Stereo recording in 3D:
Concepts and Examples

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Abstract:

- Stereophonic 3D-Audio formats offer great chances for sound engineers to deliver the full spatial and timbral fidelity of a performance to the listener. Recording principles based on stereophonic rules and experiences can perform even better now as the limitations of stereophony are further minimized.

  The advantages of the stereophonic 3D-Audio format over WFS and Ambisonics can be quite apparent, e.g. with regard to spatial perception and channel efficiency. However, there are pitfalls, as well. More loudspeakers don`t automatically create a better sound.

  Examples of setups and recordings from ambience recording, sports and music recording are presented.

Contents:

- Stereophony Basics
  - 4 Spatial Sound reproduction principles
  - Psychoacoustics of Stereo
- Stereophonic Imaging for 3D
  - Directional Image
  - Room Image
- Array design for 3D-Audio
  - Δt and/or ΔL
  - ORTF-3D

Spatial sound reproduction techniques:

- Real sources
- Stereophony
- Sound field reconstruction
- Binaural

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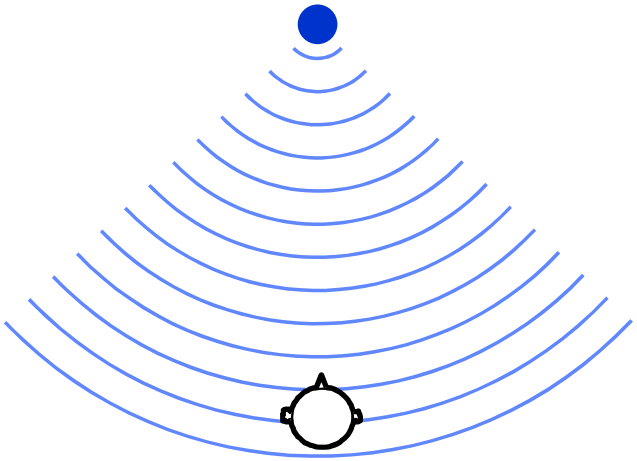

Spatial sound reproduction techniques:

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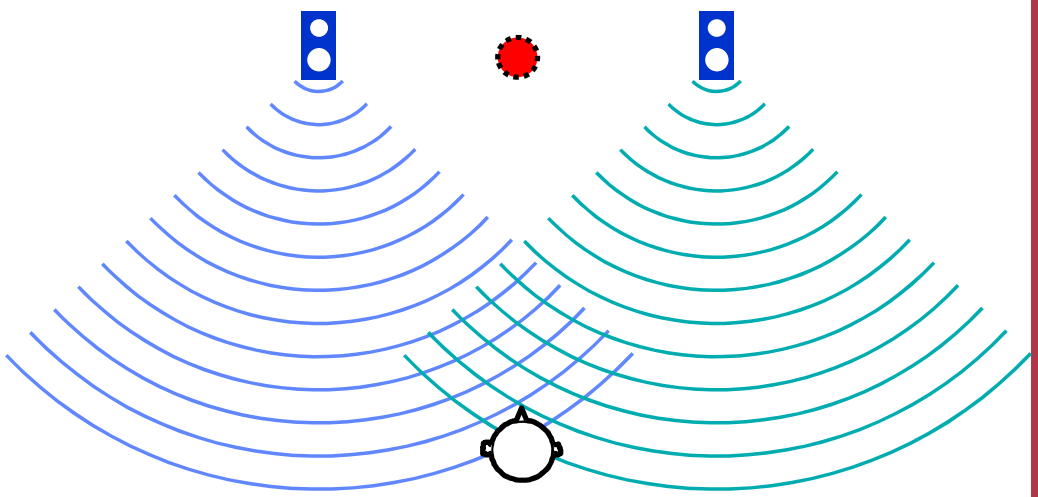


Basics

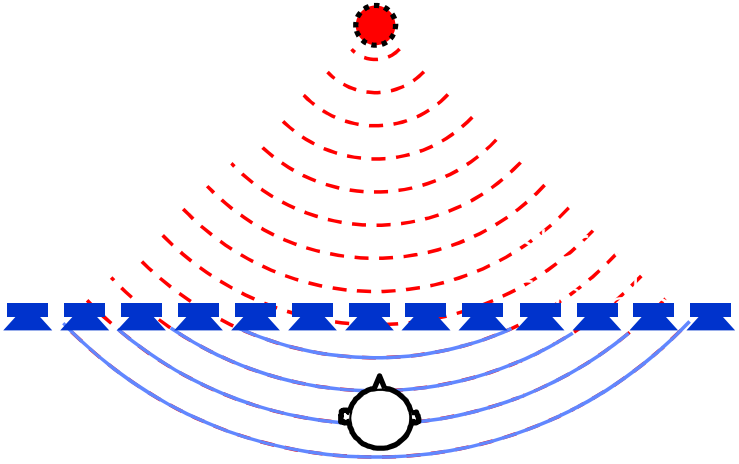
- 4 Spatial Sound reproduction principles
- Psychoacoustics of Stereo

Stereo Imaging

Array design for 3D-Audio

Spatial sound reproduction techniques:

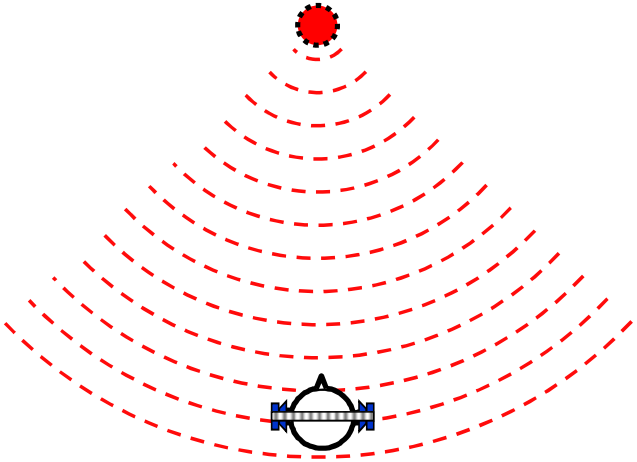
- Real sources
- Stereophony
- **Sound field reconstruction***
- Binaural



* The term „Sound field reconstruction“ includes techniques like WFS or HOA

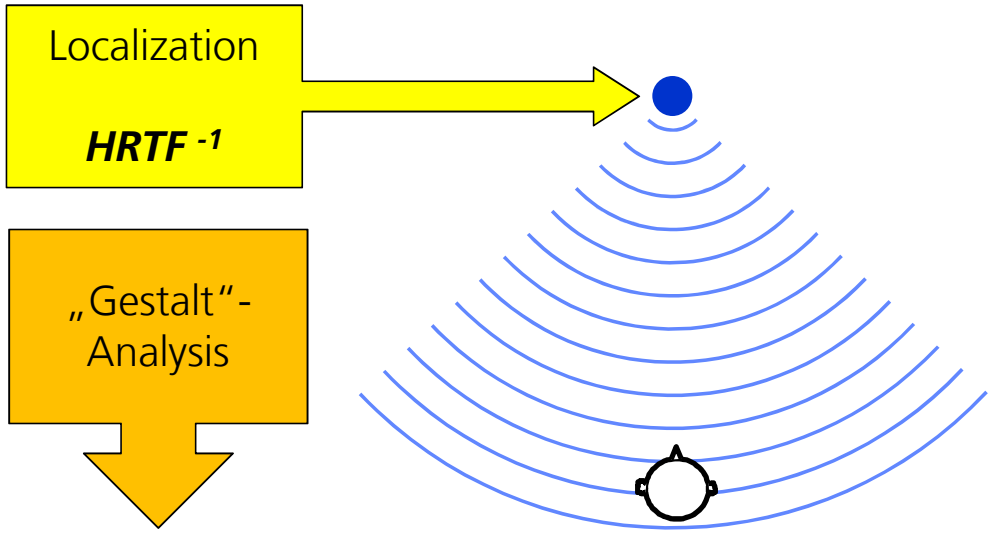
Spatial sound reproduction techniques:

- Real sources
- Stereophony
- Sound field reconstruction
- **Binaural**



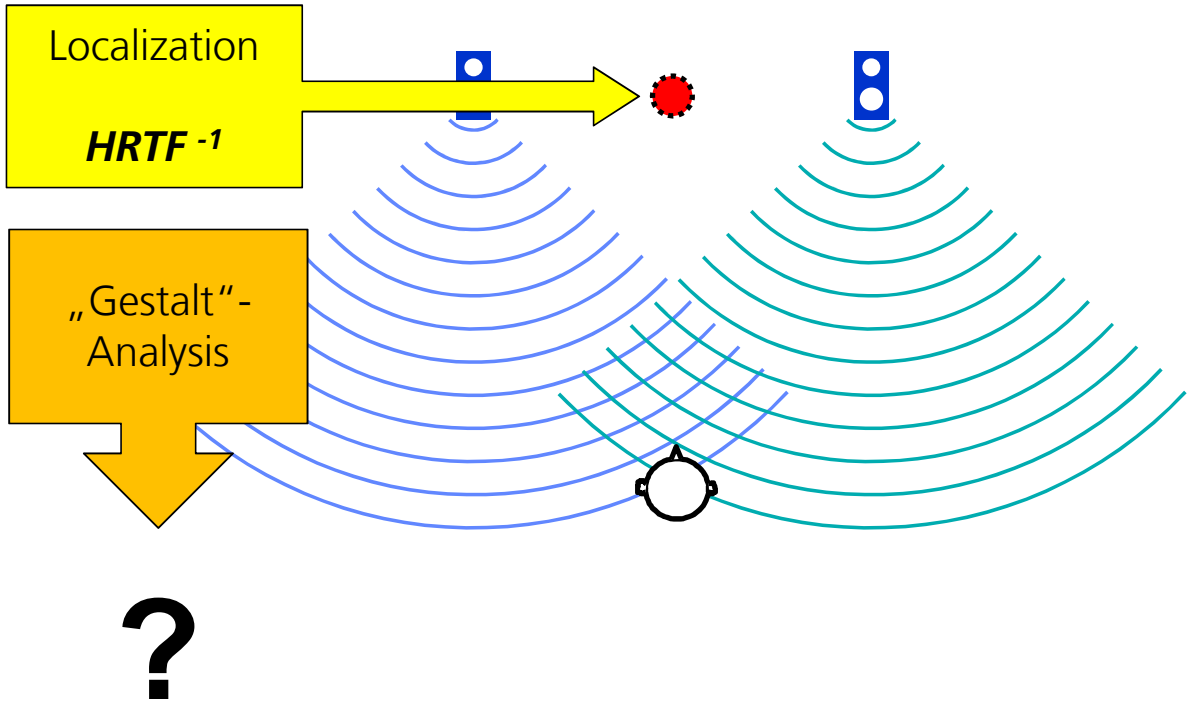
Localization and perception model:

- **Real source = Sound field reconstruction = Binaural**



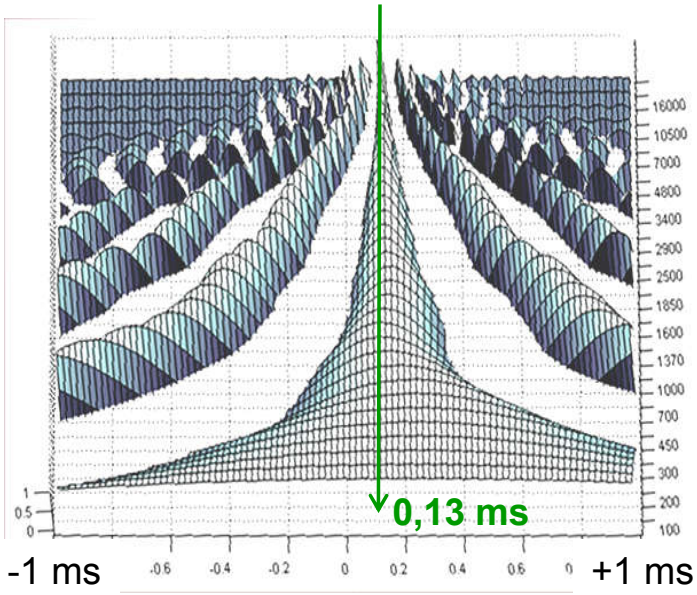
Localization and perception model:

- **Stereophony unexplained!** Summing localization with strong comb filtering



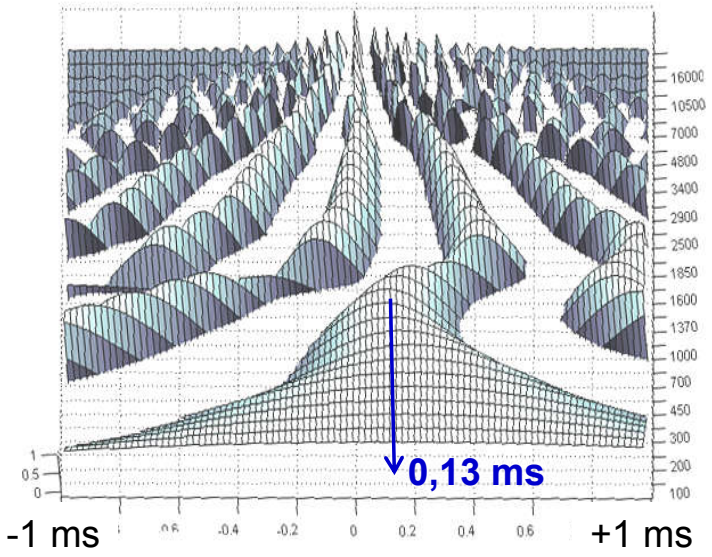
Stereophony unexplained!

- Interaural Cross Correlation

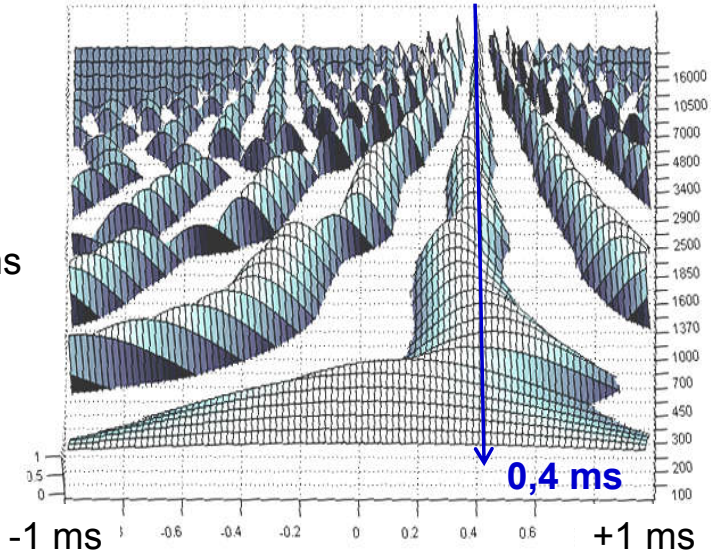


Real source, +15°

ΔL = 7dB
Δt = 0 ms



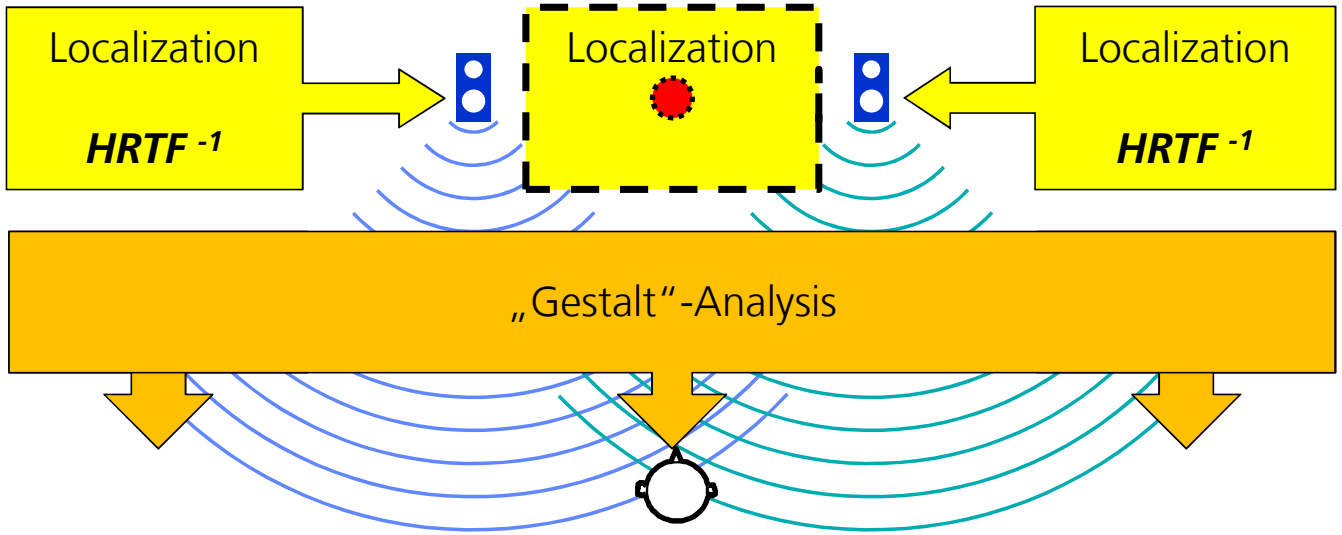
ΔL = 0dB
Δt = 0.4 ms



Phantom Source, perceived +15°

Localization and perception model:

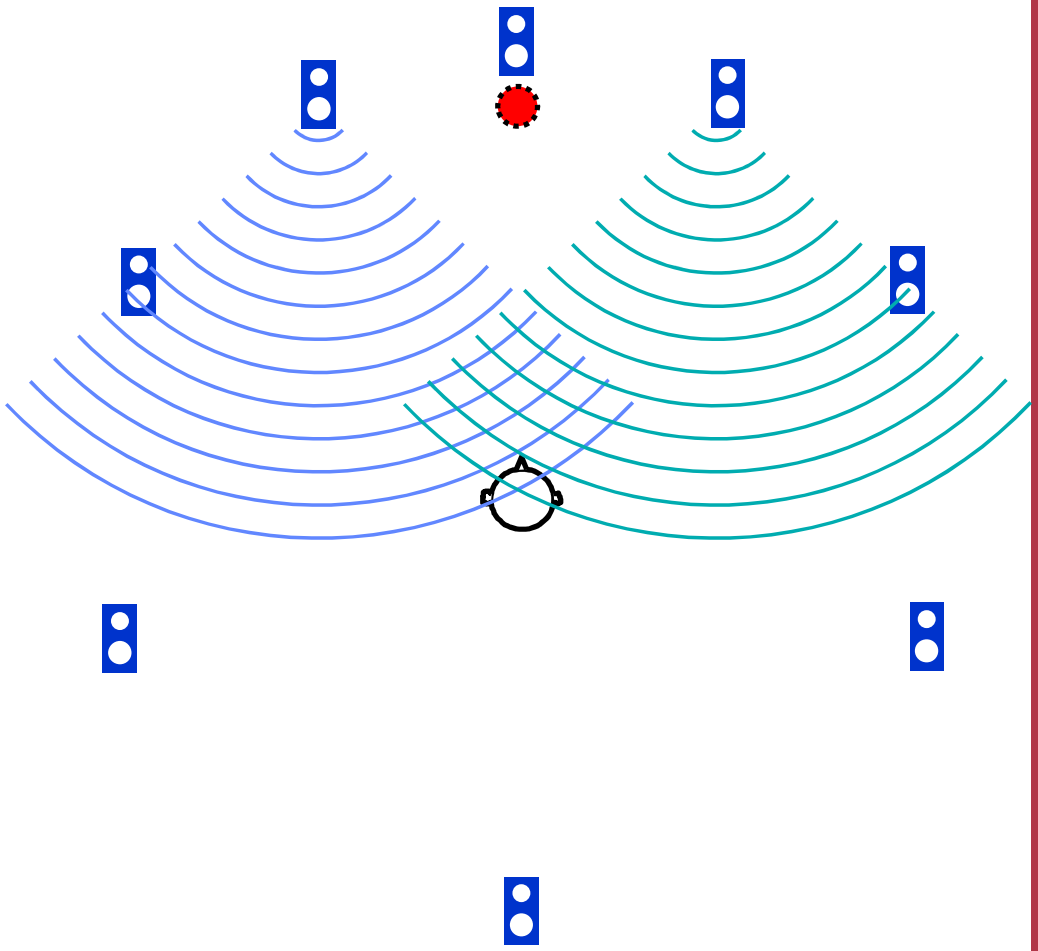
- **Stereophony** after the „Association model“ of Theile



REF G.Theile: “On the Naturalness of Two-Channel Stereo Sound”, JAES, Vol.39, 1991

Spatial sound reproduction techniques:

- ***Multichannel*** Stereophony??



Spatial sound reproduction techniques:

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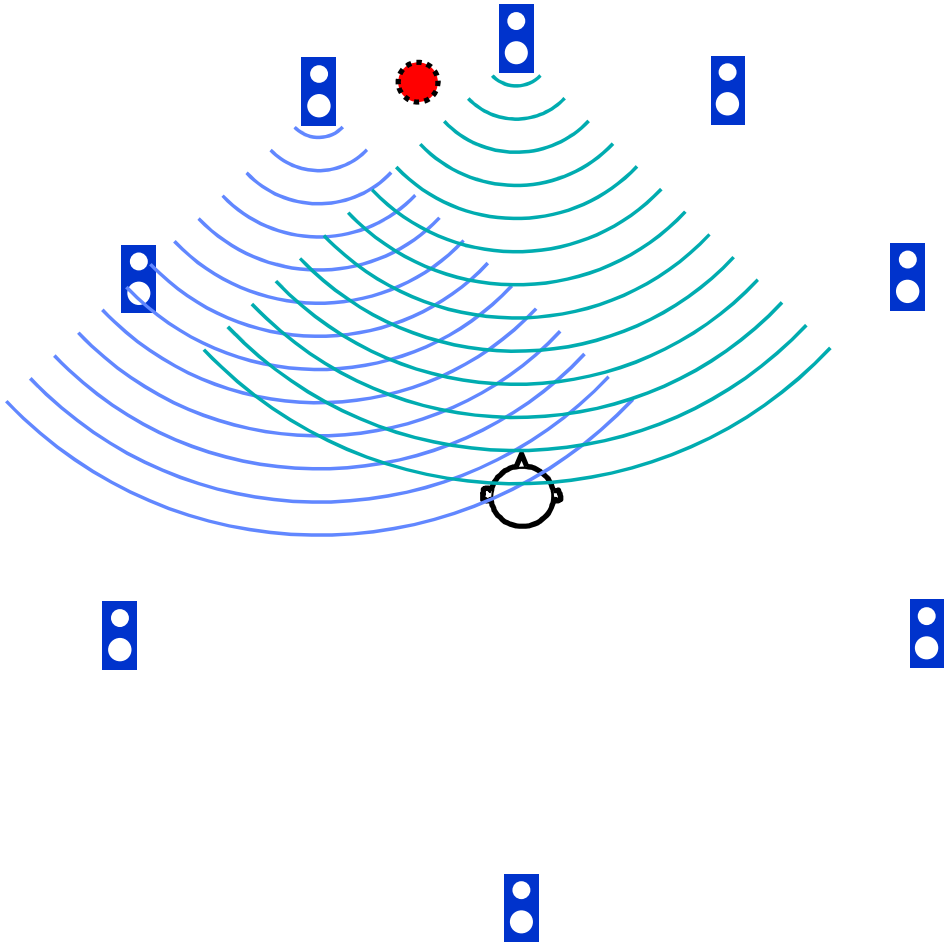

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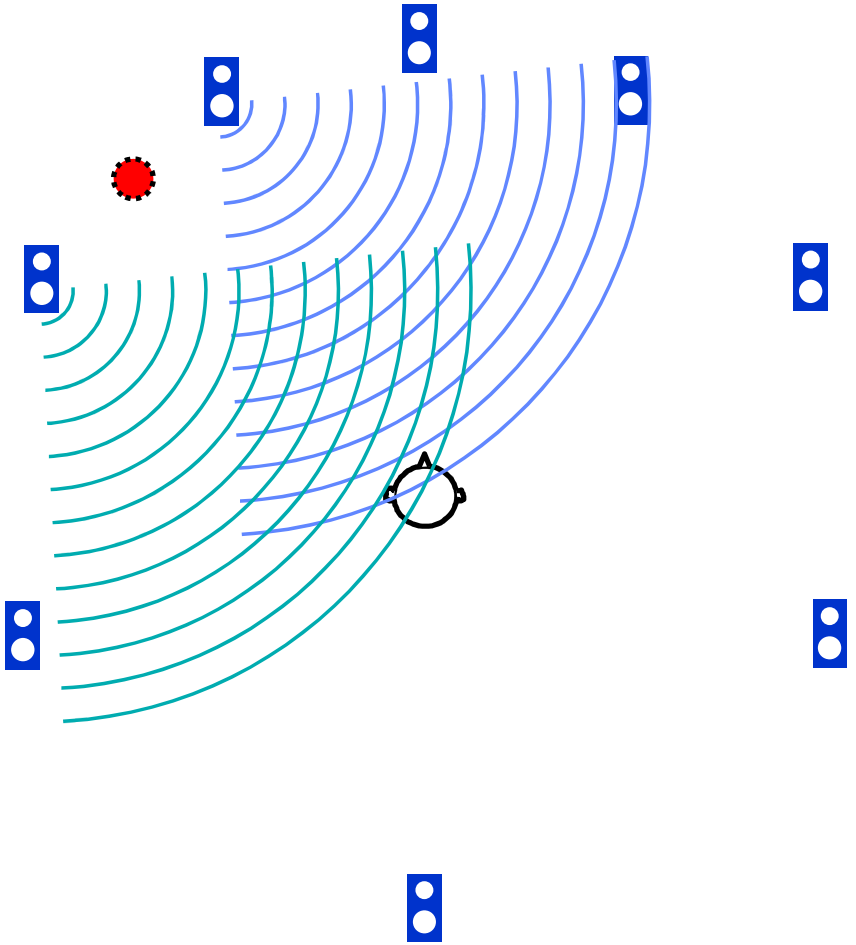

Spatial sound reproduction techniques:

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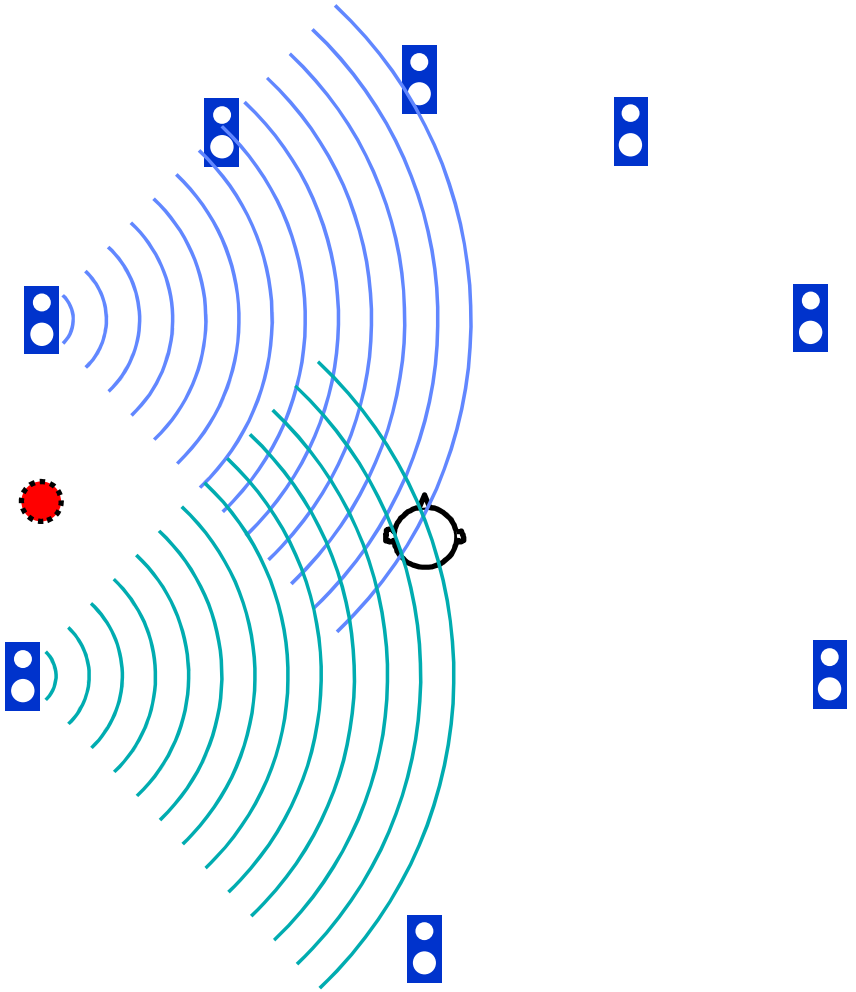
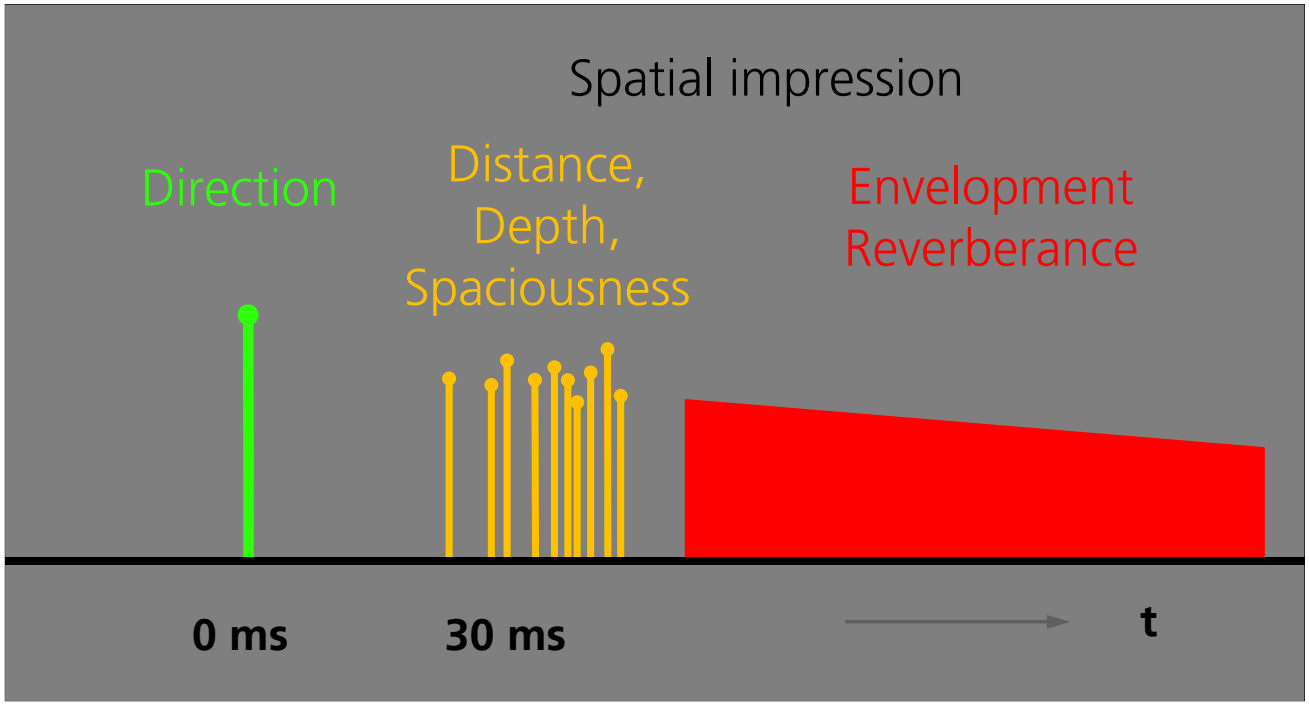
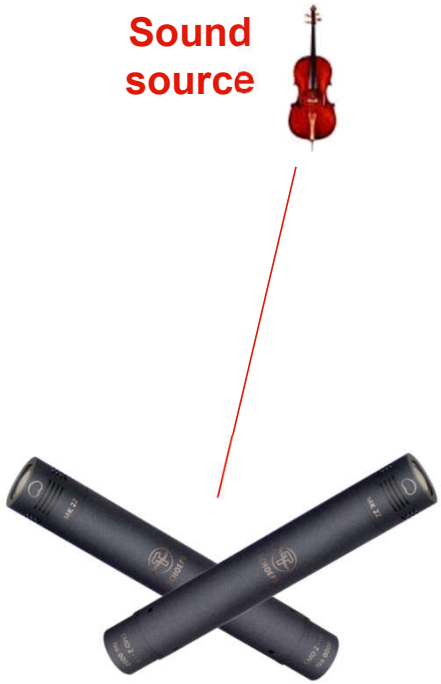


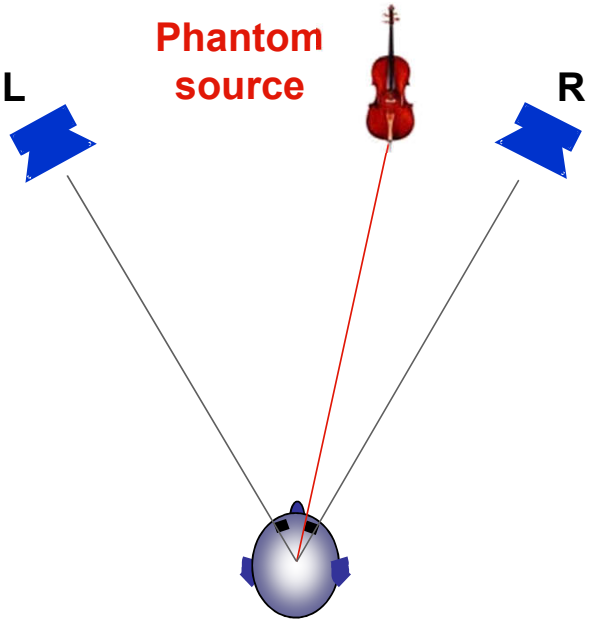


© Theile

- The Recording angle

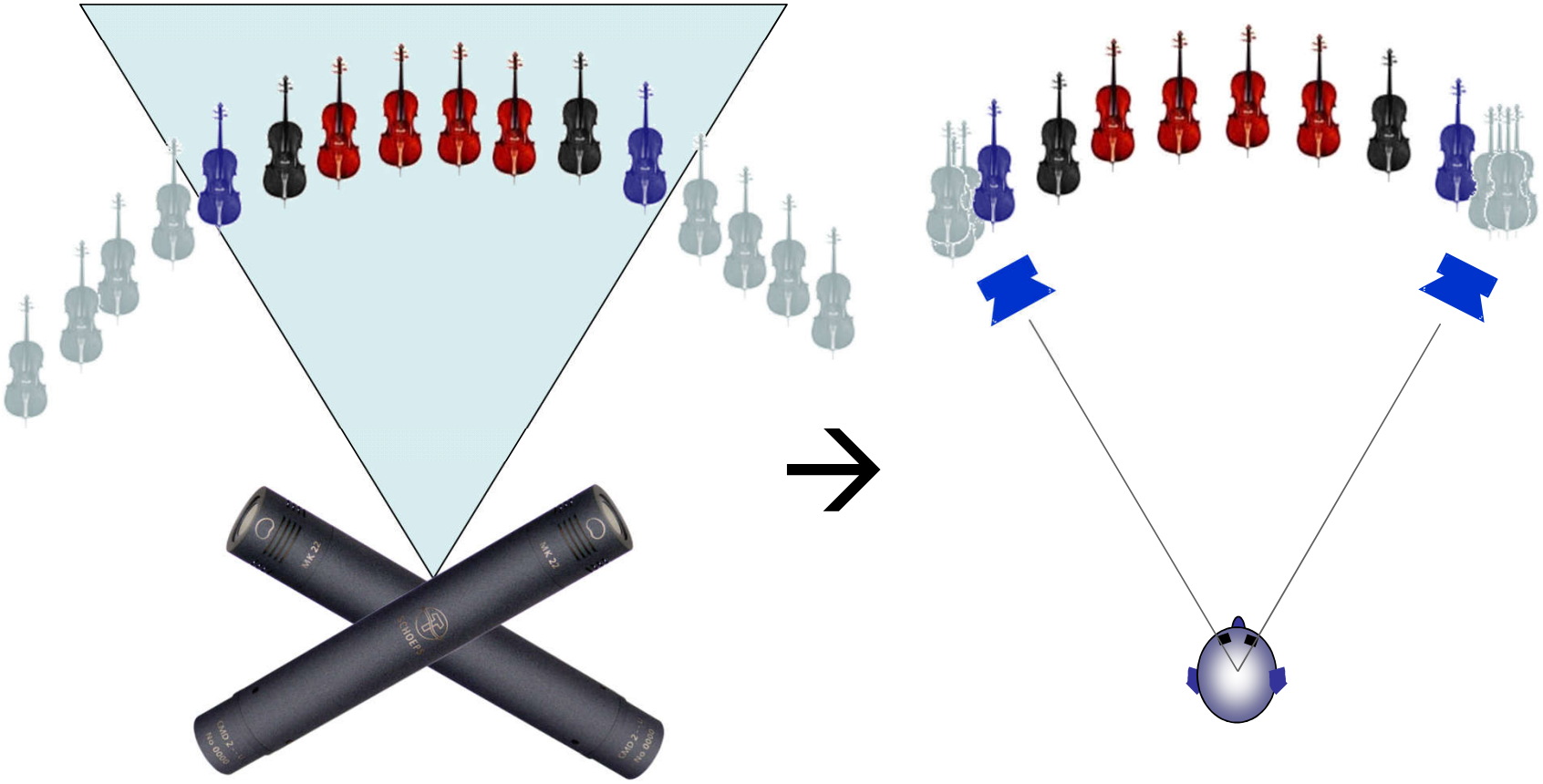


Δt, ΔL
between microphones



Δt, ΔL
between loudspeakers

- The Recording angle



Basics

Stereo Imaging

- Directional Image
- Room Image

Array design
for 3D-Audio

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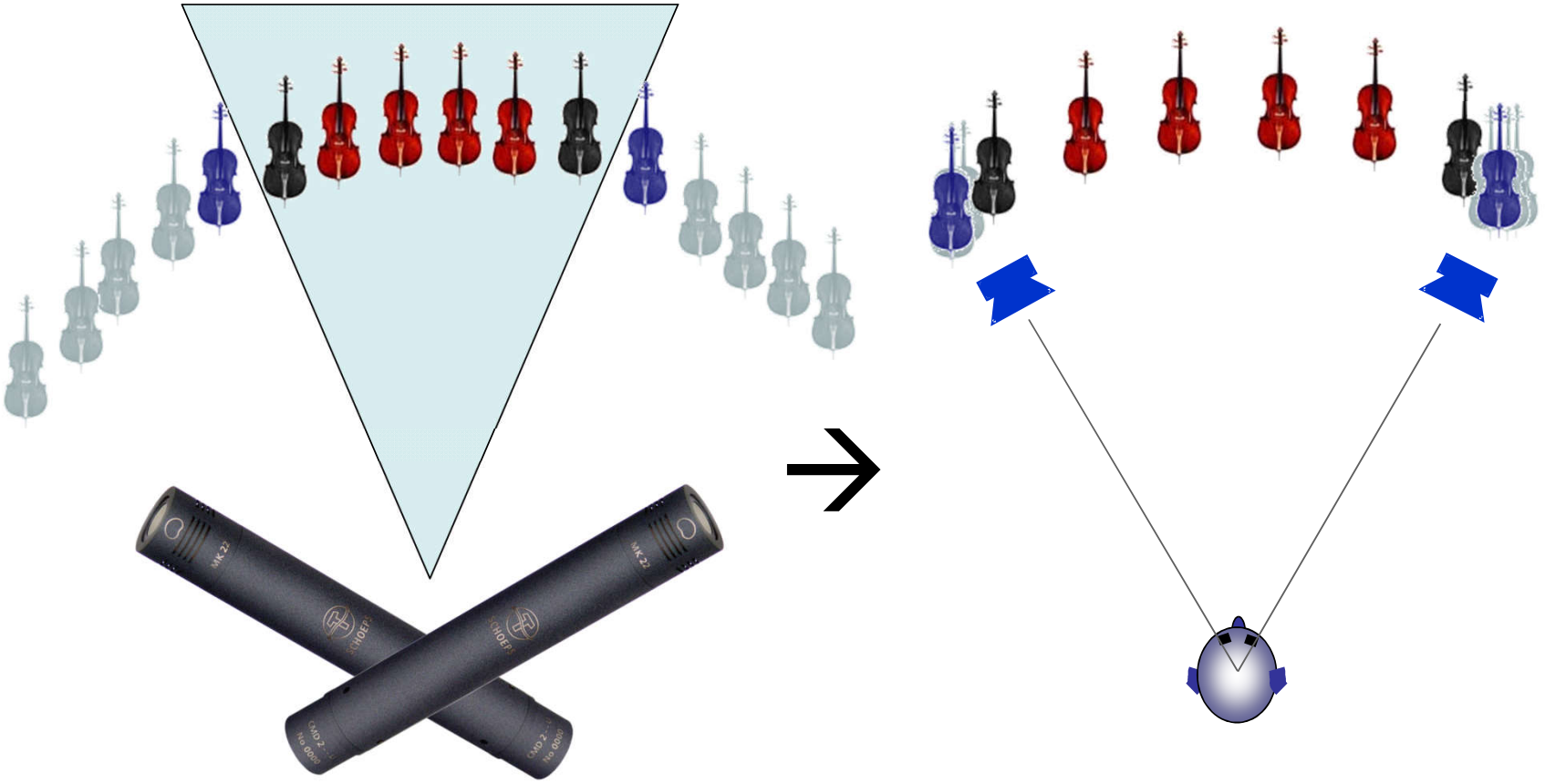
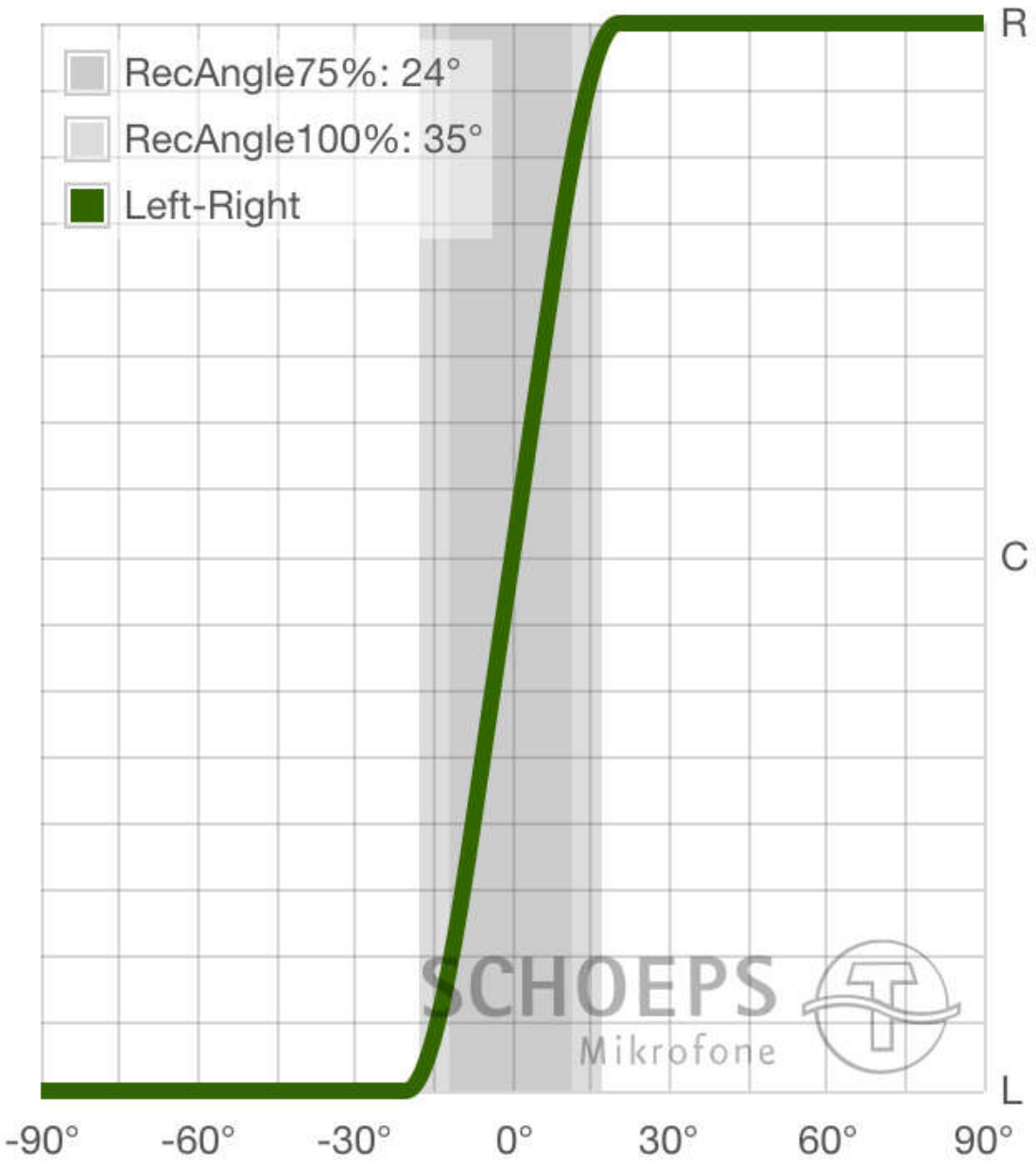
- The Recording angle

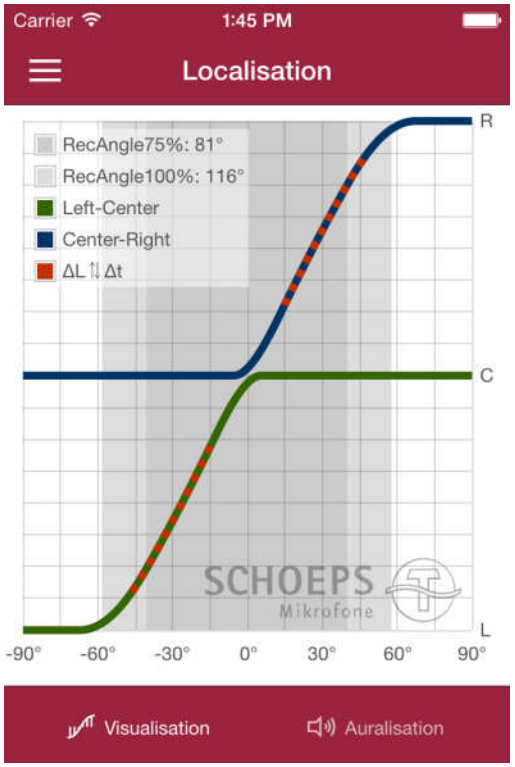


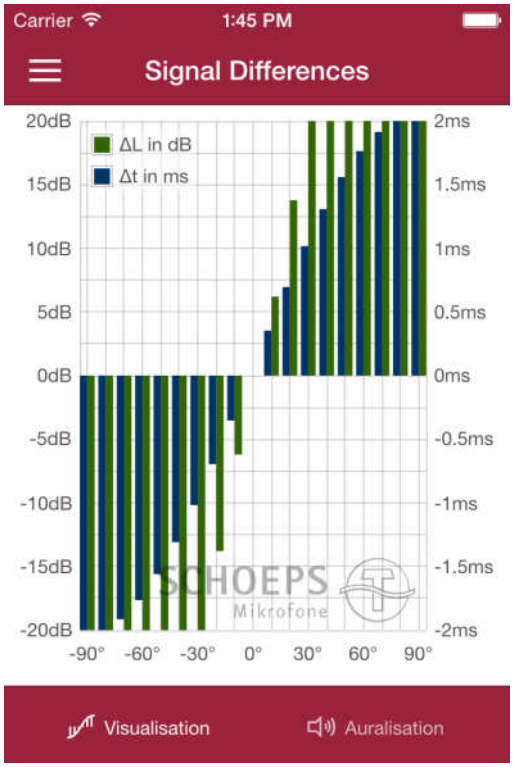
Demo Recording Angle:
Cedric 4 Stereofoniepaare “Schulhof” oder “Enten”

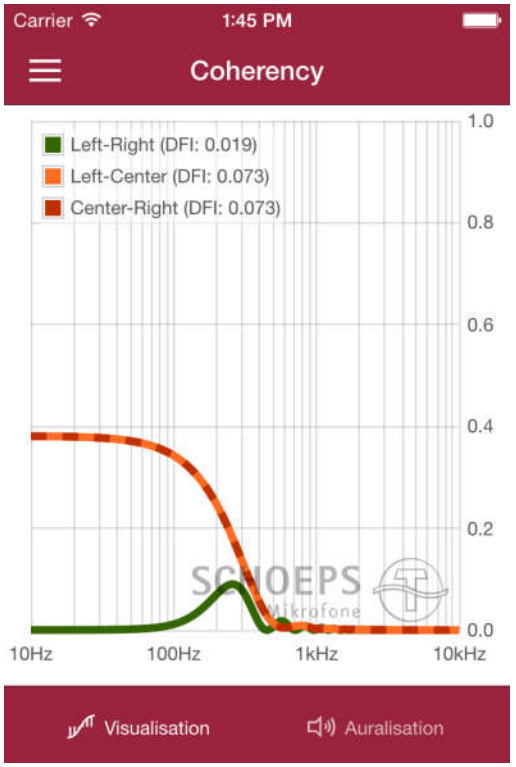
- Localisation Curve



- SCHOEPS-App “Image Assistant”: www.ima.schoeps.de







Demo App „Image Assistant“, Demo Cedric 4 Stereopaare mit Screenshots IMA3

Basics

Stereo Imaging

- Directional Image
- Room Image

Array design
for 3D-Audio

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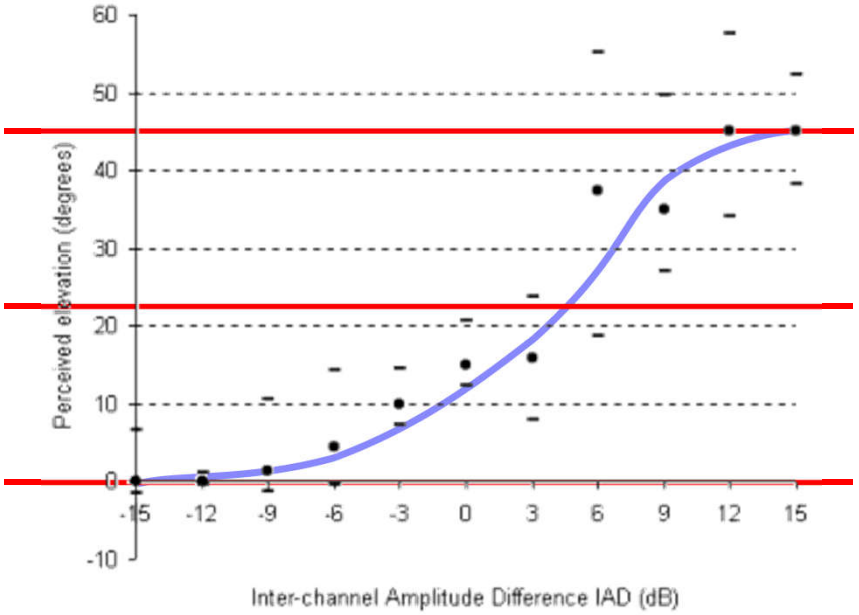
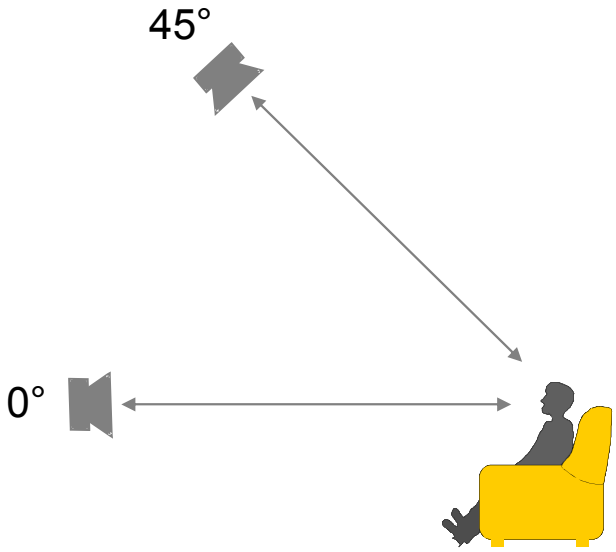
- Panning/Stereophonic Imaging between vertical loudspeaker pairs (Demo Vertical Shaker)



high

middle

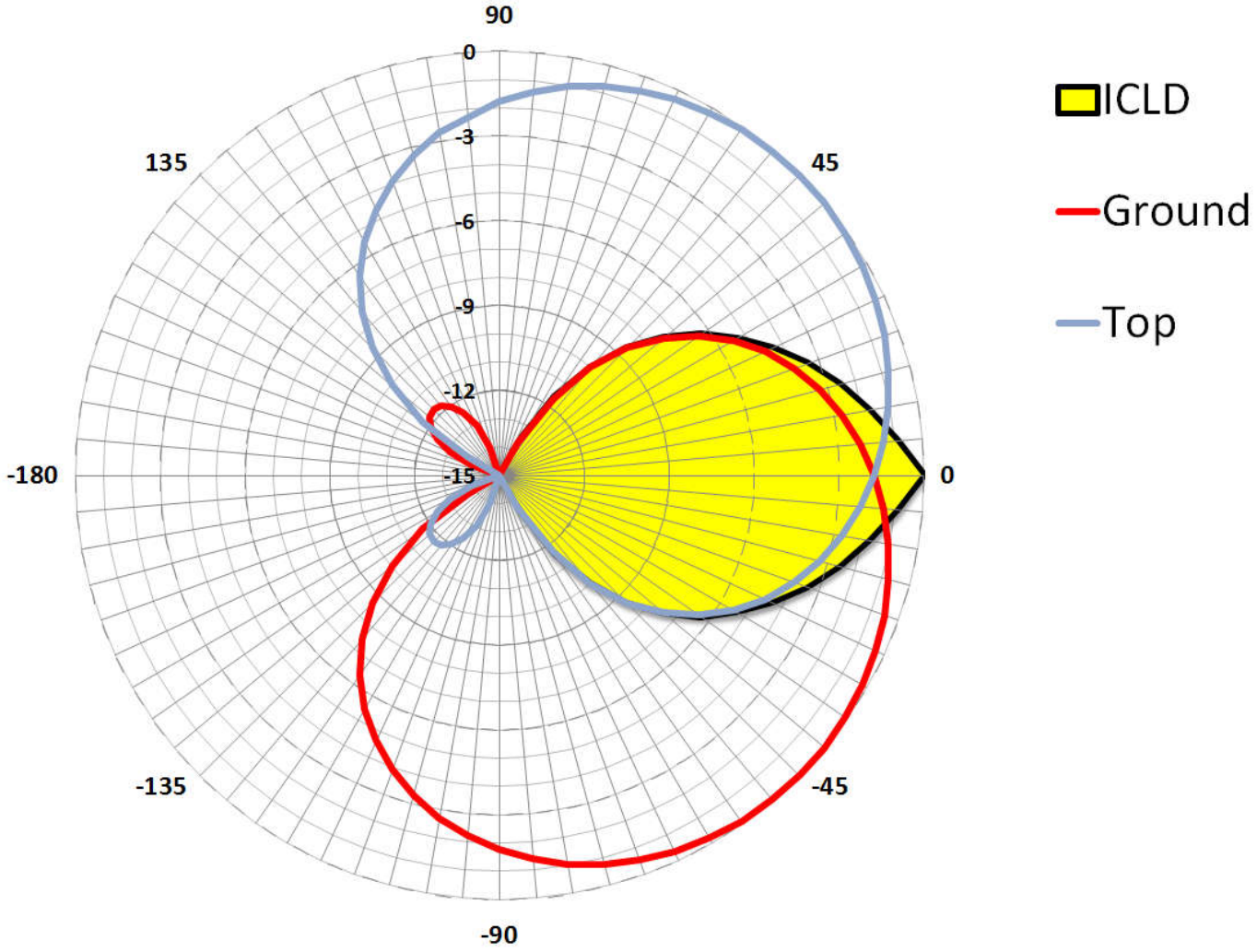
low

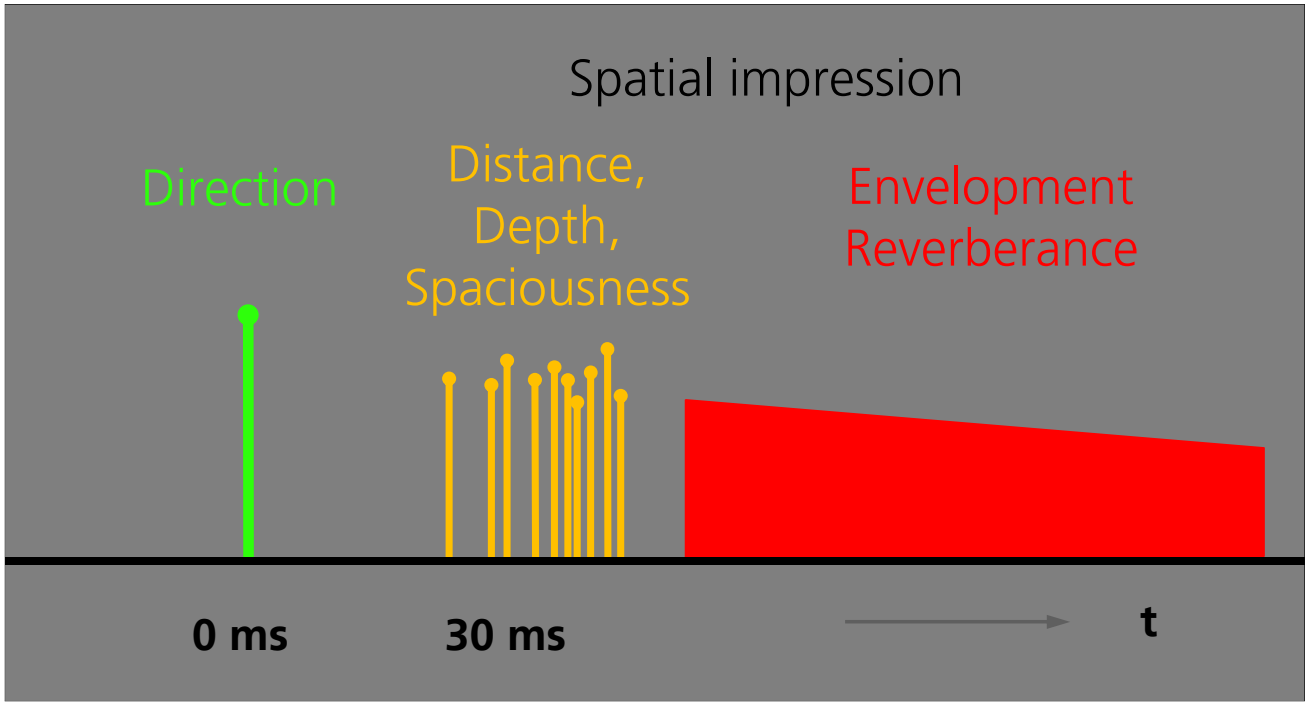


REF Jim Barbour, AES

Demo Vertical Panning (3D Grundlagen)

- Panning/Stereophonic Imaging between vertical loudspeaker pairs: X/Y microphone configuration for vertical imaging





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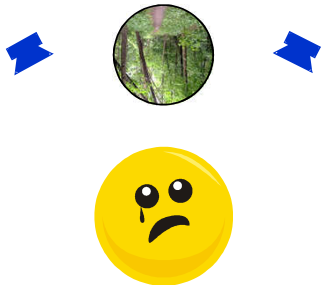
Diffuse sound in the recording room → diffuse sound in the reproduction room



Diffuse sound in the recording room → diffuse sound in the reproduction room

→ different diffuse signals
= decorrelated in the diffuse field

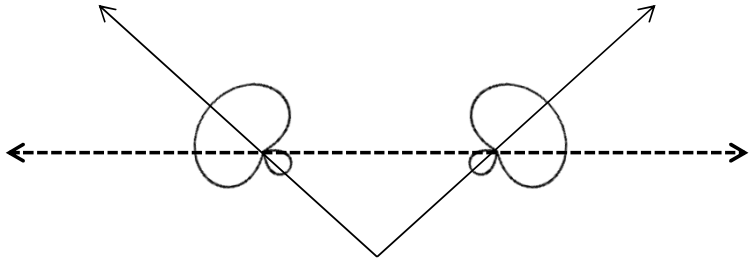
- The larger the distance, the more independent the signals

- The larger the directivity, the more independent the signals

- The larger the opening angle, the more independent the signals

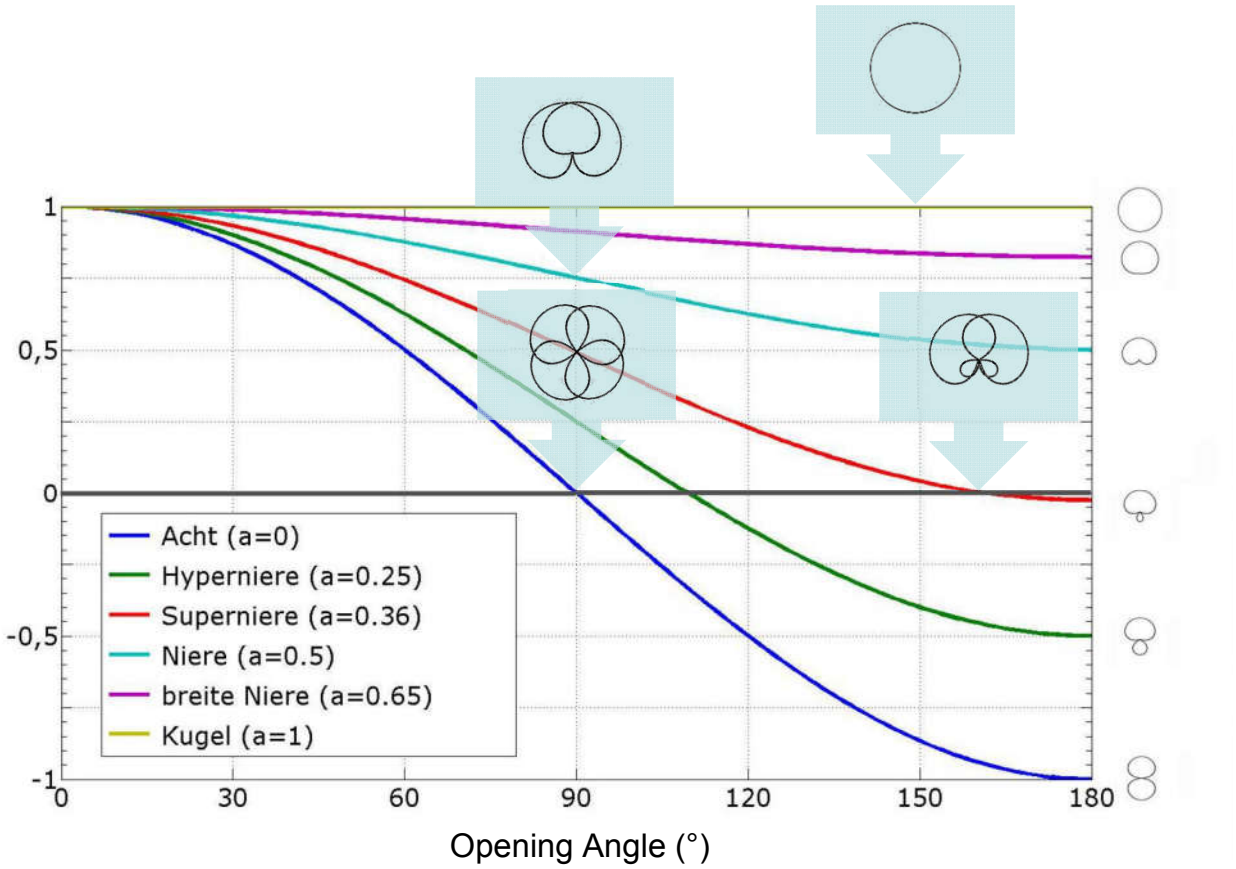
Diffuse field correlation (DFC): coincident setups

- is dependent on the distance, angle and directivity
- is dependent on the frequency (wave length)



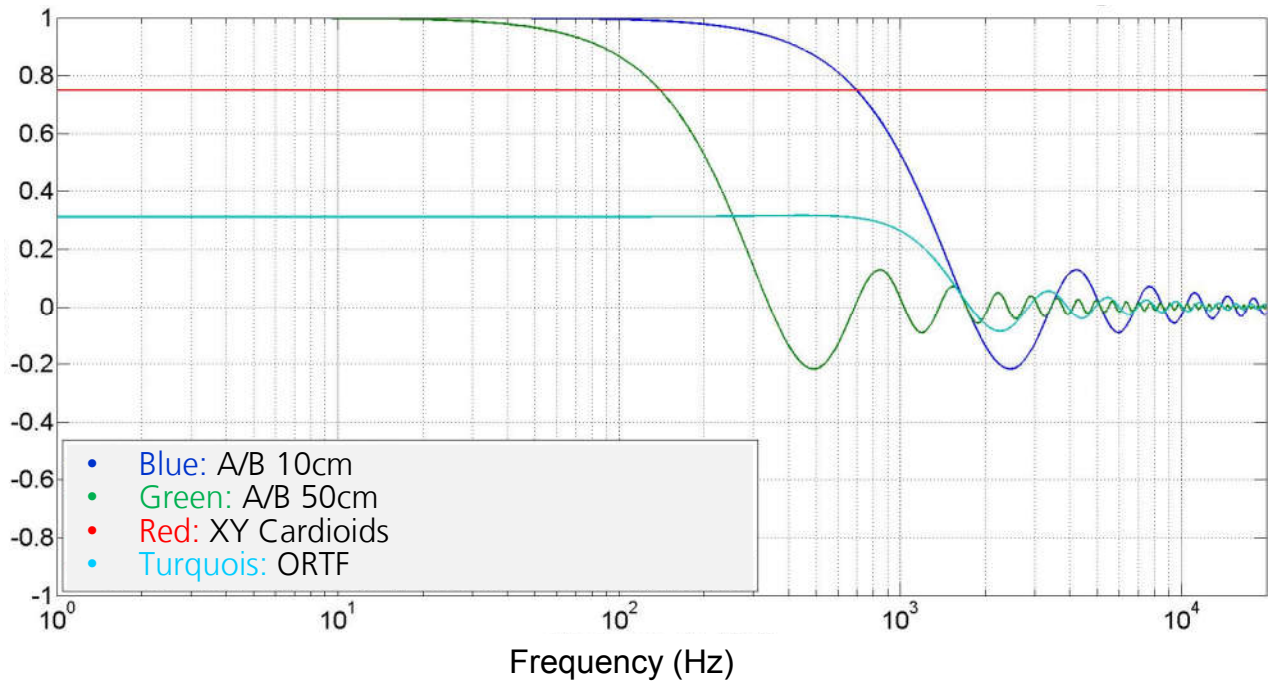
- Diffuse field correlation (DFC): coincident setups

DFC
=
Correlation coefficient



- Diffuse field correlation (DFC): spaced setups

Diffuse field correlation (DFC)

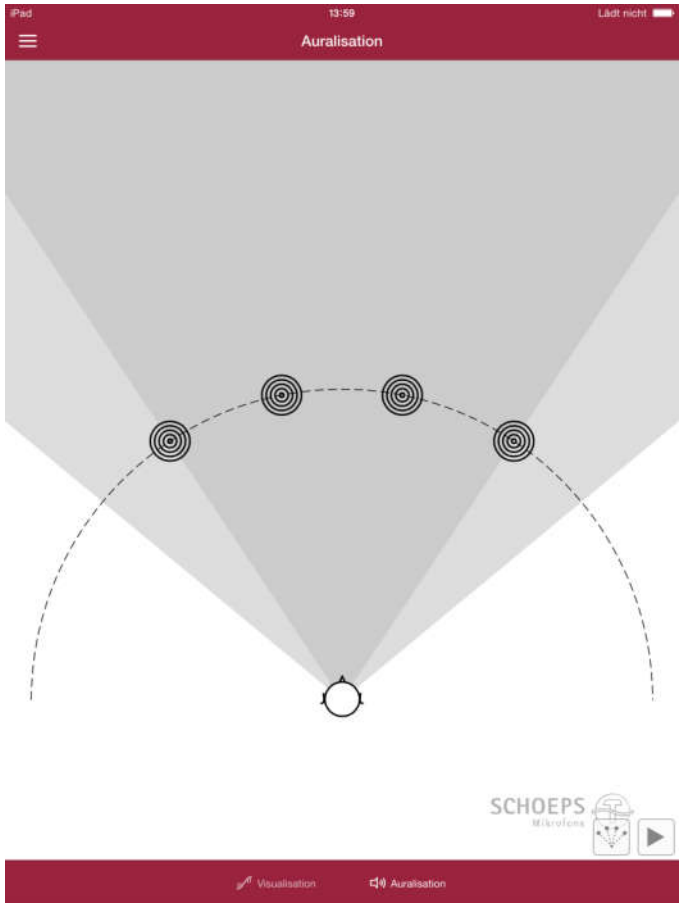


from: [Riekehof et al., TMT 2010]

- Coherence function calculated by the Image Asisstant v3

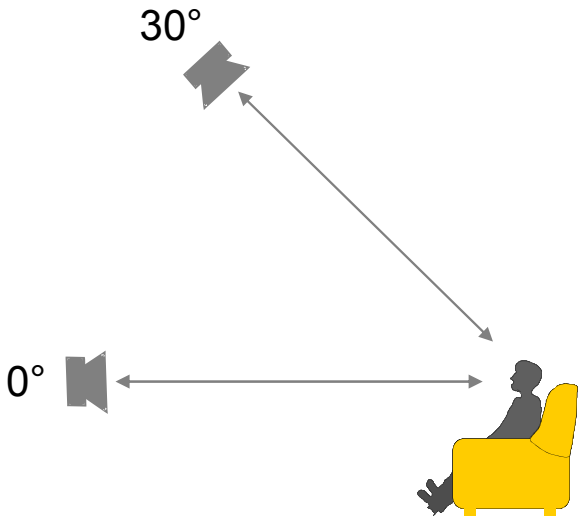
Demo Diffusfeld:
HdM Diffusfeld Koinzidenz;
Cédric 2 Stereofoniepaare mit Umschalten der Screenshots DFC, Bahnhofshalle

- Image Assistant v3
- Simulation of the DFC and proper Auralisation



- Correlation between vertical loudspeaker pairs
- Live demo: X/Y vs. A/B

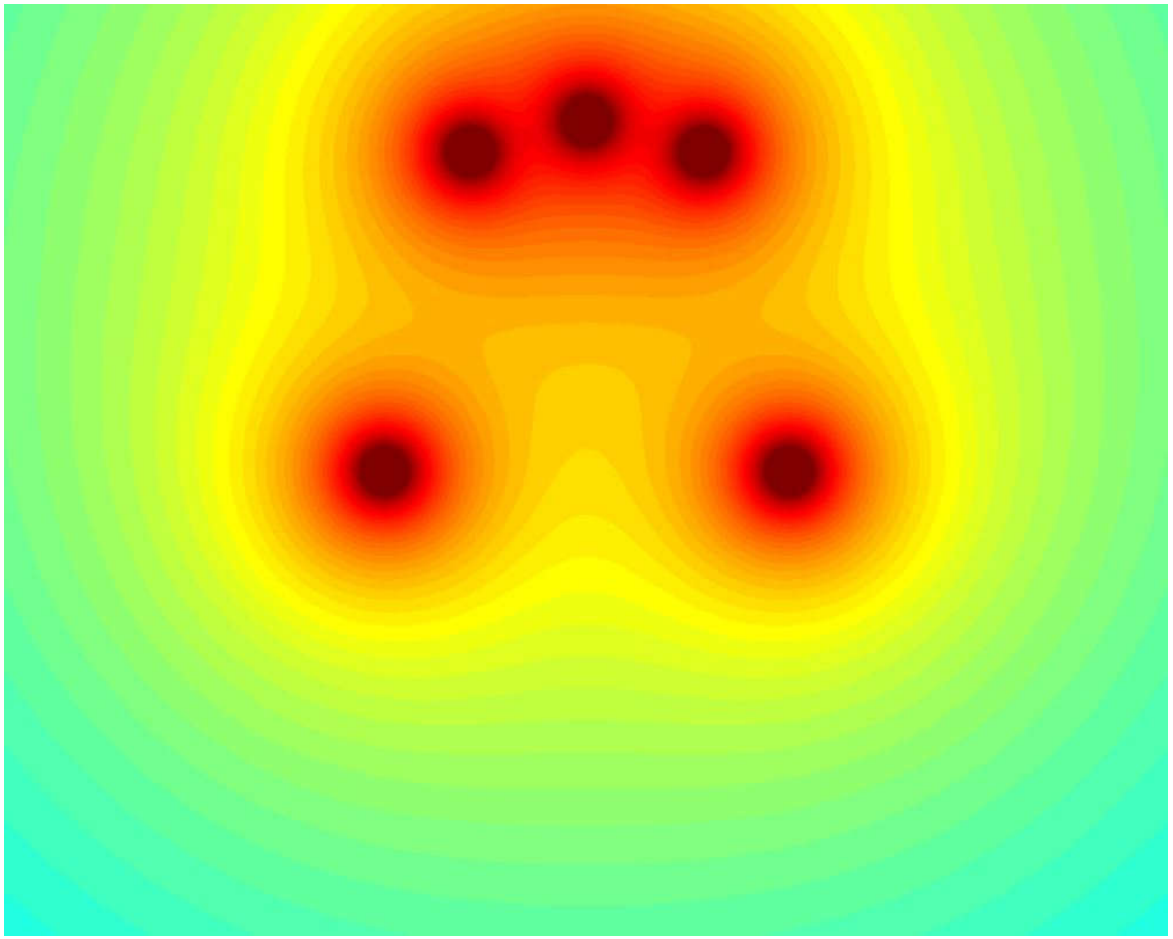
→ In the vertical domain correlation plays a different role



Demo Vertical Diffuse

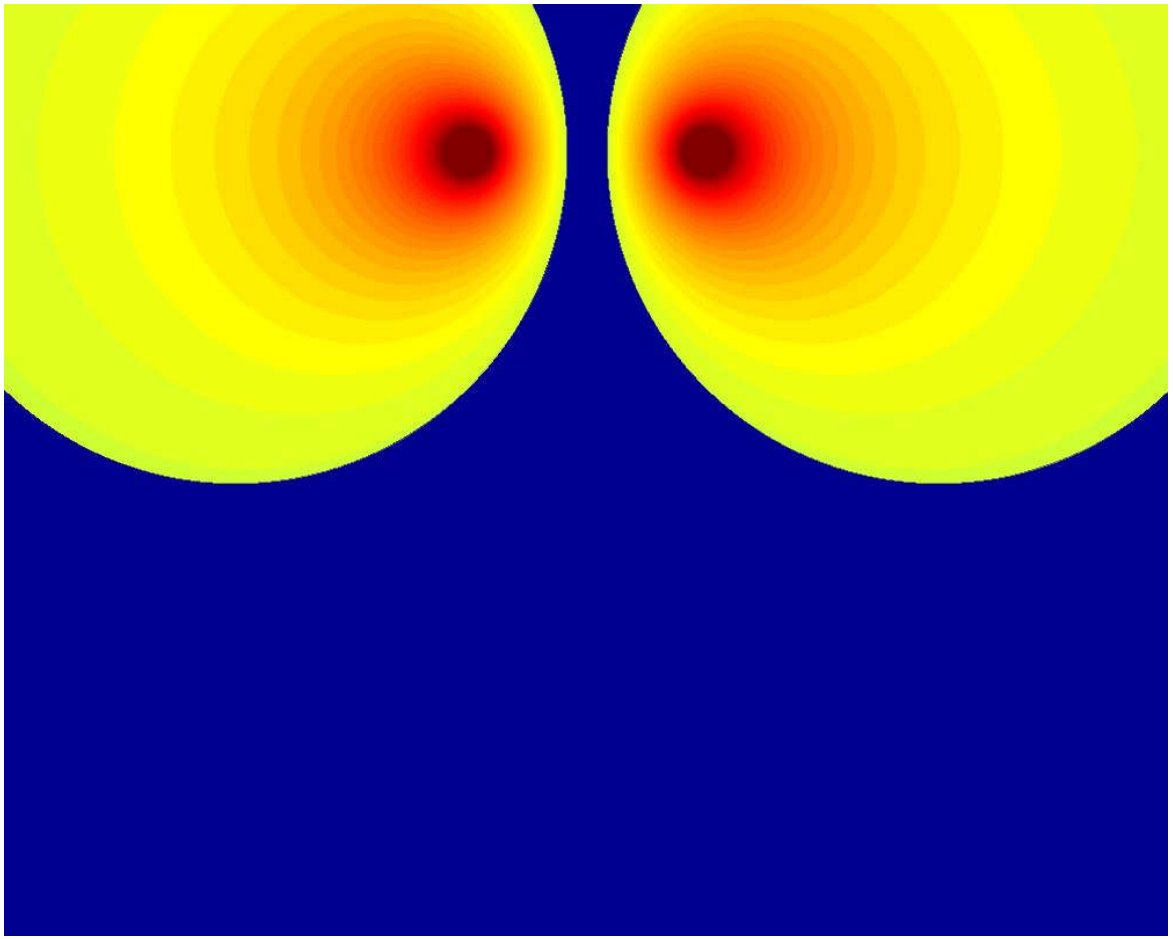
- „Diffuse Field Listening Area“

5ch Total power sum



- „Diffuse Field Listening Area“

2 ch Diffuse Field Listening Area

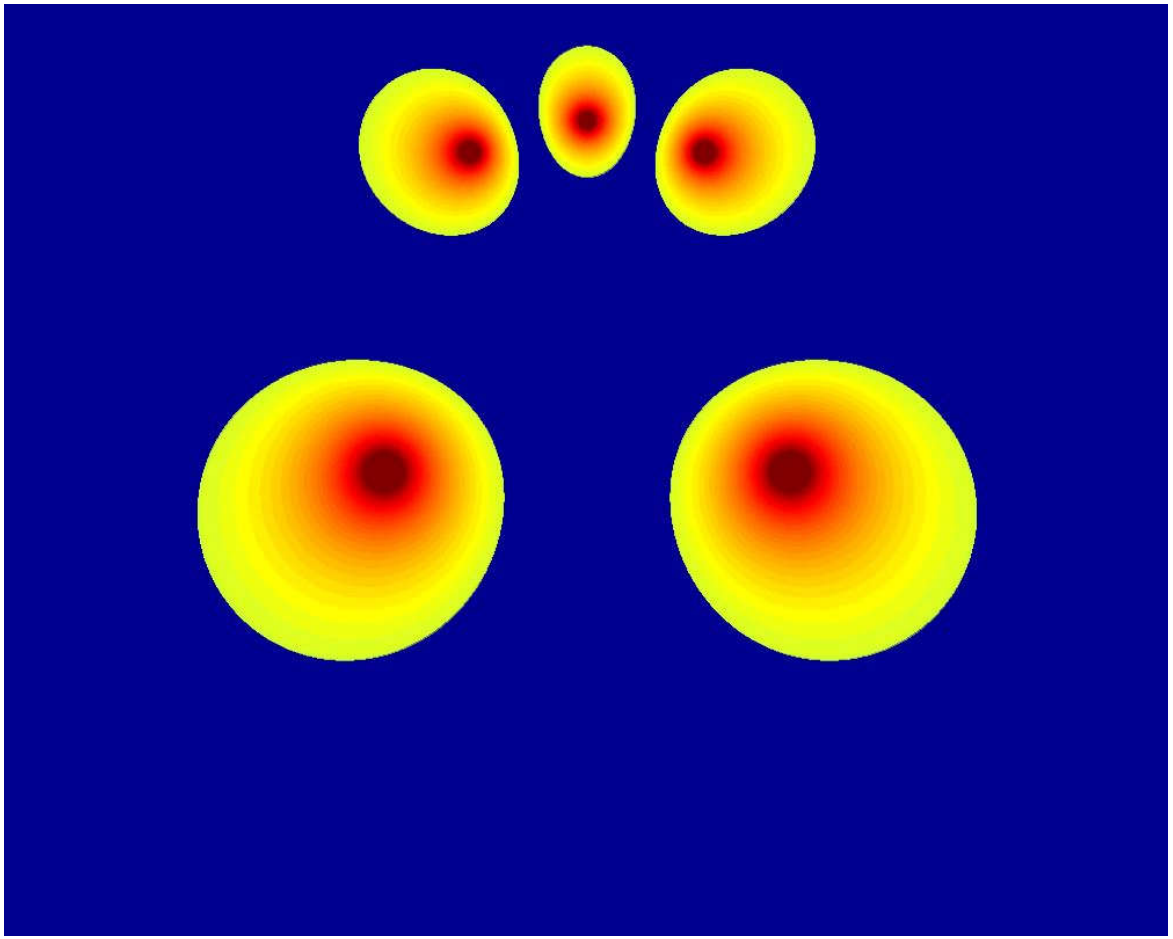


Blue Zone:

No individual loudspeaker is more than 3 dB louder than the sum of all other loudspeakers

- „Diffuse Field Listening Area“

5 ch Diffuse Field Listening Area

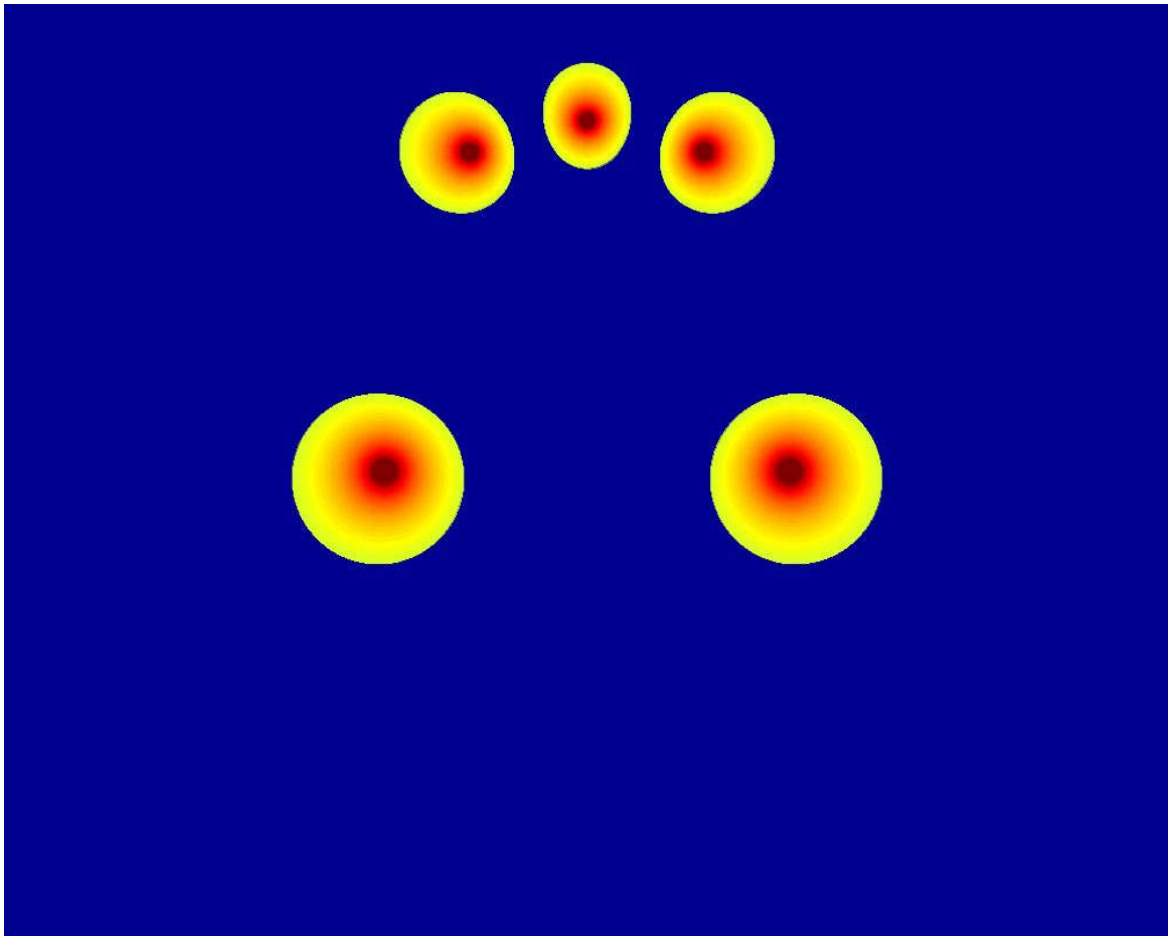


Blue Zone:

No individual loudspeaker is more than 3 dB louder than the sum of all other loudspeakers

- „Diffuse Field Listening Area“

9 ch Diffuse Field Listening Area



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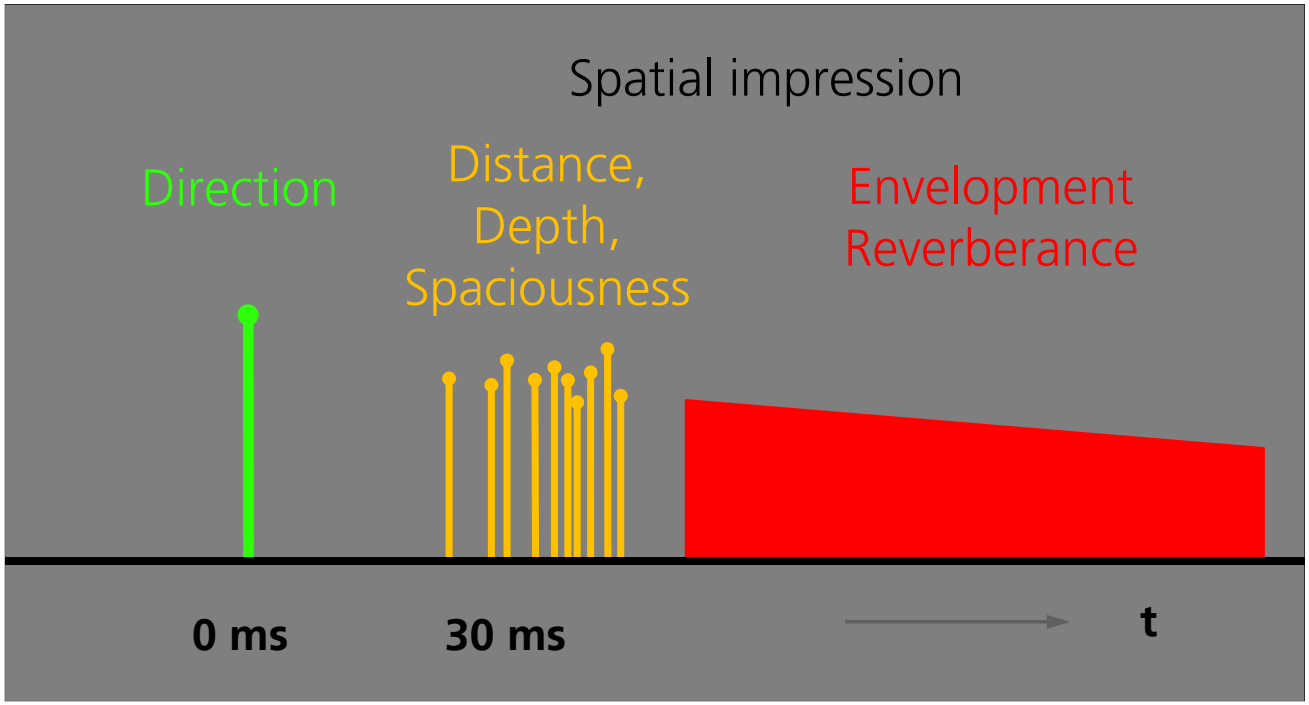
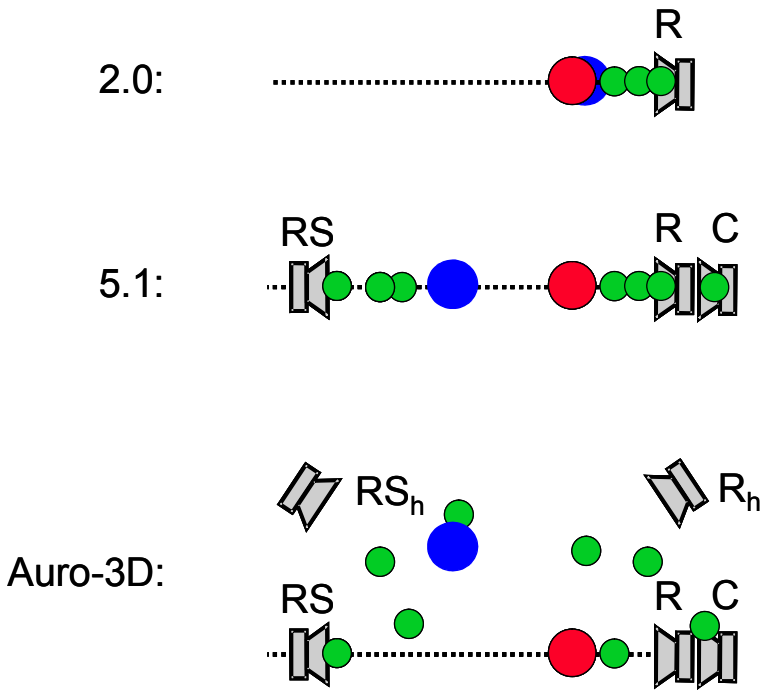


© Theile

- Distribution of reflections
- Hypothesis: Less coloration and better perception of depth/distance through better separation



Demo Galaxy Modern 9 <-> 5
Klavier 9 <-> 5

- Array design for 3D-Audio (= Stereo + height)
- Two recording principles with different priorities:

ORTF-like recording techniques

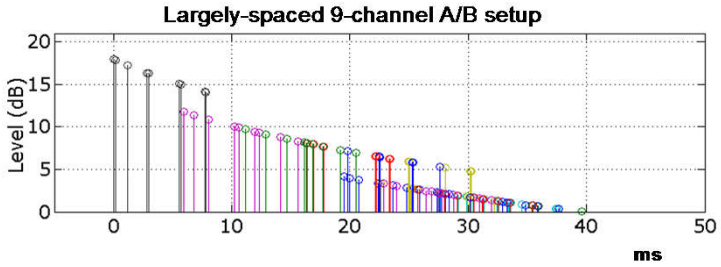
- Closely spaced, directive microphones
- Typical properties:
  - proportional and clear directional imaging
  - natural spatial impression
- Application: chamber music, drama, sports, ambience

Wide a/b-like recording techniques

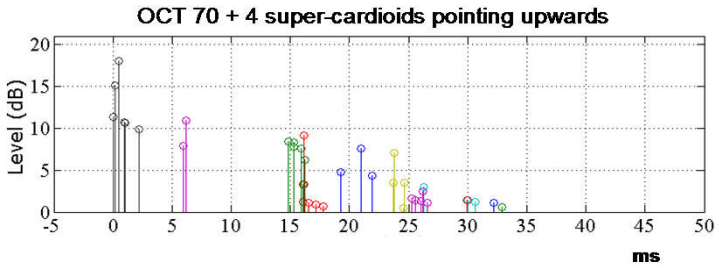
- Widely spaced, omni-directional microphones
- Typical properties:
  - stable, but not proportional directional imaging
  - enhanced spatial impression
- Application: music, film music

- Array design for 3D-Audio (= Stereo + height)
- Two recording principles with different priorities:

Wide a/b-like recording techniques

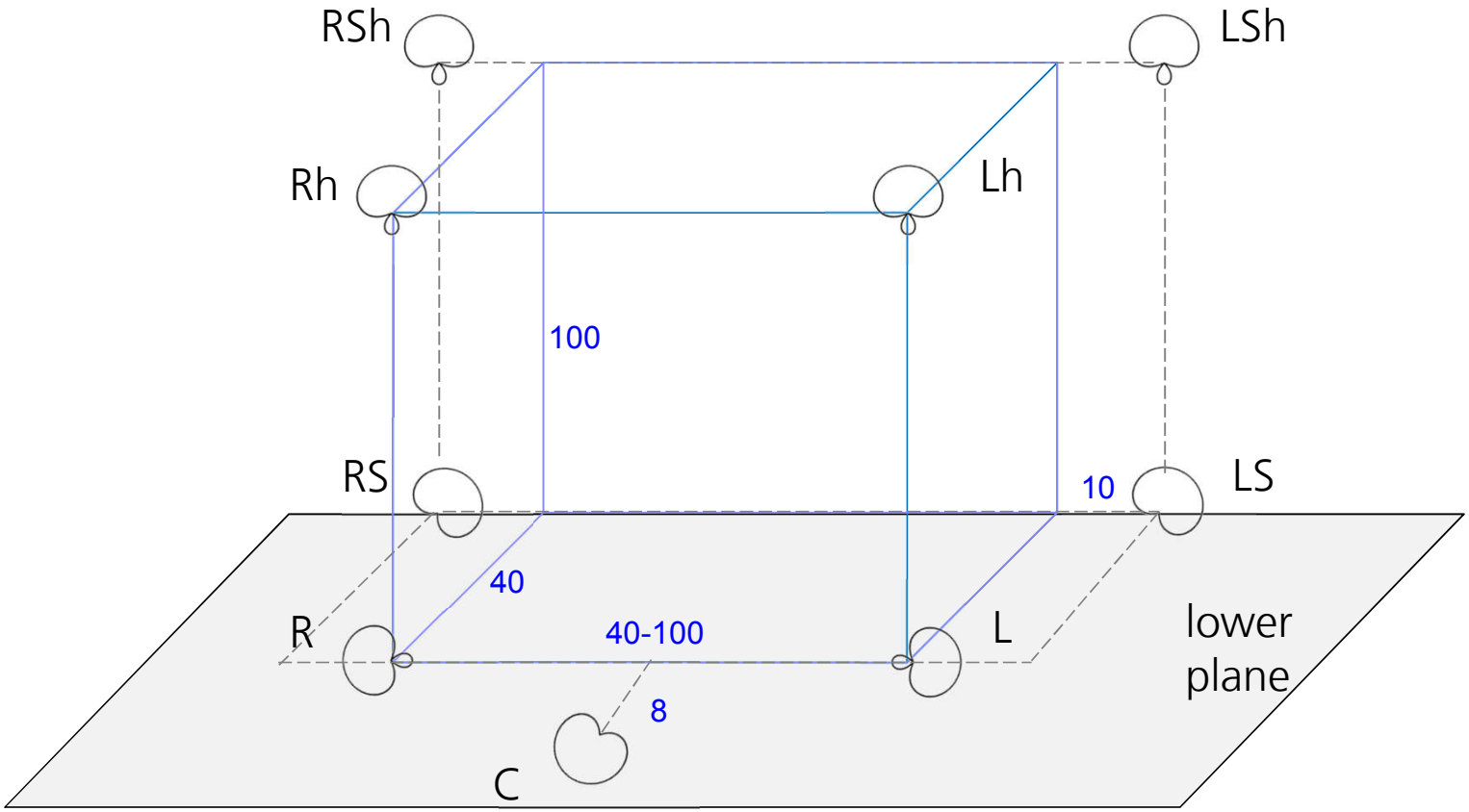


ORTF-like recording techniques



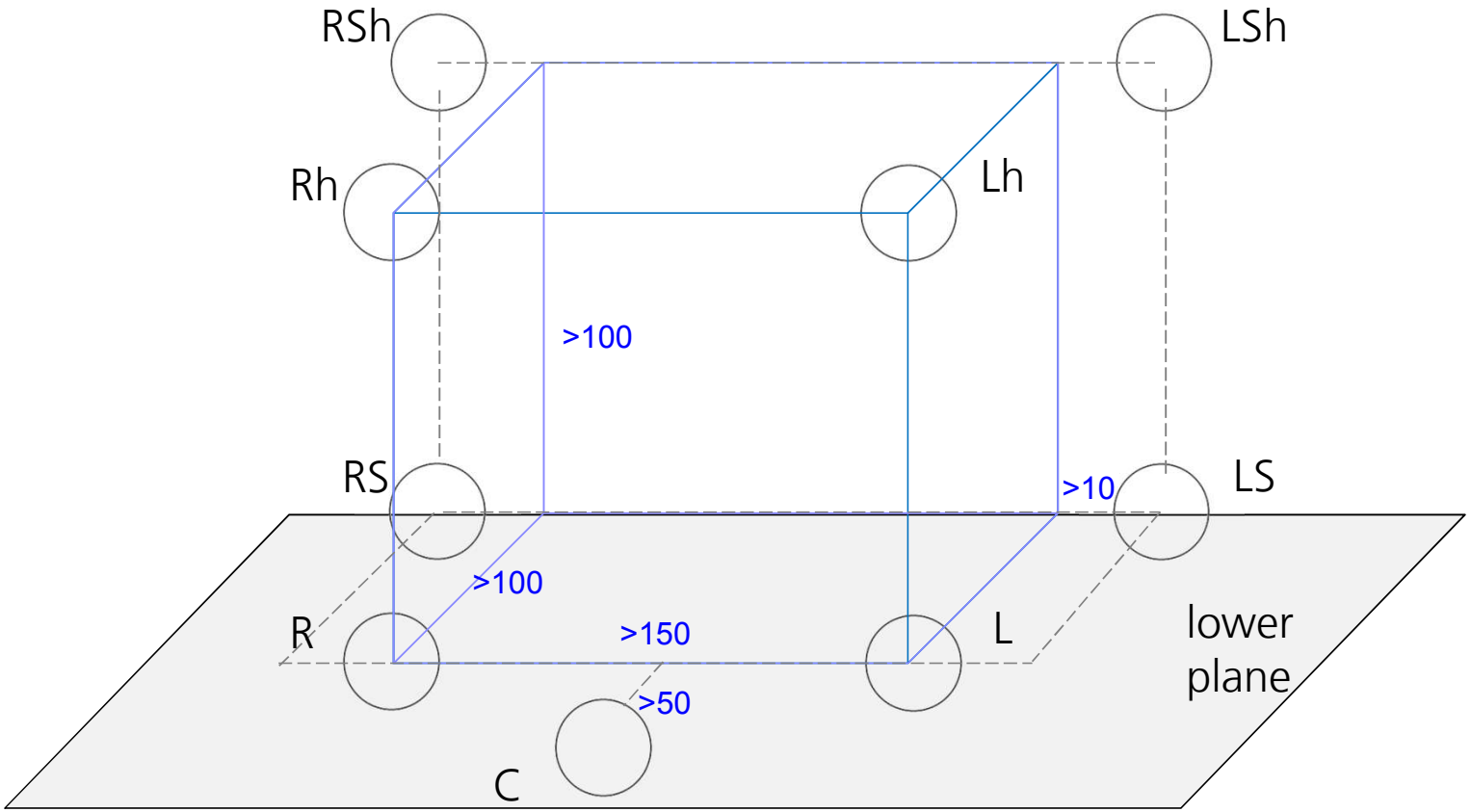
„OCT 9“ for 9.1 Surround

- lower plane: OCT Surround
- upper plane: + 100cm, 4 supercardioids pointing upwards



„Omni Array“ for 9.1 Surround

- 9 Omnis



- Test recordings in the Galaxy Studios, Belgium
- OCT 9
- Omni array

Basics

Stereo Imaging

Array design
for 3D-Audio

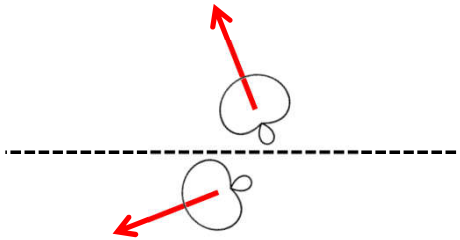
- Δt and/or ΔL
- ORTF-3D

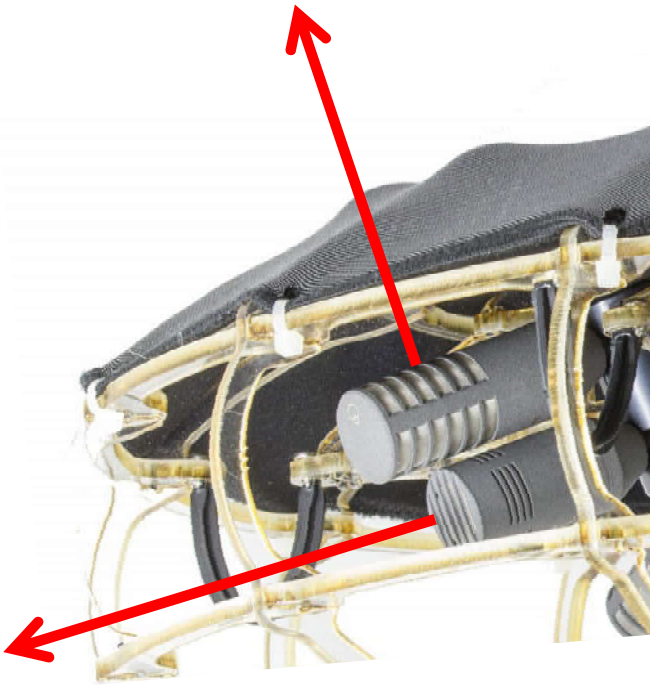
ORTF-3D regular

- 8 * Supercardioid on the edges of a cube with d = 10-20 cm

ORTF-3D „FLAT“ **(NEW)**

- 8 * Supercardioid on the edges of a rectangle/square with d = 10-20 cm
- Coincident X/Y microphone pairs for each vertical loudspeaker pair
- Orientation of the XY pair: +60° (height layer) / -30° (ground layer)



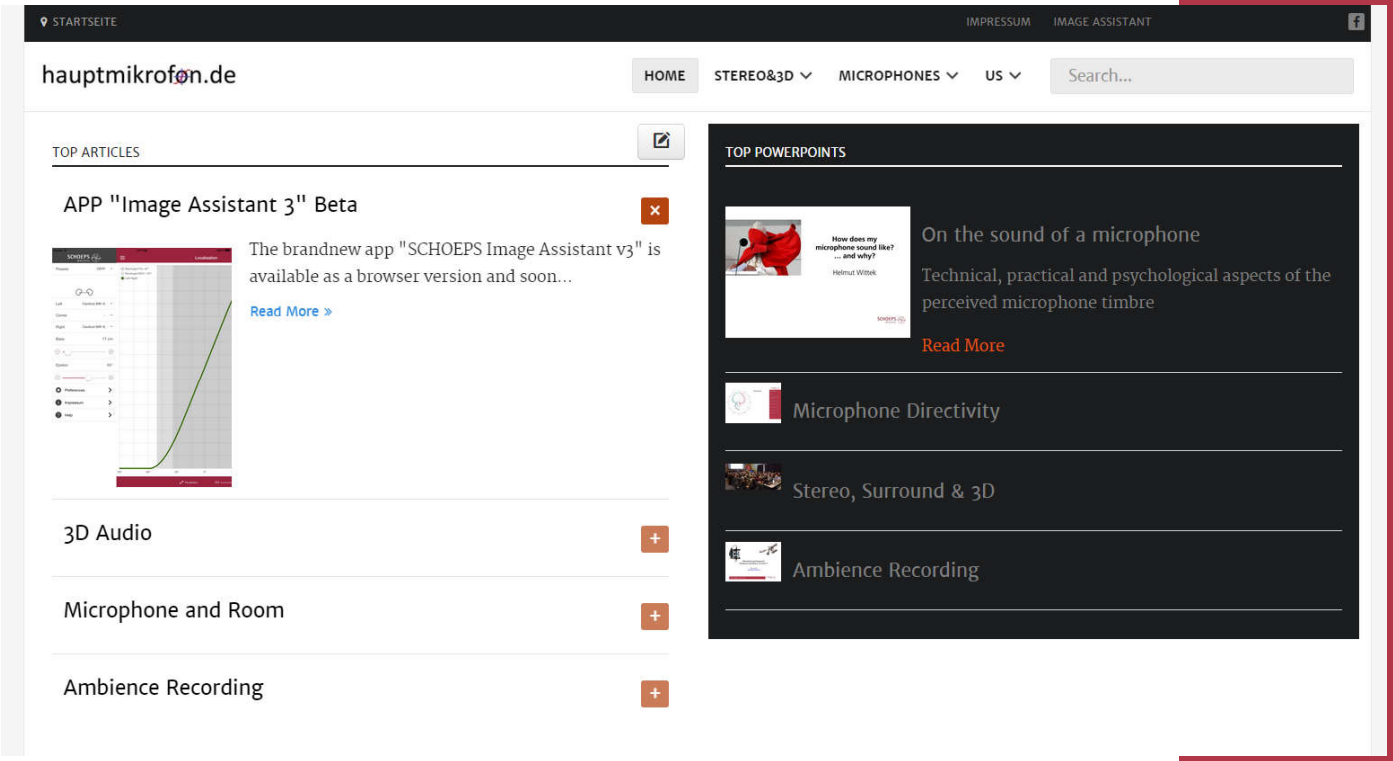


Demo Worldcup
Demos ORFT-3D Ambience

- Infos, Powerpoints, Papers, Audio demos on

  www.hauptmikrofon.de (new launch in Oct 2015)

- wittek@schoeps.de



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