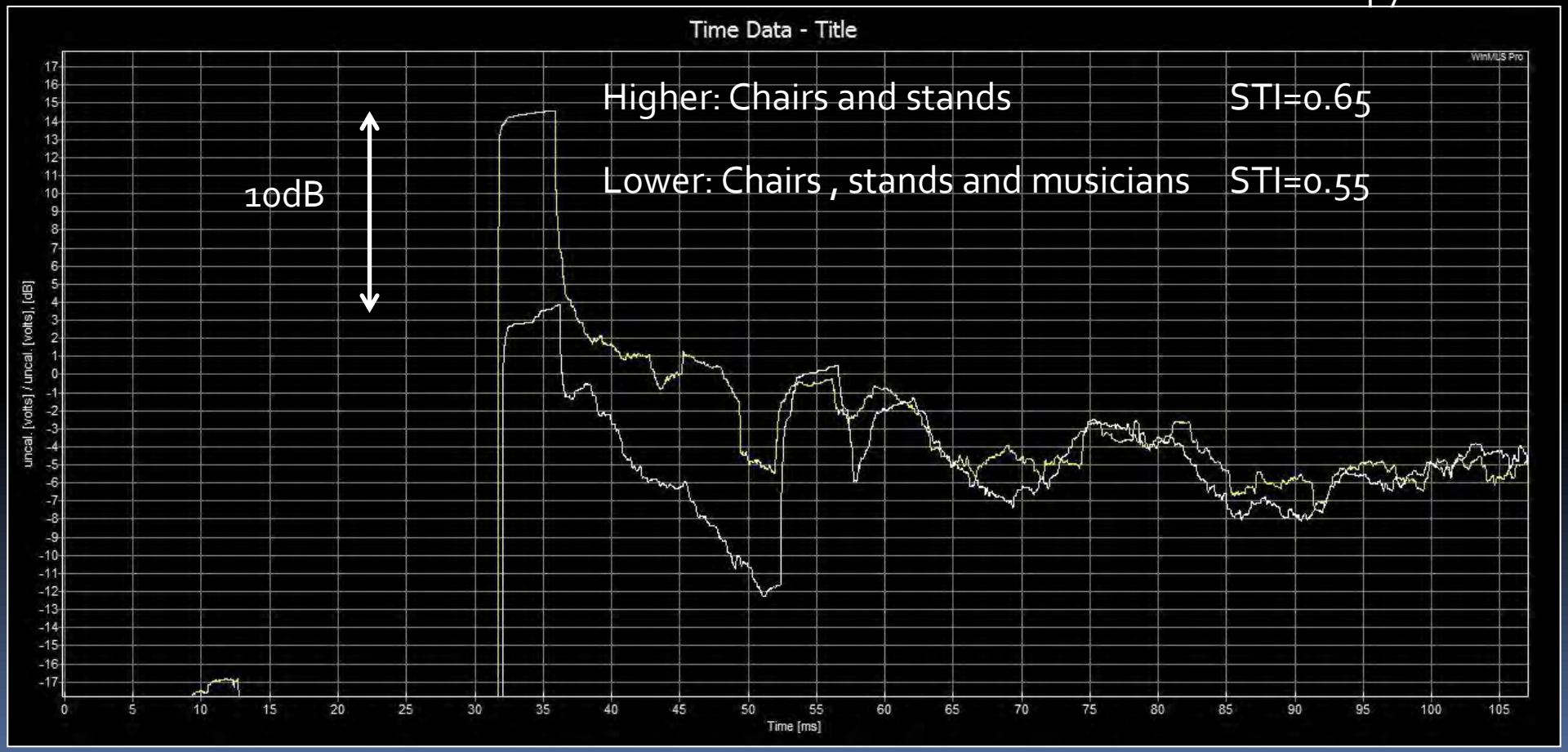
No canopy



Chairs+stands w/wo musicians

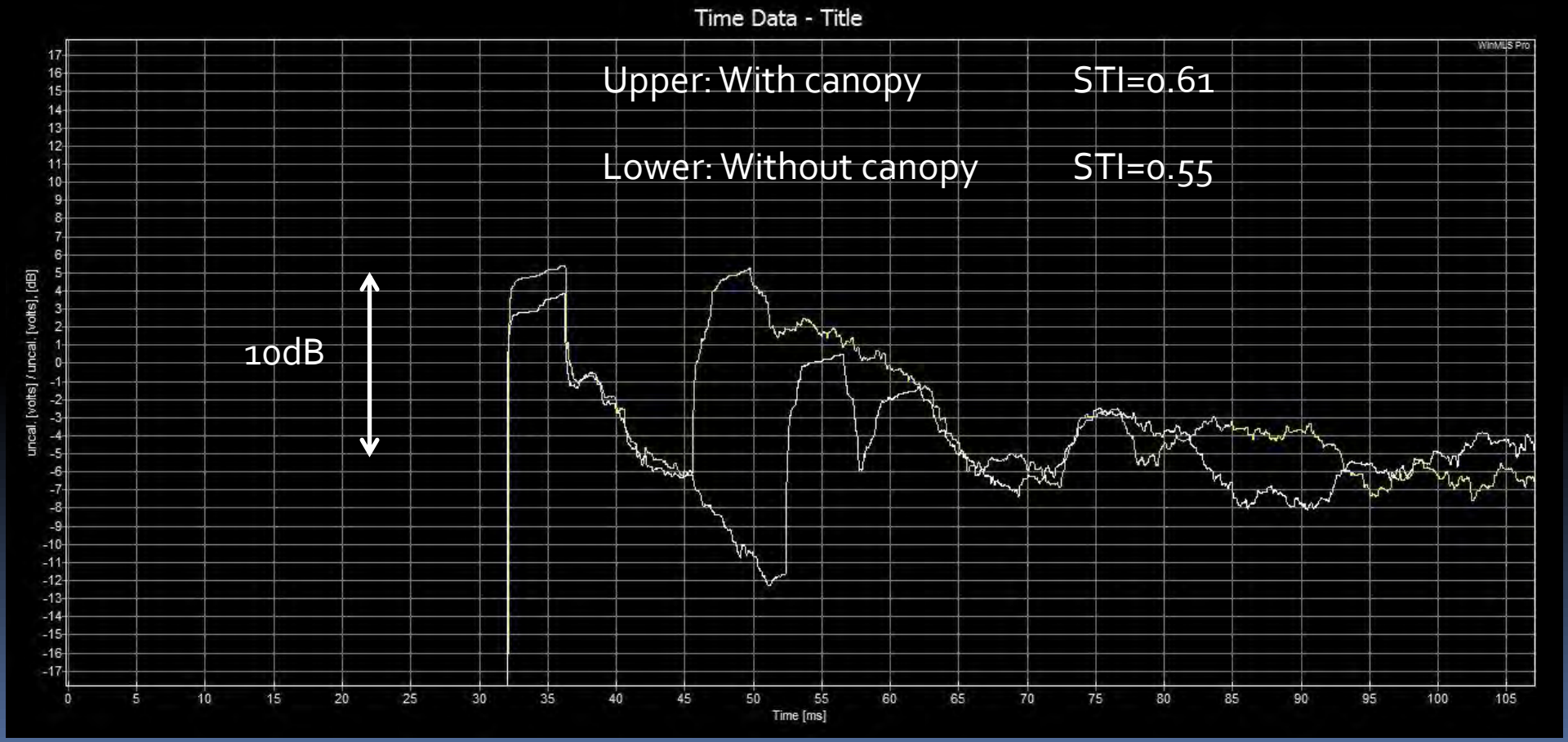
Transmission IR from 1st Violin to Basson, distance 11m

No canopy

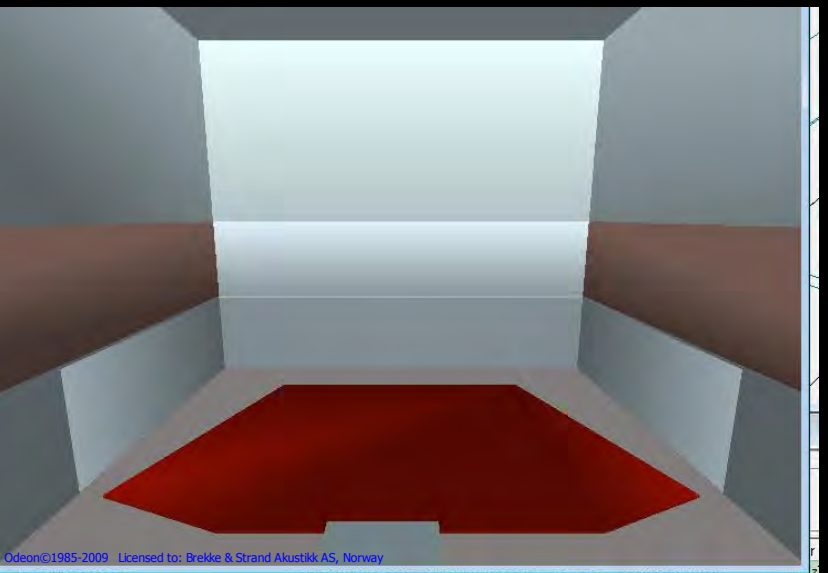


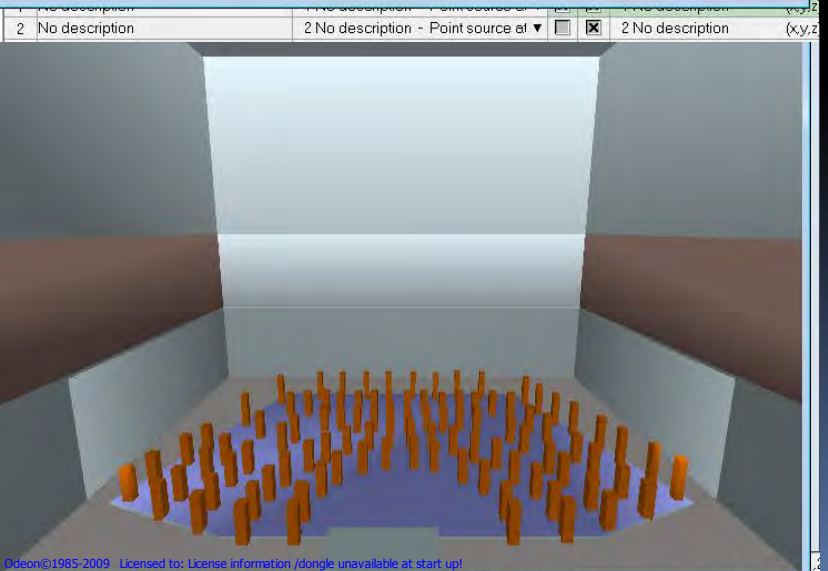
Canopy effect, no sightline

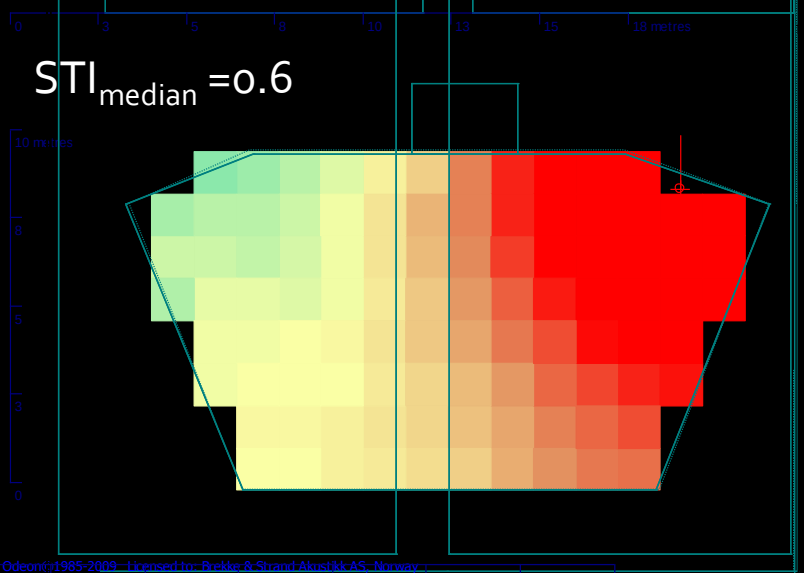
Transmission IR from 1st Violin to Basson, distance 11m

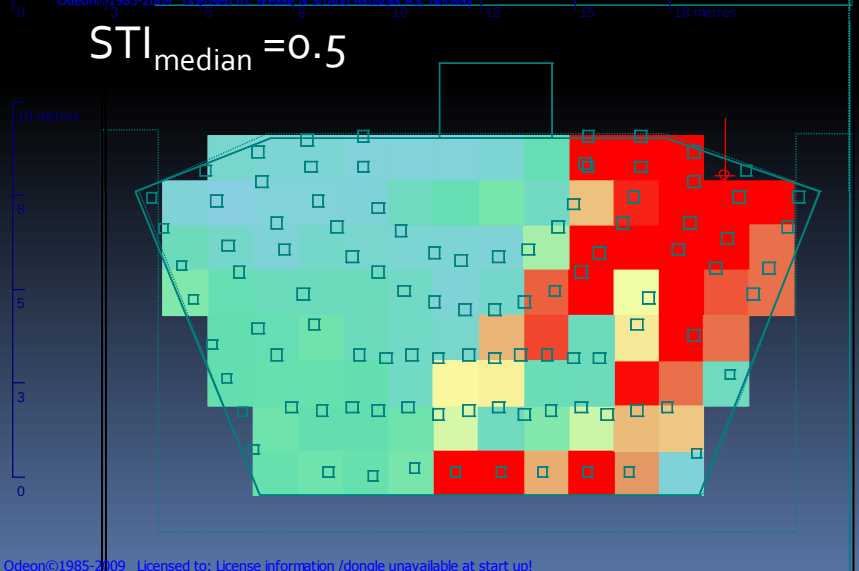


Two different models, STI

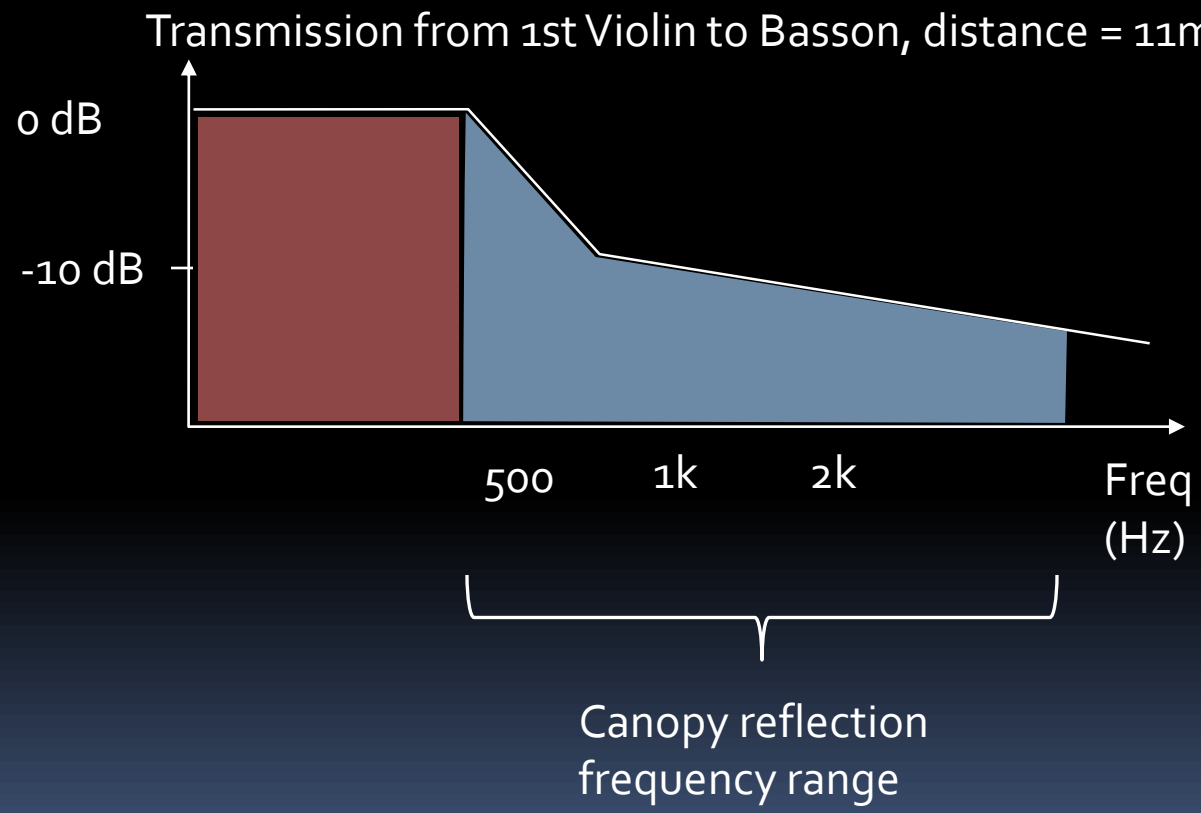




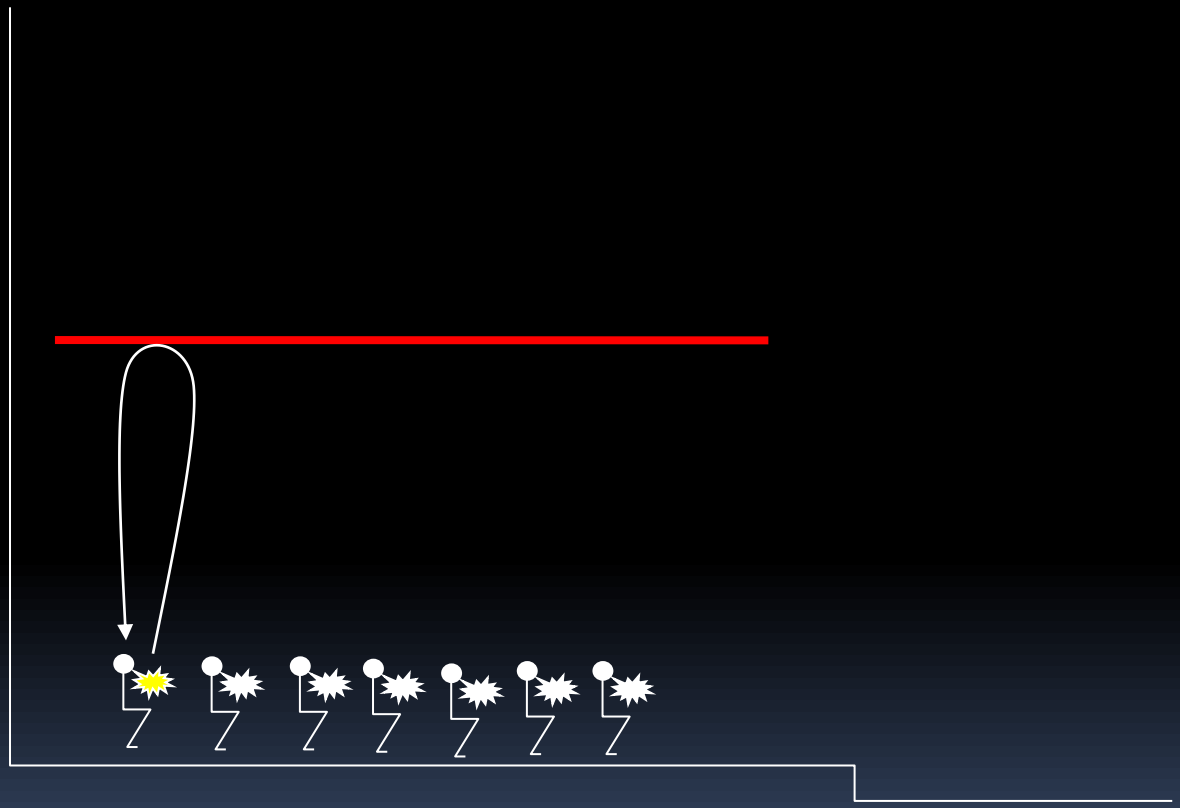




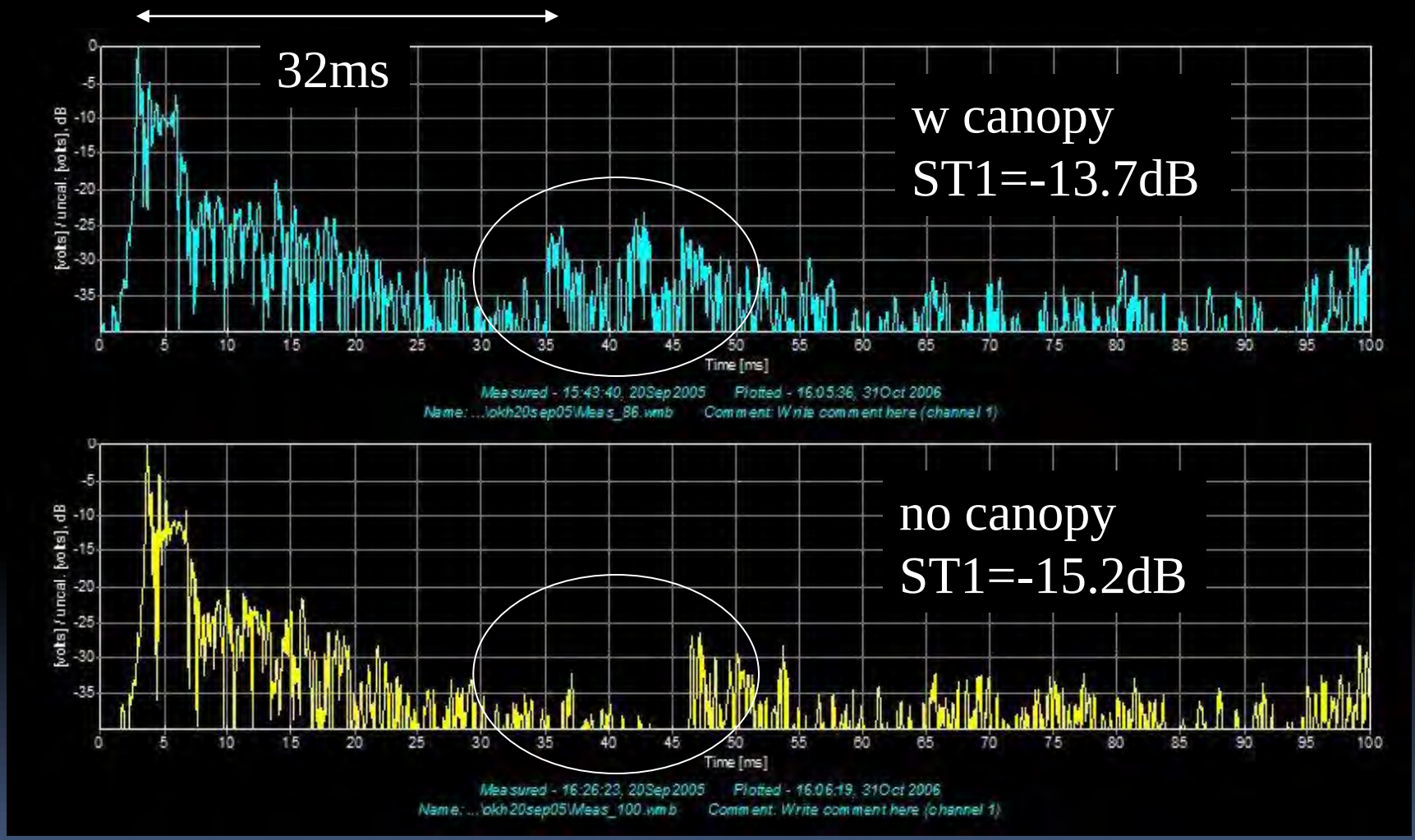
Transmission through orchestra, re free sight



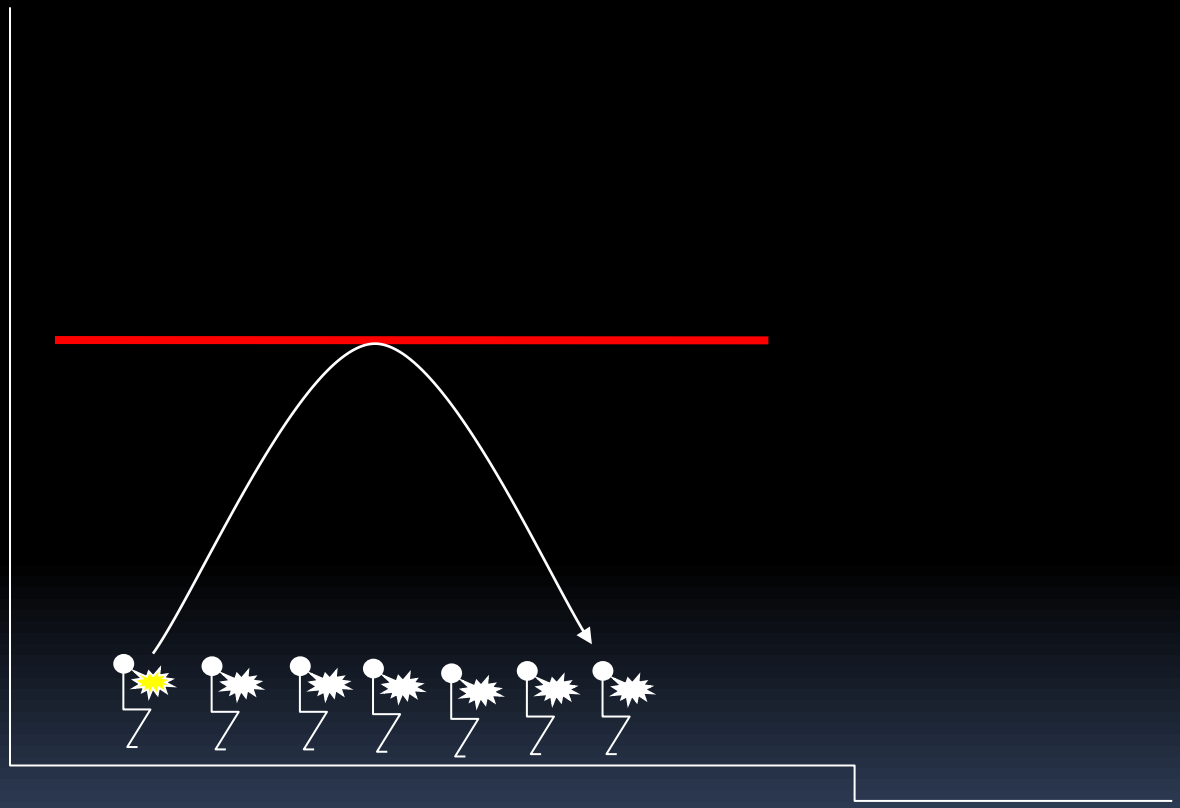
Support – hearing oneself



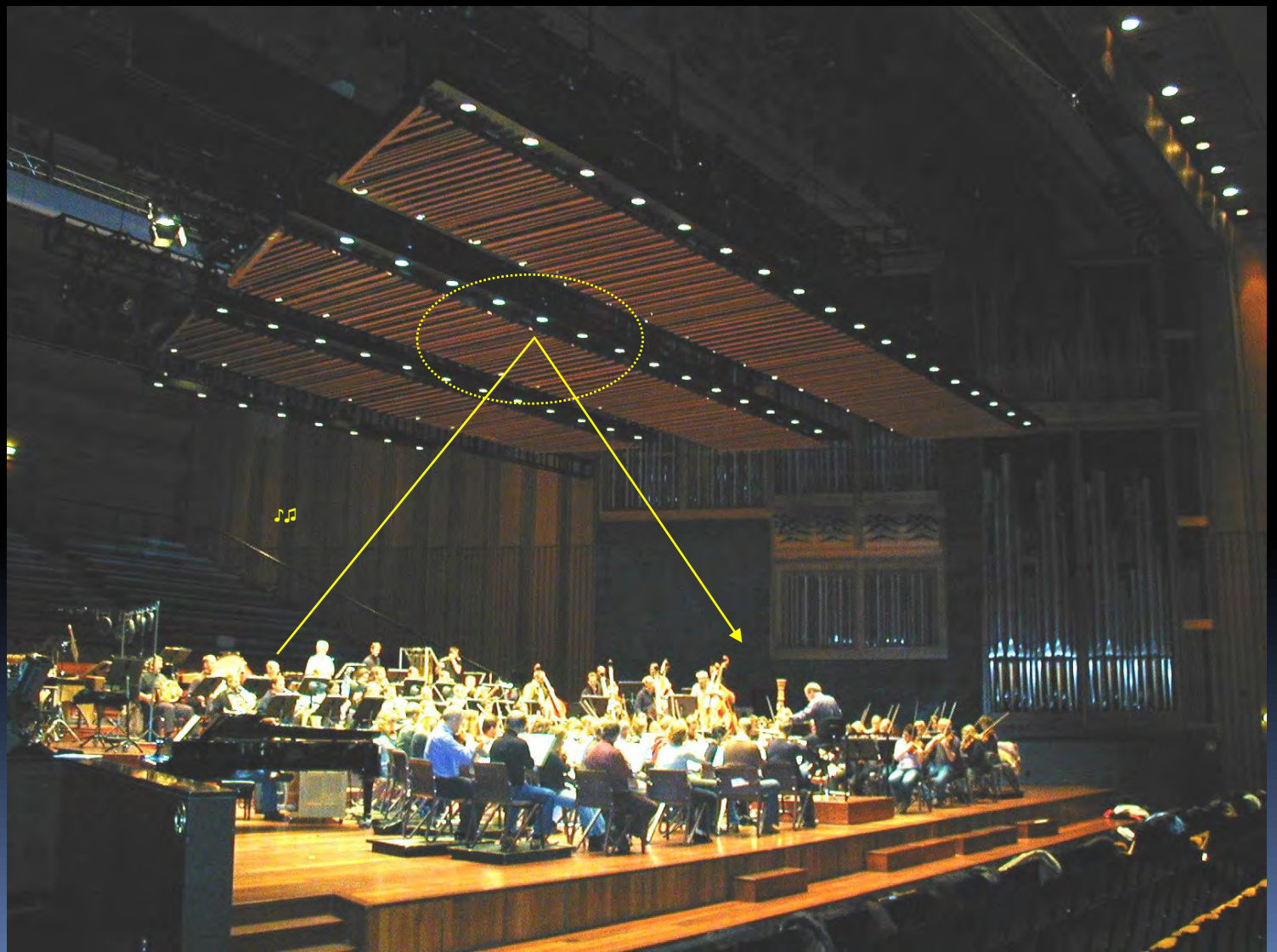
Support – fill-in-effect



Mutual hearing



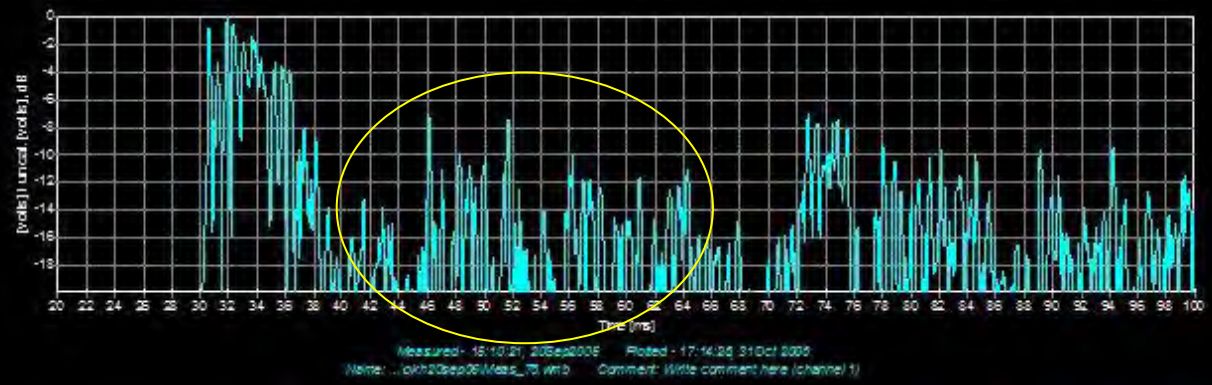
Mutual hearing



Mutual hearing

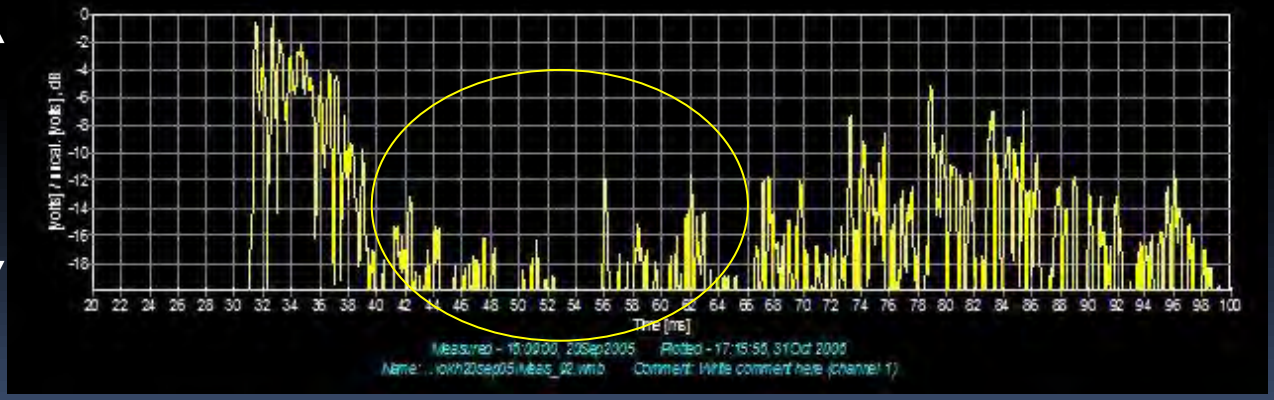
- Fill-in-effect, 10m source-receiver distance

20dB



w canopy

20dB

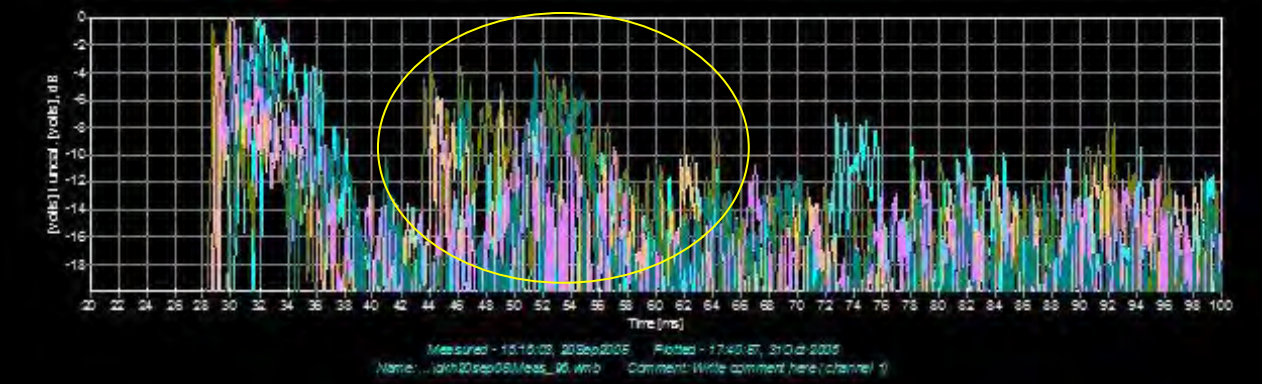


no canopy

Mutual hearing

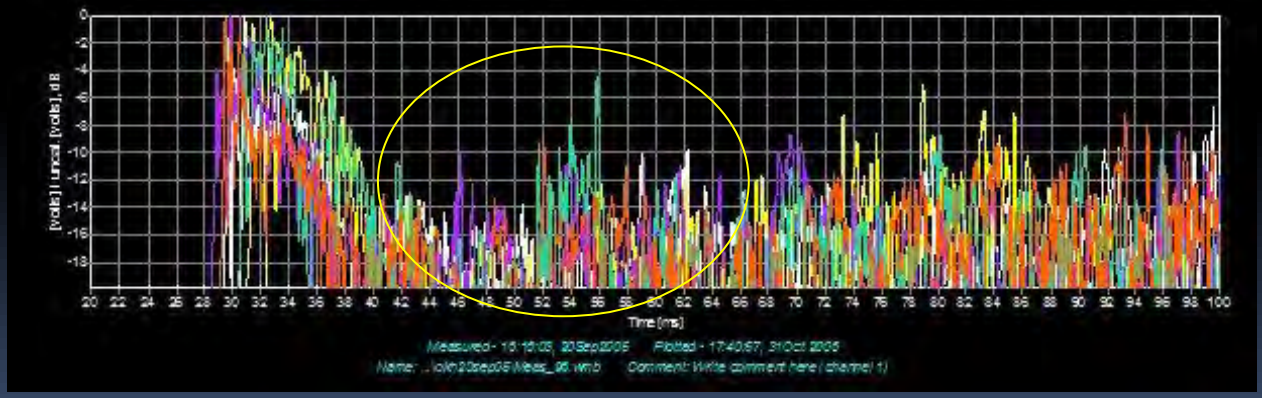
- 5 measurements, 10m source-receiver distance

20dB



w canopy

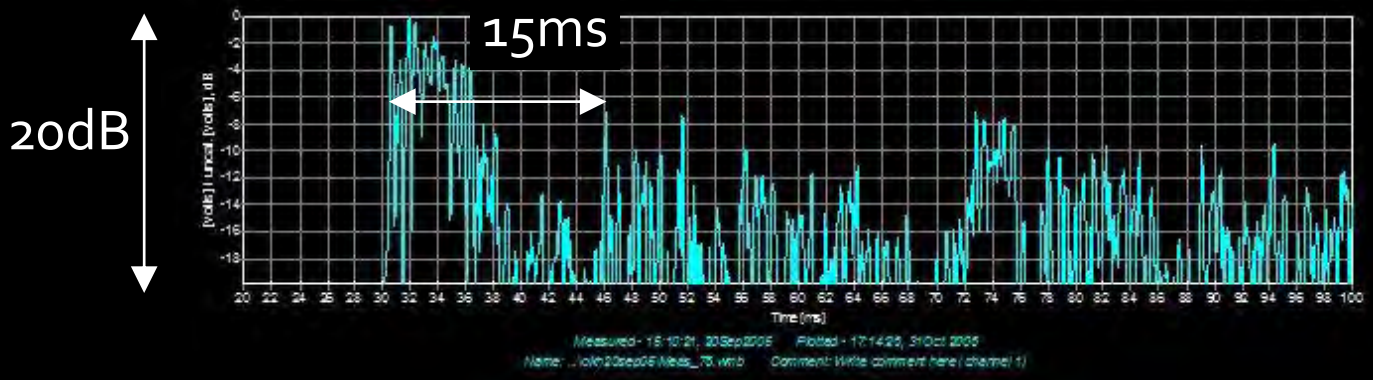
20dB



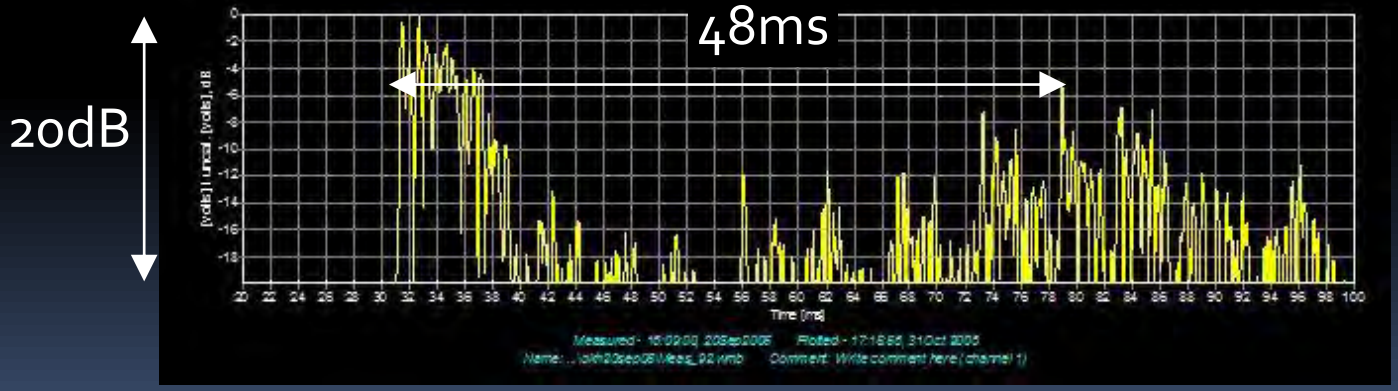
no canopy

Mutual hearing

- Initial time gap, at 10m distance

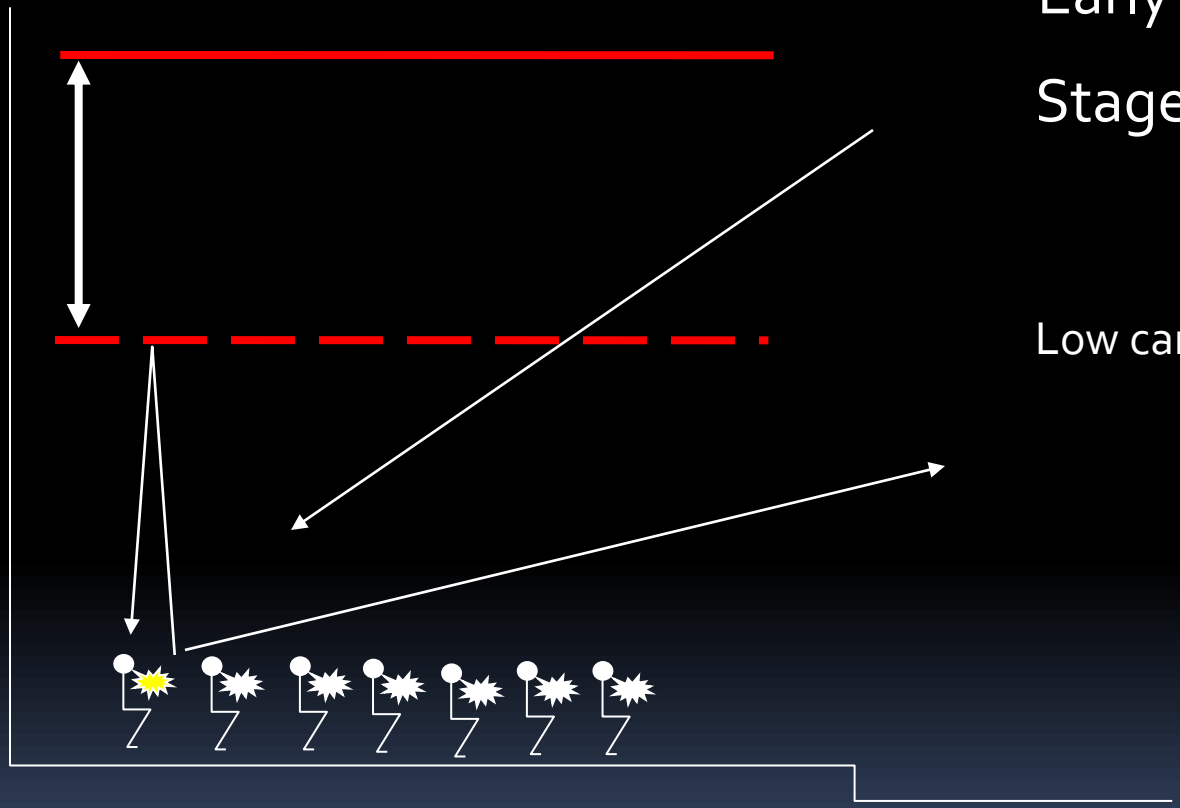


w canopy



no canopy

Height and density – level balance

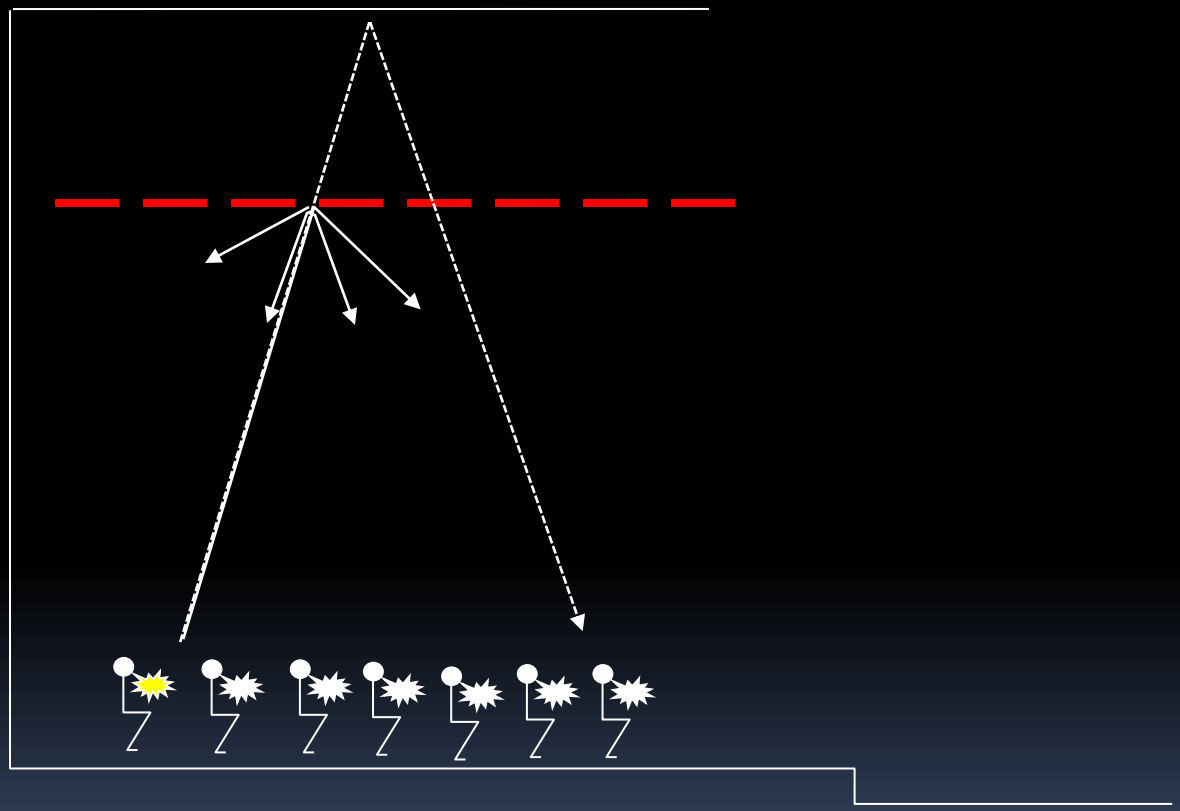


Early-Late balance C80

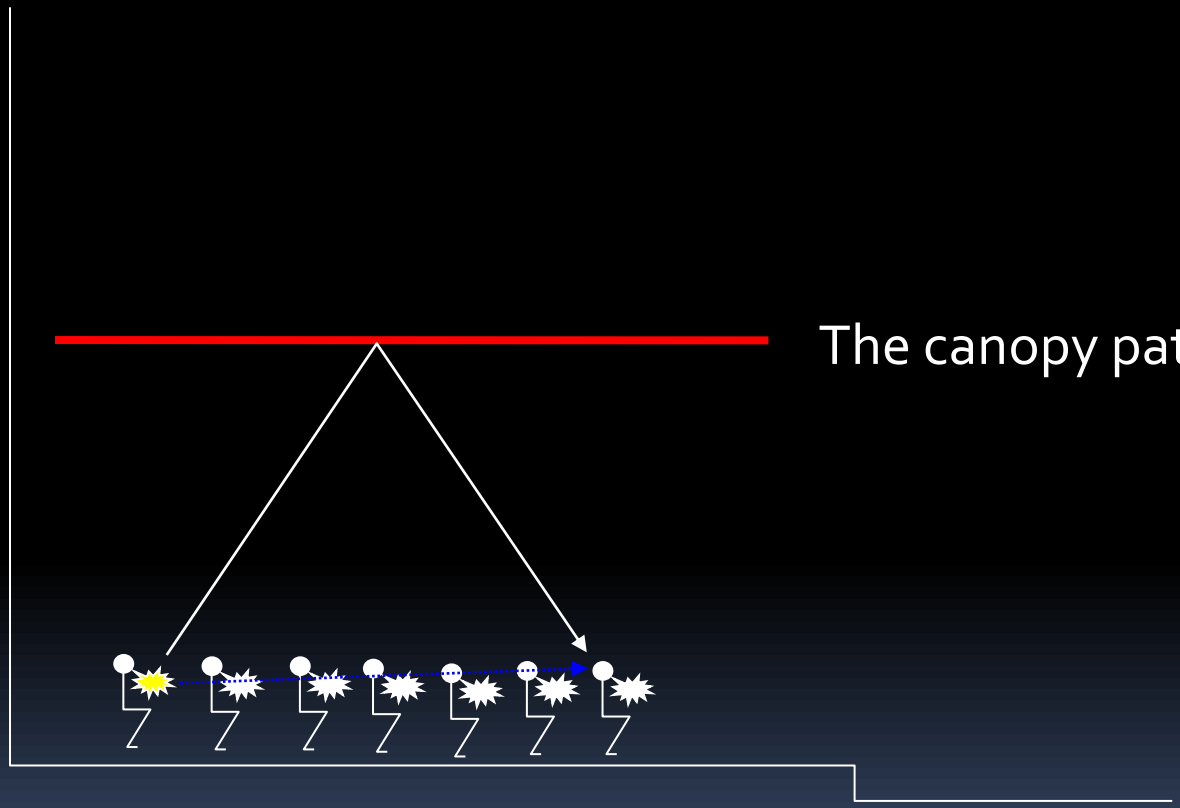
Stage-Auditorium balance

Low canopies should be transparent

Echo-breaker



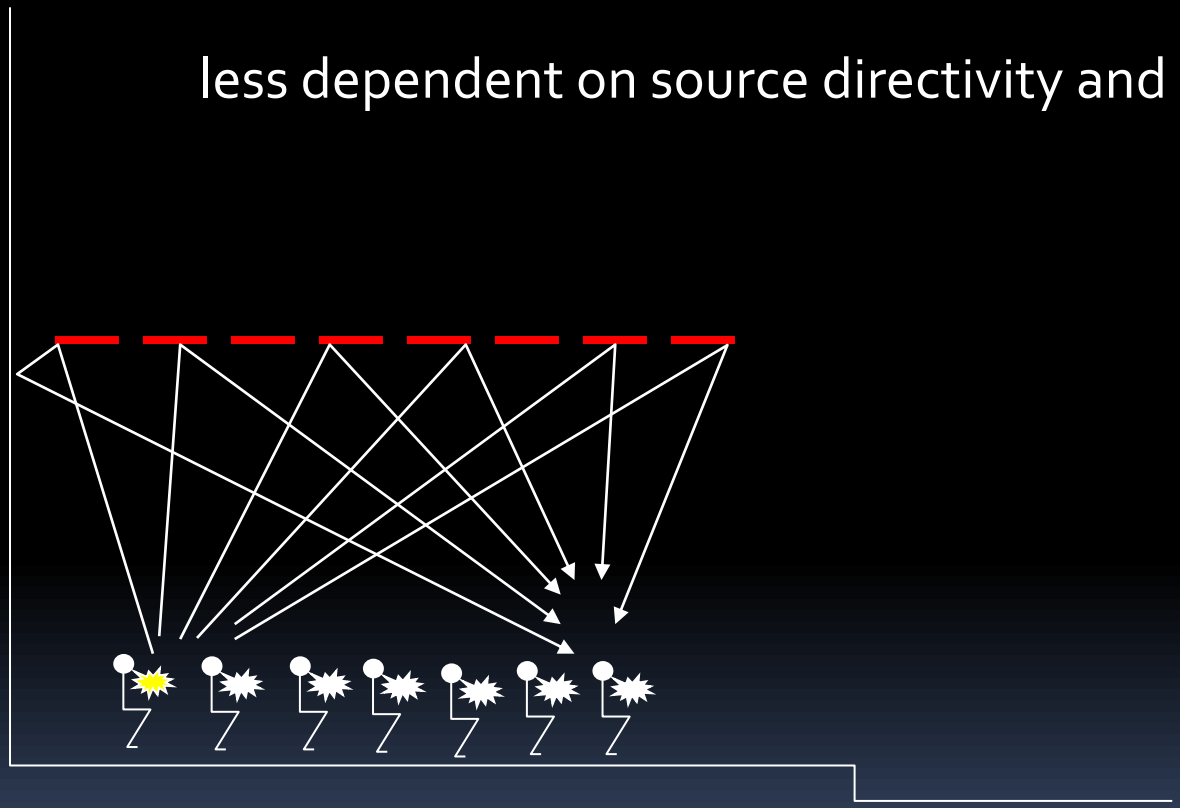
Unobstructed sound paths



The canopy path is always available

Diffuse multi-channel

less dependent on source directivity and obstacles



Homogenous foldback

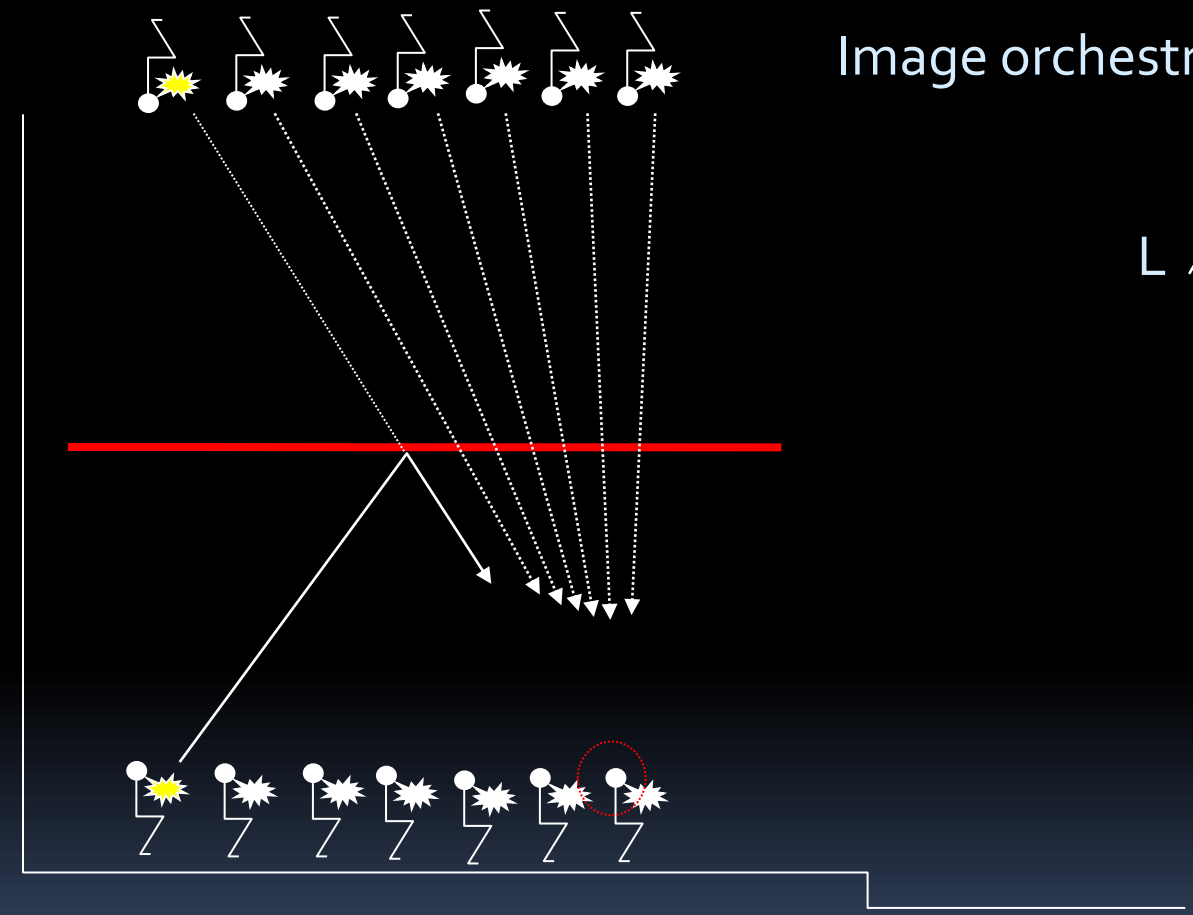
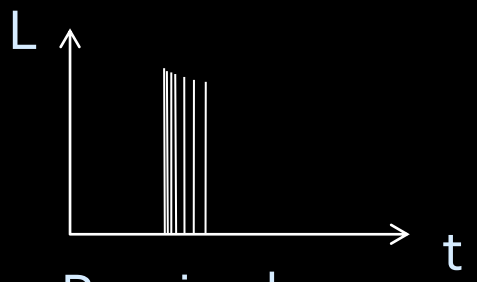


Image orchestra

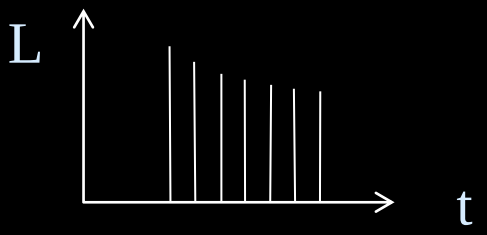


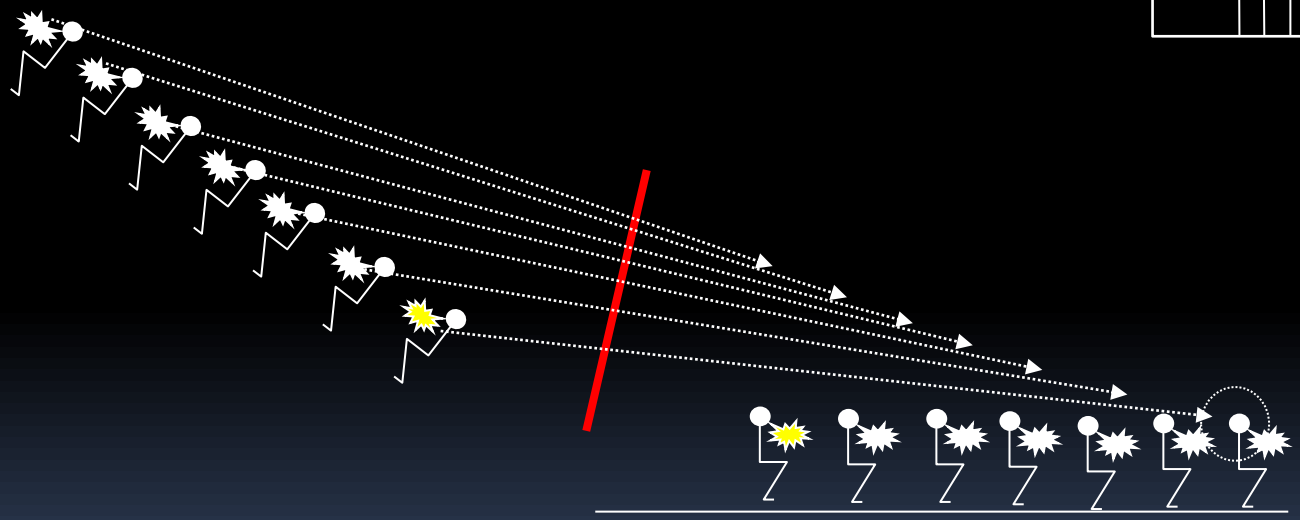
Received:

- In sync
- Equal levels

Option: Inclined surface

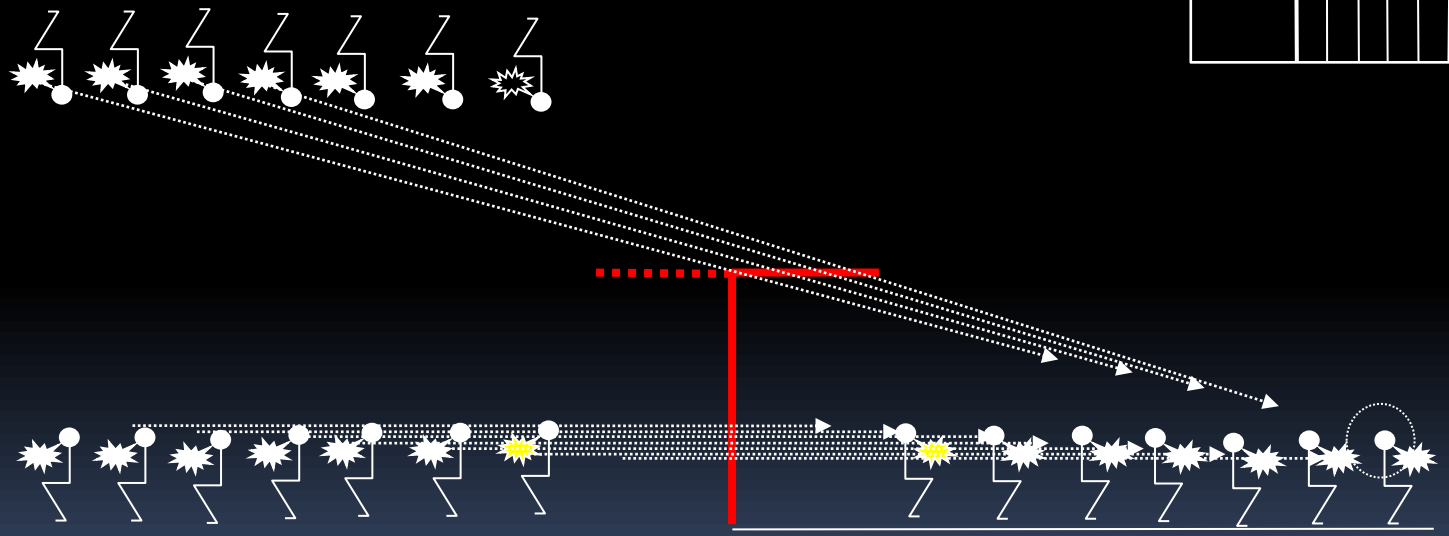
Image
orchestra

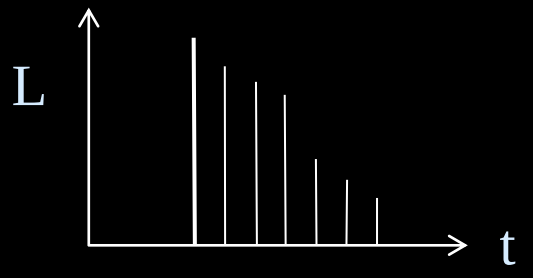




Wall + Balcony soffit

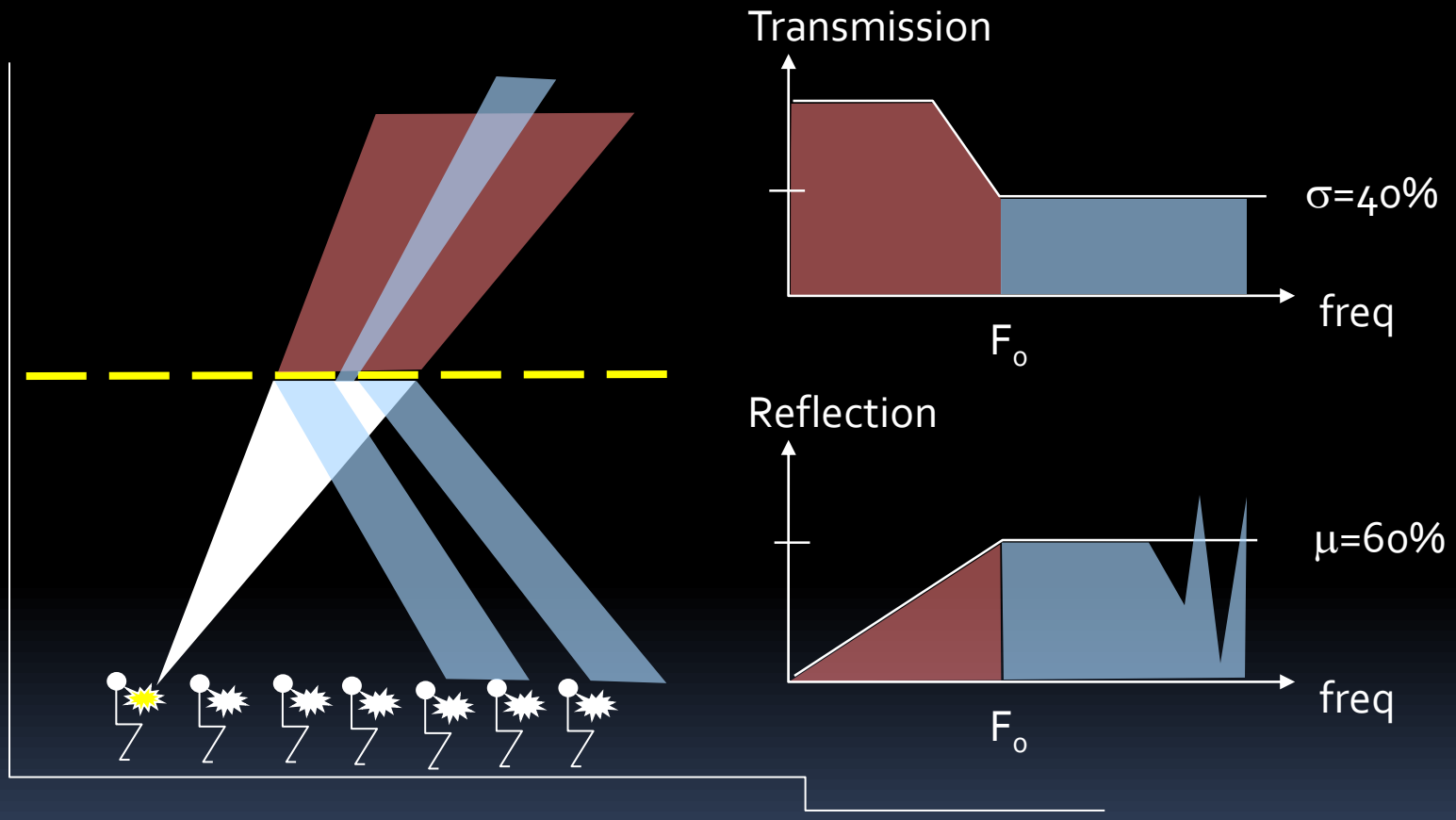
Image orchestra





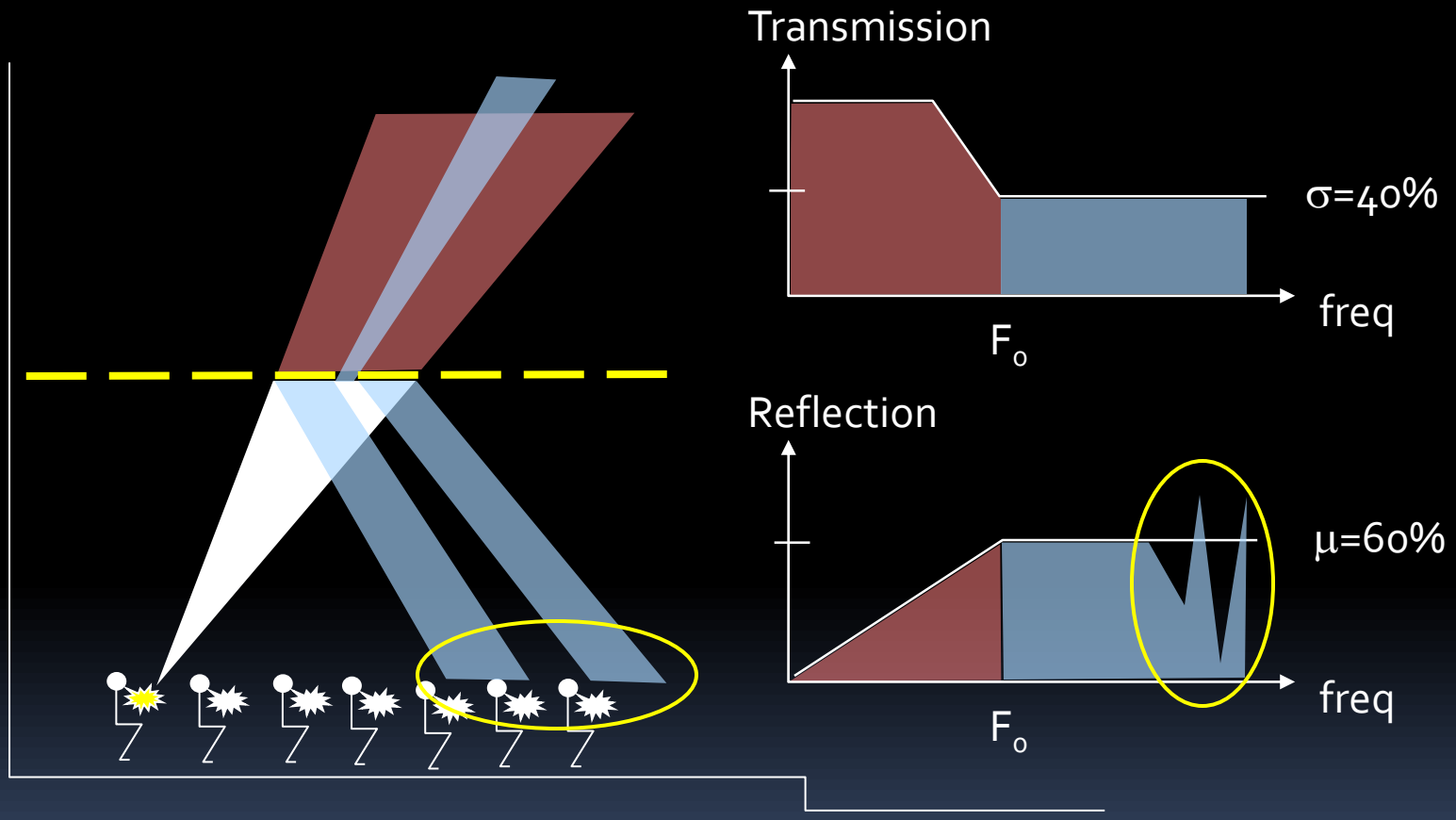
Transparent canopy
- the canopy array

Flat panel array filter



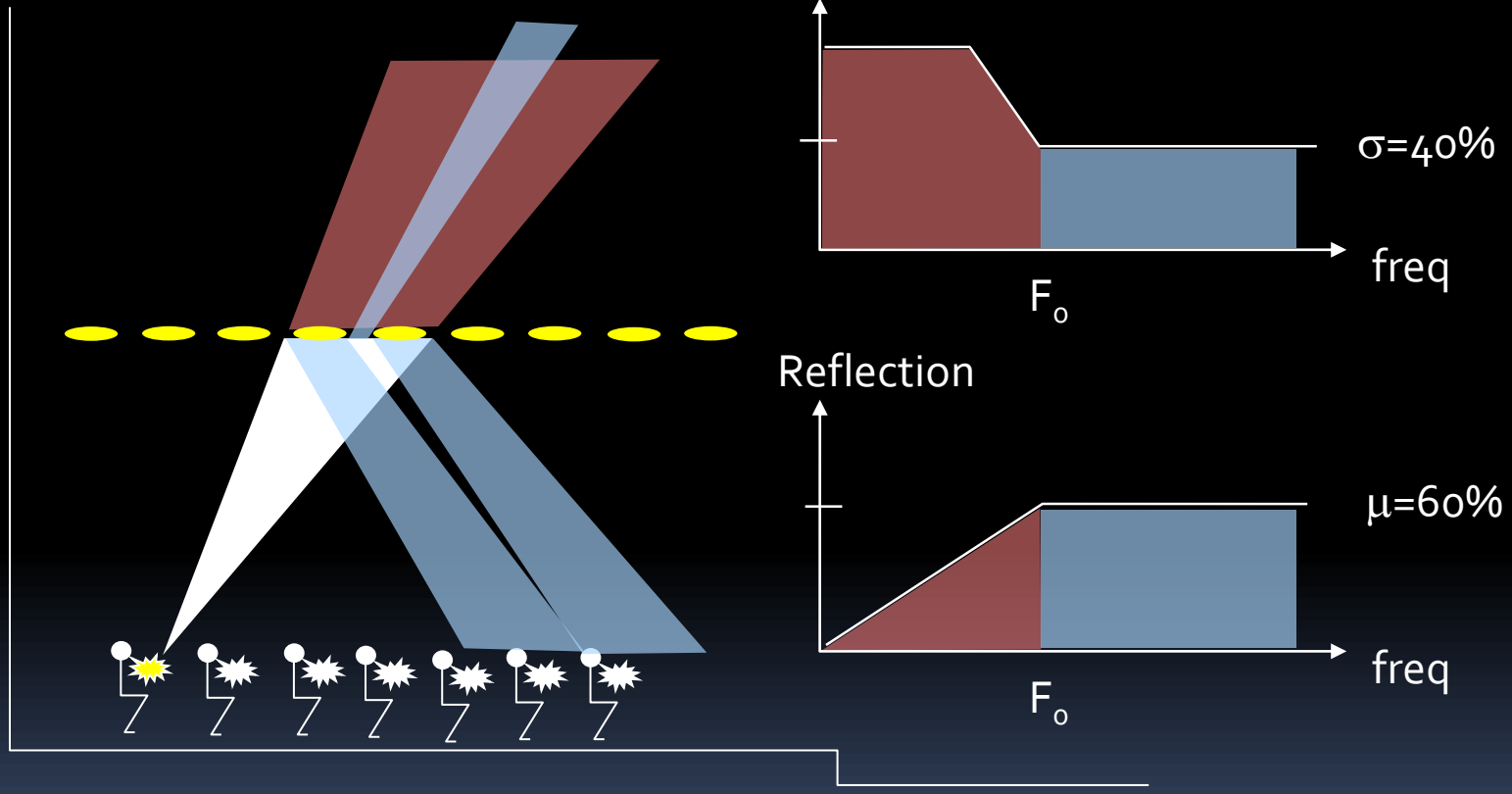
F_o ~128/a , radius a

Narrow-band filter canopy



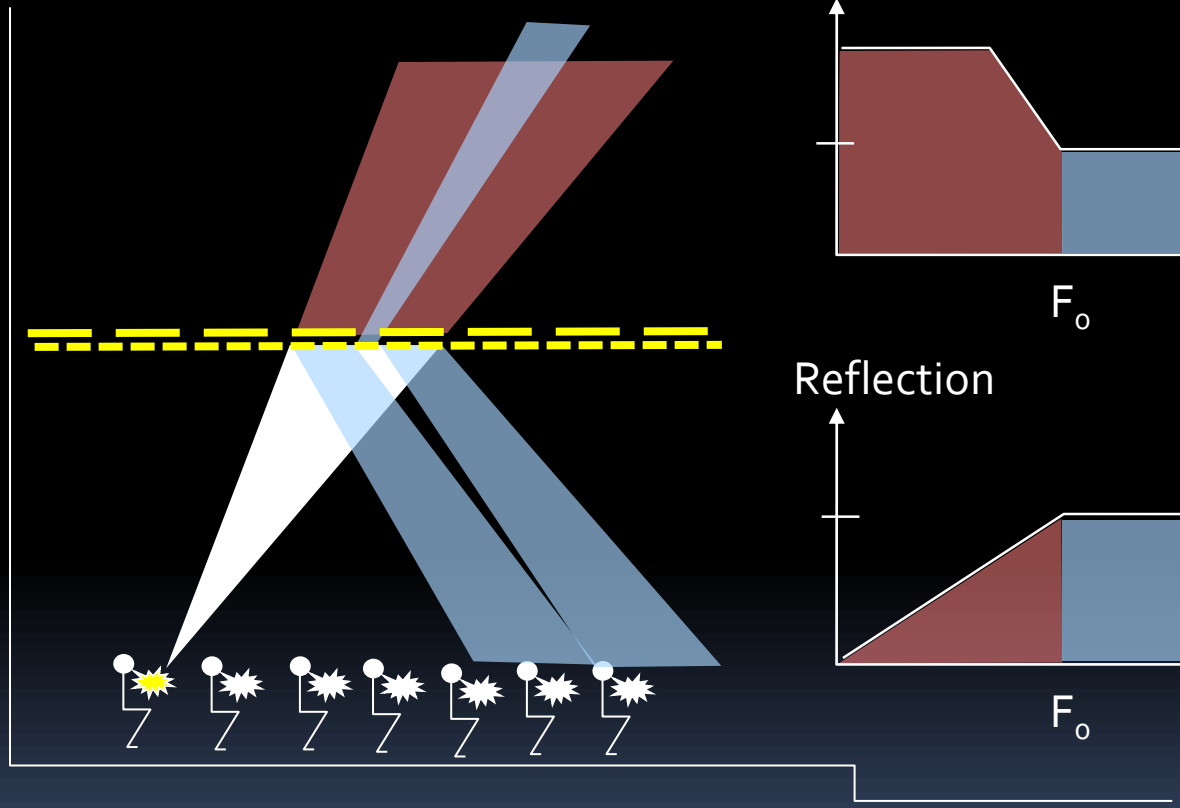
F_o ~128/a , radius a

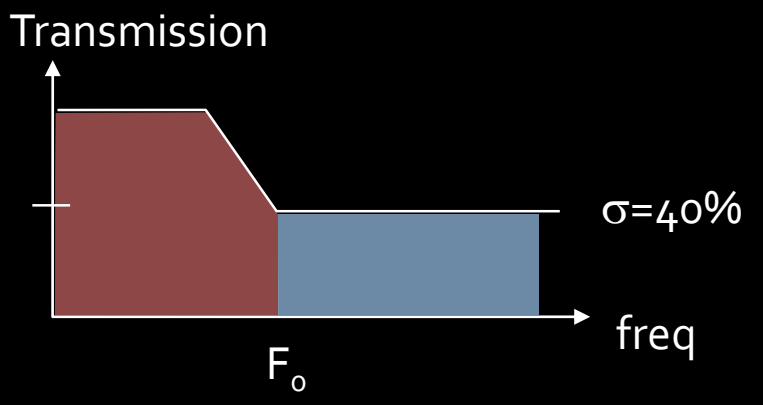
Convex panel array filter

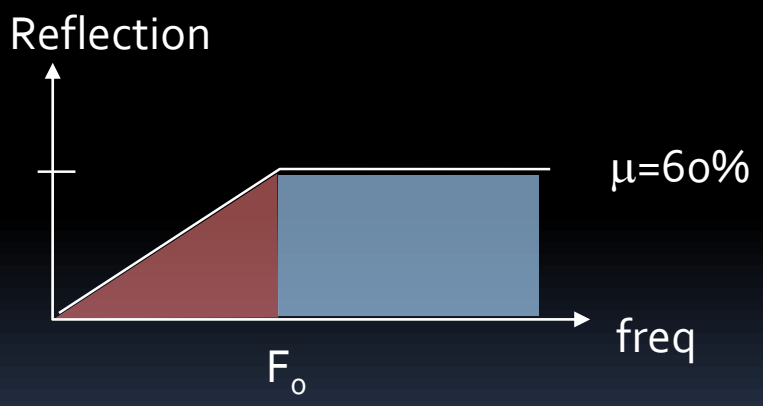


F_0 ~128/a , radius a

Two-way panel array filter







F_0 ~128/a , radius a

What I was trying to say

- Start by defining what the orchestra needs
- Design canopy as a response to needs
- Predict difference w/wo canopy
  - Subtle fill-in effect, hard to predict, hard to measure
- Don't use it if you don't need it
  - Remember Vienna, Amsterdam, Boston
- Check for unwanted side-effects
  - Uneven coverage, bad pitch-response, echoes, balance,..
- Canopy Arrays useful, but involve many design parameters
  - Element size, frequency range, Density, Height, Diffusivity and Coverage
- Effective echo-breaker
- Stage Acoustics research far from complete, demand for metric remains
  - Current parameters (ST) apply to empty stage, maybe solo, duet, quartet…….but not to orchestra conditions
  - Obstructed cross-stage paths must be taken into account

BREKKE STRAND

Thank you

More info?

The www center for search, research and open sources in acoustics

www.akutek.info

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