

7-12 SEPTEMBER 2014

BREKKE ■■■ STRAND



Magne Skålevik

Brekke & Strand, Oslo

www.akutek.info

Any consistency, despite big differences from one good room to another?

ROOM ACOUSTICS FOR THE ORCHESTRA MUSICIAN

FA 2014, Krakow, September 8th 2014

Outline

- Problem
- Sound at orchestra musician's ear
- 4 different situations - 4 Odeon models
- Measurements in orchestra musician
- Conclusions

Problem: Missing indicator

	Volume m ³	RT s	G _{refl} dB	Temp. °C
Individual rehearsal	40	0.4	25	18
Group rehearsal	700	0.9	16	18
Orchestra rehearsal Studio	5000	1.1	8	18
Performance space (Concert hall, opera,...)	20 000	2.0	5	18

Very different rooms, but each very good for their **purpose**

Can an indicator for «good», «too much» and «too little» be found?

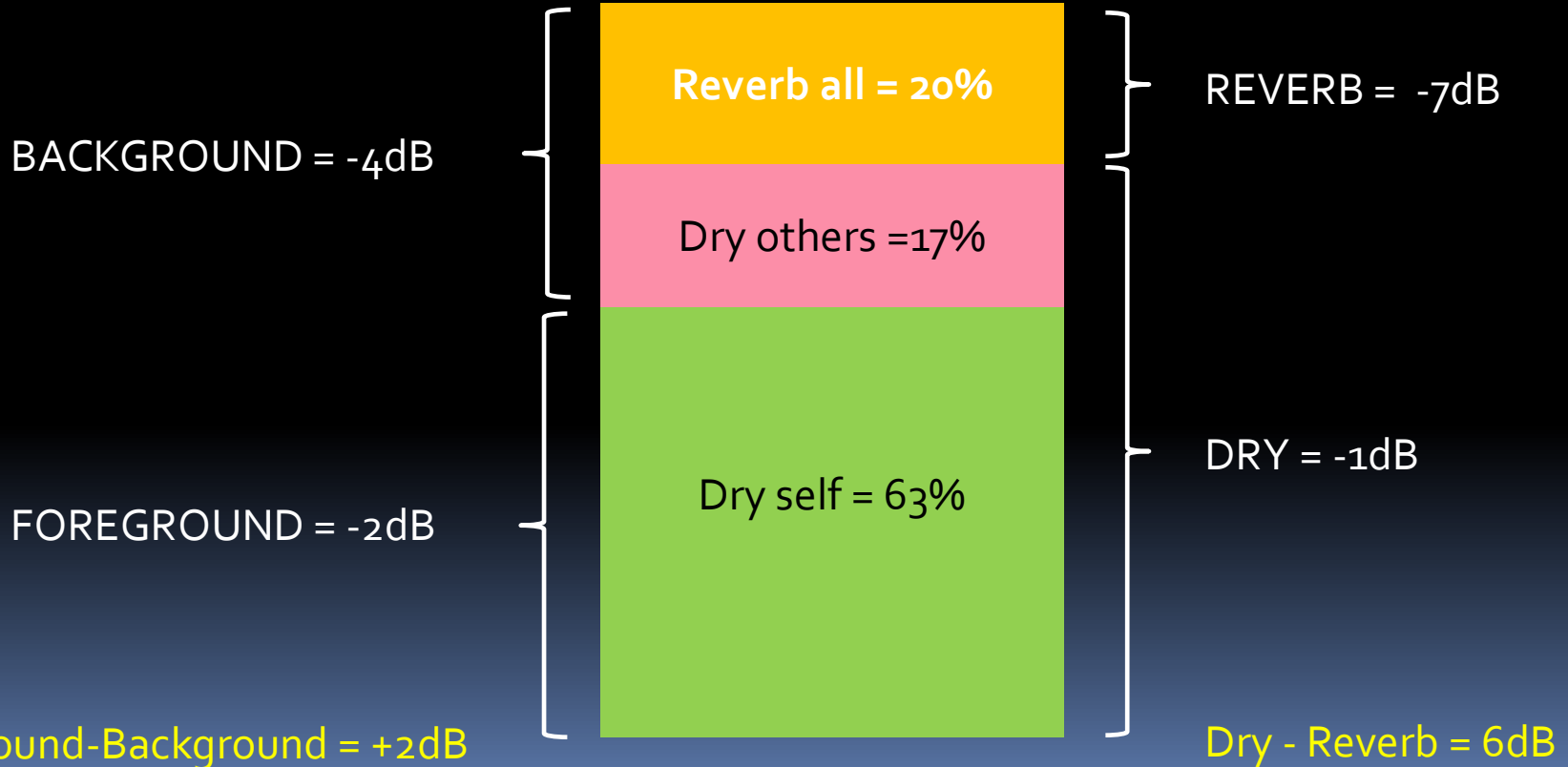
- Just like with room temperature?

Sound at musician's ear

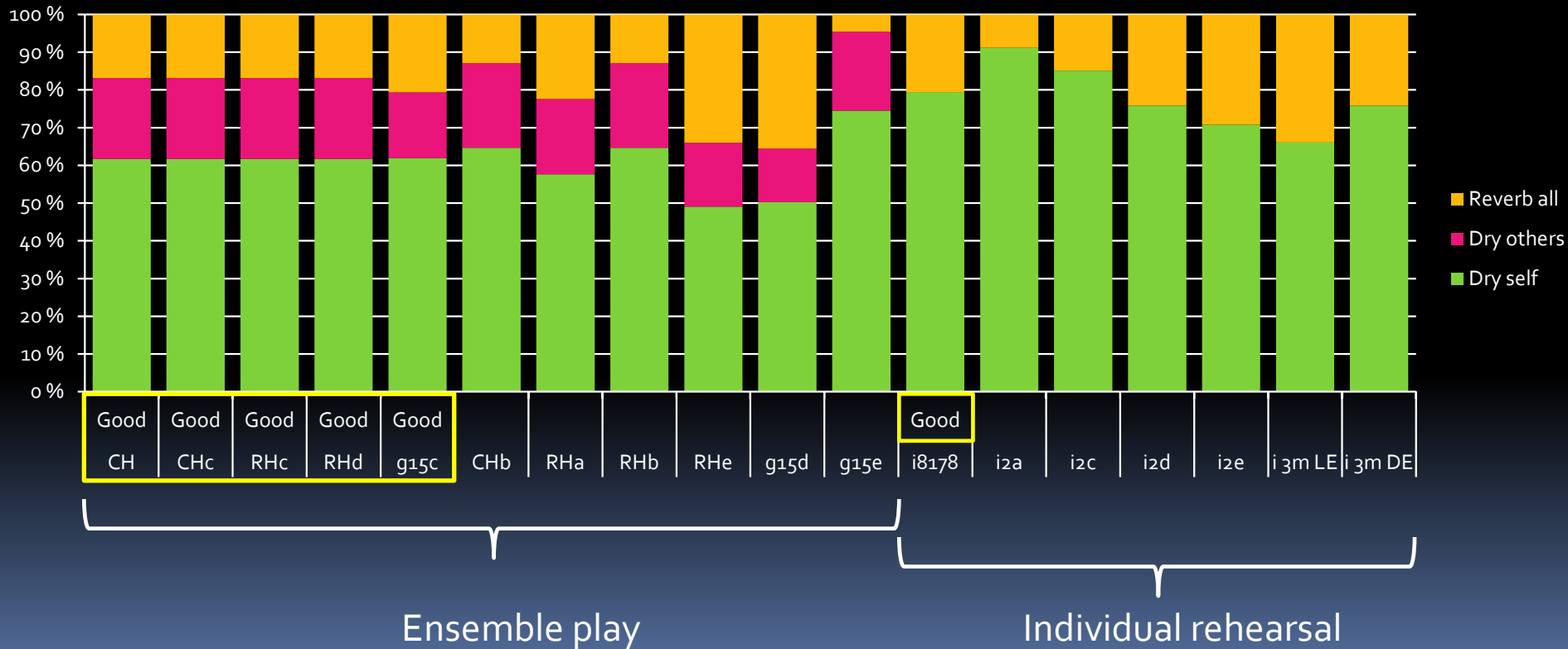
Total sound = **Dry self** + **Dry others** + **Reverb all**

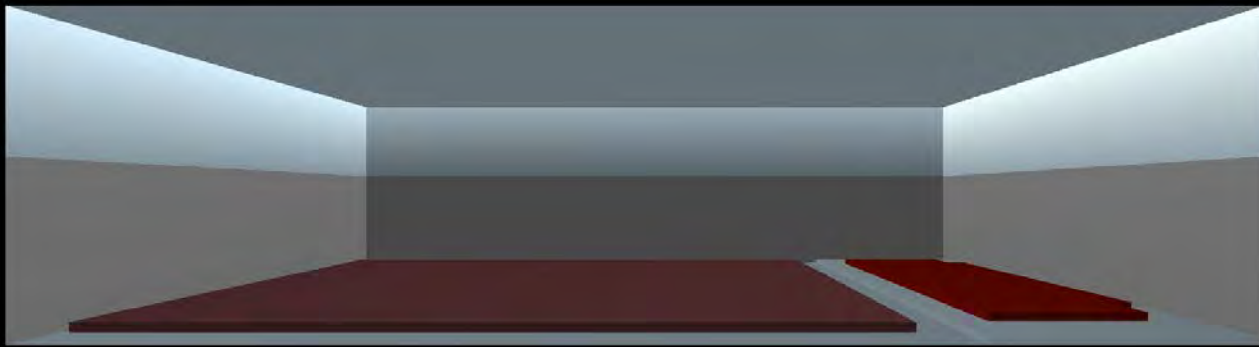
- **Dry self** = anechoic sound from own instrument
- **Dry others** = anechoic sound from other instruments
- **Reverb all** = reverberant sound from all instruments

Sound energy analysis

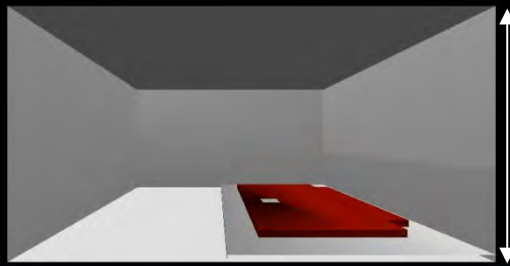


Simulated examples





Concert Hall,
height=18m



Rehearsal Studio,
height=14m



Group rehearsal room
height=5.0m



Individual rehearsal room
height=2.5-2.7m

4 Odeon models
4 situations
in the orchestra
musician's daily life

Highlighted: Consistent values of good rooms, FG-BG=2dB

Room type	CONCERT HALL			REHEARSAL STUDIO			GROUP REHEARSAL			INDIVIDUAL REHEARSAL ROOMS			
Recommended (NS8178=X)	Yes	-	Yes	X	X	-	X	-	-	-	-	-	X
V	18000			5600			691			28			41
T30 glob (occ)	2,2	1,5	2,2	1,3	1,1	2,4	0,9	1,5	0,6	0,4	0,4	0,5	0,4
G refl theor. r->0	6	4	6	9	8	11	16	18	14	26	26	28	25
FG-BG	2	3	2	2	2	0	2	0	5	8	5	4	6
Dry-Reverb, all	7	8	7	7	7	3	6	3	13	8	5	4	6

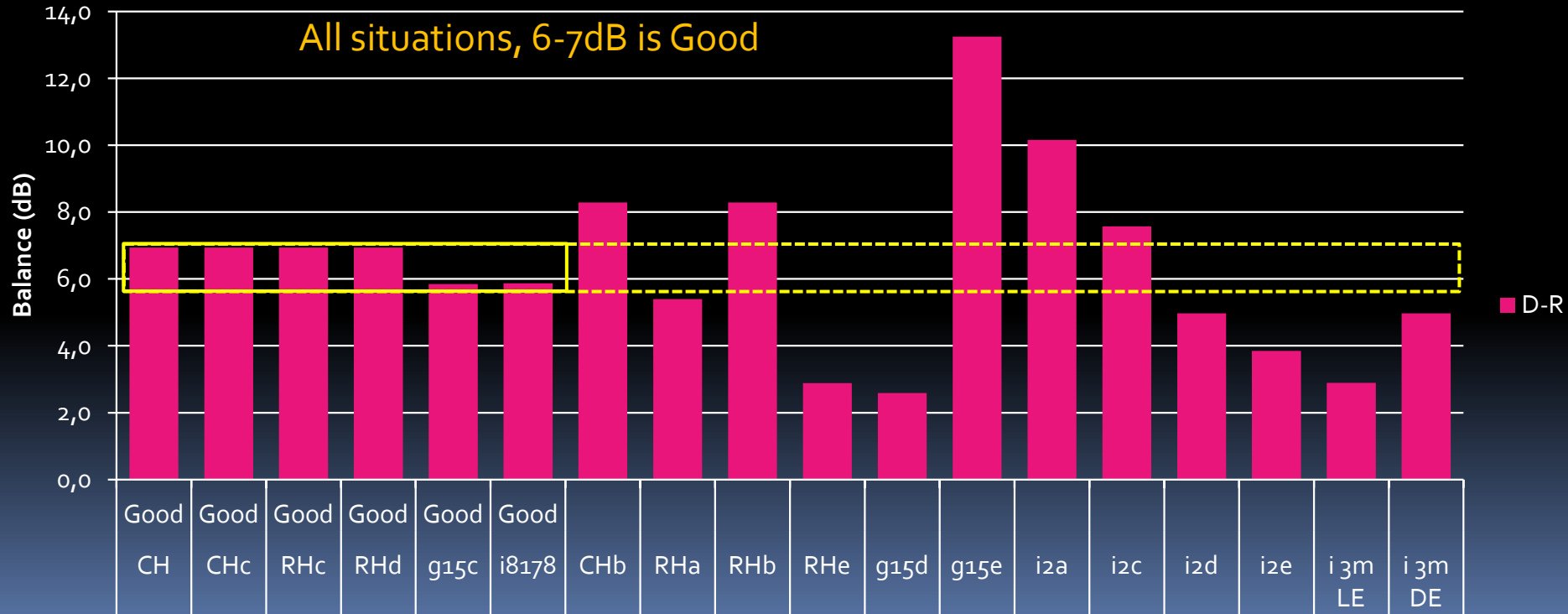
Foreground-Background-Balance appears relevant for ensemble but not for individual practice

Highlighted: Consistent values of good rooms **Dry-Reverb=6-7dB**

Room type	CONCERT HALL			REHEARSAL STUDIO			GROUP REHEARSAL			INDIVIDUAL REHEARSAL ROOMS			
Recommended (NS8178=X)	Yes	-	Yes	X	X	-	X	-	-	-	-	-	X
V	18000			5600			691			28			41
T30 glob (occ)	2,2	1,5	2,2	1,3	1,1	2,4	0,9	1,5	0,6	0,4	0,4	0,5	0,4
G refl theor. r->0	6	4	6	9	8	11	16	18	14	26	26	28	25
FG-BG	2	3	2	2	2	0	2	0	5	8	5	4	6
Dry-Reverb, all	7	8	7	7	7	3	6	3	13	8	5	4	6

Dry-Reverb Balance

D-R



Measurements on violinist in
opera orchestra

Preferably
use
headphones



$T=0.4$
 $G_r=25$

Small rehearsal room



$T=0.7$
 $G_r=15$

Big rehearsal room



$T=1.0$
 $G_r=8$

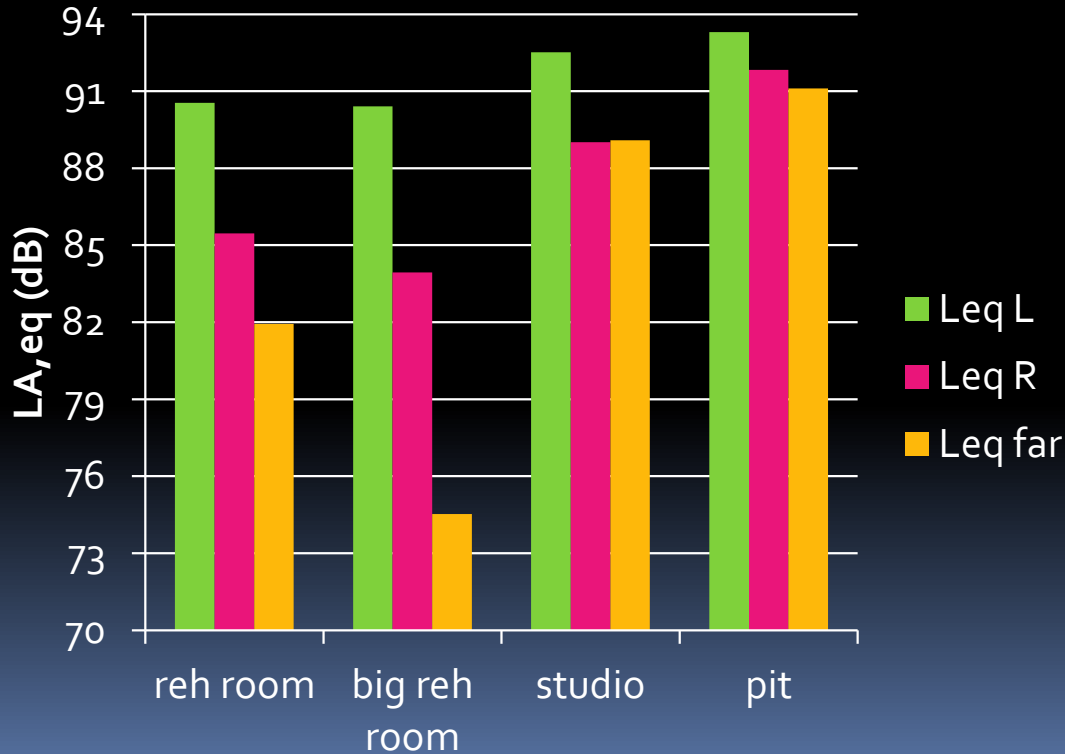
Orchestra Rehearsal Studio



$T=2.1$
 $G_r=6$

Opera House Orchestra Pit

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

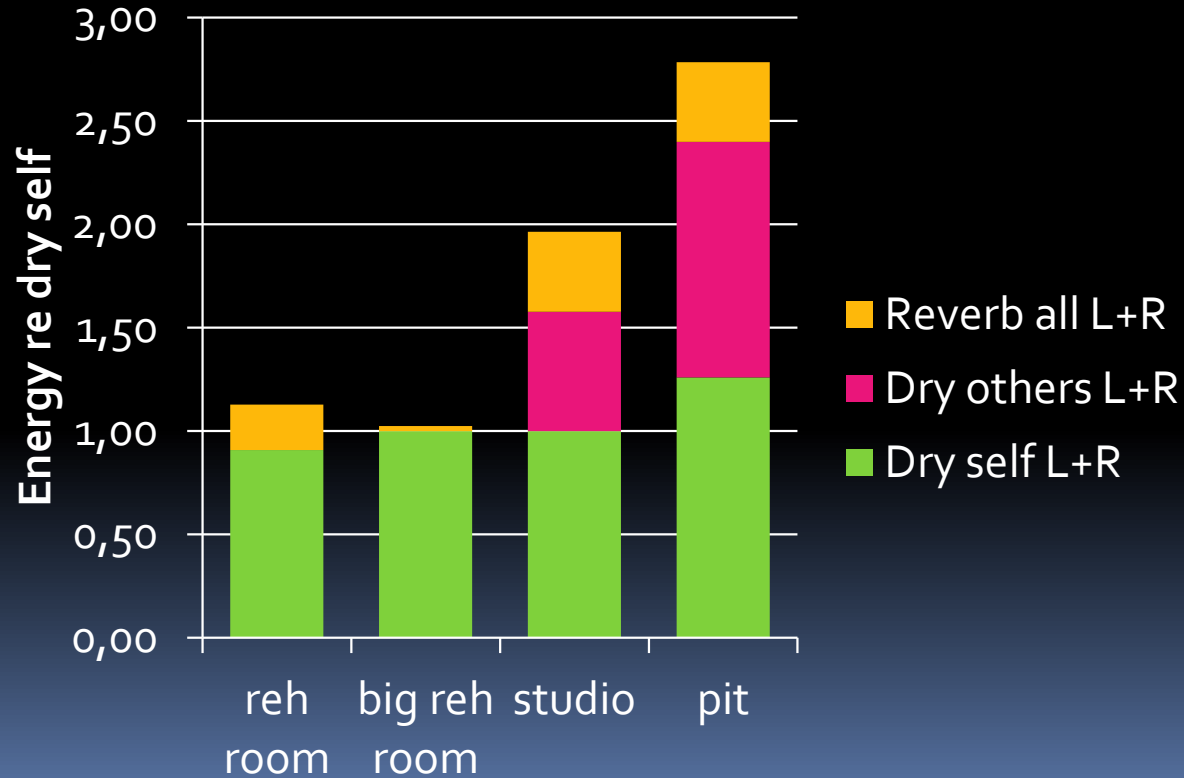


L = Left ear canal entrance
R = Right ear canal entrance

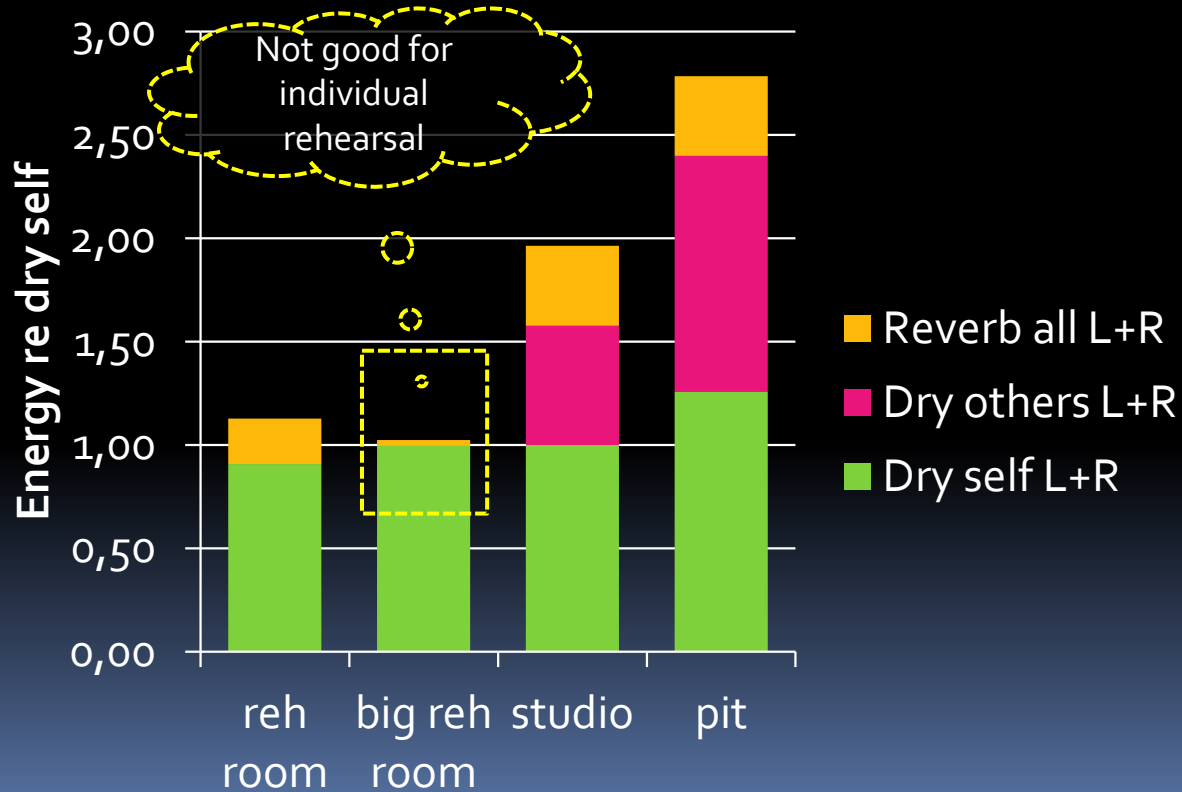
far = behind the back, i.e. screened from own instrument

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

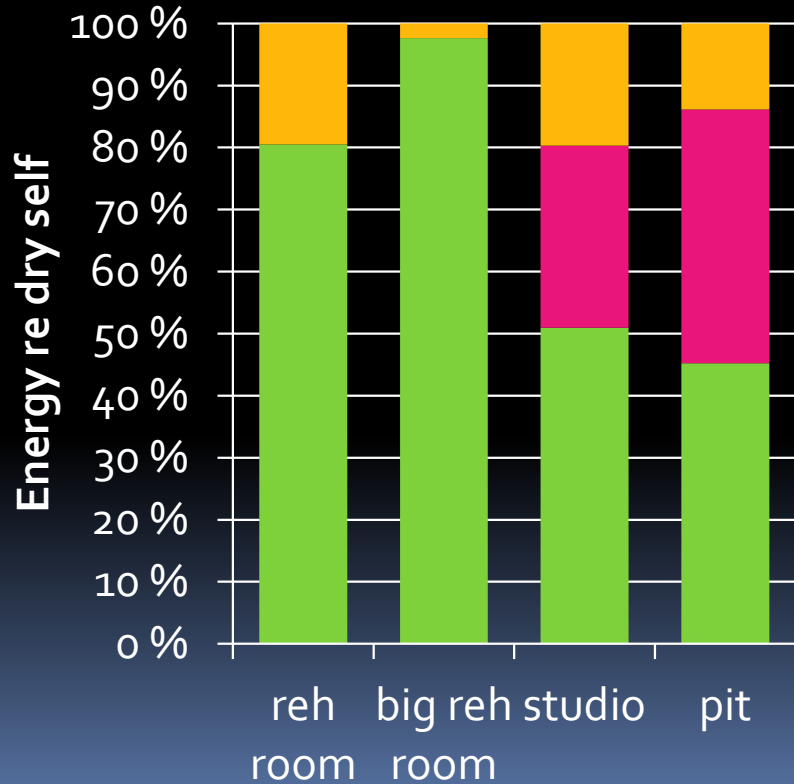
Analysis: energy re self



Analysis: energy re self



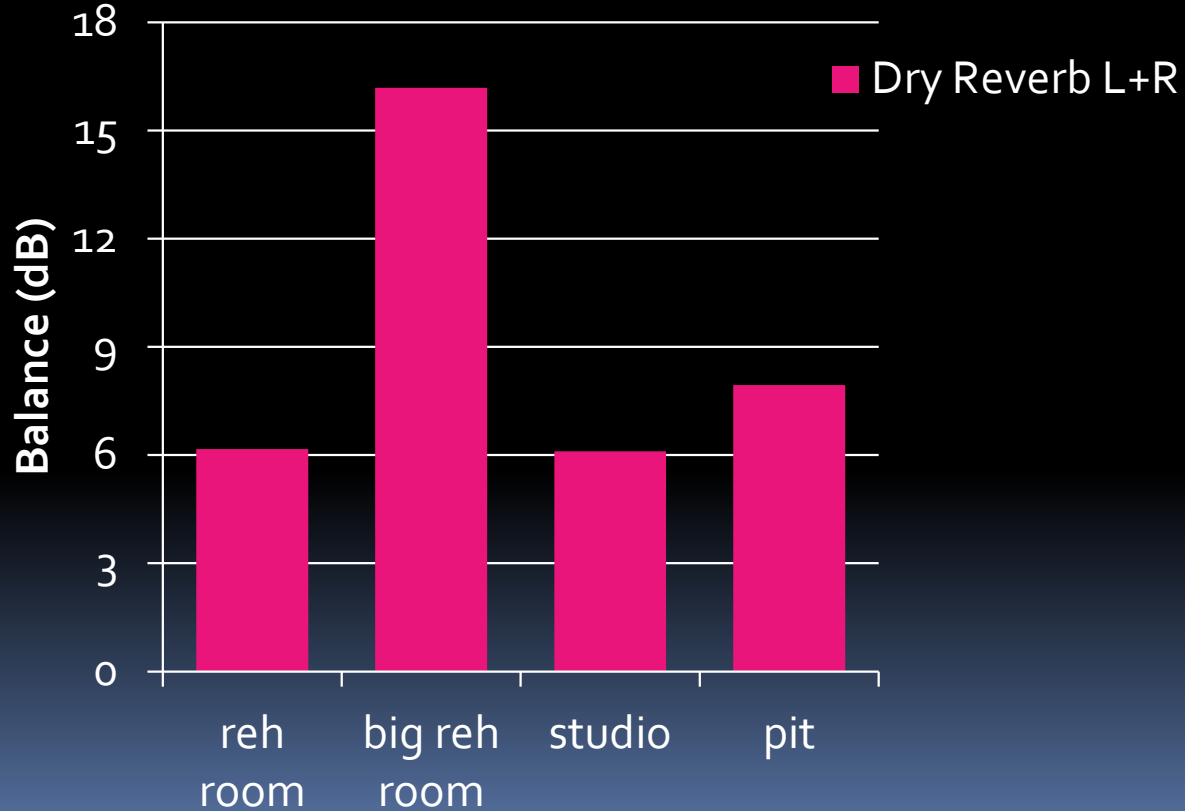
Analysis: energy fractions



Reverb fraction appears to be consistent
-while self and others alternates in the dry part

- Reverb all L+R
- Dry others L+R
- Dry self L+R

Dry-Reverb Balance



Conclusions

- Big variation in volume, RT and G_{refl}
- Consistency found in **Dry-Reverb Balance**
 - - a possible indicator for «good», «too much» and «too little»
- Foreground-Background-Balance
 - - relevant for understanding of ensemble acoustics, consistent values
- Measurements on violinist conforms with simulations
 - However model needs adjustments (instrument-ear distance)
- Further work: Measurements on different instruments
 - Apparent instrument-to-ear distance likely to be important

Balance	Good rooms simulated
Dry-Reverb	6-7dB
Foreground-Background, ensemble	2dB

7-12 SEPTEMBER 2014

BREKKE ■■■ STRAND



Thank you

More info?

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

www.akutek.info

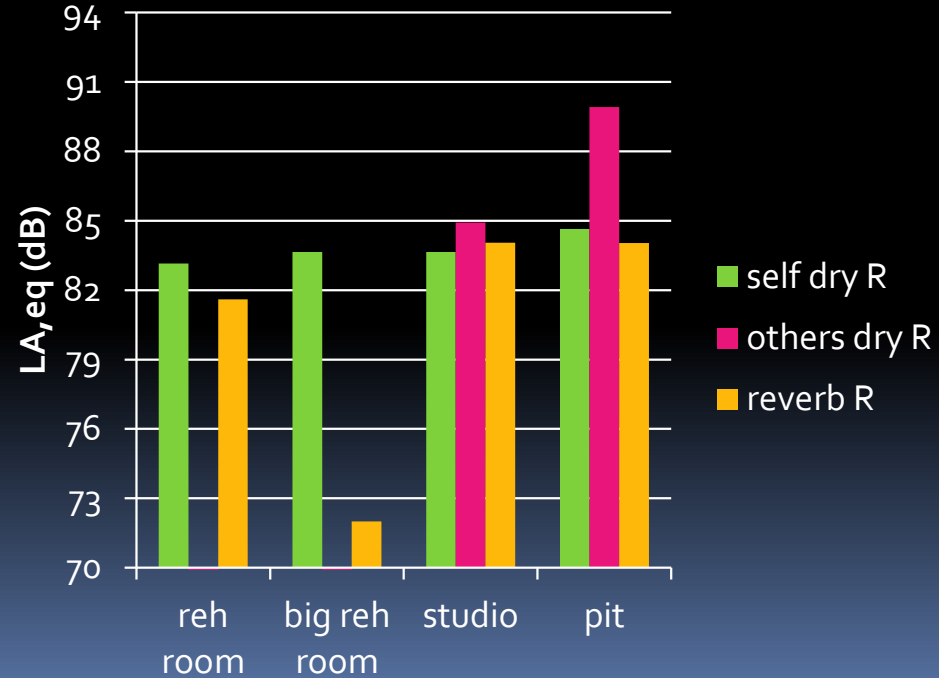
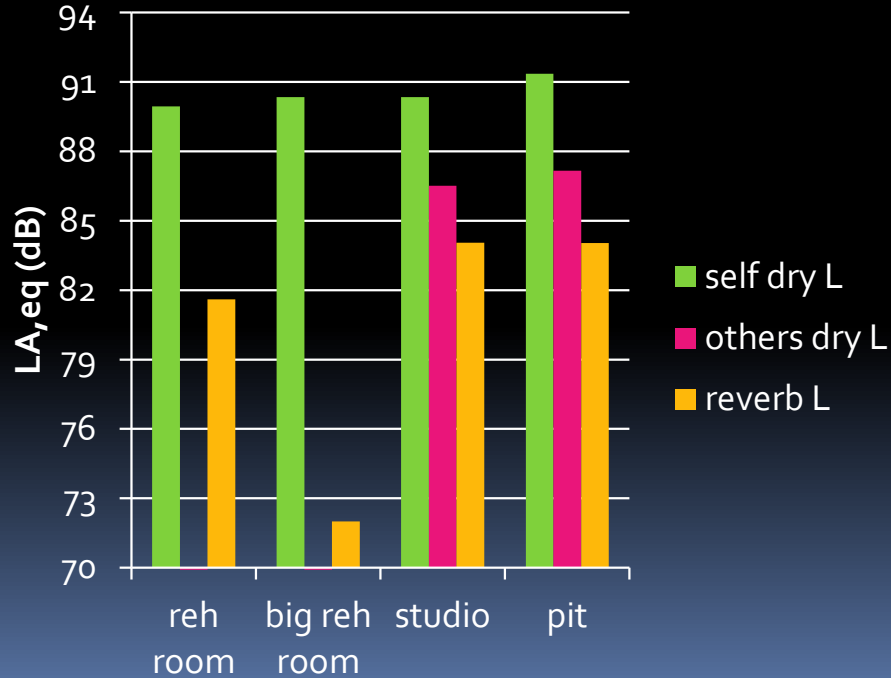
magne.skalevik@brekkestrand.no

Full result matrix

Decomposition by Best Fit
(see paper)

	Rehearsal Room	Big Rehearsal Room	Orchestra Rehearsal Studio	Orchestra Pit
L_{Aeq} L	91	90	93	93
L_{Aeq} R	84	84	89	92
L_{Aeq} far	81	75	89	91
L_{Aeq} self dry L	90	90	90	91
L_{Aeq} self dry R	83	84	84	85
L_{Aeq} self dry far	71	71	71	72
L_{Aeq} other dry L	$-\infty$	$-\infty$	87	87
L_{Aeq} other dry R	$-\infty$	$-\infty$	85	90
L_{Aeq} other dry far	$-\infty$	$-\infty$	87	90
L_{Aeq} all dry L	90	90	92	93
L_{Aeq} all dry R	83	84	87	91
L_{Aeq} all dry far	71	71	87	90
L_{Aeq} reverb all	81	72	84	84
L_{wA} power all	87	88	107	109
G_{refl} room gain	25	15	8	6
L_{wA} power self	88	88	88	89
L_{wA} power other	$-\infty$	$-\infty$	107	109
self r'(L) [m]	0,22	0,22	0,22	0,22
self r'(R) [m]	0,47	0,47	0,47	0,47
self r'(far) [m]	2,0	2,0	2,0	2,0
other r'(L) [m]	∞	∞	3,0	3,5
other r'(R) [m]	∞	∞	3,6	2,6
other r'(far) [m]	∞	∞	2,7	2,5
FBB (avr{L+R})	6	16	0	-1
DRB (avr{L+R})	6	16	6	8

Components at Left vs Right



Foreground-Background Balance

