Siegfried Challenge Report

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The Challenge to Find the Optimum Radiation Pattern and Placement of Stereo Loudspeakers in a Room for the Creation of Phantom Sources and Simultaneous Masking of Real Sources

Siegfried Linkwitz

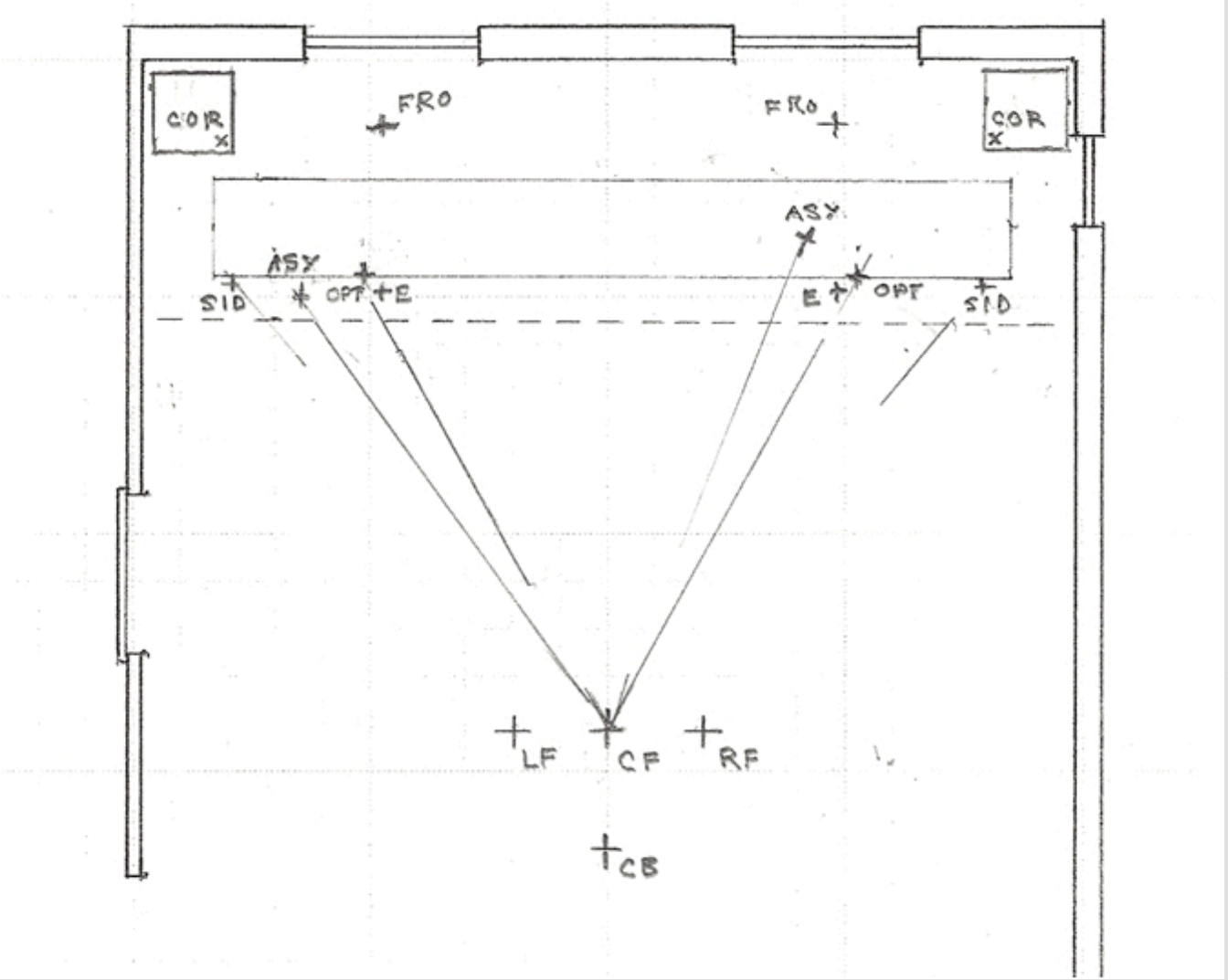
- Paper delivered by to AES Convention, October 2009

- SL claims that (his) speakers, properly positioned in an ordinary room can provide a "transparent" acoustic window to the original recording space
  - Real sound sources "disappear"
  - Local acoustics are not heard
  - Phantom images identical to the original
  - Acoustics of the venue are heard
- If this happens, we have achieved the goal of High Fidelity since the beginning using only two channels

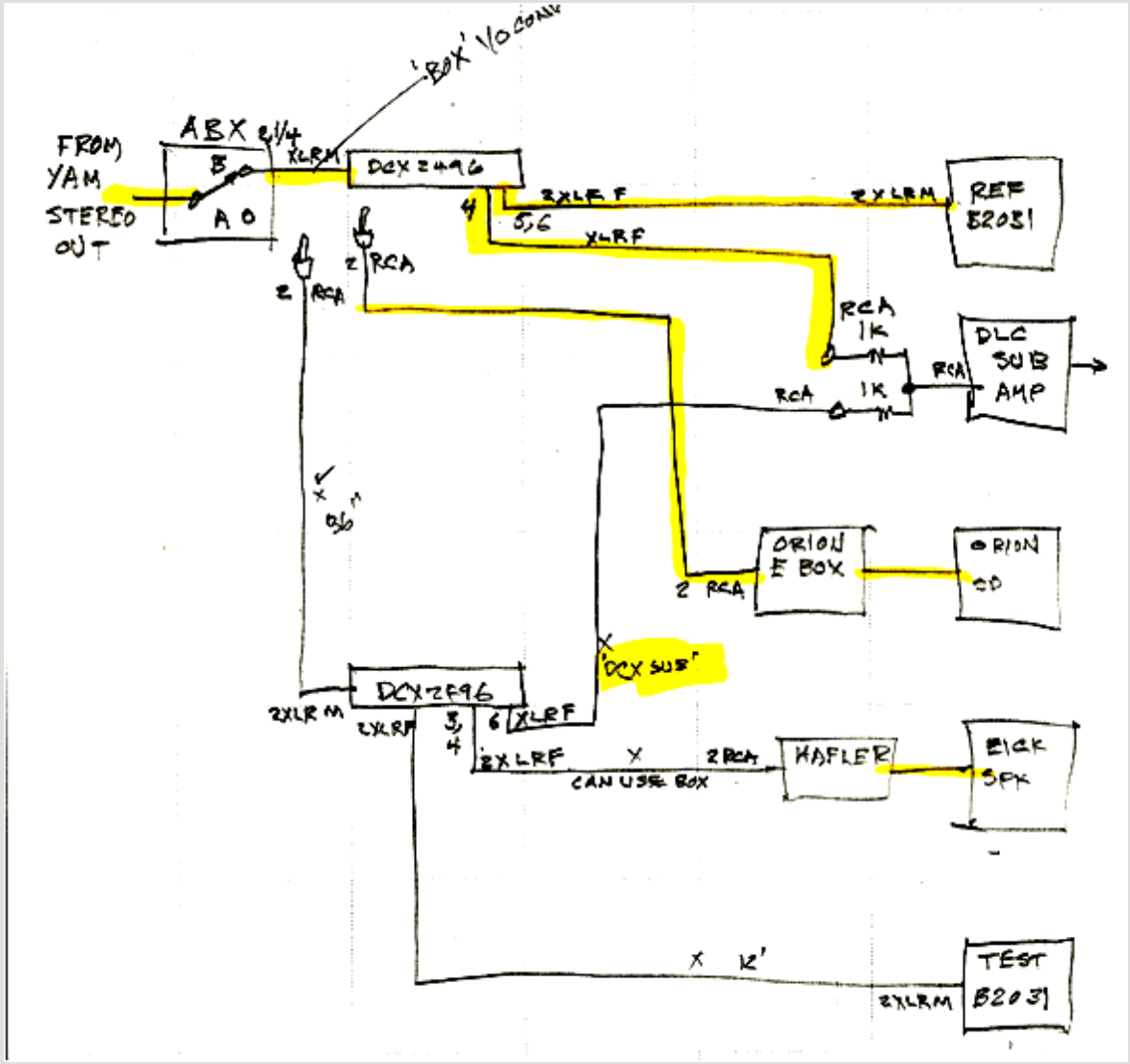
Summary

- January, SL sent pair of Orion speakers to DLC
- DLC modified his 20’ X 28’ living room for test
  - Moved couch and tables to open center of room
  - Closed off opening to make front of room reflective
  - Ran support cable side to side for opaque screen
  - Provide mounting for two Behringer pairs and Eickmeier speaker
  - Added DSP, power amps and routing to allow fast changeovers
- Equalizing speakers
  - SL asked that no EQ be used on his Orions
  - All other configurations equalized to Orions in Optimum position
  - Subs added for Behringers and Eickmeiers. Levels matched

Front of Listening Room



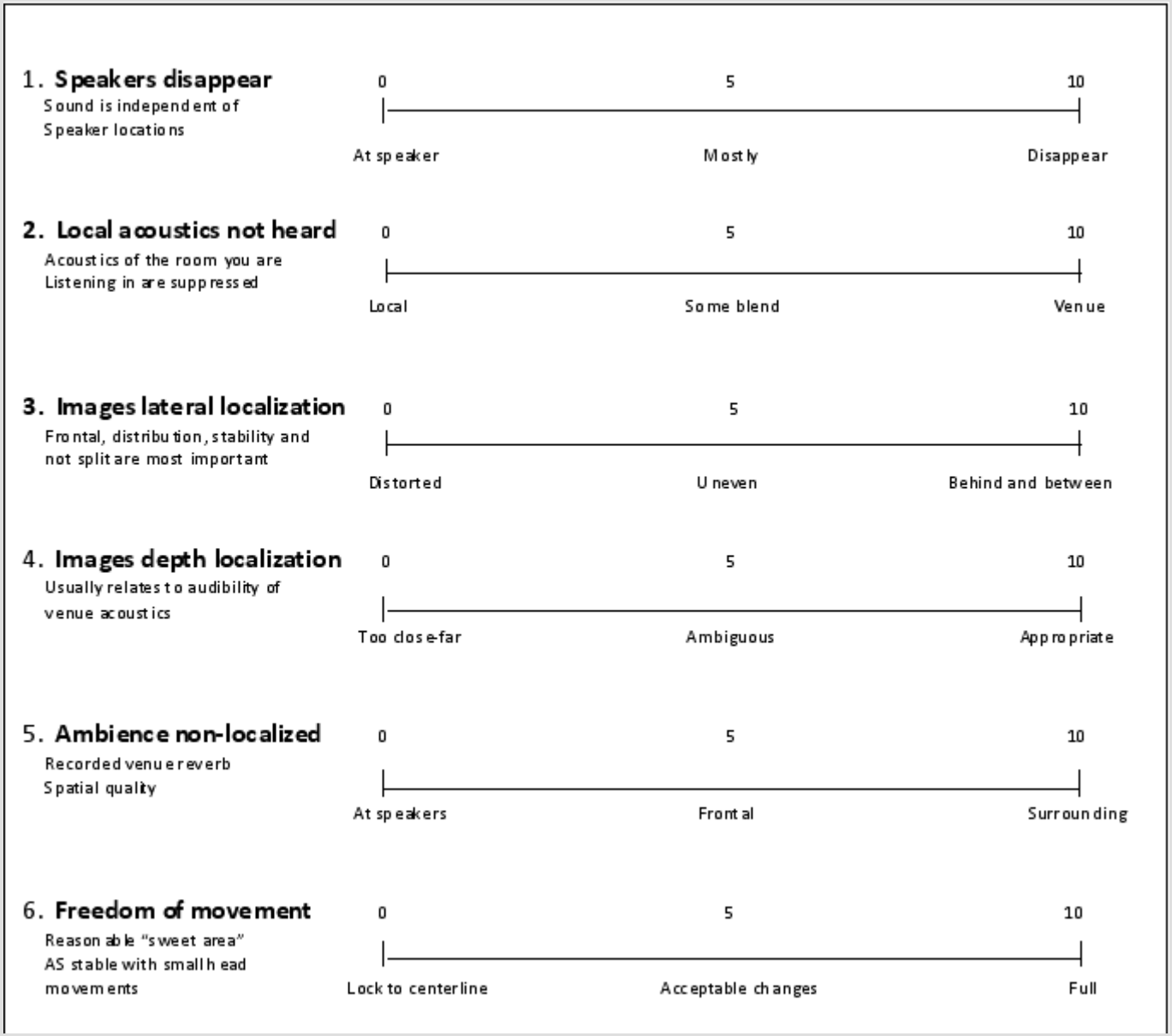
SL Challenge Wiring



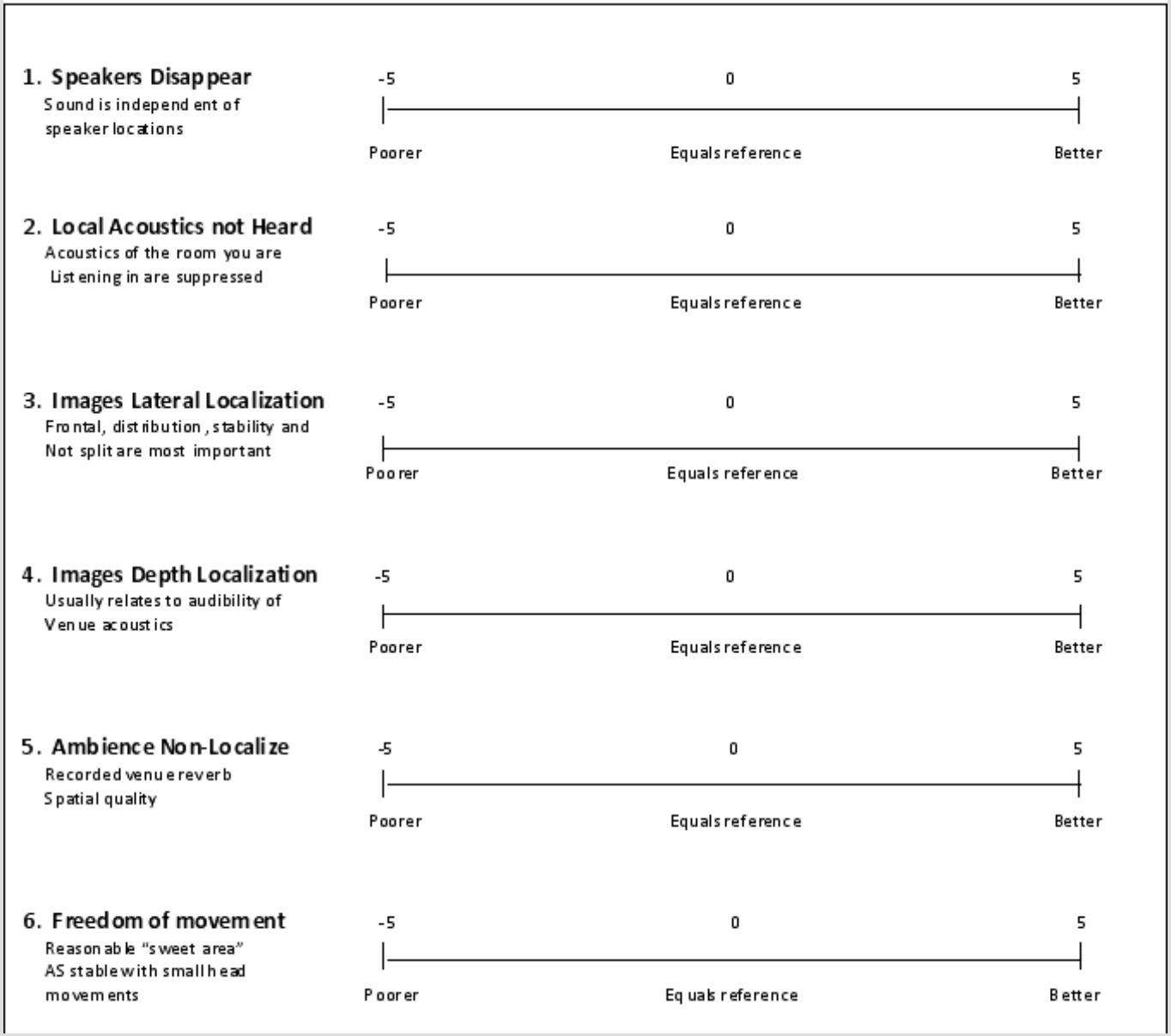
Summary Continued

- Core group met several times to refine tests
  - D. Carlstrom, T. Nousaine, J. Snyder, R. Klacza, D. Green, B. Muller,
  - Music selections
  - Effect of listening location
  - Dry run tests: “Is a plausible Auditory Scene (AS) created by reference speakers?”
  - Wording of instructions and test forms
  - Ponder variables:
    - Listener experience with acoustic music and halls
    - Radiation pattern of speakers
    - Order of presentation
    - Duration of sessions

AS Existence form



AS Compare To Reference Form



Summary Continued

- Testing started late April
  - Six sessions of 13 listeners total
  - **Each Session** used a random draw of three speaker configurations (configs) out of six available. Presentation order randomized
  - **Each Test** in a session used three music selections
    - DLC voice from LiT disk. Mono, dry should be front and center
    - Harry James big band. Various front-back and left-right instrument locations in a medium-size space
    - Tchaikovsky Sym. #4. Plucked strings reveal hall acoustics
  - **Six attributes** of each config were scored for each program selection
- **936 total responses**, including AS existence question

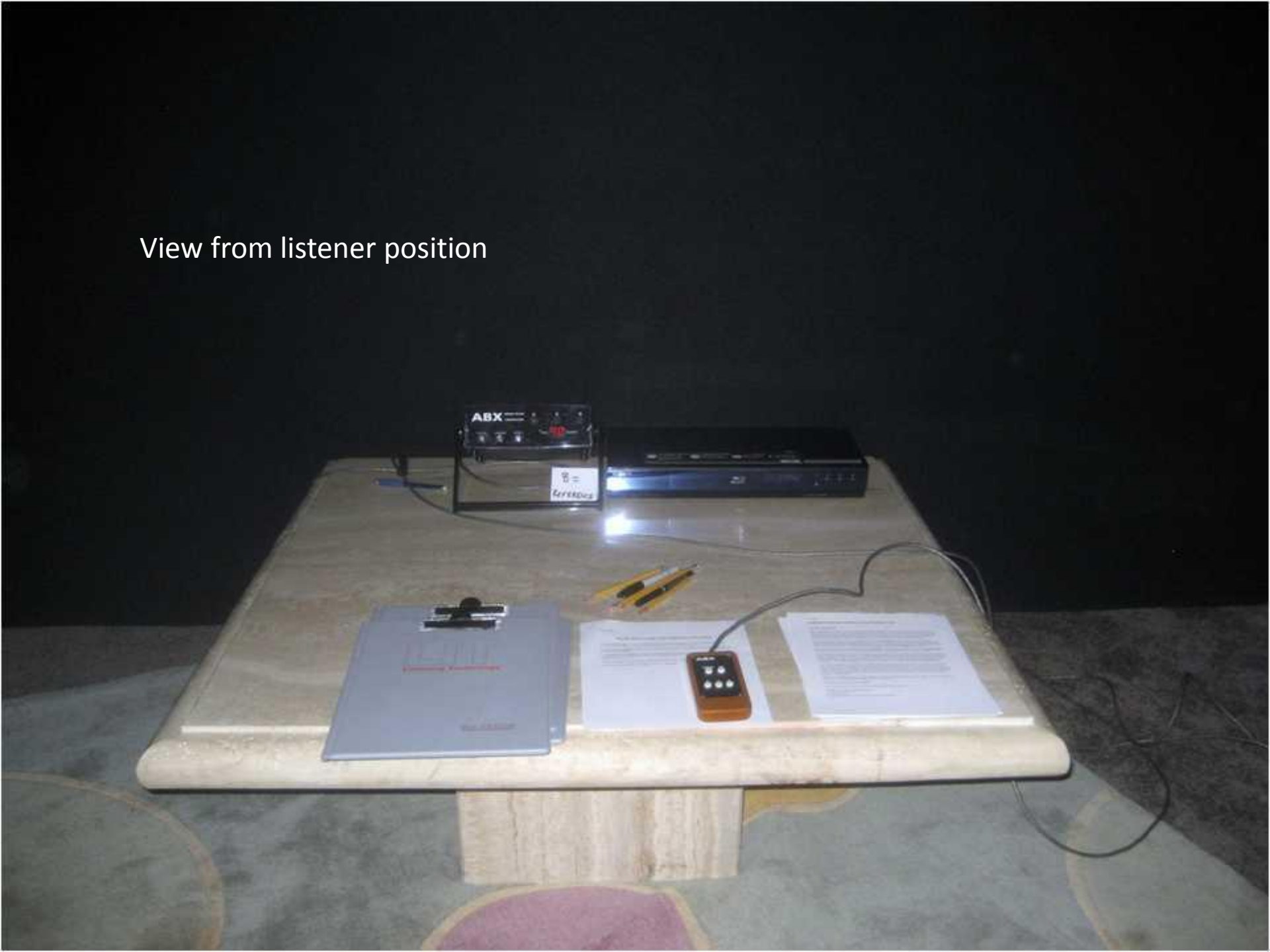
Summary Continued

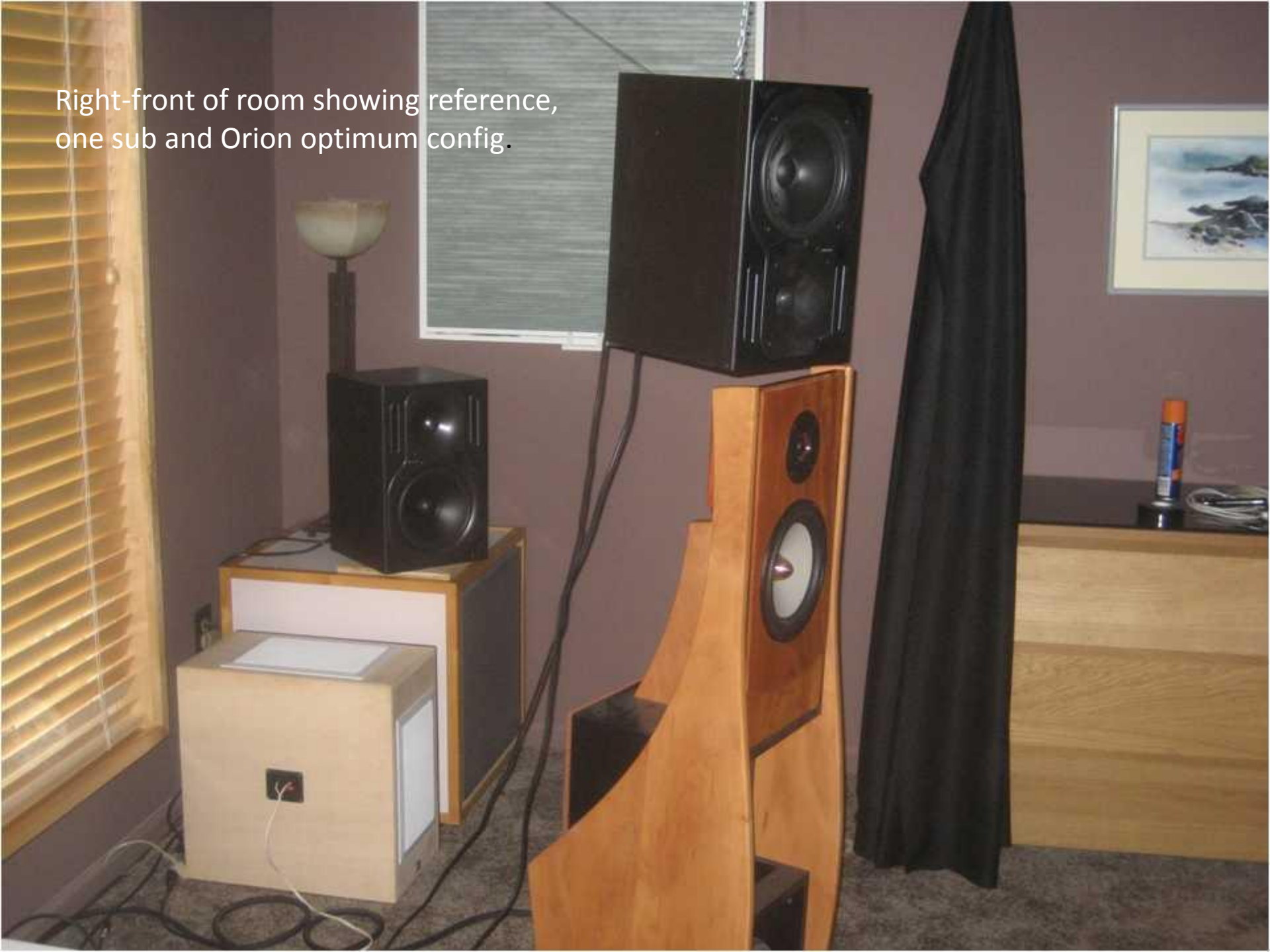
- Thee program selections put on a single disk with relative levels pre-set
- Playback SPL was pre-set
  - 72 dB DLC voice, peal
  - 92 dB Harry James, peak
  - 92 dB Tchaikovsky, peak on 4th movement (3rd quieter)
- Listeners switched between reference and unknown config at will, and changed tracks at will


Config not seen by listeners


Opaque screen in place

View from listener position




Right-front of room showing reference,
one sub and Orion optimum config.


Left front of room showing
positioning guides on floor


Left front of room showing
Eickmeier speaker config
LF

Results

- AS existence question: All listeners scored the Behringer powered monitors as creating a plausible AS (7.40 average out of 10)

- Config scores **relative to reference** (+/- 5 range)
  - +0.32 Eickmeier (only speaker judged better than reference)
  - -0.50 Orions asymmetrical in room (> 1 meter from walls)
  - -0.55 Orions close to front wall
  - -0.58 Orions in optimum location
  - -0.88 Orions close to side walls
  - -1.09 Behringers in front corners (a second set identical to reference)

Duh?.

1. How did Eickmeier's cheesy boxes of multiple cheap in-walls come out on top?
2. Why didn't the Orions in optimum location blow away the references and everything else?
3. Why didn't placing the Orions near walls hurt their sound more?
4. Why were all the averages clustered around 0.0 (equal to the reference)?

Things to Think About

- The core group found that AS could not be judged without EQ-ing the speakers
  - Matching was not perfect even after EQ
  - The Orions lost bass output as they were moved towards walls
- The AS plausibility of the Behringers/subwoofer was very good
  - It is not an insult for the Orions to be “almost as good”
  - Perhaps the room acoustics dominated over speaker differences
- 60 degrees stereo angle was requested by SL
  - Listeners thought it was too wide
  - Eickmeier speakers had smallest angle to inner speakers
  - Two alternate configs went wider than 60 to be near walls

Eickmeier Speakers—Image Model Projectors

- "Improvement" to Bose 901s—according to Gary
  - Four Radio Shack in-wall speakers, one on each face of cabinet
  - Pair firing back towards front wall, full level
  - Inward facing, 6 dB attenuated
  - Outward facing, 12 dB attenuated
- Alternative to dipole and box radiation pattern
  - Very irregular pattern due to directivity of drivers and diffraction
  - Gary claims his imaging is "real" because strong "virtual sources" are created behind the speakers by reflection from the front and side walls. Image Model Theory
  - Gary claims 45 degree angle of inward speakers widens sweet spot by time-intensity trading due to directivity

What's Next?

- Get more data and apply proper statistical analysis
- Experiment with EQ change on reference speaker only. (To determine role of EQ on AS)
- Compare multi-speaker stereo up-mix system to reference (DLC has this in place and believes that it is superior to any of the two-speaker configs in envelopment and robustness of off-centerline listening)
- Measure time, direction and frequency response of reflected sound to enable prediction of plausible AS (if program source is capable)

Thanks!