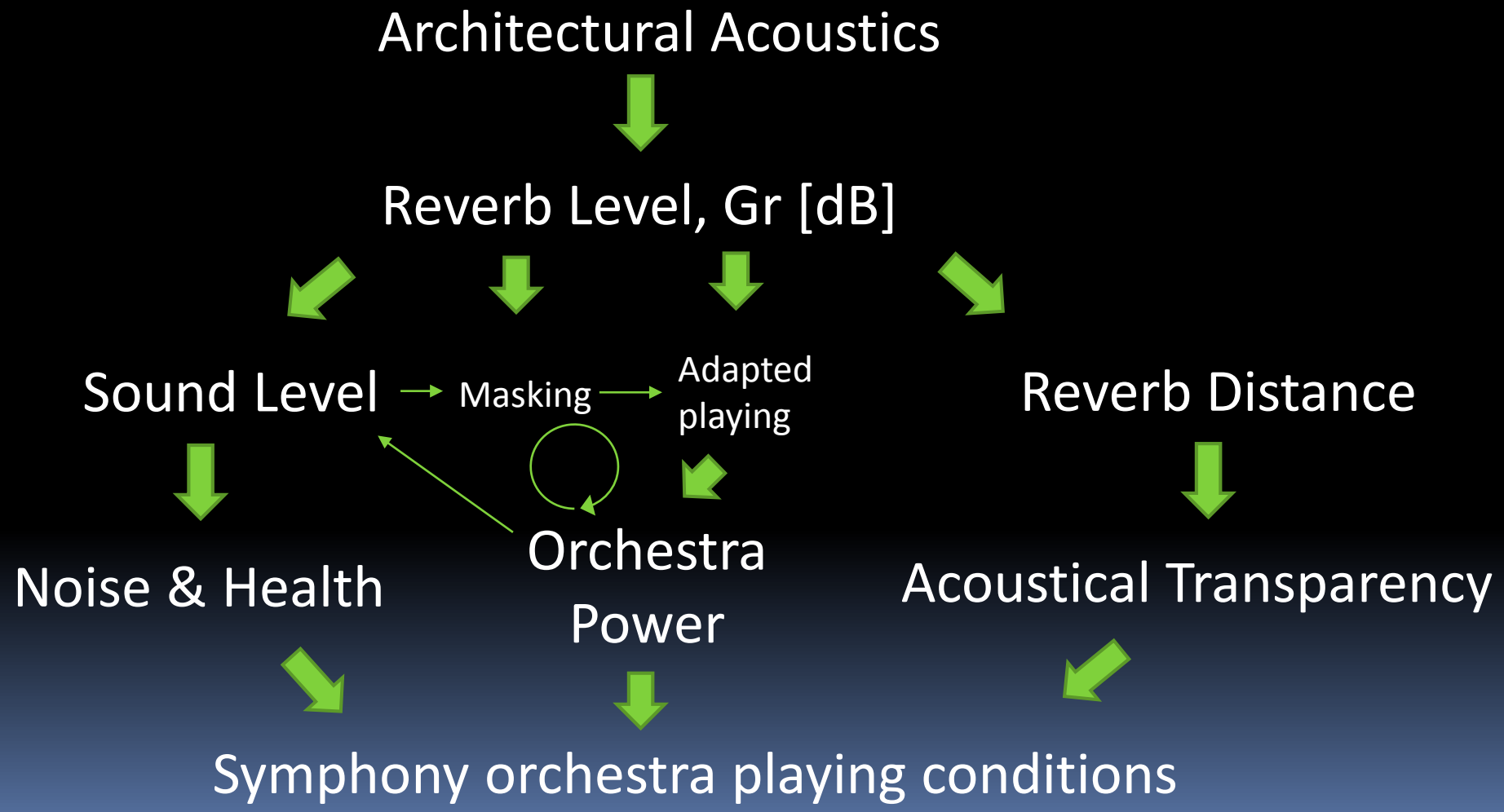
Magne Skålevik

AKUTEK
and
Brekke & Strand, Oslo
www.akutek.info

COMPUTATIONS OF SOUND POWER AND LEVEL COMPONENTS IN SYMPHONY ORCHESTRAS


Architectural Acoustics
Reverb Level, Gr [dB]
Sound Level
Masking
Adapted playing
Reverb Distance
Noise & Health
Orchestra Power
Acoustical Transparency
Symphony orchestra playing conditions

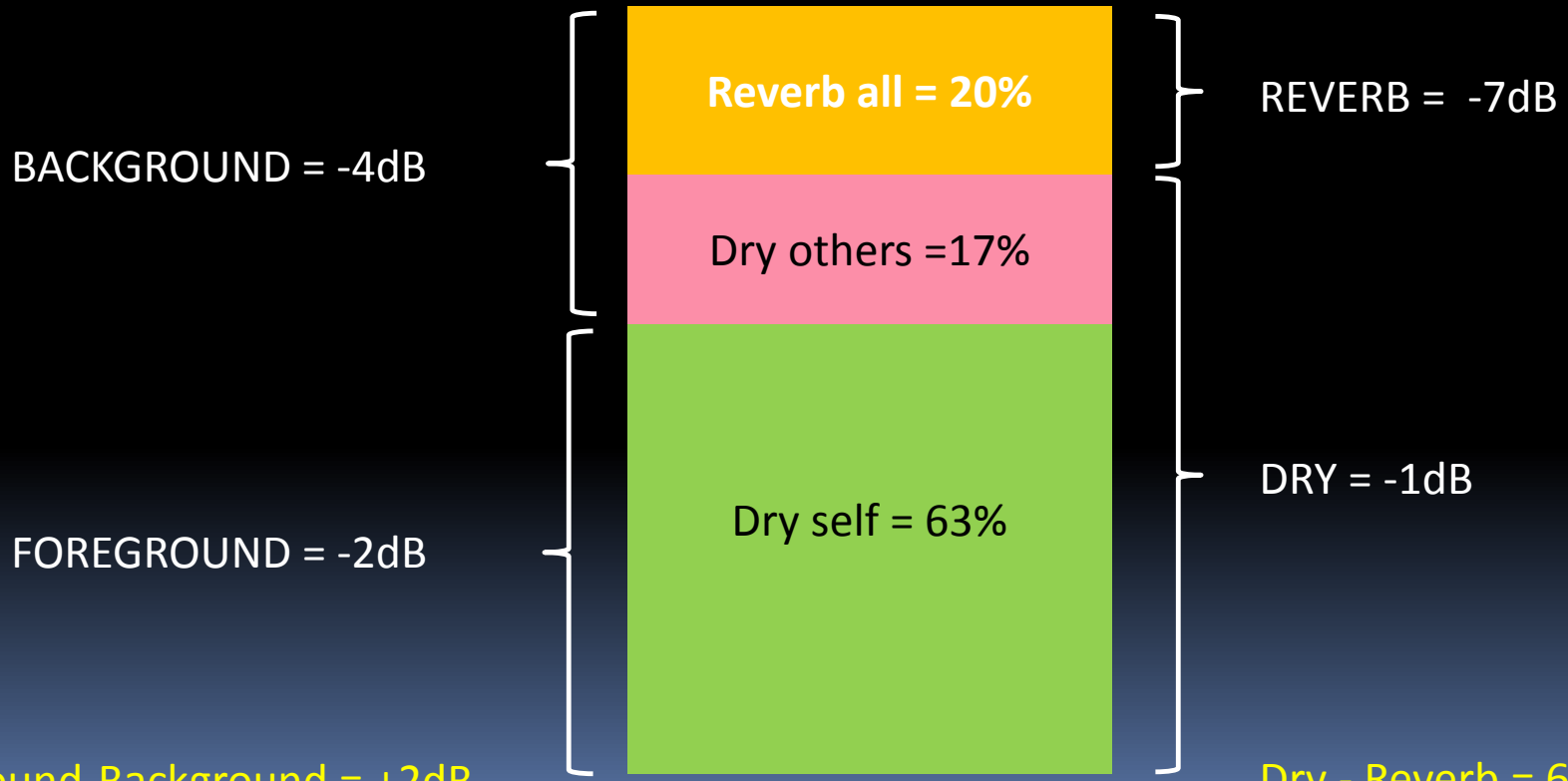
Symphony Orchestra LA,eq (dB) levels

Same music – two different venues

1. Requires more orchestra effort -> higher dose

2. Requires less orchestra effort -> smaller dose

Sound components at a violinist's ear



T=0.4
G_r=25

Small rehearsal room

T=0.7
G_r=15

Big rehearsal room

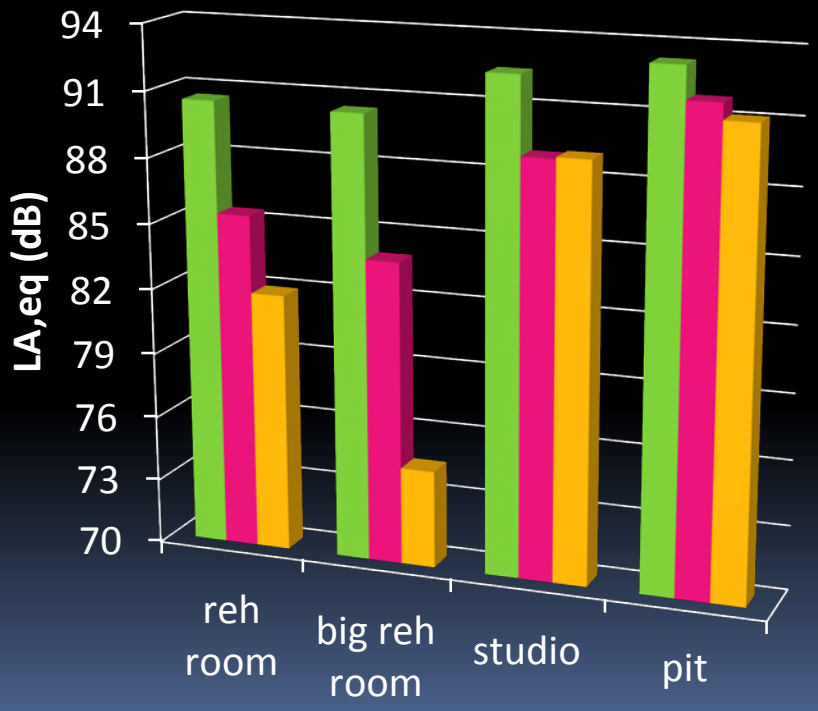
T=1.0
G_r=8

Orchestra Rehearsal Studio

T=2.1
G_r=6

Opera House Orchestra Pit

At violinist's ear $L_{A,eq}$ (216s at ff)



Leq L

Leq R

Leq far

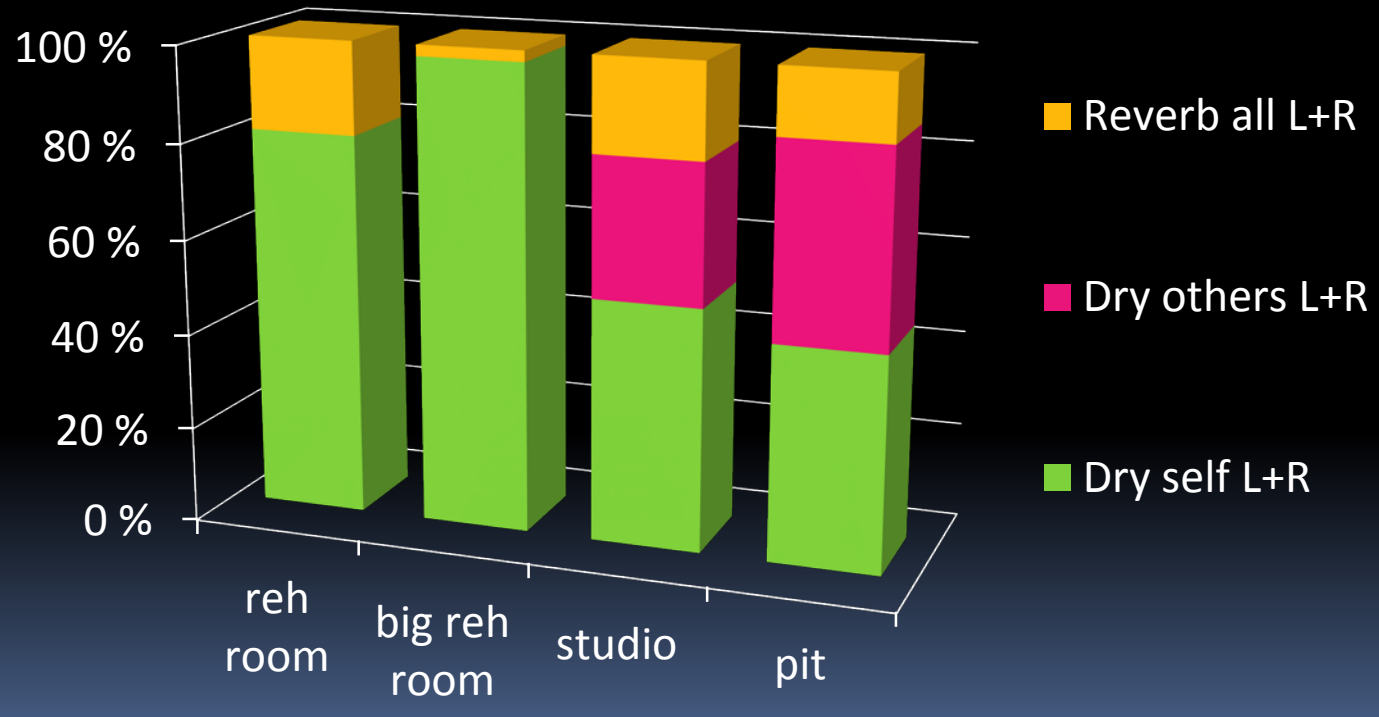
L = Left ear canal entrance

R = Right ear canal entrance

far = behind the back, i.e. screened from own instrument

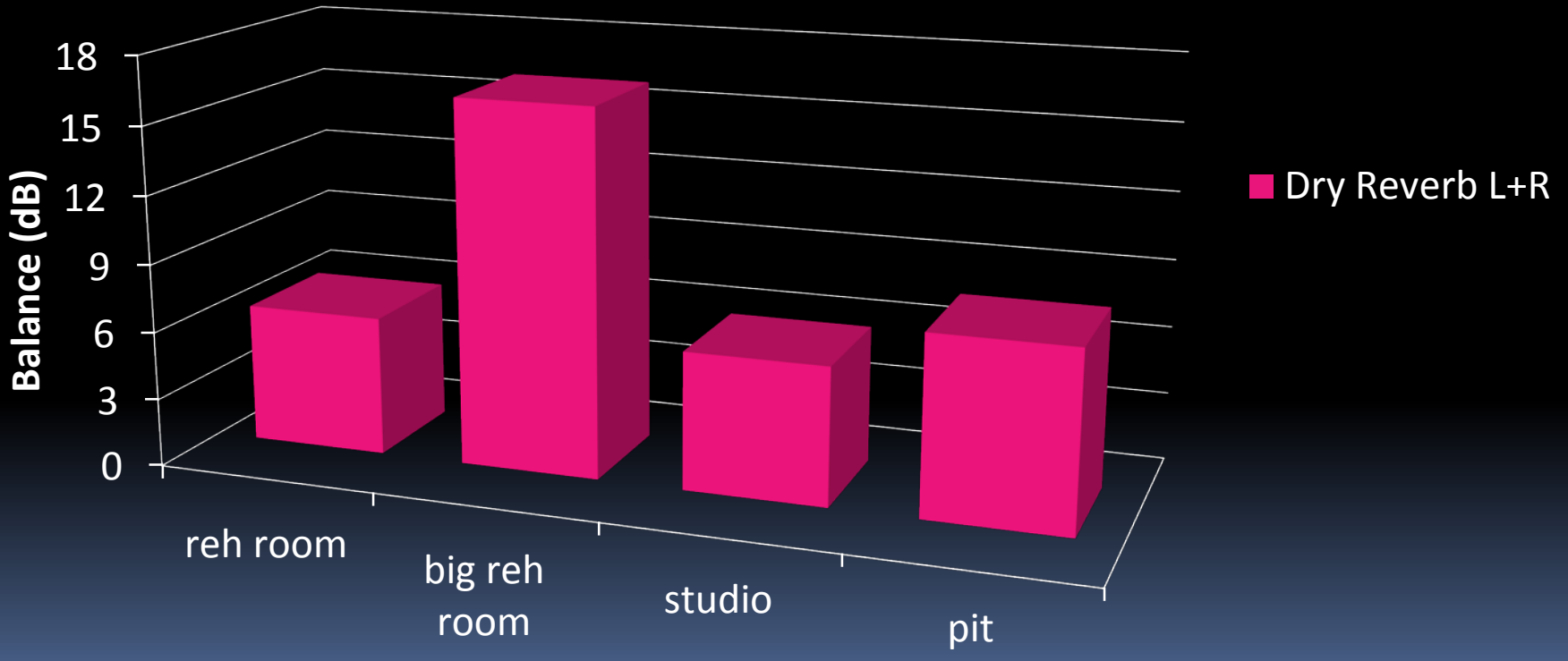
3 ff parts, total duration 216s, Tchaikovski Swan Lake

Analysis: energy fractions, violinist



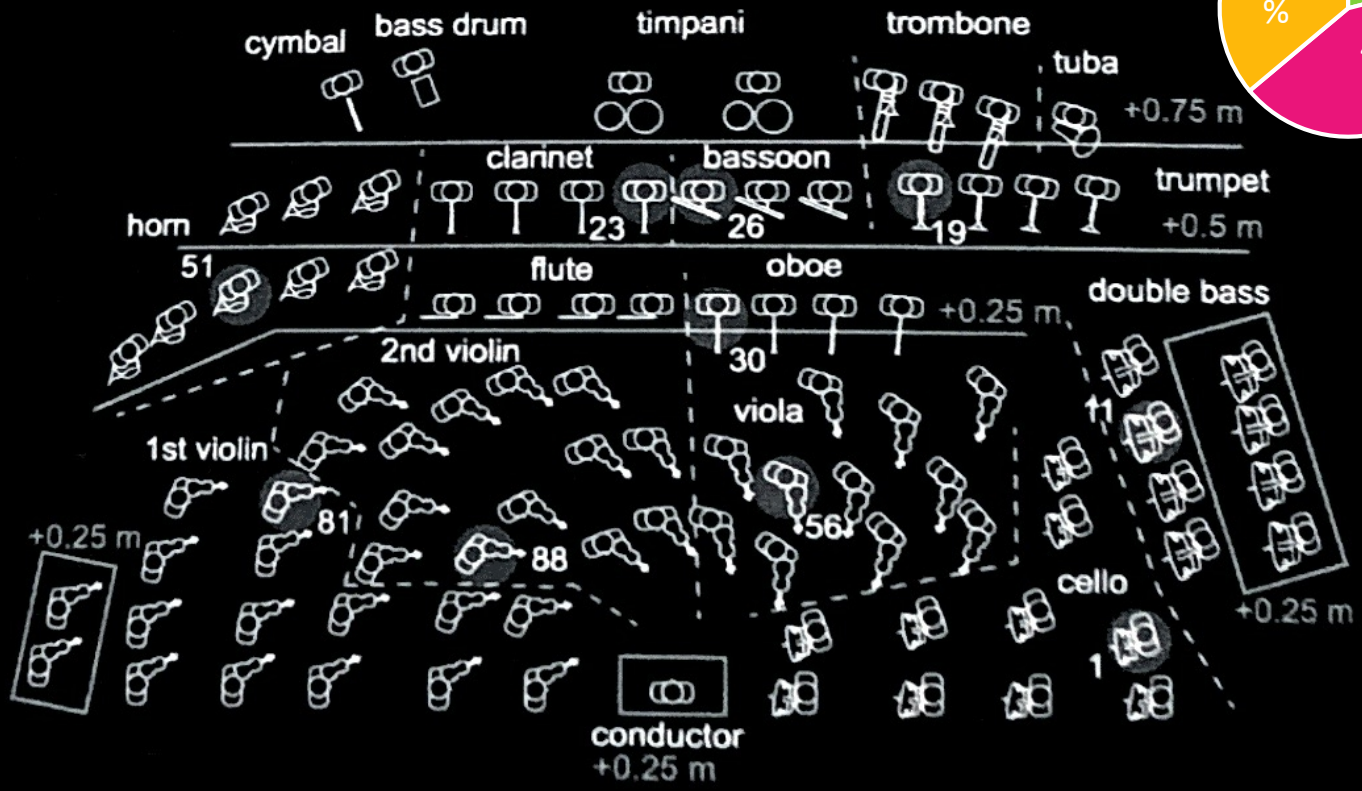
Reverb≈20% in preferred rooms, big or small

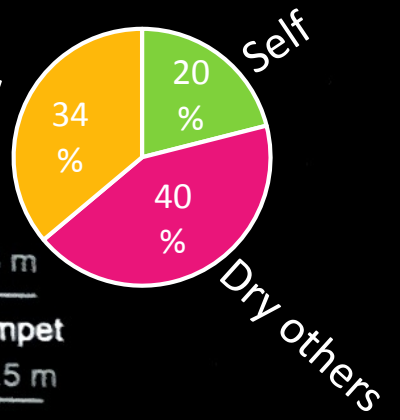
Dry-Reverb Balance, violinist



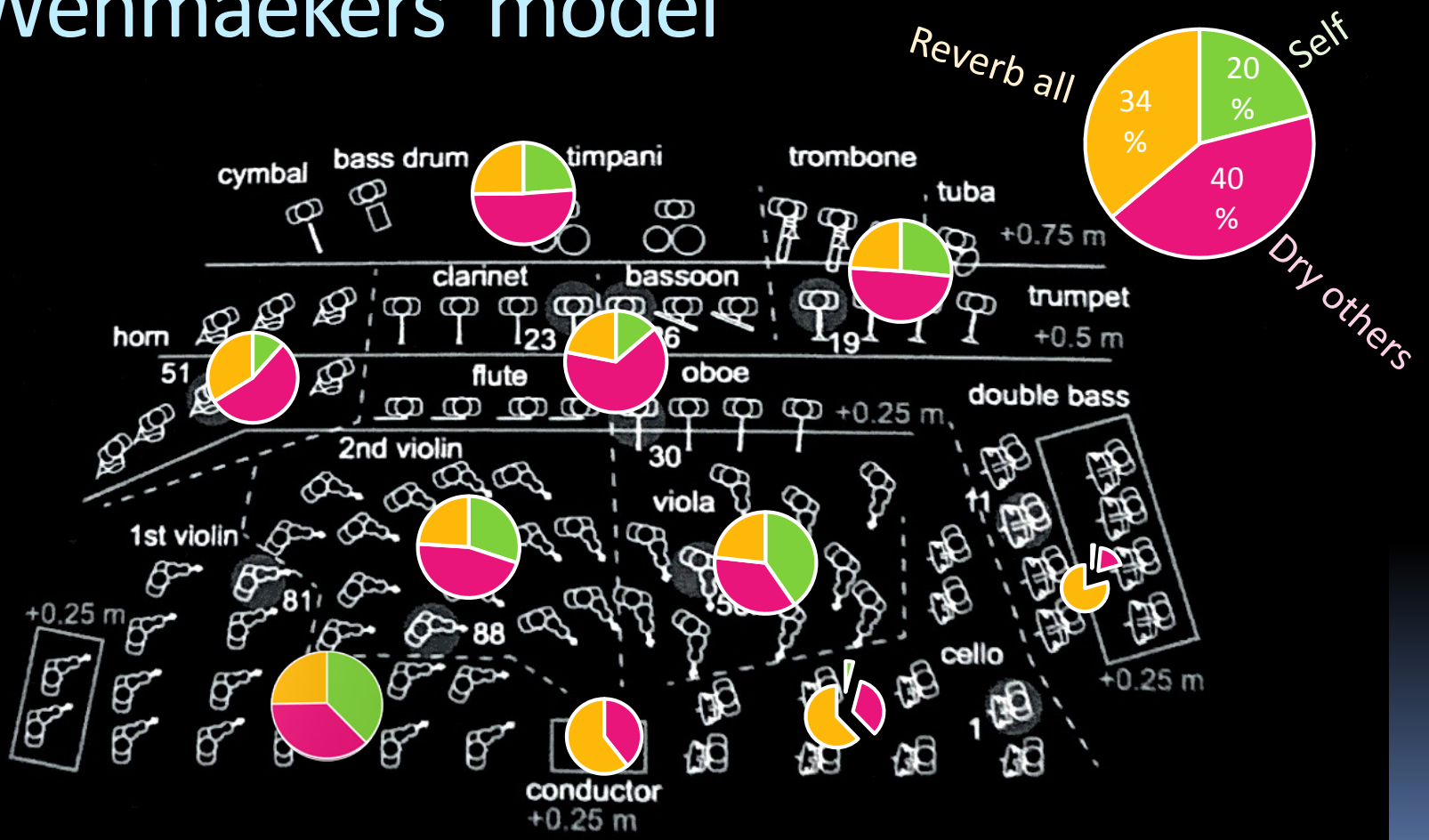
6-7dB in preferred rooms, big or small

Wenmaekers' model

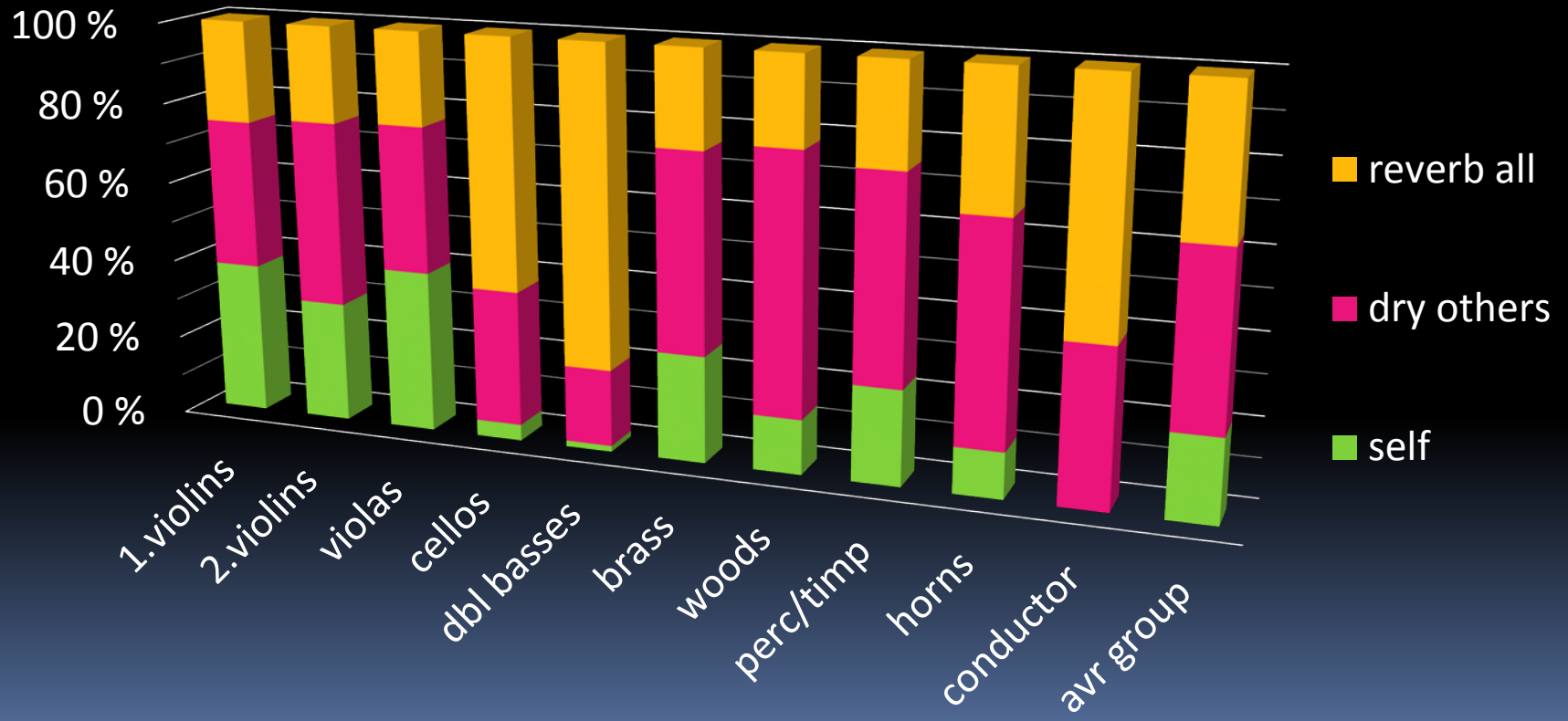




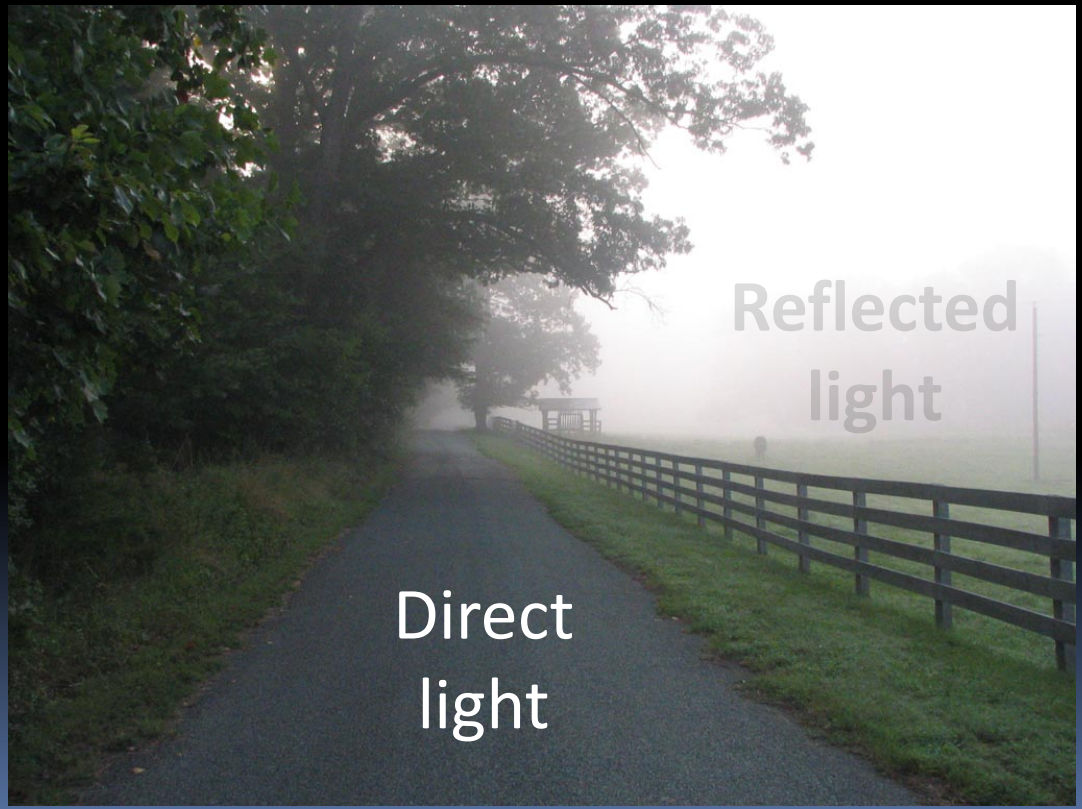
Wenmaekers' model



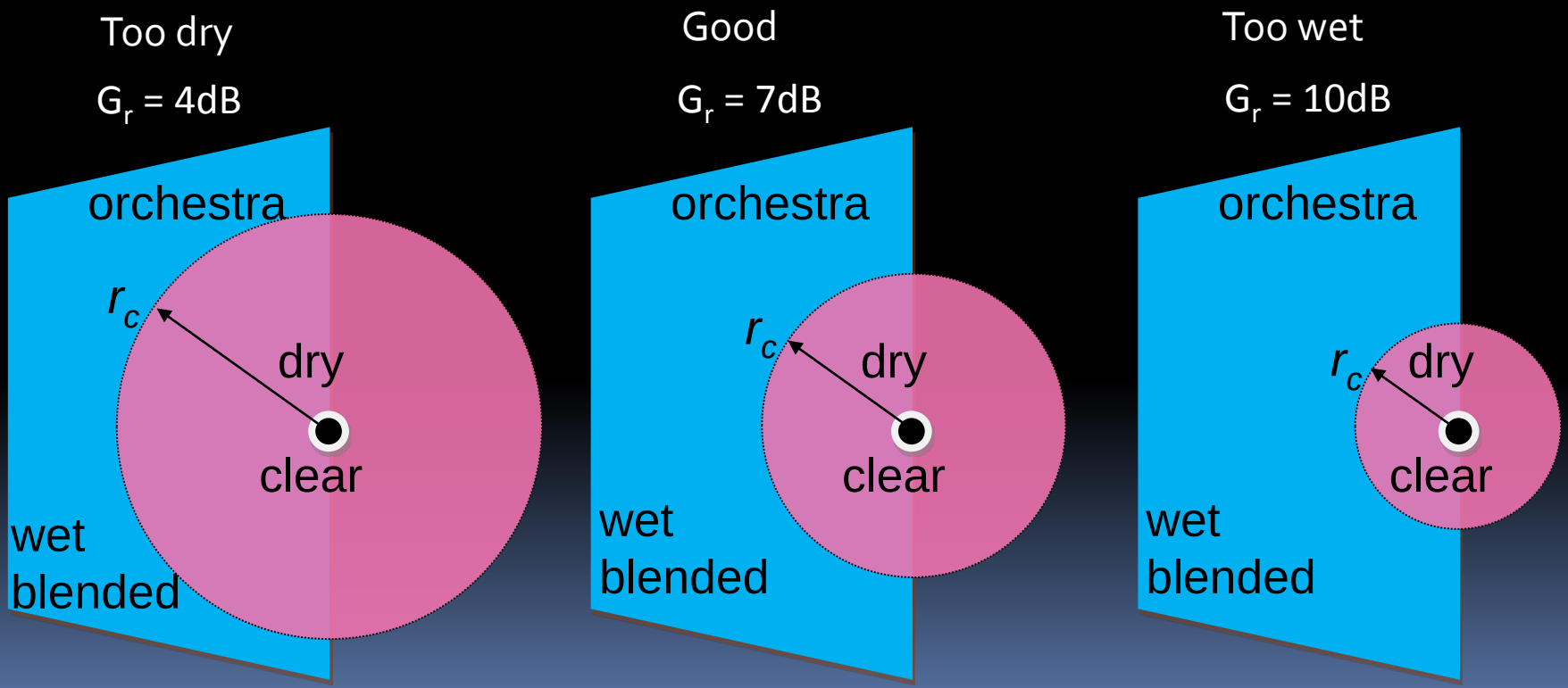
Self / Others / Reverb in tutti forte

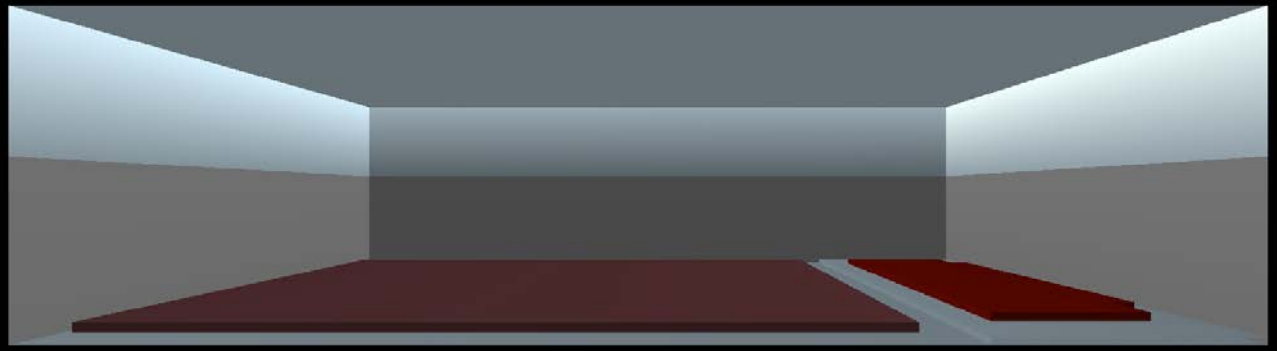


Transparency – optical analogy

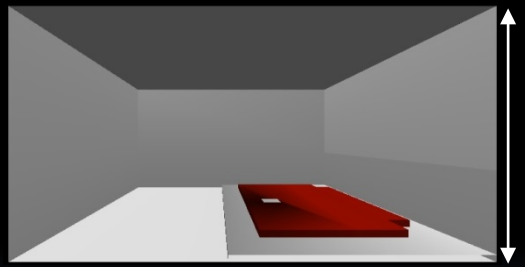


Conductor's Transparency and Reverb level G_r





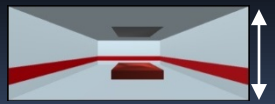
Concert Hall,
height=18m



Rehearsal Studio,
height=14m

4 Odeon models
4 situations

in the orchestra musician's daily life

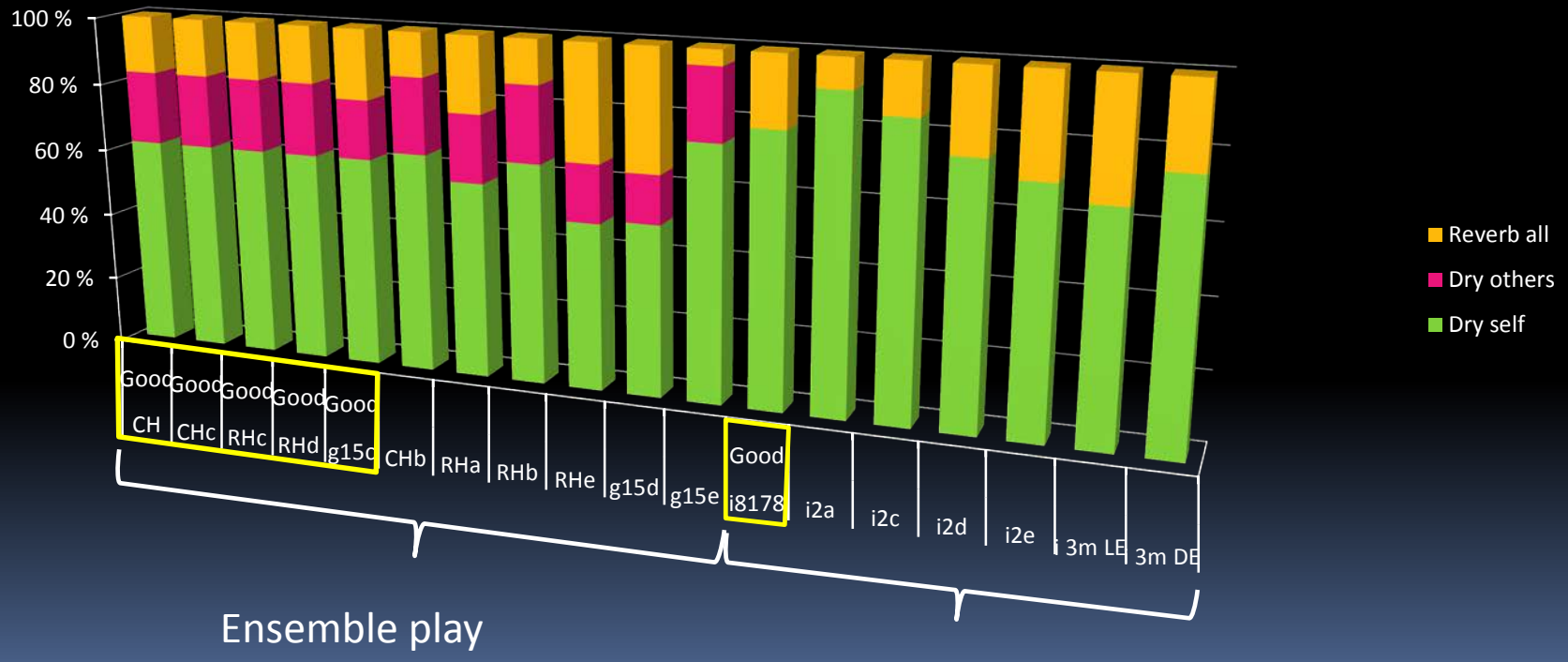


Group rehearsal room
height=5.0m

Individual rehearsal room
height=2.5-2.7m

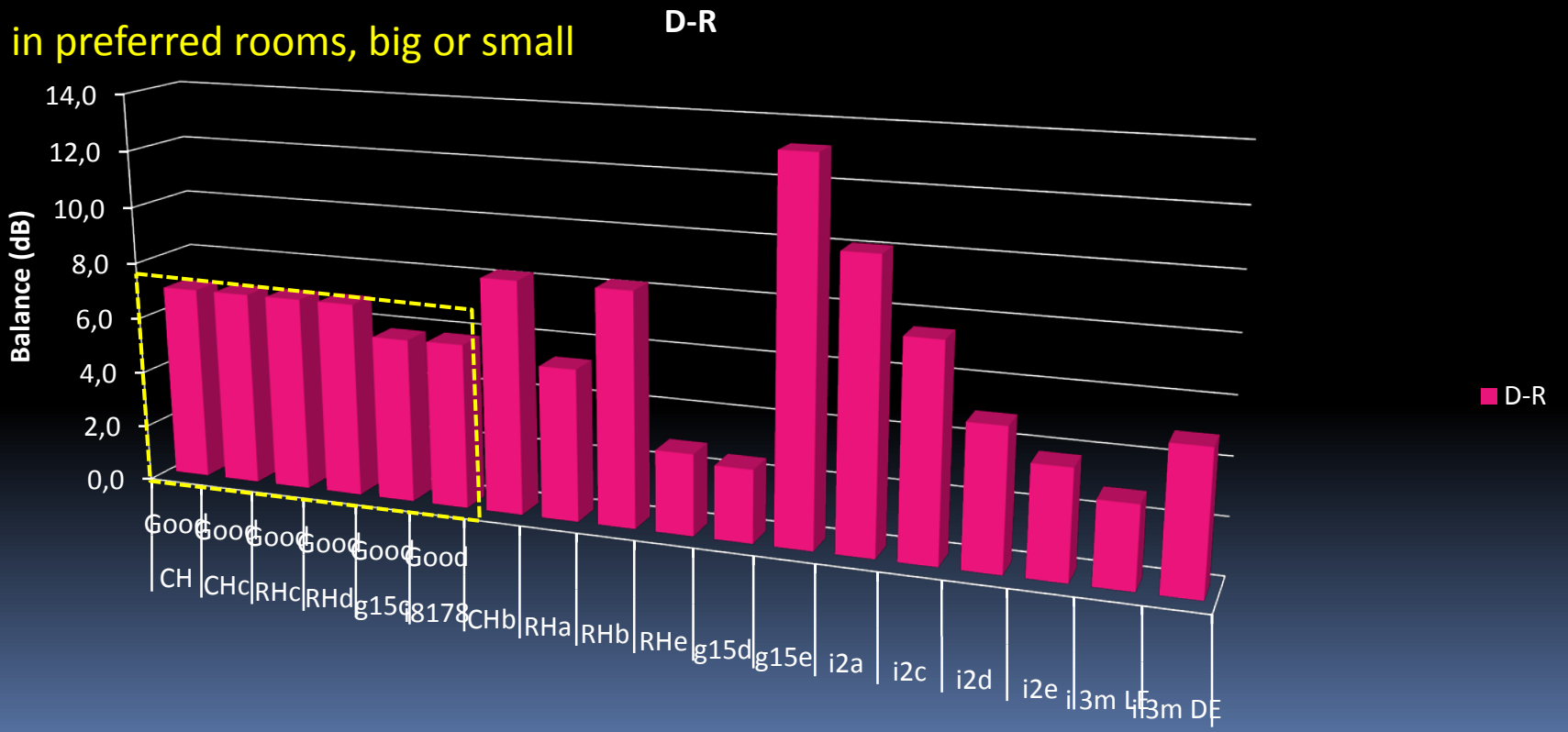
Simulated, violinist, different rooms

Reverb≈20% in preferred rooms, big or small



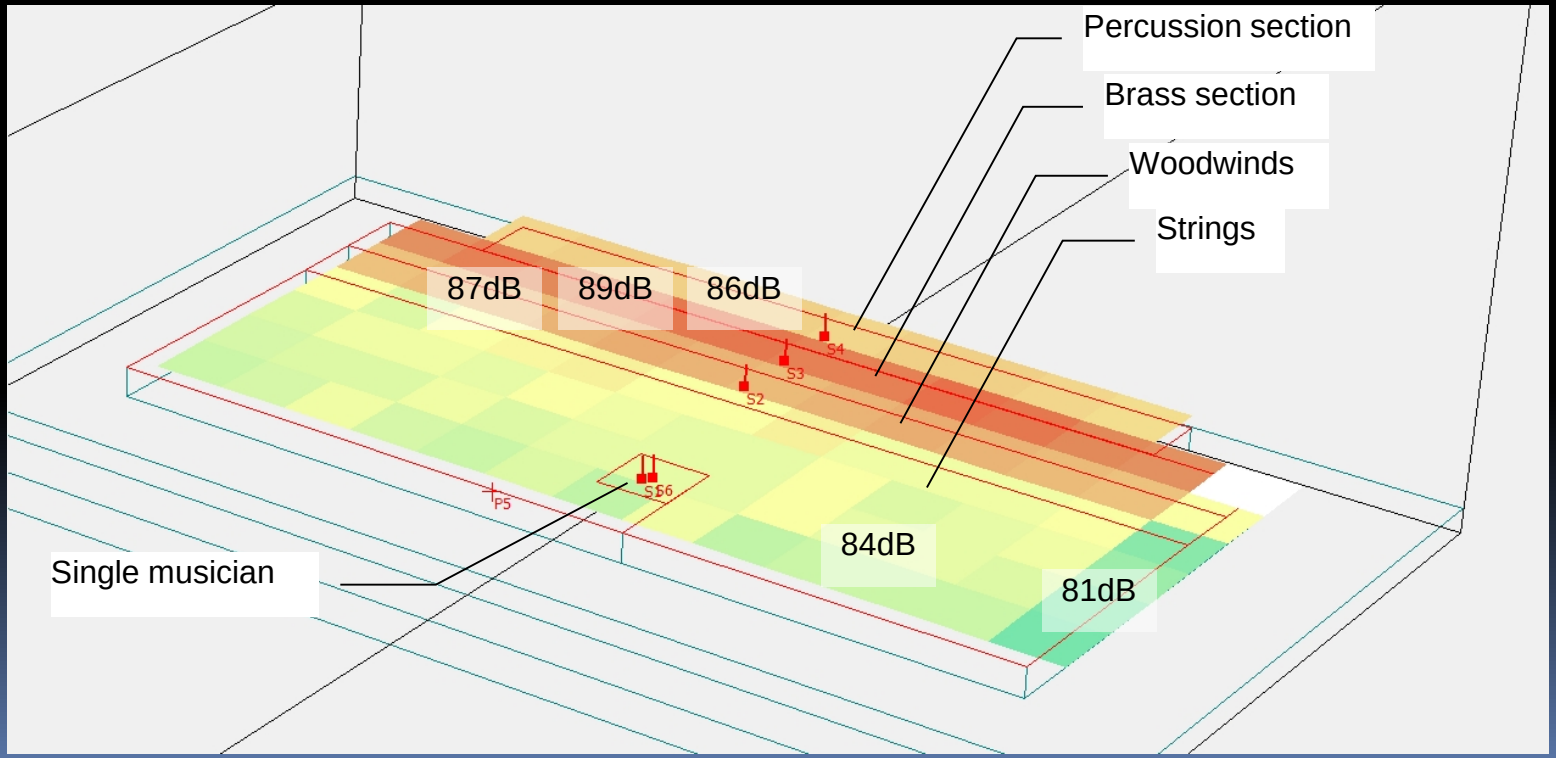
Dry-Reverb Balance, violinist

6-7dB in preferred rooms, big or small

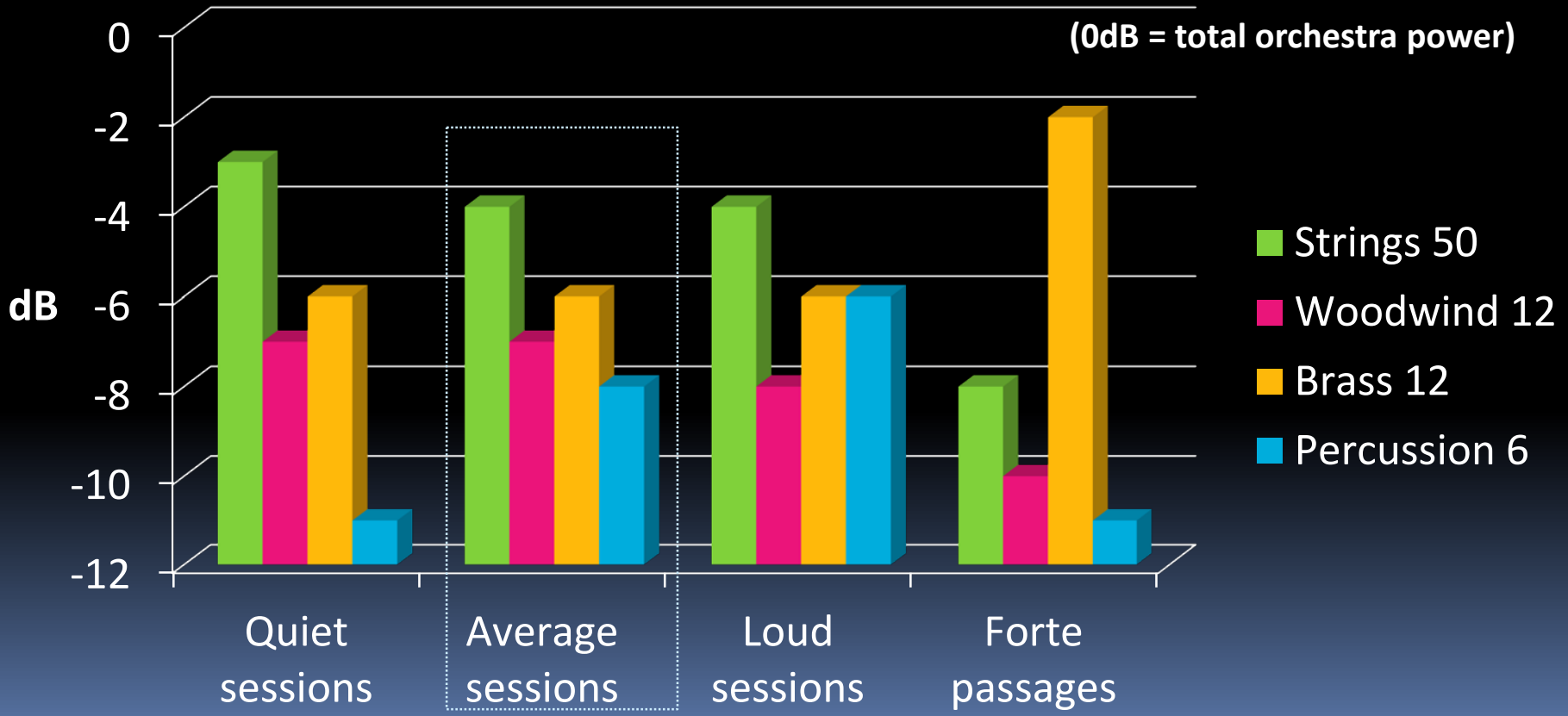


Source power best fit to 5000 hrs dosimetry

1609 measurements, all orchestra sessions 2004-2007 (O'Brien et al 2008)



Orchestra Power Balance



Summary

- Symphony orchestra sound components are calculated from measurements
- Musicians hear 3 components
  - SELF - Own instrument
  - OTHERS - Other instruments
  - REVERB - Reverberant sound
- Reverberant sound is critical
  - On average 34% of total sound exposure
  - Potentially driving escalating power levels
  - Reverberation distance -> Acoustical Transparency
- Computations provide insight and a basis for design criteria in Architectural Acoustics

ASA ACOUSTICAL SOCIETY OF AMERICA

BREKKE STRAND

Thank you

Want more info ?

www.akutek.info

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

magne.skalevik@brekkestrand.no