

Illuminarium Experiences

The soundscapes of Illuminarium

2021

Client

Illuminarium Experiences

Venue

Illuminarium

Location

Atlanta, US

Website

Illuminarium.com

Application

Immersive space

System configuration

Full immersive

Technology partners

ELECTROSONIC

 **disguise**

 **LEGENDS**

Panasonic

rockwellgroup

Contact

info@holoplot.com

HOLOPLOT

Illuminarium Experiences

VR without goggles

Where do you want to go today?
Illuminarium will take you there.

Illuminarium's immersive venues are already transporting visitors to places they can only dream of experiencing. Audiences are placed "inside" the narrative with techniques used in traditional motion picture production and virtual reality that facilitate the experience of real-world, filmed content (like a safari) and authentic, re-created worlds in an immersive environment. Most importantly, this is achieved without the need for wearable hardware.



WILD: **A Safari Experience**

The great outdoors, indoors

Two rooms. Four countries. One realistic, multi-sensory safari experience. WILD allows visitors to experience the great outdoors, indoors.

Cinematic content from Radical Media uses custom camera arrays to provide a 240-degree native field of view (versus the average 210-degree human field of view).

Strobe effects, gentle floor vibration, immersive, authentic sounds and scents, and realistic & responsive projection all contribute to the trip of a lifetime as you're immersed in Tanzania, Kenya, Rwanda, and South Africa without leaving Atlanta's BeltLine.



HOLOPLOT X Illuminarium

Experience the power
of true immersion

What if there was an entirely new way of engaging audiences with audio? What if an unprecedented level of control over sound was now within reach?

When using the HOLOPLOT X1 System, you have at your fingertips a previously inaccessible level of control over sound in both axes as well as exceptionally authentic sound localization – with lifelike distance and directional perception of audio objects.

Even within the audience room, you can position a sound source as if it's right in front of, beside or behind the listener. Sound objects are no longer bound to the position of a loudspeaker; instead, they come to life, moving on command through 3-D spaces as they deliver an incredibly realistic and tangible audience experience.

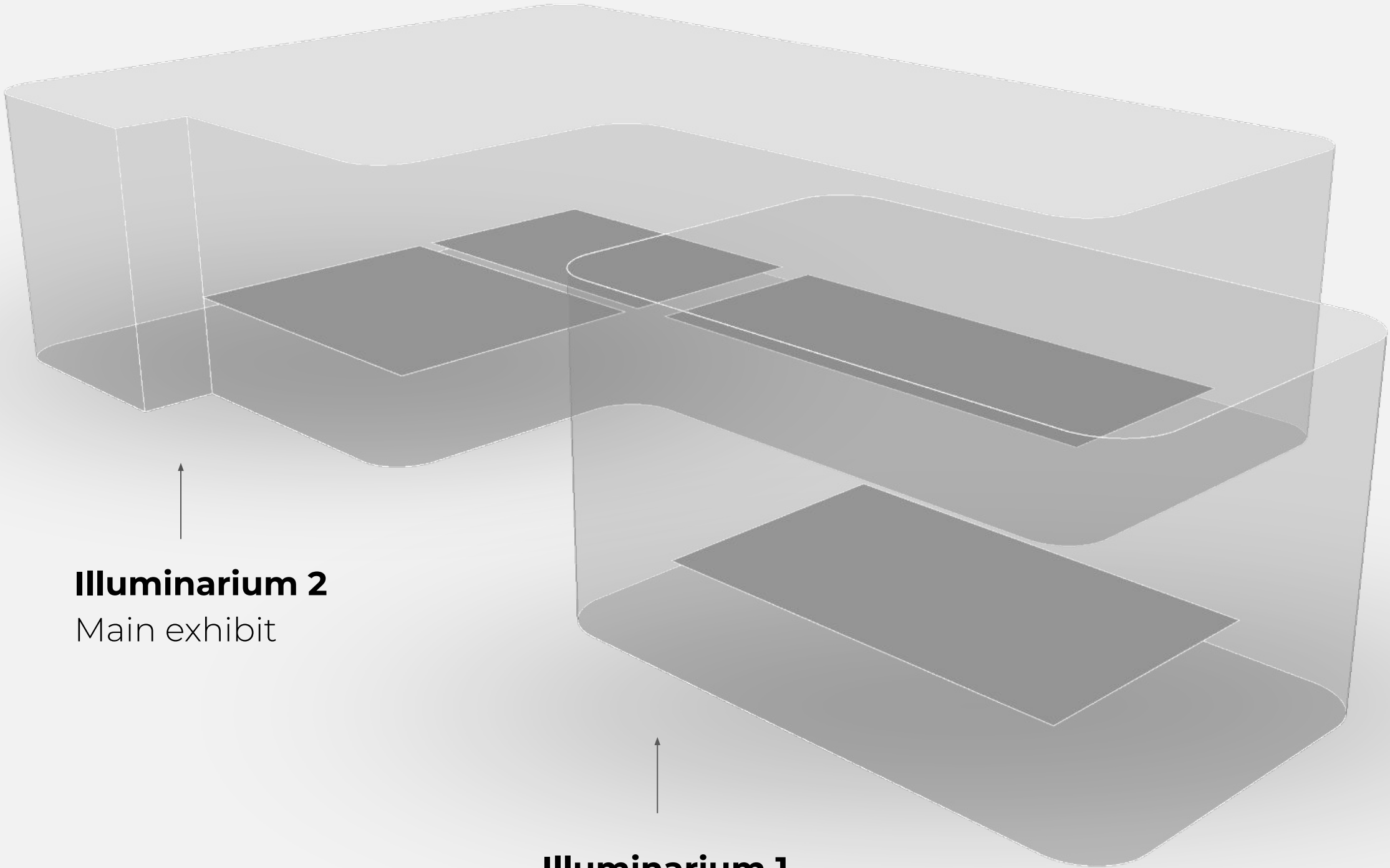


HOLOPLOT



Venue specs

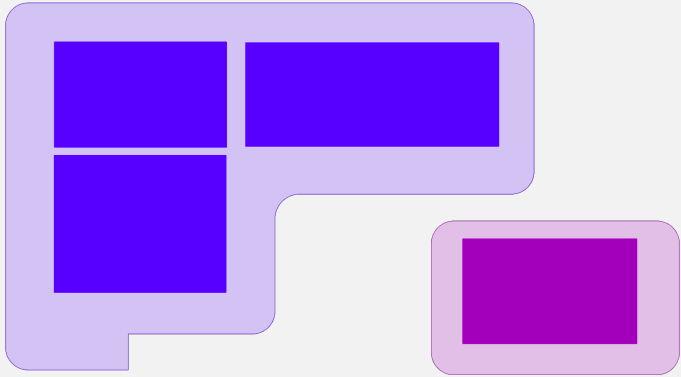
Venue



Illuminarium 2
Main exhibit

Illuminarium 1
Entrance

Top view



Illuminarium 1 System design

Guests arriving at Illuminarium enter through 'Illuminarium 1'. The space operates as a waiting area before entering the main exhibit, while also doubling as a bar unlike any other. Guests are transported to a Japanese night market, an awe-inspiring interstellar nebula, a Parisian flower garden, or a luminous reef below the ocean's surface.

Illuminarium 1 system includes:

- A **6**-module MD96 matrix array positioned above the room entrance at 13.4 ft*, (concealed behind an acoustically transparent panel within the wall)
- **2** individual MD80-S modules installed on the opposite wall, at 22.0 ft* (above the visual projection line).

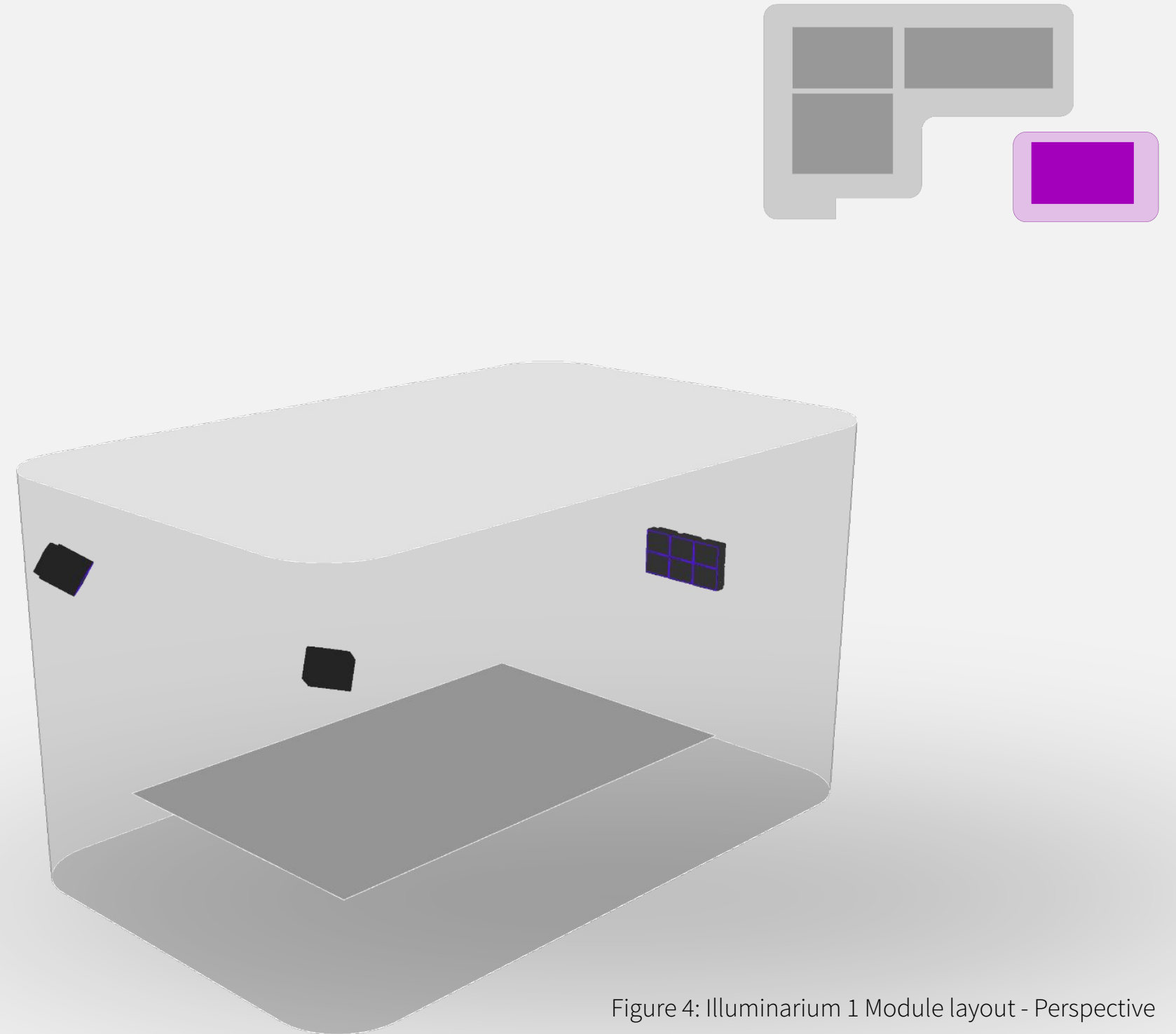


Figure 4: Illuminarium 1 Module layout - Perspective

* heights given in this report are AFFL to the underside of the HOLOPLOT module/array

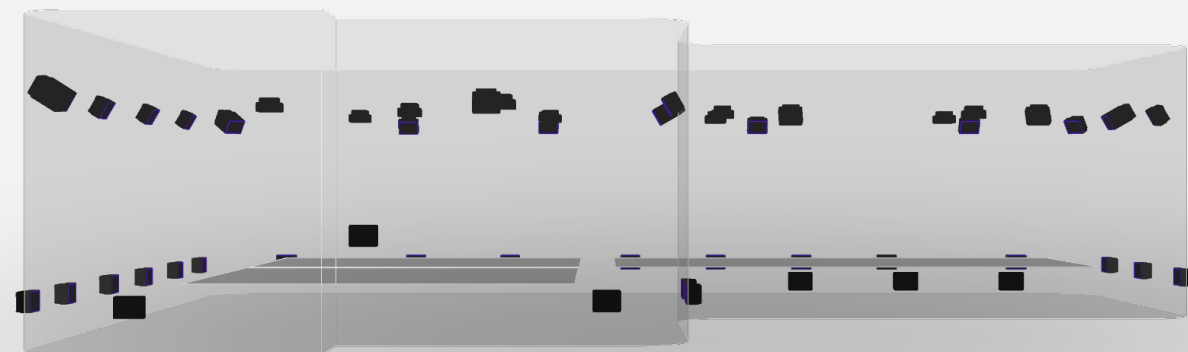
Illuminarium 2

System design

Illuminarium 2 houses the main exhibits, which at time of writing is Wild: A Safari Experience.

Illuminarium 2 system includes:

- **25** MD96 modules concealed behind an acoustically transparent panel within the projection wall at the listeners ear height.
- **12** MD96 and **5** MD80-S surround modules above the visual projection line at approx. 22.0 ft*
- **9** MD96 overhead modules at approx. 23.0 ft.



* heights given in this report are AFFL to the underside of the HOLOPLOT module/array

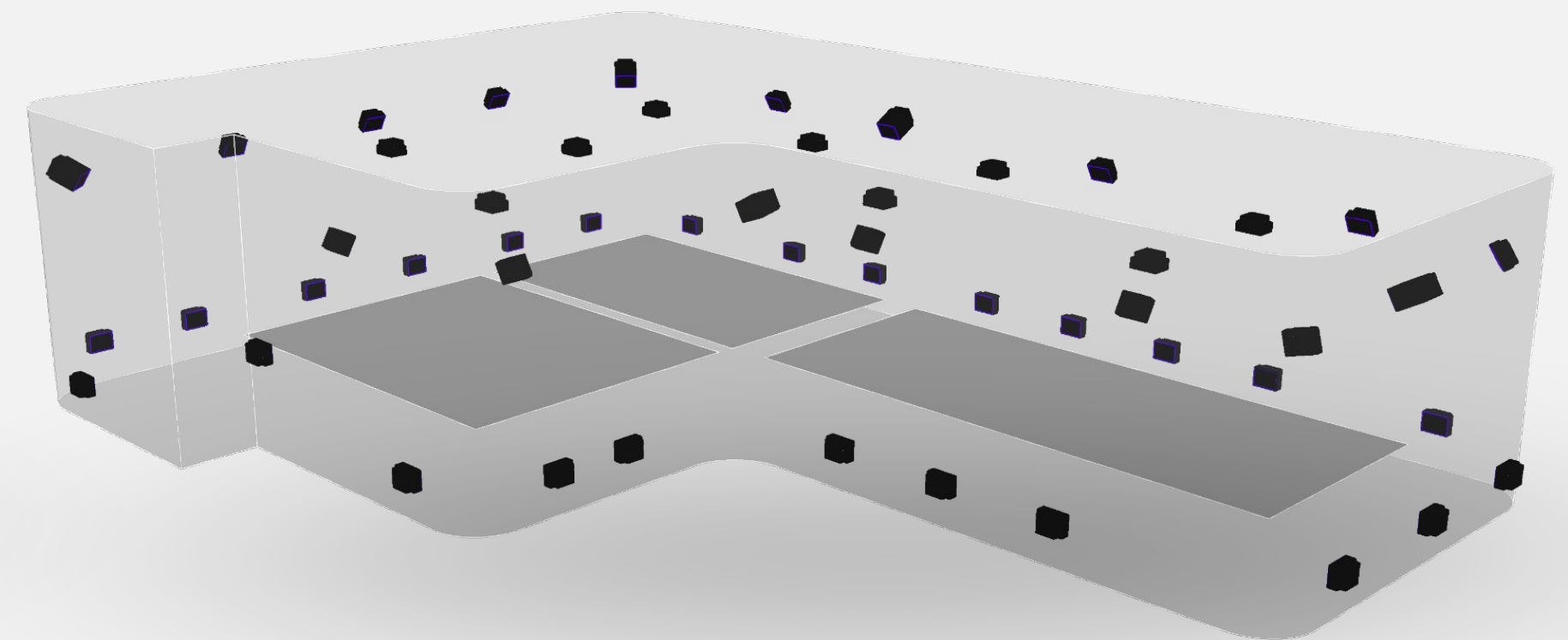
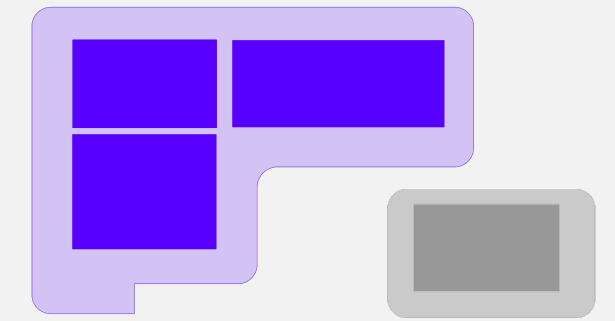
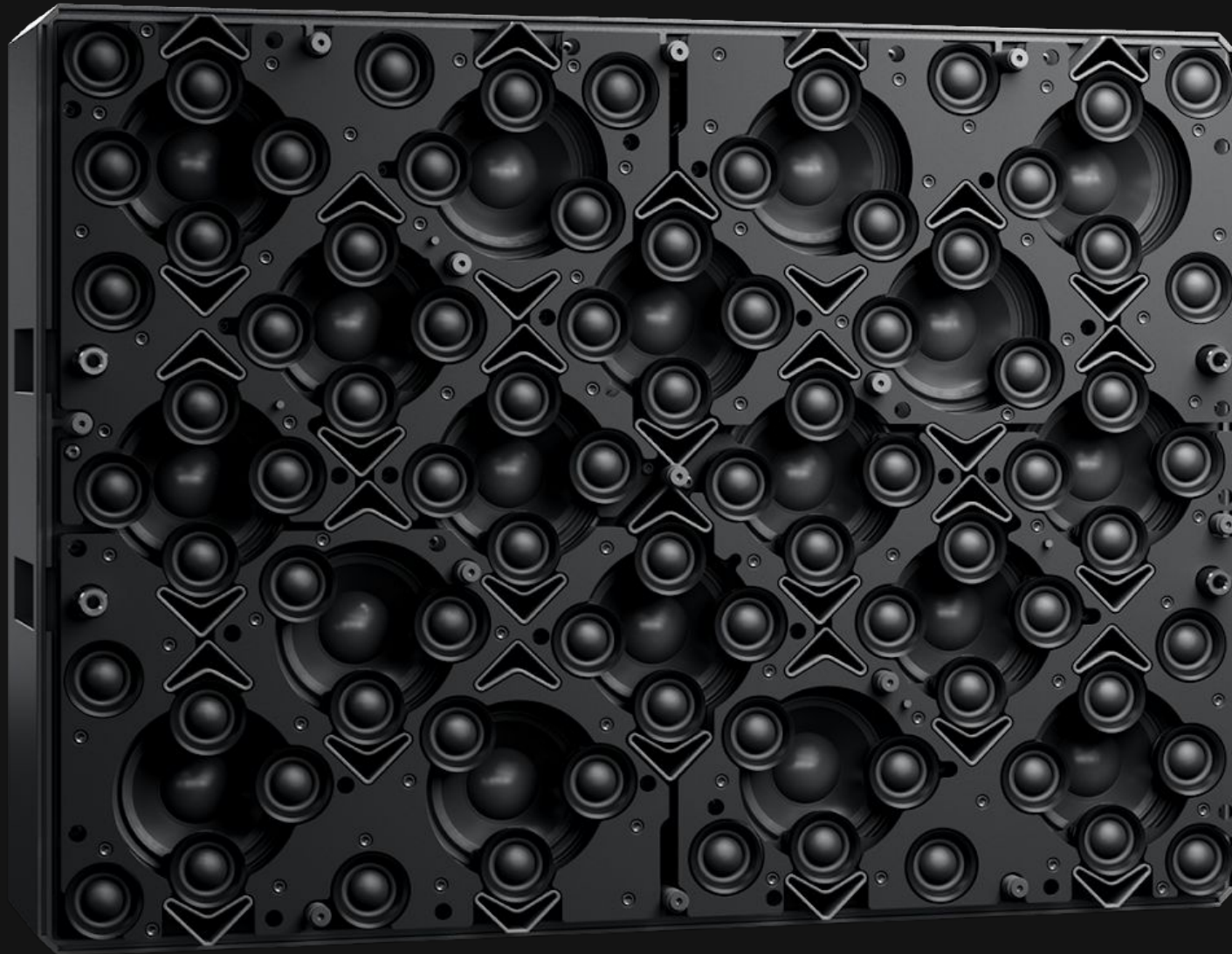


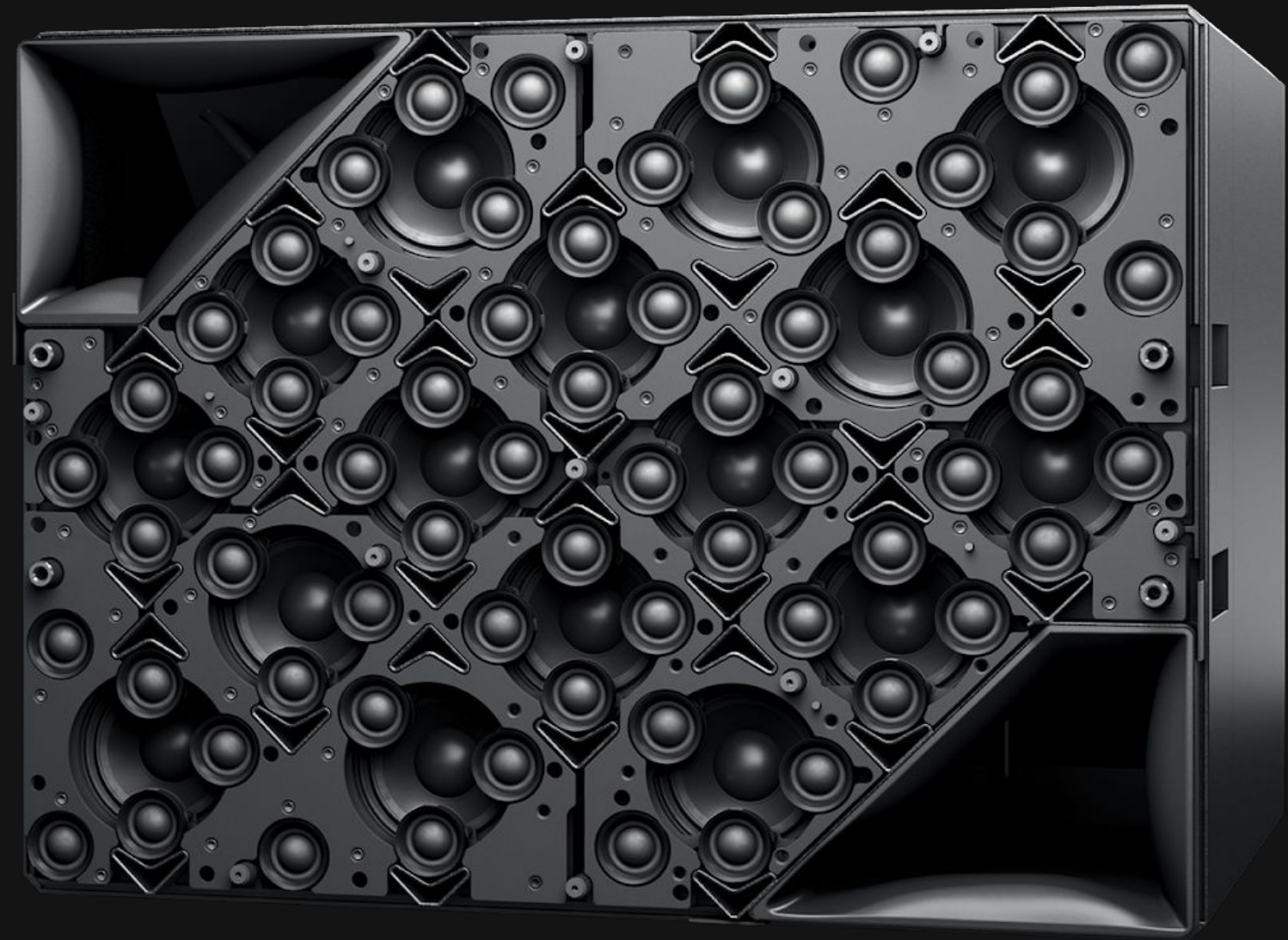
Figure 6: Illuminarium 2 Module layout - Perspective and Top View

HOLOPLOT

Modul 96
Full range



Modul 80-S
Full range + sub



52

Modul 96

7

Modul 80-S

1

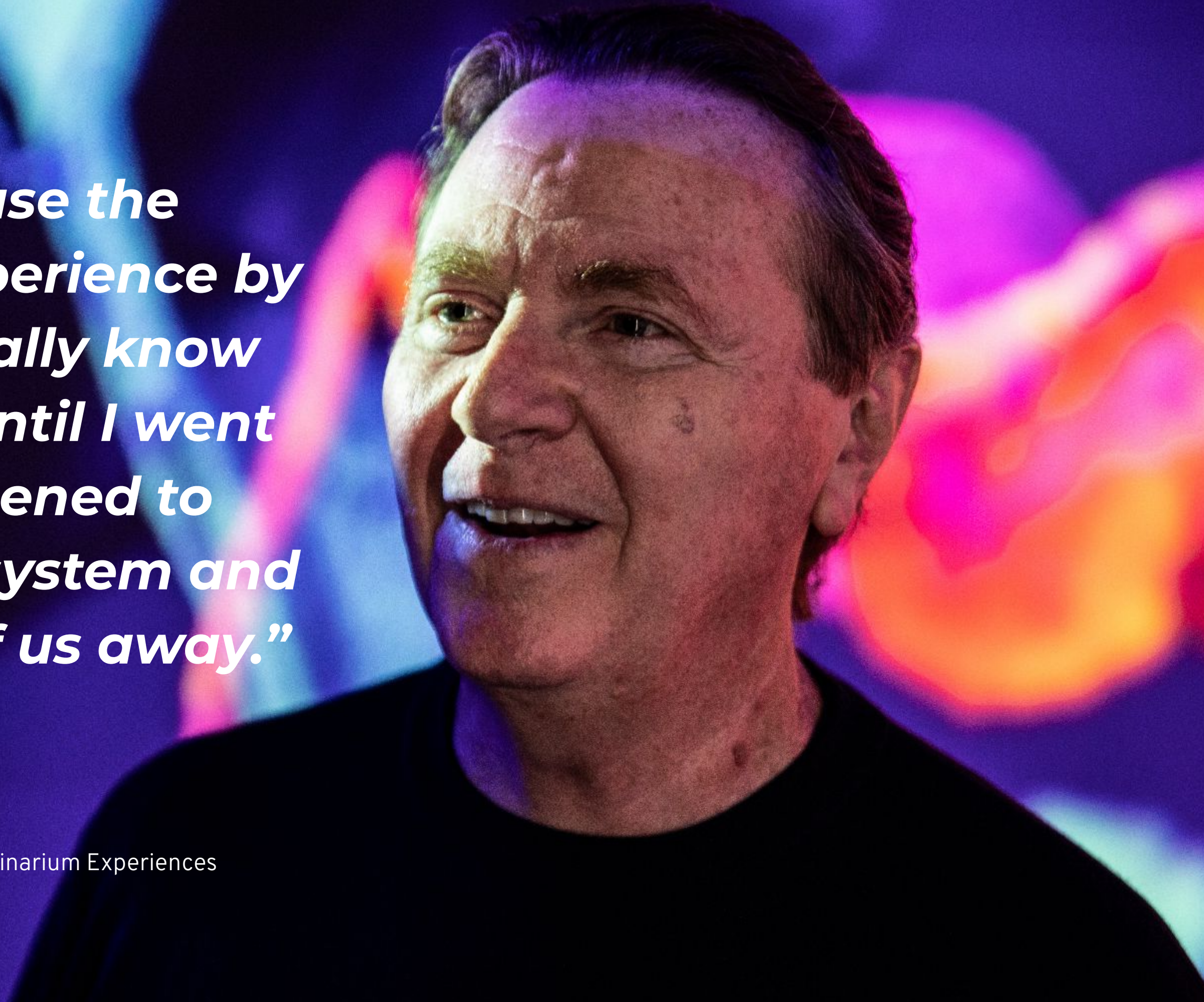
HoloController

Illuminarium Atlanta
Hardware Summary



Audio will increase the power of the experience by 50%. I did not really know what it meant until I went to Berlin and listened to the HOLOPLOT system and it just blew all of us away.”

— Alan Greenberg, CEO and founder of Illuminarium Experiences





Challenges

Venue challenge #1

Reproduce convincing soundscapes that represent a natural environment

Studio grade drivers provide precise source reproduction; achieving brilliance and detail in the high frequencies needed for birdsong – plus power and energy in the low frequencies required for a raging thunderstorm.

HOLOPLOTs optimised beams achieve spectral uniformity to any given target curve, providing sound designers the confidence that their studio mixes will be reproduced as intended. Each module can be optimised to homogeneously cover a defined audience area reducing hotspots and providing each visitor the same experience regardless of their location within that area.



Venue challenge #2

Recreate a sound environment that matches the visual projections

Unlike conventional technologies, HOLOPLOT audio objects are not restricted to the 2D surface of the projection wall. Sound designers can play with depth, so an audio object can appear to be far away or, on the other hand, whisper in your ear.

HOLOPLOT spatialization algorithms, its homogeneous coverage and optimized arrival times enable visitors to accurately localize audio objects and their trajectory across the venue, in perfect synchronicity with the distinct visual show elements.

Customised system design ensures that any audio object location can be authentically reproduced.

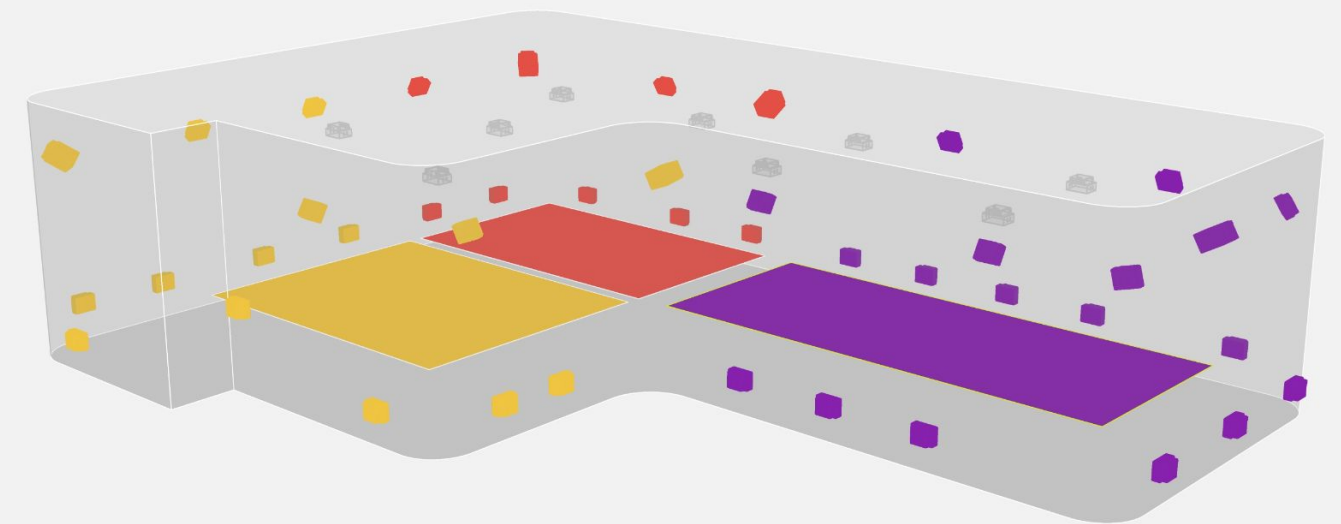
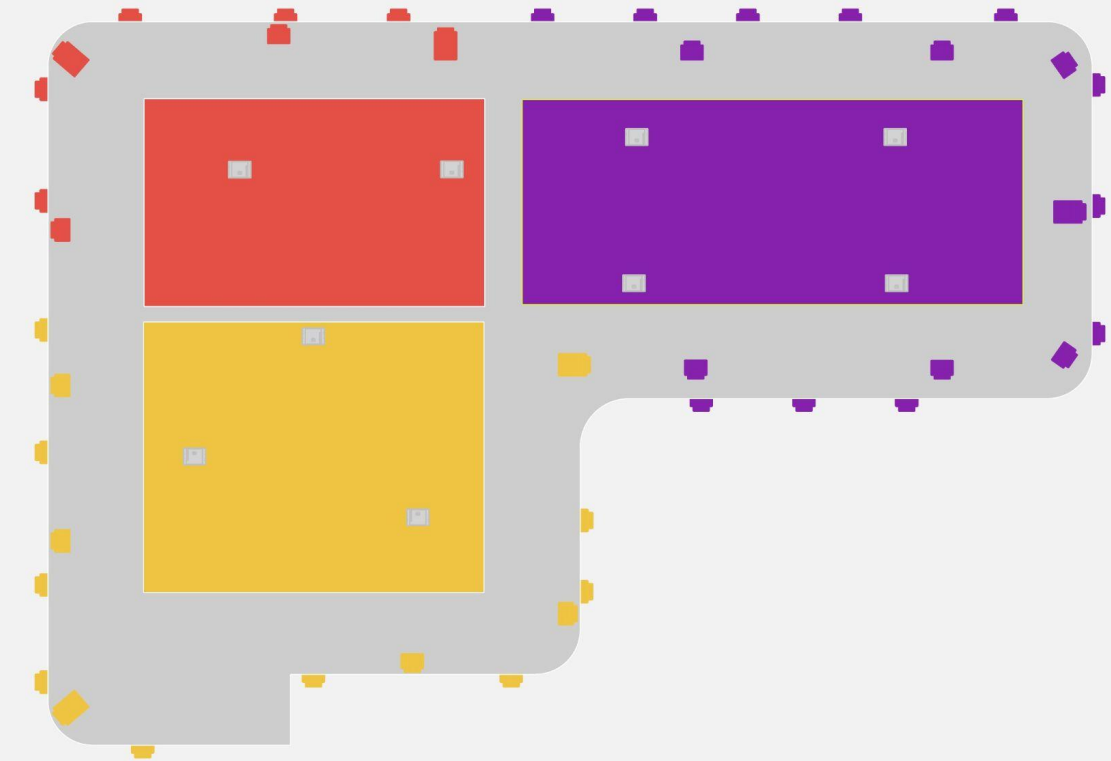


Venue challenge #3

Create different audience zones each with unique content in one large room, that can also be one zone

The unique HOLOPLOT 3D beamforming technology allows for multiple precise audio zones to be created. A HOLOPLOT audio module can, independently or collectively, generate multiple sound fields simultaneously – each with its own content, equalization, level, shape, and position.

For each zone the modules in that section are all optimised to form a soundfield capable of enveloping the listener and operating as an independent spatial audio system. Allowing the visual designer to create separate scenes within a single space and ensuring synchronicity of the audio content to that scene.



HOLOPLOT

Venue challenge #4

Conceal the audio technology, making it invisible to the eye

The audio modules are built in to the walls of the exhibition, positioned behind a specially designed micro perforated wall panel.

The combination of HOLOPLOT module and strong MDI panel has been extensively tested. Transmission losses from the MDI panel were measured in 3D space to later be compensated in the HOLOPLOT optimization engine.

The result is a clear, full range sound with virtually no coloration and a completely unobstructed visual projection surface.

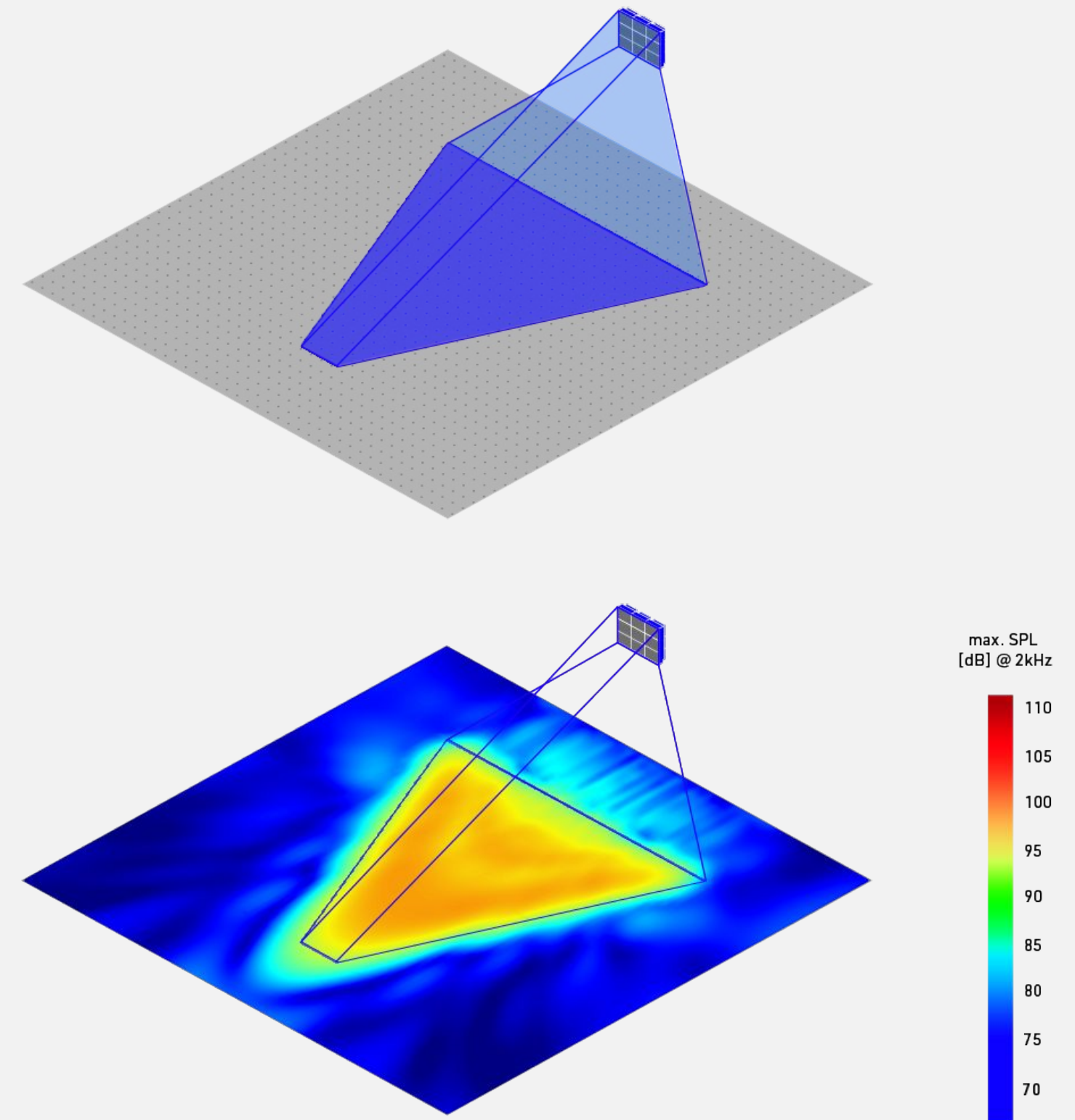


Venue challenge #5

Ensure adherence to the venues noise breakout limits while maximizing the sound inside

HOLOPLOT 3D beamforming technology can focus energy on the audience zone and not on the walls. This improves the direct to reverberant ratio; reducing unwanted reflections and audible echoes – ultimately resulting in increased speech intelligibility. This also ensures maximum sound pressure level targets at the facades are adhered to and that acceptable levels are achieved in the adjoining spaces based on calculated sound transmission losses through the exhibition wall builds.

The HOLOPLOT system in a given design can be simulated prior to installation to ensure performance is as expected.



HOLOPLOT

A man with short brown hair and a beard, wearing a blue denim button-down shirt over a white t-shirt, is seated and looking slightly to his left. He has his hands clasped in front of him. The background is a vibrant, out-of-focus display of colorful light patterns in shades of blue, purple, orange, and yellow, resembling a digital or artistic installation.

“The X1 really allows us through its toolsets of capabilities to work with designers and creators in ways they never even dreamt of.”

— Brian Allen, Executive VP of Technology and Content, Illuminarium

Technical Results

Illuminarium 1

Homogeneous coverage

SPL and spectral consistency

A full uniform zone coverage is achieved in Illuminarium 1. All the visitors have the same listening experience at each point of the room. The listening area is positioned at ear-height.

HOLOPLOT simulations of the Matrix Array also include correction for MDI and acoustically transparent panels.

Concealing the system does not limit the capabilities of X1. In Illuminarium, where audio modules are concealed, the optimization of the system still offers headroom to adapt to any experience.

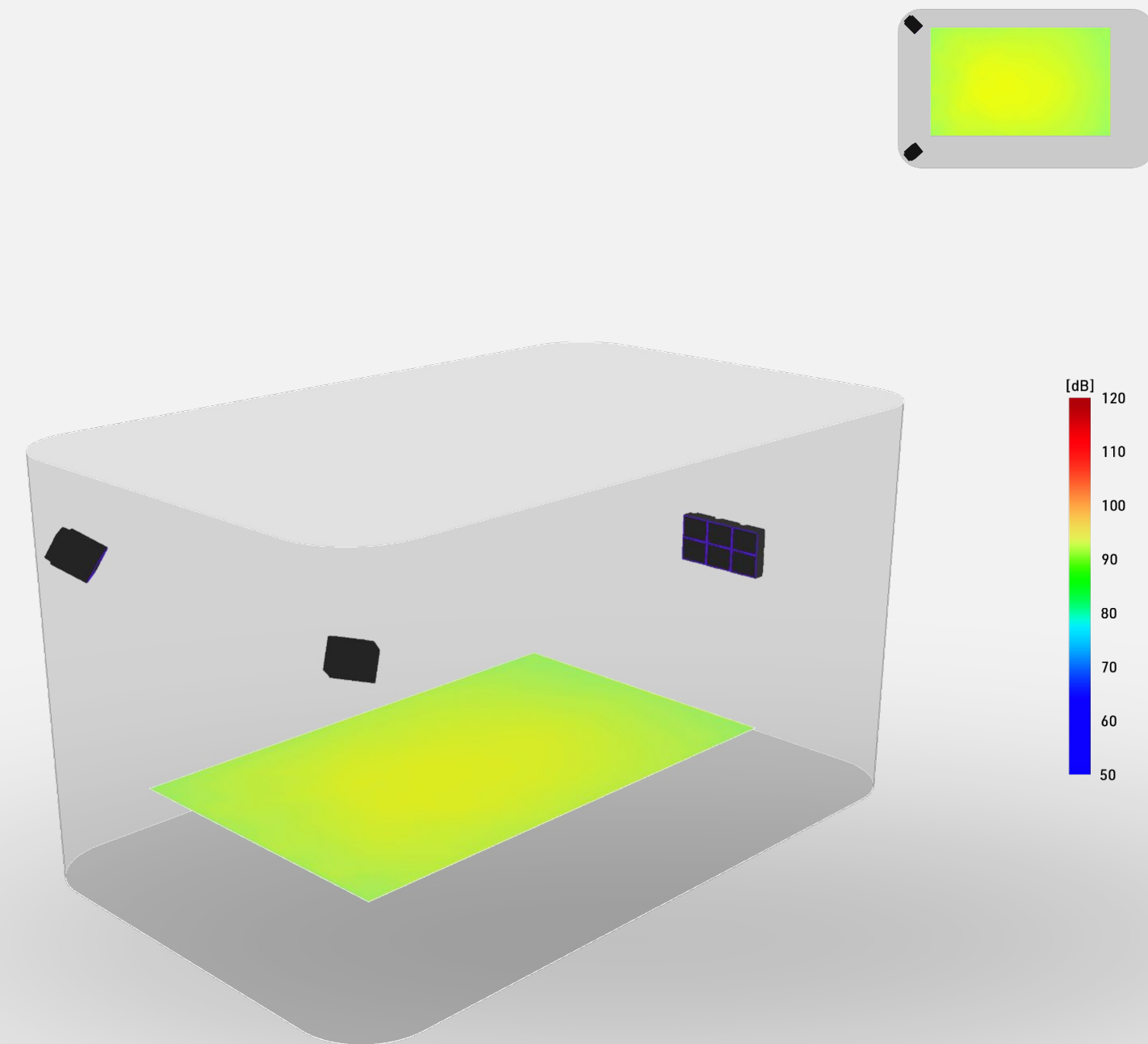


Figure 1: Homogeneous sound level distribution with 97.1% coverage 91.0 dB(A) +/- 3 dB (broadband, 100-10000 Hz)

Illuminarium 1

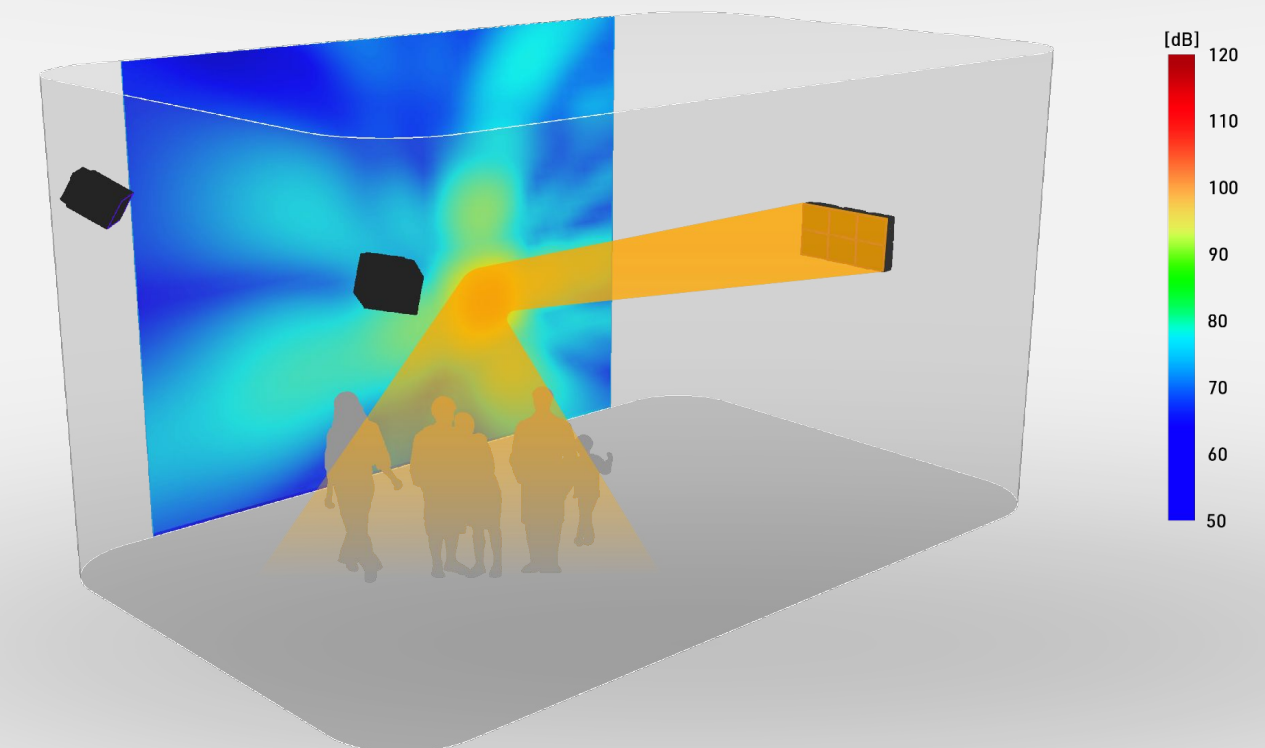
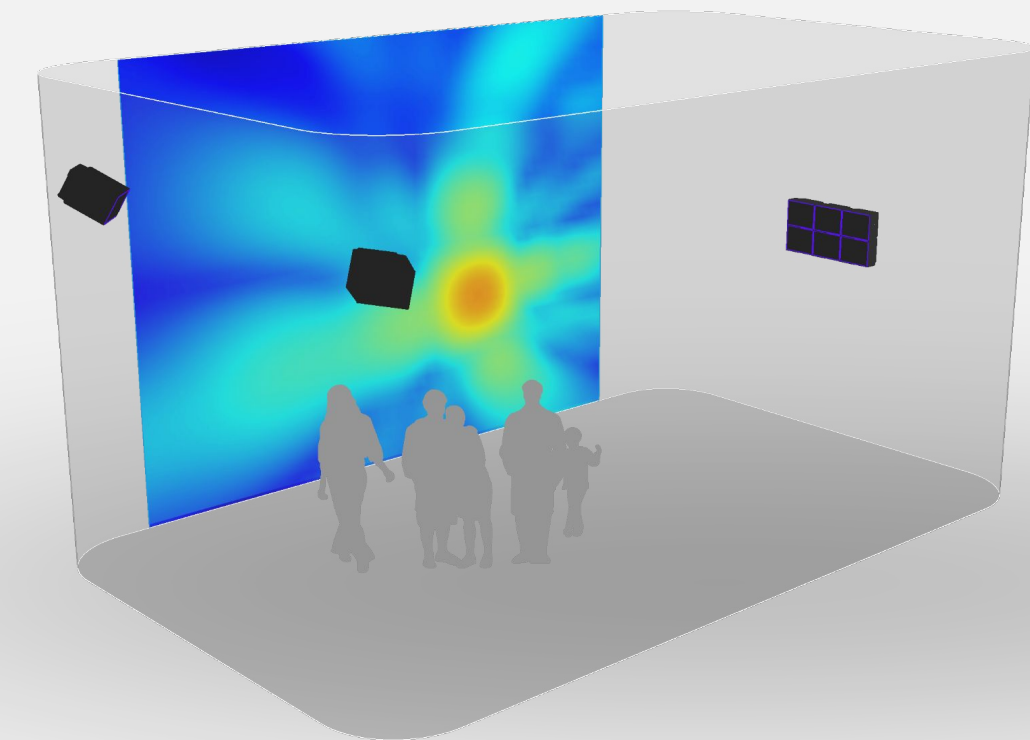
Targeted zones

Focused coverage with reflectors

Using reflectors, the central Matrix Array positioned above the room entrance can generate tightly focused sound beams. It's therefore possible to create an audio source where no physical speaker is placed - a powerful tool for delivering targeted sound experiences, and creating special effects at specific listener positions.

The beam has been set up with a vertical steering angle of 12.8° and a horizontal steering angle of 38.7° . In this configuration, the intended listener position is at approximately 12 m (~39.4ft) in front of the array, at 1.60m (~5.2ft) above the floor level (ear height).

The reflection plot indicates how and within which frequency bands the beam focuses a given signal outputted from the central matrix array.



Definition of points on walls in Illuminarium 1 for reflections assessment

Illuminarium 2

Homogeneous coverage

SPL and spectral consistency

X1 is capable of optimizing acoustic coverage by distributing sound levels homogeneously across the targeted audience areas. A broadband sound pressure level of 91.0 dB (A) \pm 3 dB is achieved across 98% of the audience area.

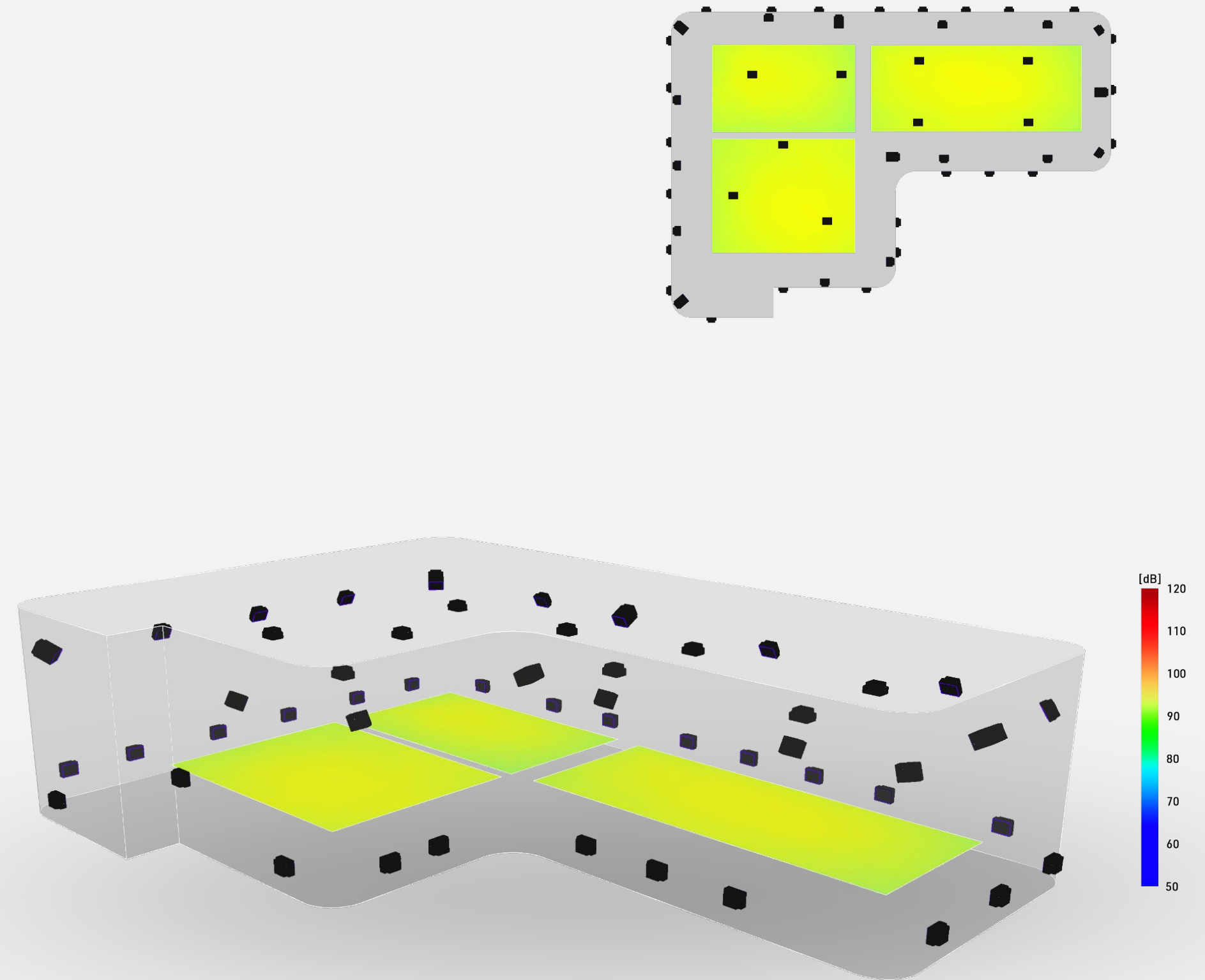


Figure 1: Homogeneous sound level distribution with 98% coverage 91.0 dB(A) \pm 3 dB (broadband, 100-10000 Hz)

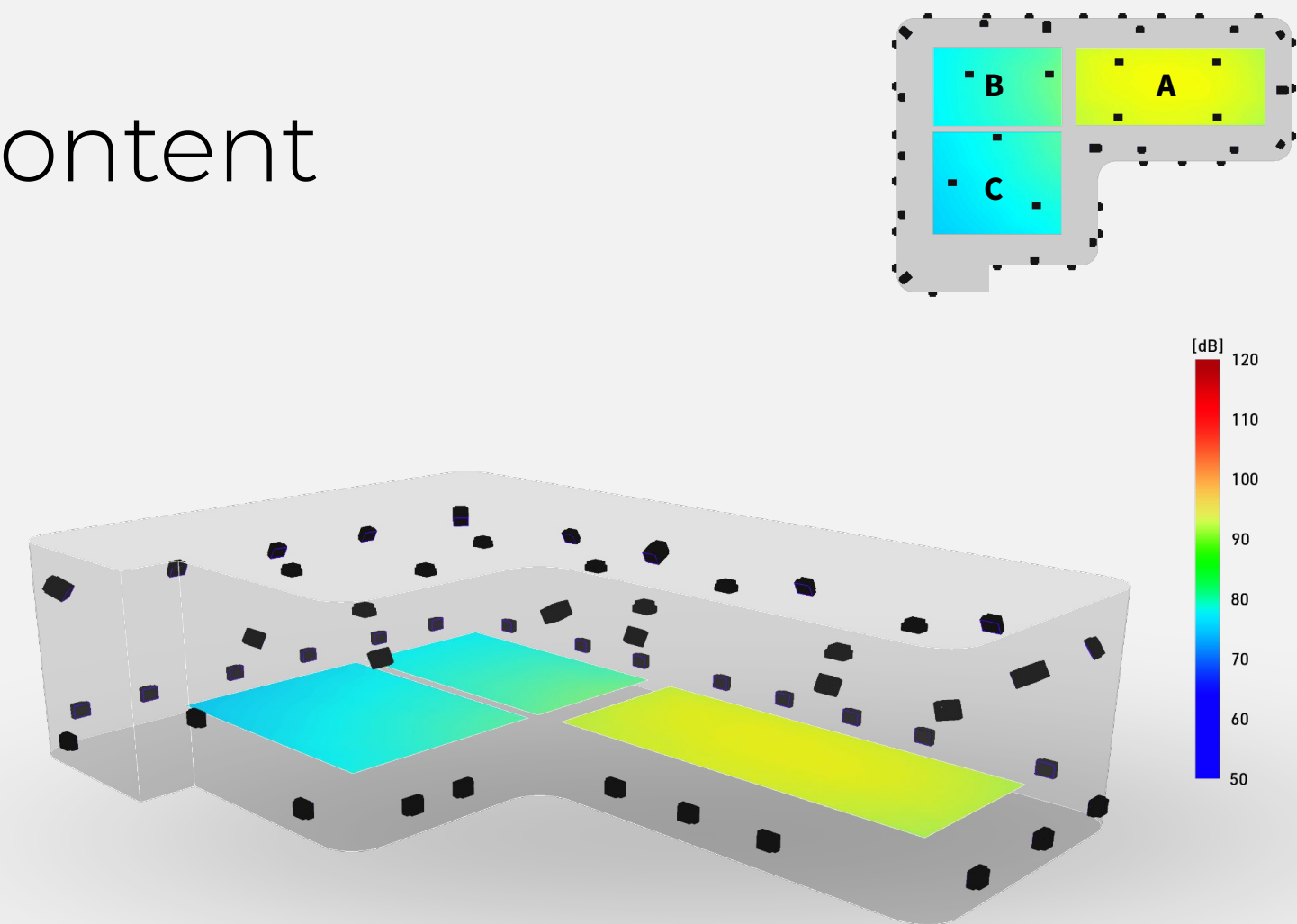
Illuminarium 2

Coverage beams

Simultaneous zones with different content

The HOLOPLOT system is capable of precisely delivering a high degree of separation between multiple audio zones within a single space. The results below show the levels in Zones B and C when only the modules in Zone A are active - the system delivering an average level drop of 10.7 dB and 14.1 dB respectively.

The audio modules assigned to each zone can operate as an independent system or as a whole. Giving you the flexibility to create synchronicity with dedicated visual content assigned per zone.



Average Direct SPL(A) per zone: -A: 90.6 dB(A) -B: 79.9 dB(A) -C: 76.5 dB(A)	Level drop towards Zone B: -Avg. - Avg.: 10.7 dB -Side-to-side: 3.0-4.0 dB -Mid-to-mid: 13.0 dB	Level drop towards Zone C: -Avg. - Avg.: 14.1 dB -Side-to-side: 6.0 dB -Mid-to-mid: 16.0 dB+
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Illuminarium 2

Lifelike localization

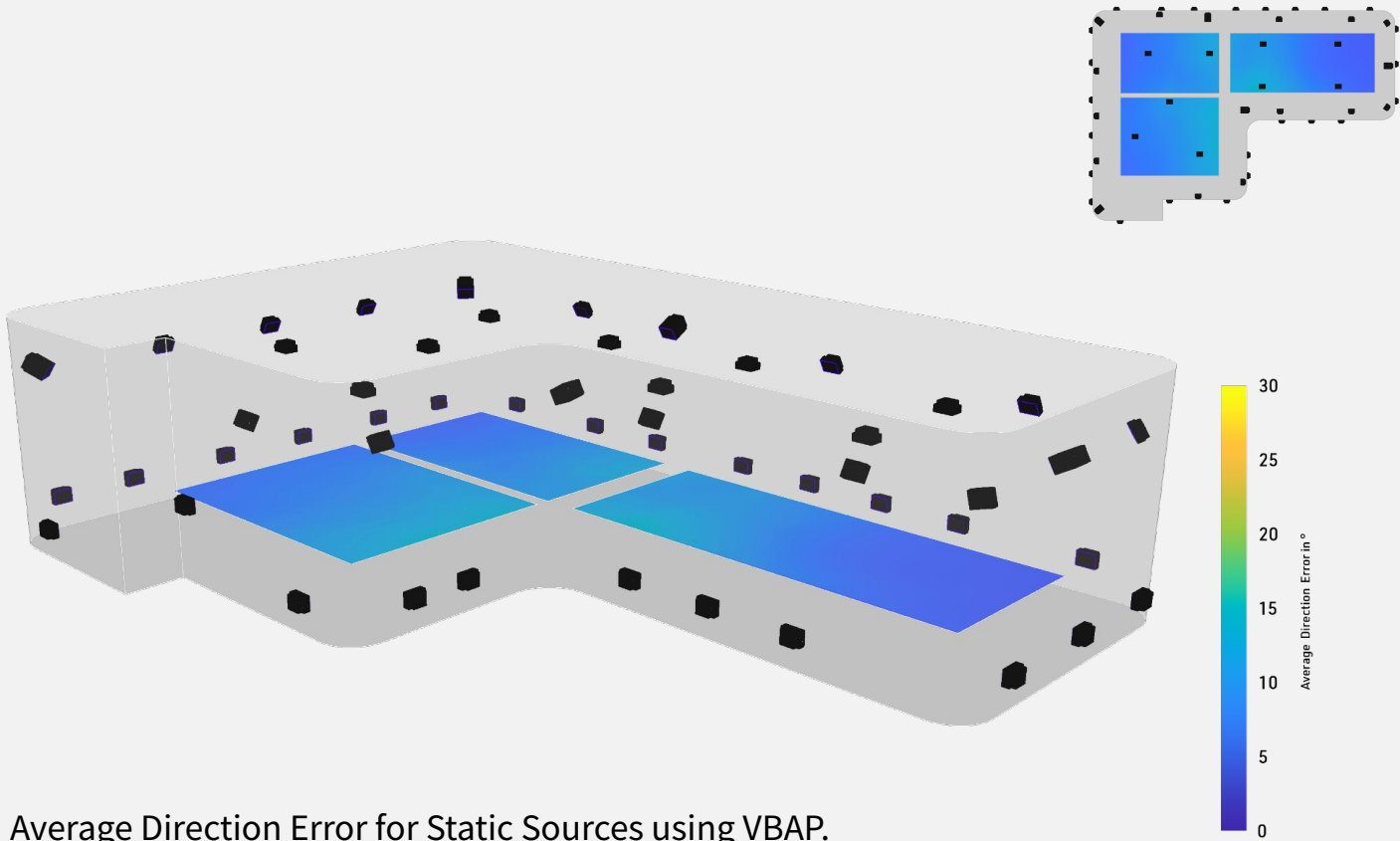
Immersive configuration

HOLOPLOT allows designers to predict the listener’s spatial perception of a sound system. Using “Average Direction Error”, it is possible to evaluate the difference between the intended and perceived direction of an audio source enabling designers to optimize the system early in the planning phase.

The 'Average Direction Error' index shows that the HOLOPLOT system installed in Illuminarium provides ‘perfect localization’ across the entire hall. The high spatial resolution of the HOLOPLOT system ensures perfect synchronicity of the audio objects with the multiple, moving visuals.

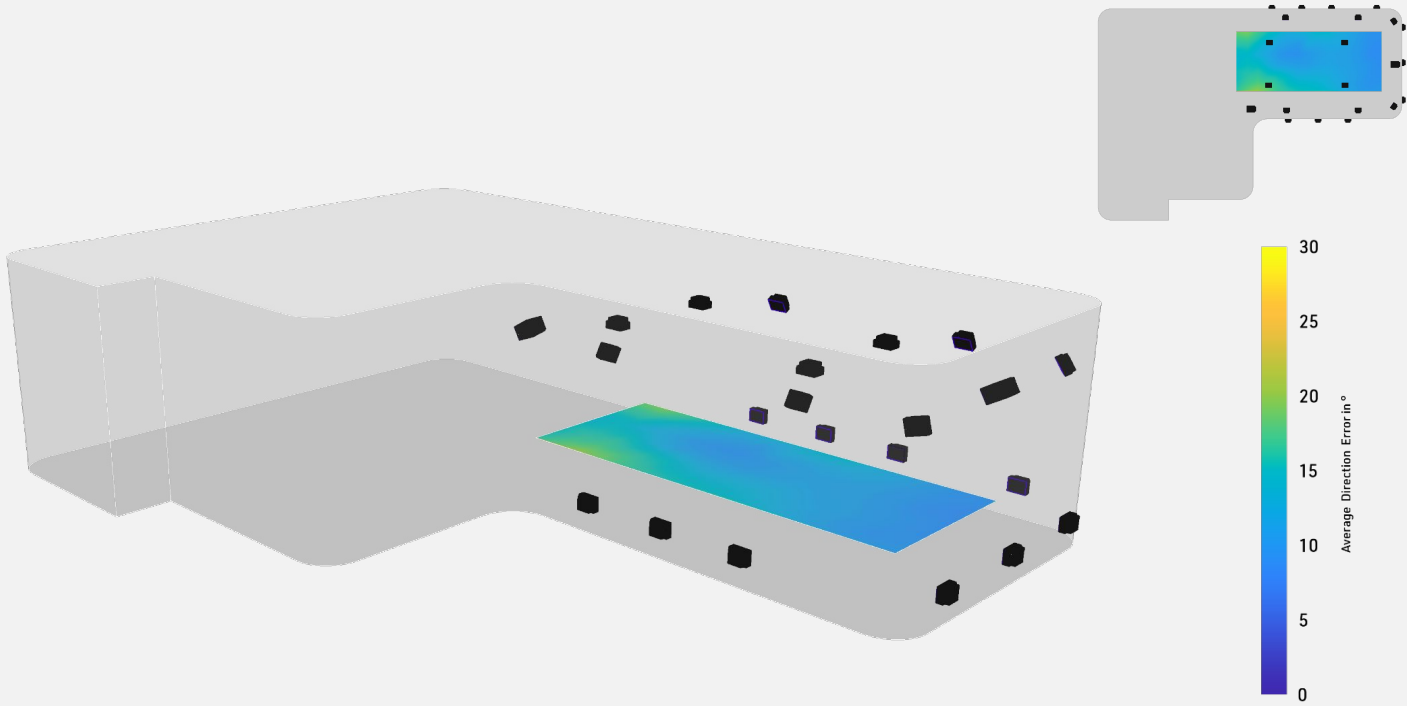
Categorization of
‘Average Direction Error’
(after Franz Zotter):

perfect localization	$< 10^{\circ}$
plausible’ localization	$10^{\circ} - 30^{\circ}$
rough / not sufficient	$> 30^{\circ}$
poor	$> 90^{\circ}$



Average Direction Error for Static Sources using VBAP.

The average direction error plots show a near-perfect localization from all modules in place for static sources using VBAP panning algorithm.



A nearly perfect localization for static sources can also be achieved if the zones are considered separately.

Illuminarium 2

Creating Narrow Zones

Two modules active

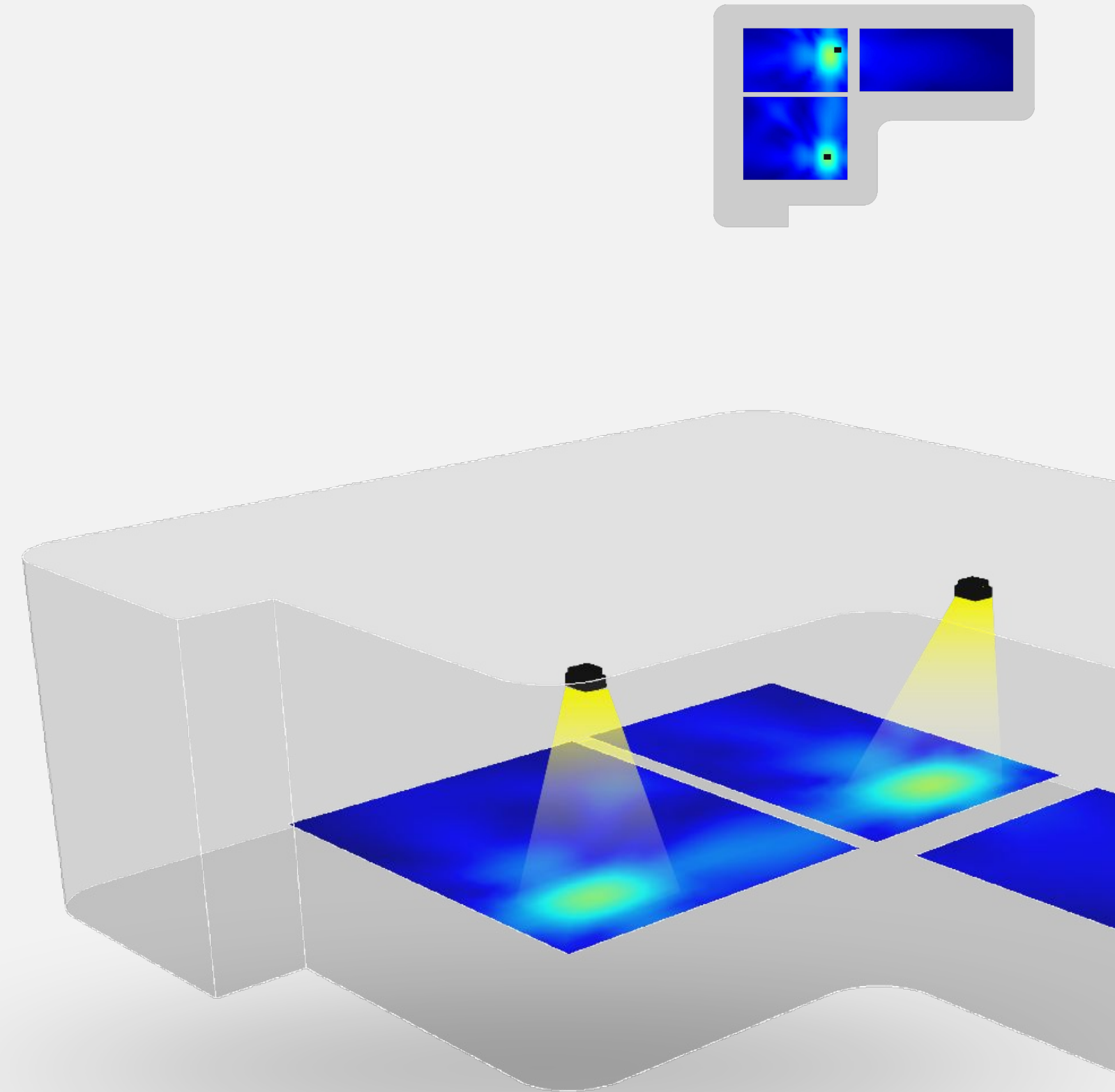
The HOLOPLOT X1 system can be used to create precise focus spots with varying diameters. Each focus spot can reproduce unique content.

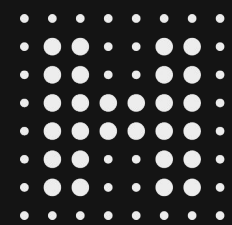
Narrow zones such as this allow for the creation of individual audience experiences as the exhibition is explored.

For illustration: Narrow zones in Illuminarium 2 - 2kHz

2kHz octave band levels for two overhead modules targeting a small spot slightly off-axis. Clear hotspot visible as intended with little spread around it (1-1.5m).

Zone 2B Spot vertical steering angle 8.3° , horizontal steering angle 3.4° .
Zone 2C Spot is on the axis of the active module.





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