

# LIMINAL SPACES

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*Waking through dawn  
Walking through dusk  
Wanting through it all  
The liminal spaces to see,  
To hear, to know*

*Before the night, dusk  
Beyond the night, death  
Beware the dark calls  
The liminal spaces to reveal,  
To respond, to relent*

*Inward we reflect  
Outward we feel  
Onward we are drawn  
To liminal places through dawn,  
Through dusk, through night*



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**Ben Knapp**  
Production and Text

**Eric Lyon**  
Composition

**Natasha Staley**  
Reading

**Tanner Upthegrove**  
Tesseract technology

**Brandon Hale**  
Bone conduction  
headphone research

**Gustavo Araoz**  
Lighting



Liminal Spaces started out as a piece for drones. Our intention was to put a loudspeaker on a drone, so that the spatial trajectory of sound could be crafted by programming the flight path of the drone. The initial experiments were promising, but technical difficulties with the drones paused this line of research, giving us an opportunity to rethink our project.

From the outset, Liminal Spaces addressed an underlying challenge posed by our spatial experiences with high-density loudspeaker array systems, such as in the Cube. While we could create extraordinarily rich spatial experiences around and above the listener, we could not bring the sound close to listeners given their physical distance from the loudspeakers. A drone could bring the sound closer to the listener. But we found another way to accomplish audio proximity, using different technologies. The Tesseract, developed by ICAT media engineer Tanner Upthegrove, is a configurable scaffolding bearing up to 64 loudspeakers. Putting the Tesseract inside the Cube gave us a nearfield loudspeaker array in addition to the more distant Cube array. Adding a bone conduction headphone to the

Cube and Tesseract allowed us to bring sound right up to the head of the listener without occluding the ears, so that all three layers of spatial sound could contribute to a musical experience without mutual interference. This layered audio system is the canvas on which we painted Liminal Spaces.

The sound sources for Liminal Spaces are primarily of two kinds - spatially encoded four-channel field recordings made at our homes, and purely synthetic sounds. The third sound source was a poem written by Ben Knapp and read by Natasha Staley. With these ingredients, we were able to place Natasha's voice inside the listener's head with the bone-conduction headphones, very nearby with the Tesseract, and increasingly distant with the Cube. Rainstorms were presented with nearfield delicacy just above the head of the listener, combined with menacing thunder in the distance. Our layered audio system allowed us to create a more naturalistic spatial sound experience than we had ever heard before in an electronic music context.

Unlike the recorded natural sounds, the synthetic sounds do not provide a spatial model

that is intuitively understood by the listener. Therefore, we could create more abstract spatial patterning, such as a passage where a group of six chords are heard alternating among the headphones, the Tesseract, and the Cube, creating a palpable sense of audio perspective. In the final section, a melodic texture starts in the headphones, moves out to the Tesseract, then up to the ceiling of the Cube. The final chord of this texture culminates in a massive reverberation trail. But rather than dying away naturally, the reverberation descends the walls of the Cube, then swirls around the audience, coming closer and closer, through the "starburst" speakers, the Tesseract, and finally the reverberation arrives and dissipates in the bone conduction headphones - a private sound heard only inside one's head.

Thank you for experiencing Liminal Spaces. We would love to hear any thoughts about the piece that you may wish to share.

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