

Intro to Zirkonium 3.7

Dan Wilcox
Artistic R&D: Hertzlab
ZKM | Center for Art & Media Karlsruhe

PdMaxCon~ 2025

Outline

What is spatialization?

Introduce Zirkonium, a free spatialized sound environment (version 3.7)

Play example piece (excerpts) realized using Zirkonium3

Download Zirkonium (requires macOS) and example project for the workshop

Connect Pure Data and/or Max project to Zirkonium

Gimme Gimme



Workshop info, links, and download materials at:

class.danomatika.com/workshops/zirkonium

Download Zirkonium 3.7:

zkm.de/zirkonium

Zirkonium3 & accompanying apps: macOS 10.13+

Pure Data spatialization server: cross platform (for the brave)



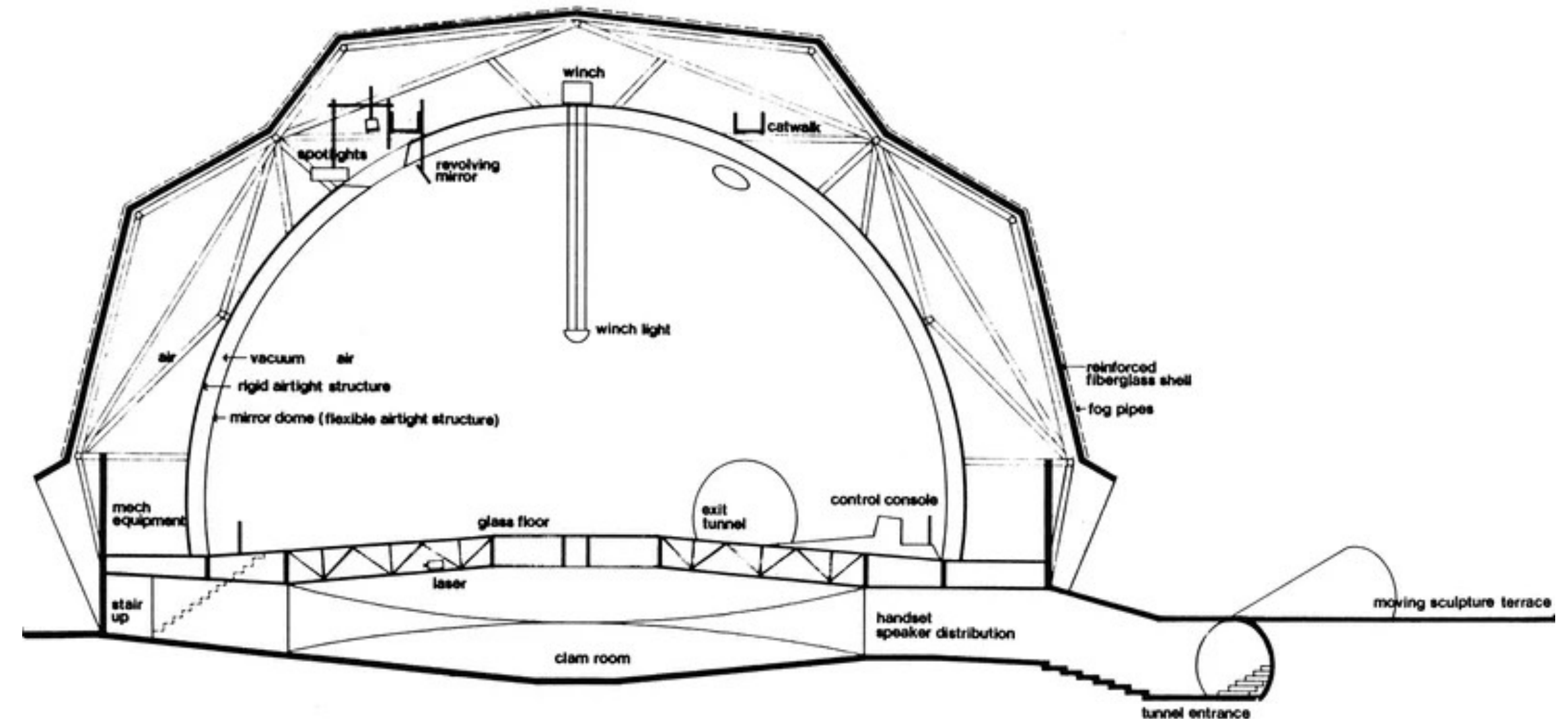
Spatialization

Placing multi-channel sound within space



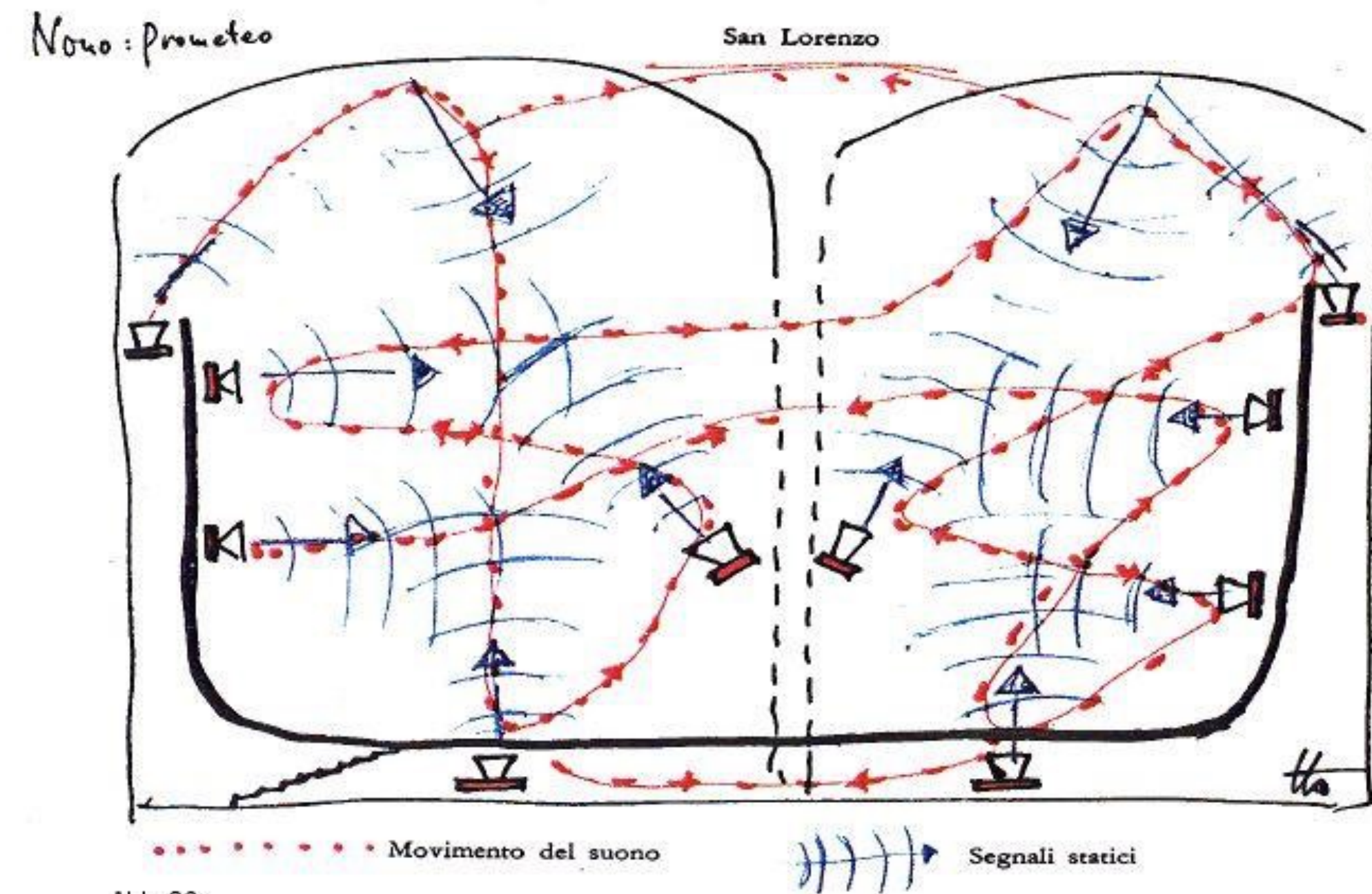
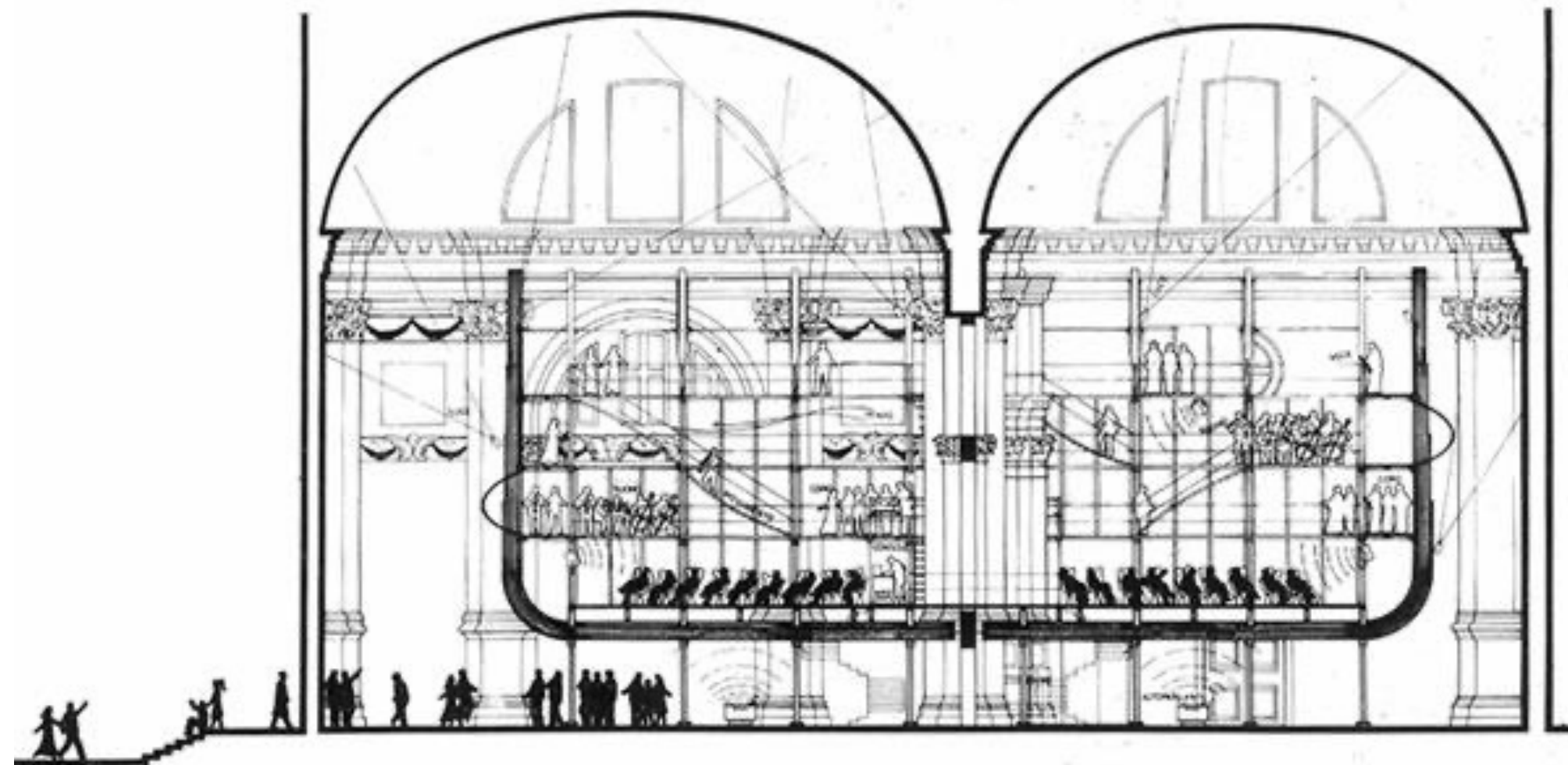
Spatialization

Example: Expo '70 PepsiCo Pavilion, E.A.T., 37 channel system - David Tudor



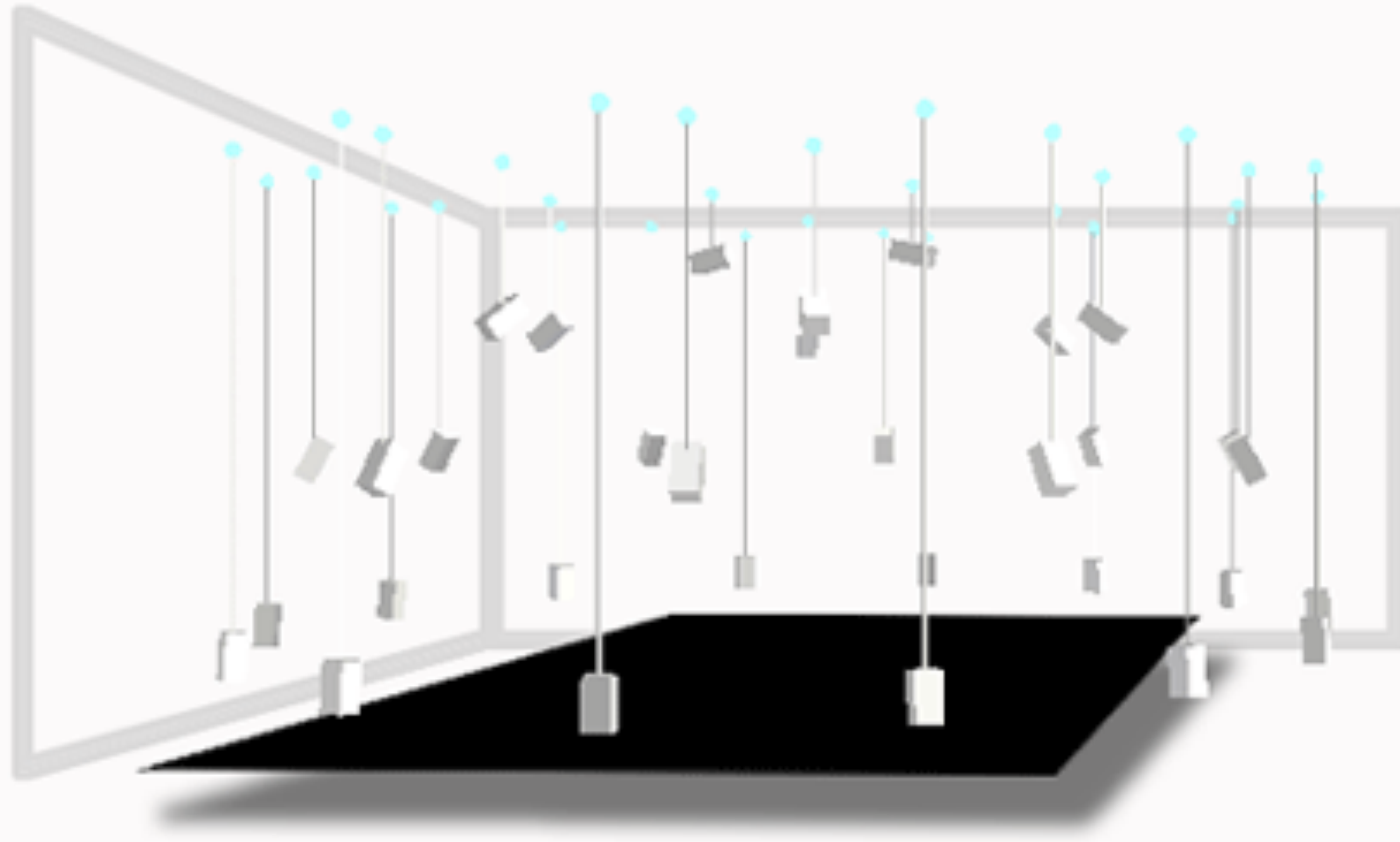
Spatialization

Example: *Prometeo* - Luigi Nono
Realized with HaLaPhon from SWR Experimental Studio



Spatialization

Half-dome speaker system



Kubus Klangdom

ZKM 
Karlsruhe





Zirkonium?

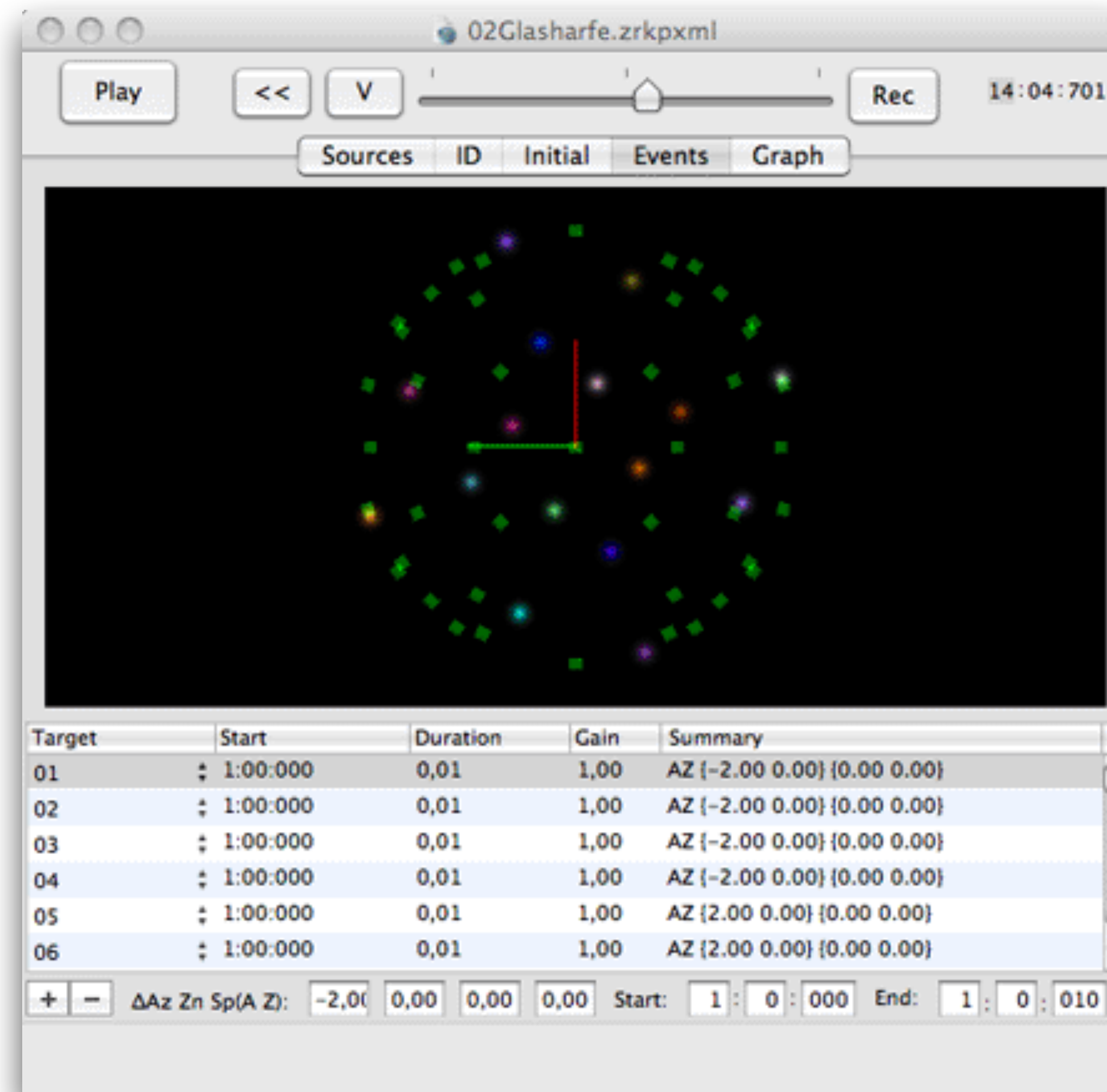


Spatialization engine

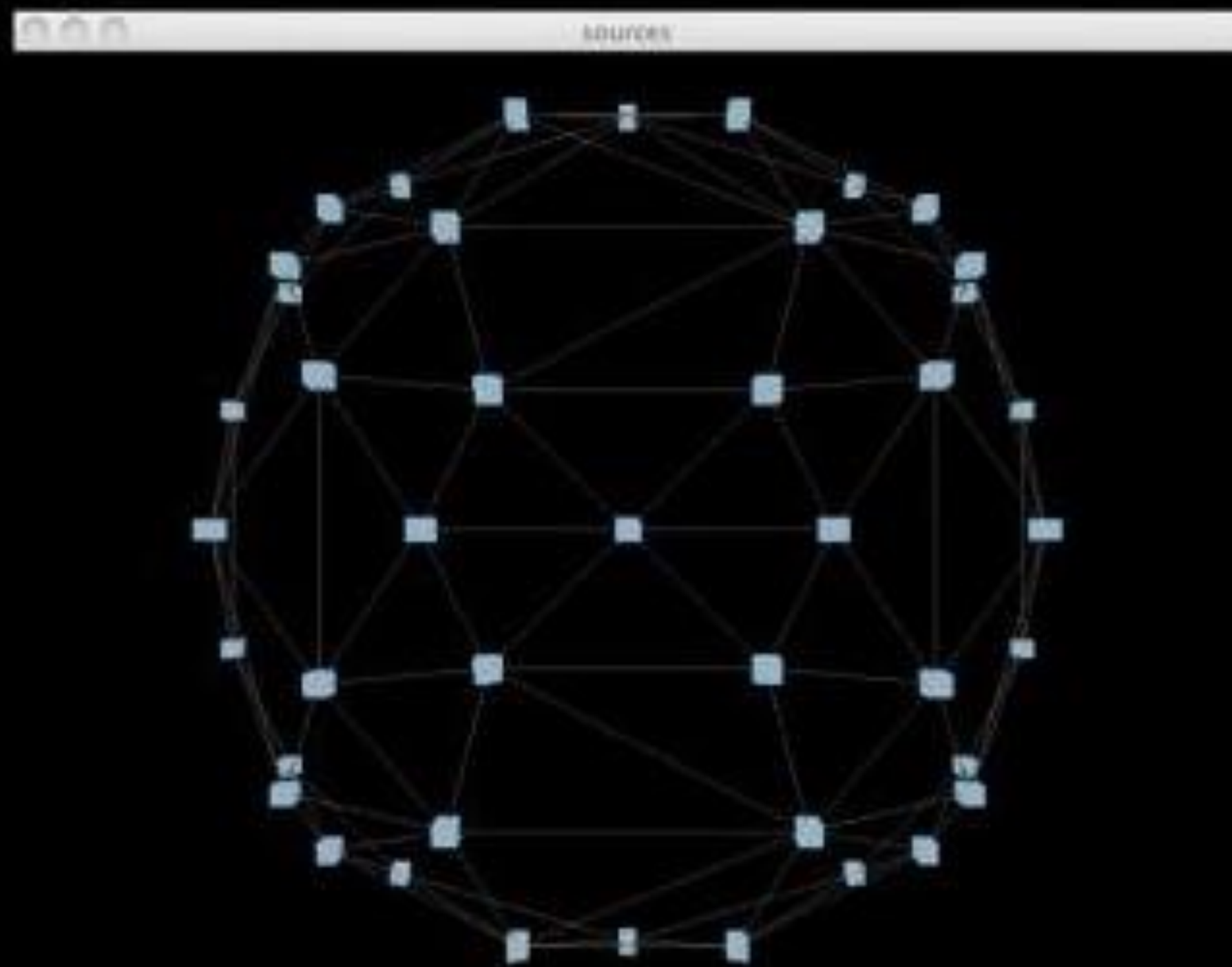
Sound playback

Movement event sequencer

Zirkonium MK1

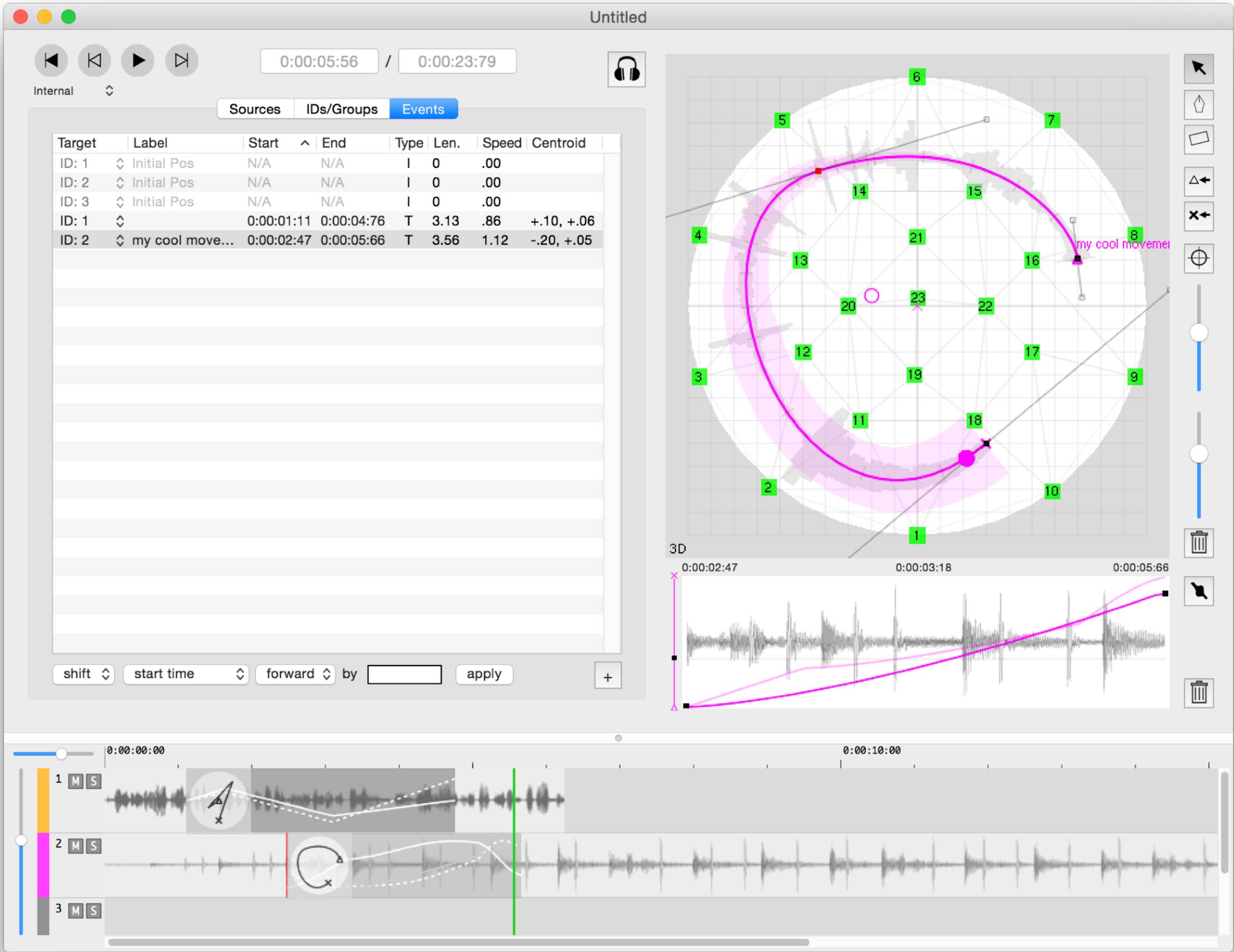


Zirkonium MK2

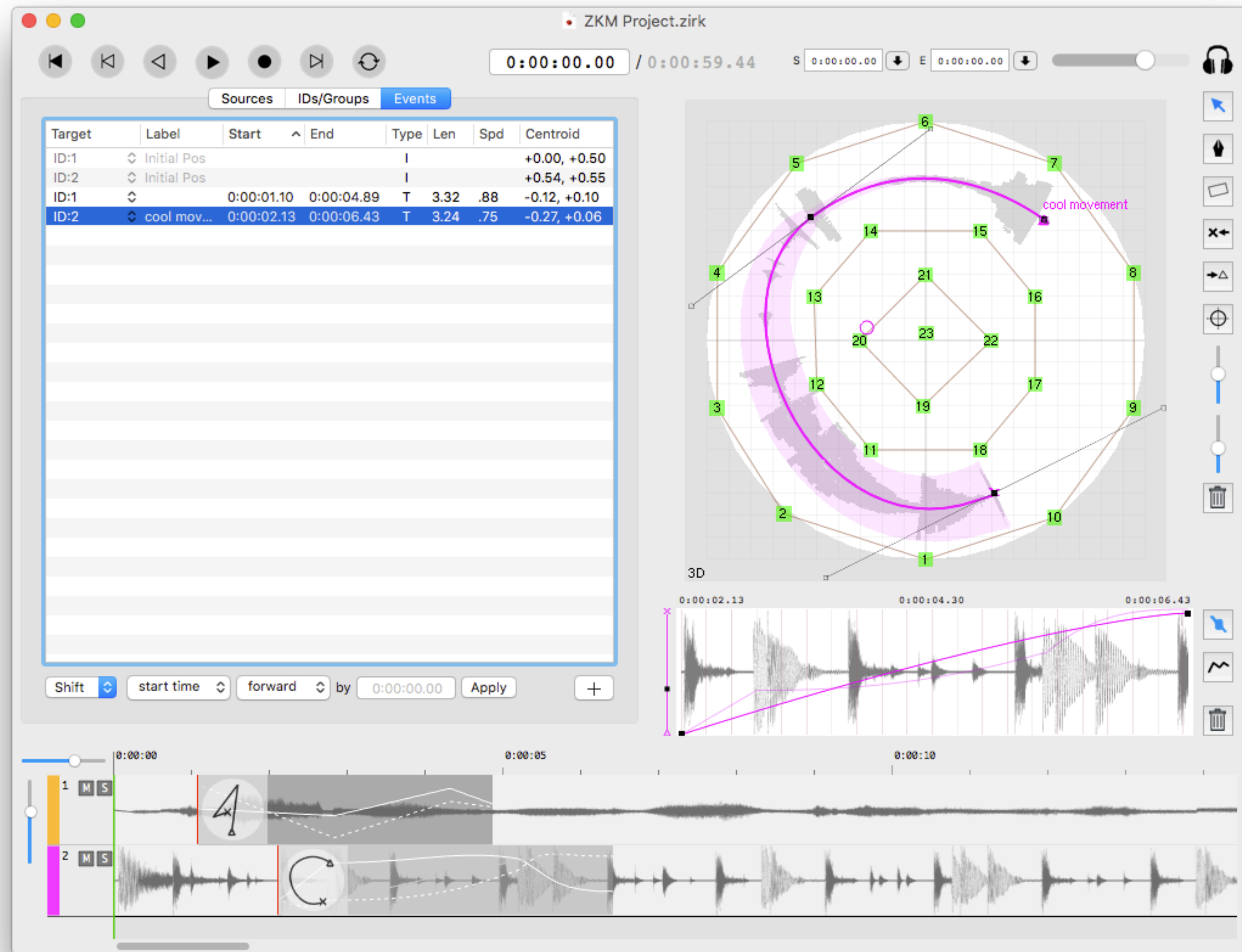


A screenshot of the Zirkonium Spatialization Server interface. The window title is "Zirkonium Spatialization Server". It features two main sections: "Inputs~" and "Patched Outputs~". The "Inputs~" section has a row of 20 input slots, each labeled with a number from 1 to 20. The "Patched Outputs~" section has a row of 36 output slots, each labeled with a number from 1 to 36. Below these sections is a control panel with various settings and buttons. The control panel includes sections for "Socket Port" (2000), "OSC Port" (11475), "MTC" (to Zirkonium), "Add Inputs" (20), "Define Speakers" (add speakers), "Audio Settings" (audio on, audio settings, performance config), "File record" (choose file, mp3, wav, aiff, stop), "Save / Load Presets" (save, load), and checkboxes for "Display Input Meters", "Display Output Meters", "Only show empty sources", and "Forward OSC".

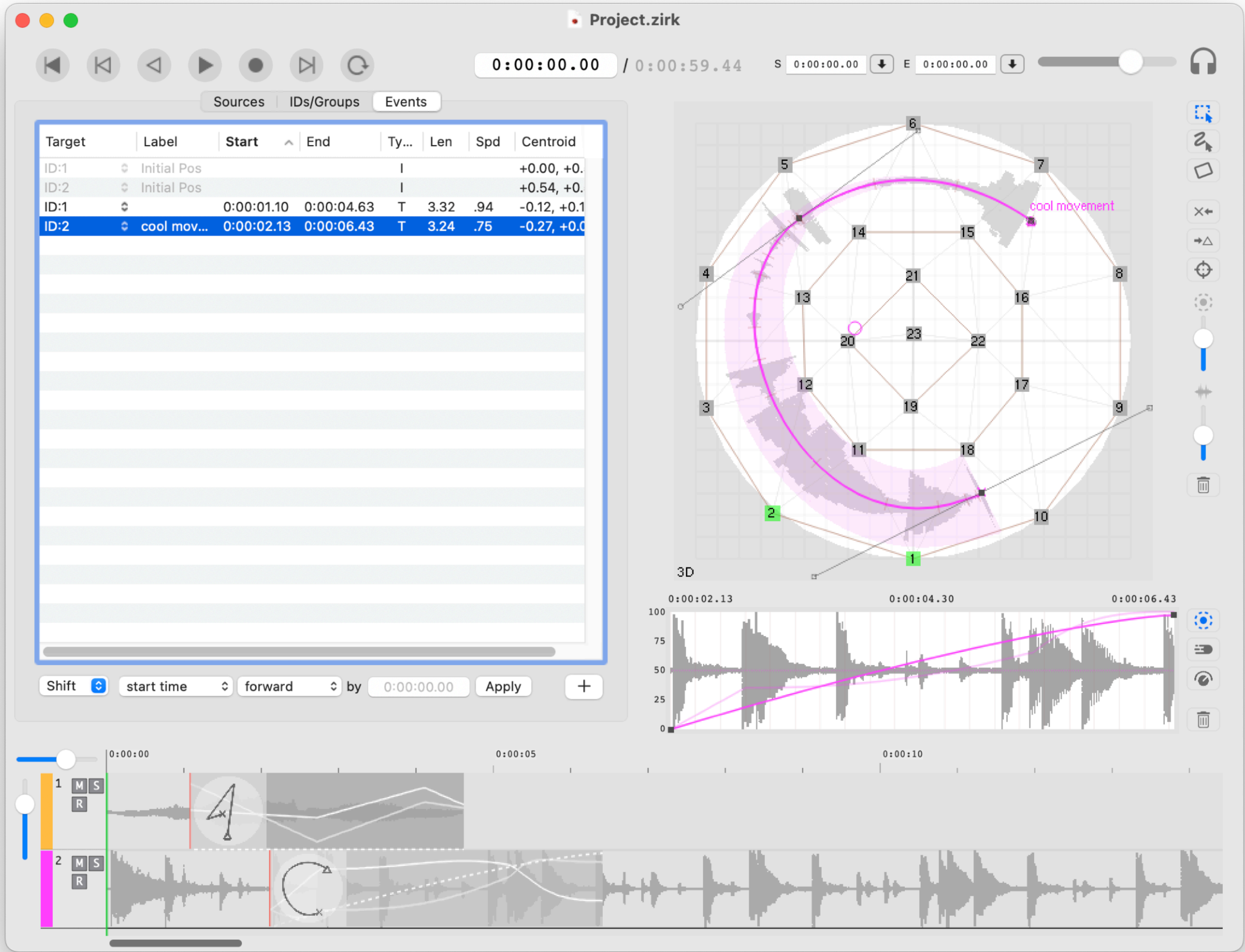
Zirkonium MK3



Zirkonium 3.4



Zirkonium 3.7



Example

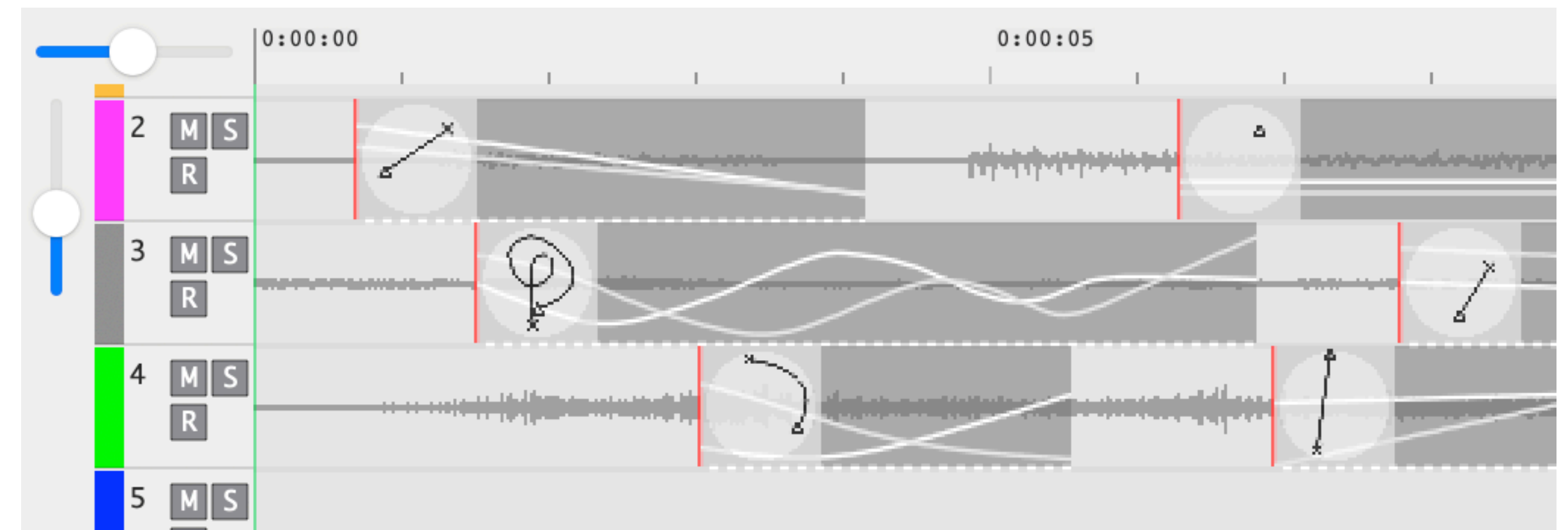
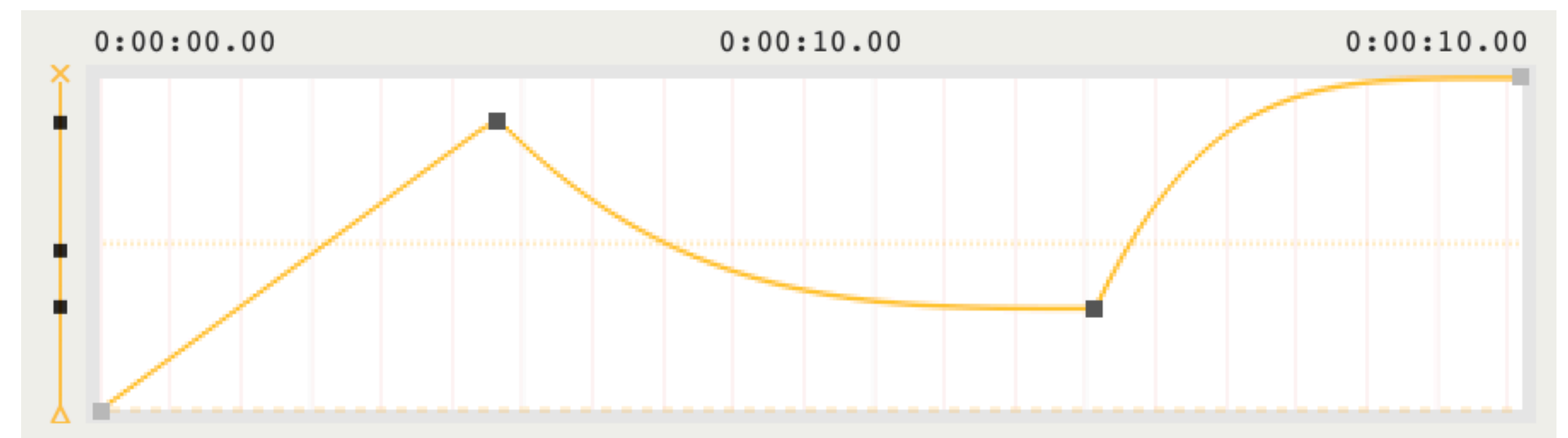
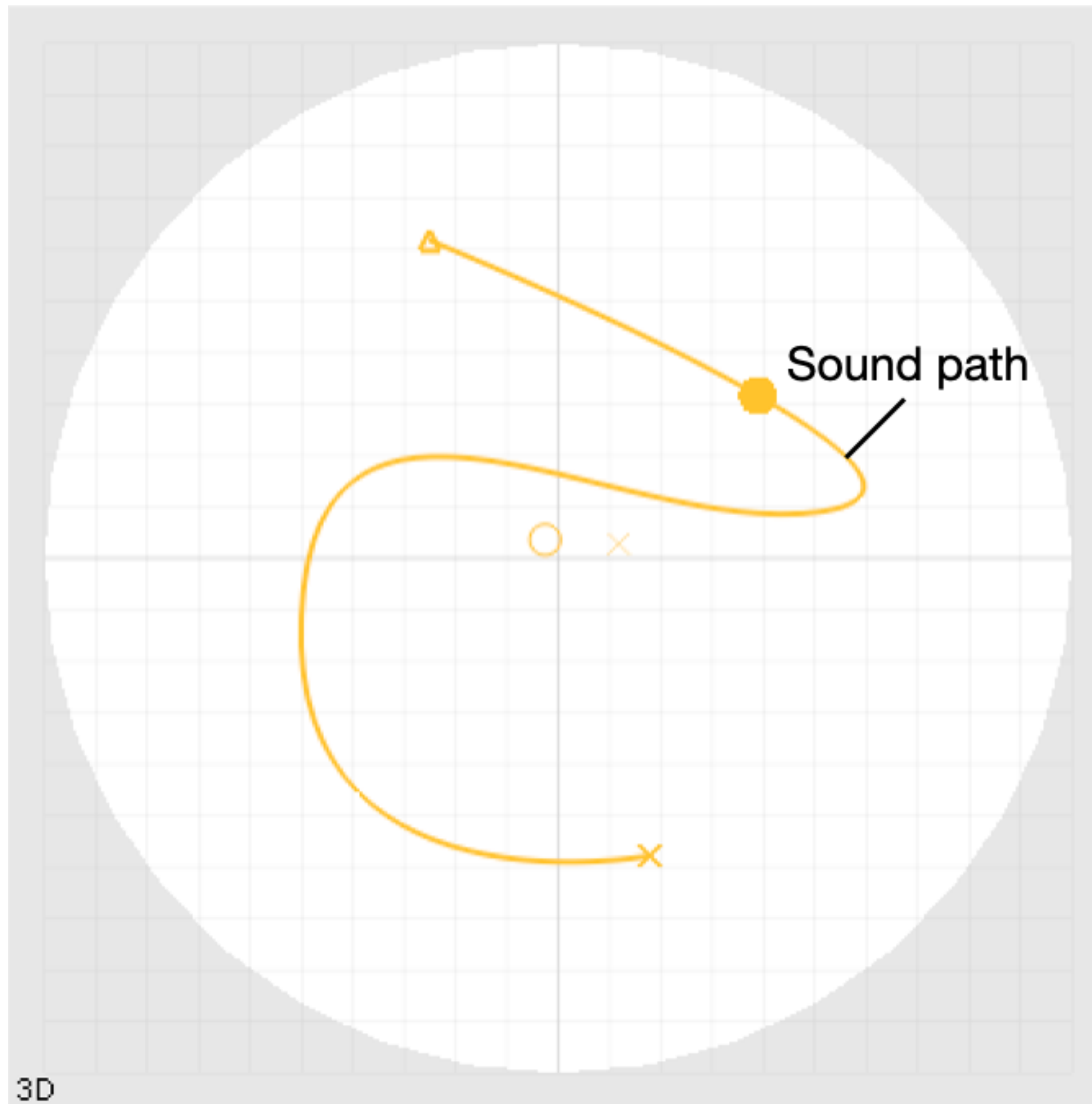
Giulia Lorusso »Poetica Liquida« 2022 Fixed Media

»Poetica Liquida« is a multichannel piece especially conceived for the Kubus at ZKM | Karlsruhe. Leveraging different tools for music generation and hybridation of timbre, this piece explores the notions of metamorphosis and hybridation, fluid identity, and essence. Machine Learning techniques like »Variational Auto-Encodeing« (VAE) have been used to transform generate sounds via variational neural audio synthesis. Tools based on recurrent neural networks (RNN) have been also employed to freely explore the algorithm proposals as well as possible developments of the same pattern, searching for unexpected outcomes in the perspective of a round trip with the machine via supervised process.

<https://zkm.de/en/event/2022/05/artificial-creativity-sounding-ai>

Giulia Lorusso's production »Poetica Liquida« took place within the framework of the Joint ZKM/IRCAM Residency.

Visual



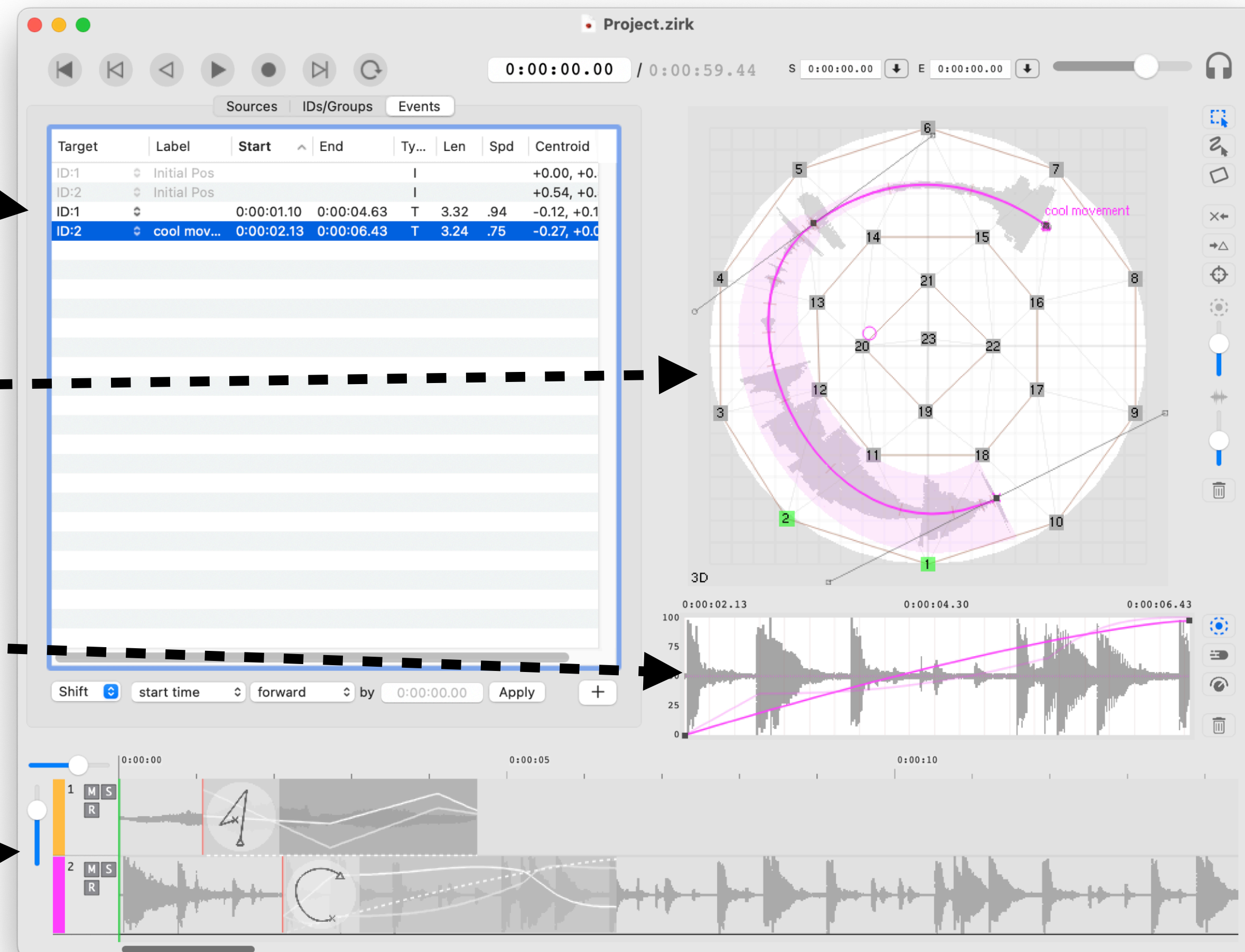
Overview

Source/ID/Event
Tables

Dome View

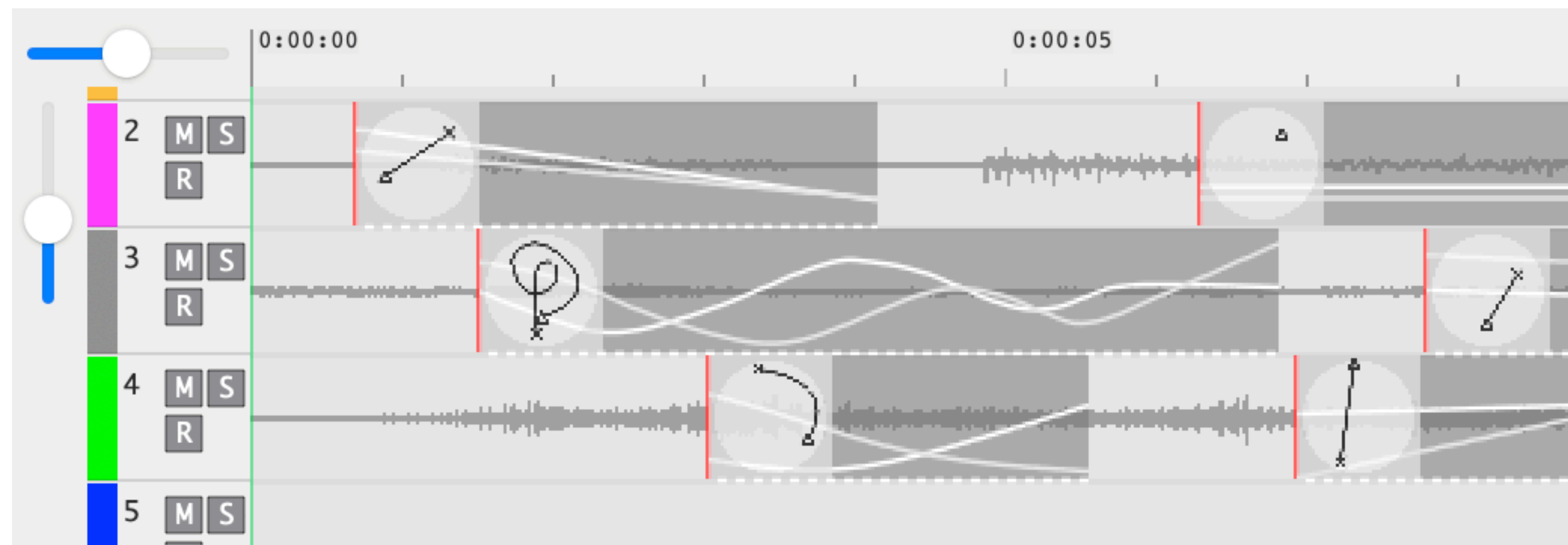
Motion View

Event View



Not a DAW...

Looks like DAW tracks...
but this is for event handling
not audio editing



Fundamentals

Source: input audio channel (file or live input)

ID: source moving over time (map source → events)

Group: ID movements relative to master ID

Event: position or movement trajectory over time (ID or Group path)

Gnome Analogy

ID: Gnome with a mono speaker

Source: channel playing on the speaker

Events: timed movement instructions

We think of *where*, *when*, & *how long*

Gnome handles interpolation



Sources

Live input: 64 channels

Audio file: 64 files

- 8 channel each
- uncompressed AIFF, WAV, CAF
- 44.1k, 48k, 96k

No playback sample rate conversion

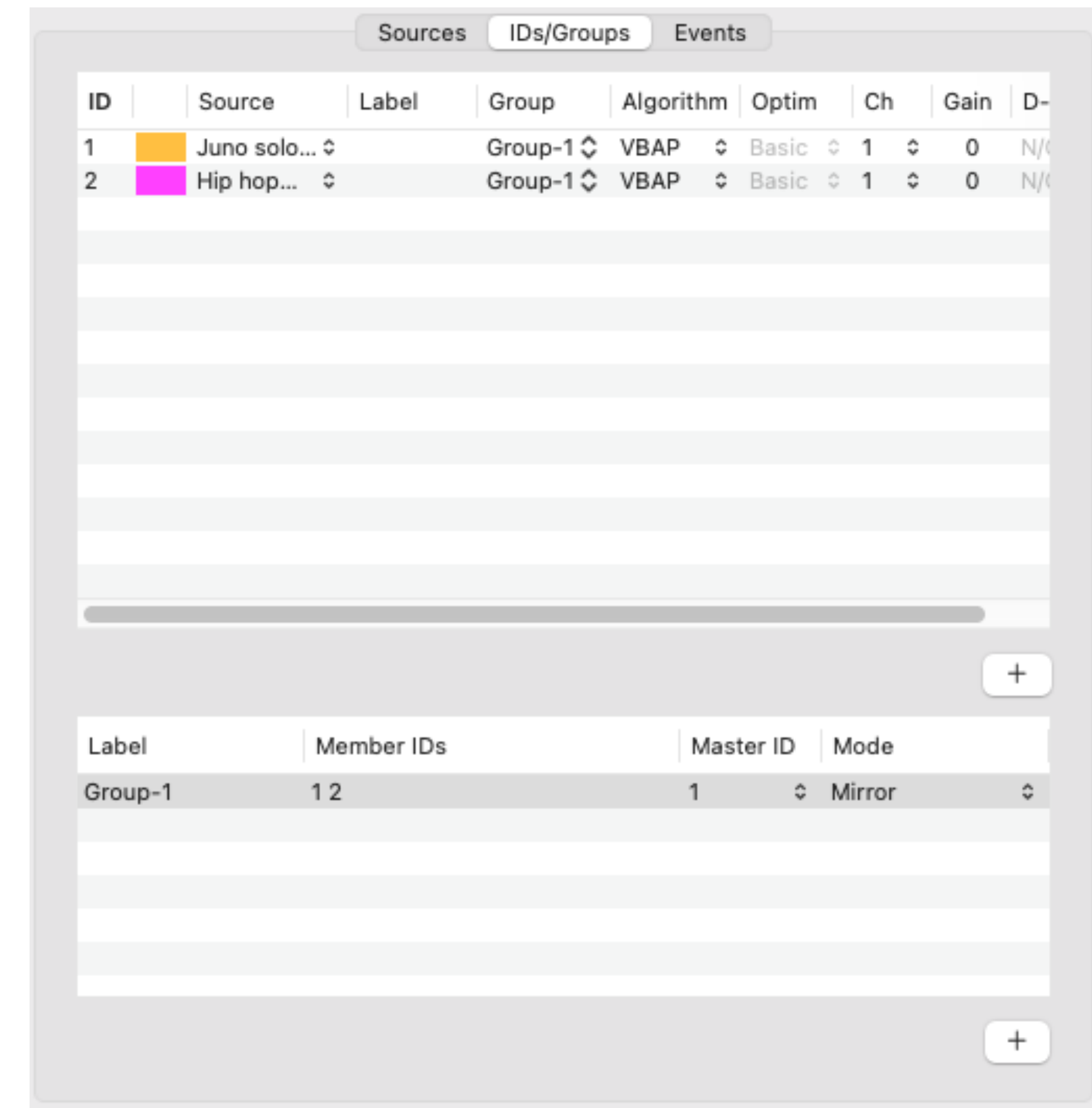
[illegible]

IDs

Sound source channels mapped
to virtual speakers

Algorithms:

- VBAP
- HOA
- OSC
- None (Direct Out)



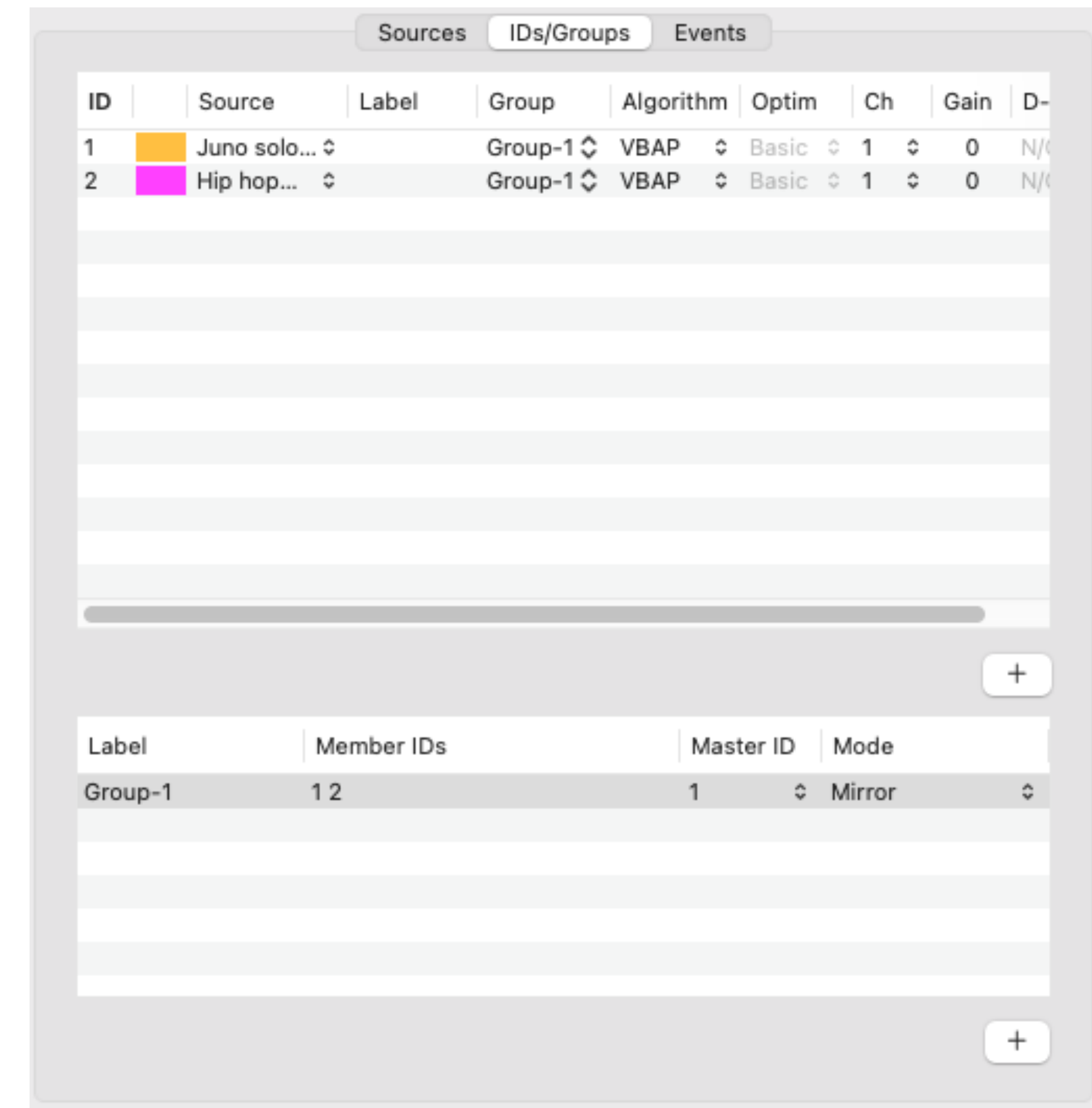
Groups

Cluster ID movement

Group member IDs together to follow a single master ID

Modes:

- Translate
- Rotate
- Mirror



Events

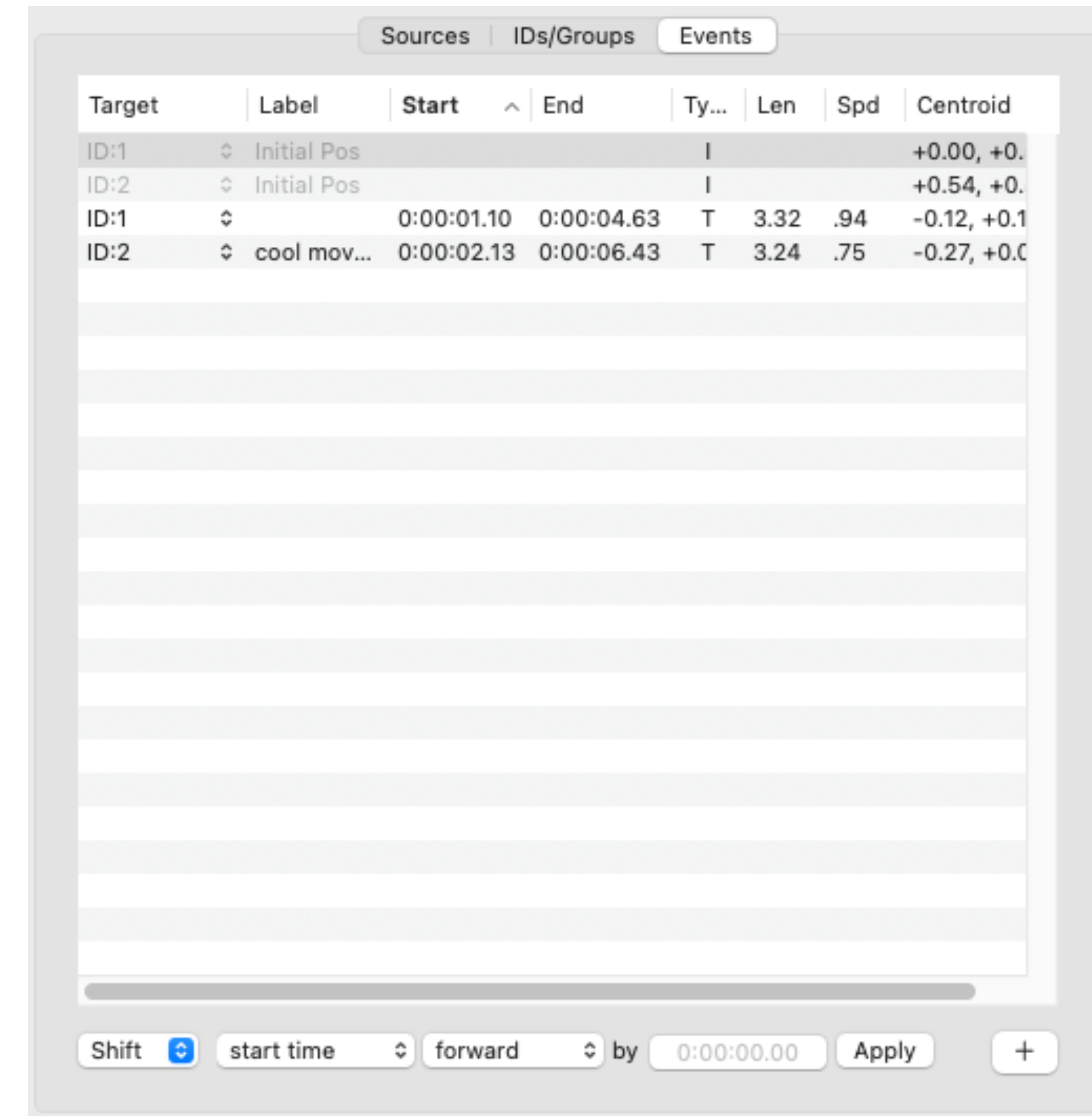
Timed movements or markers

Target: ID or Group

Defined start and end times

Motion curves:

- Span (virtual ID width)
- Motion
- Gain



The screenshot shows a software interface with three tabs: 'Sources', 'IDs/Groups', and 'Events'. The 'Events' tab is active, displaying a table with the following columns: Target, Label, Start, End, Ty..., Len, Spd, and Centroid. The table contains four rows of data, with the first two rows having a grey background. Below the table is a large empty area with horizontal grey lines, and at the bottom is a control bar with buttons for 'Shift', 'start time', 'forward', 'by', a time input field, 'Apply', and a '+' button.

Target	Label	Start	End	Ty...	Len	Spd	Centroid
ID:1	Initial Pos			I			+0.00, +0.00
ID:2	Initial Pos			I			+0.54, +0.00
ID:1		0:00:01.10	0:00:04.63	T	3.32	.94	-0.12, +0.12
ID:2	cool mov...	0:00:02.13	0:00:06.43	T	3.24	.75	-0.27, +0.00

Event Types

Undefined

?

Undefined (marker)

"Movement 1"

Instantaneous



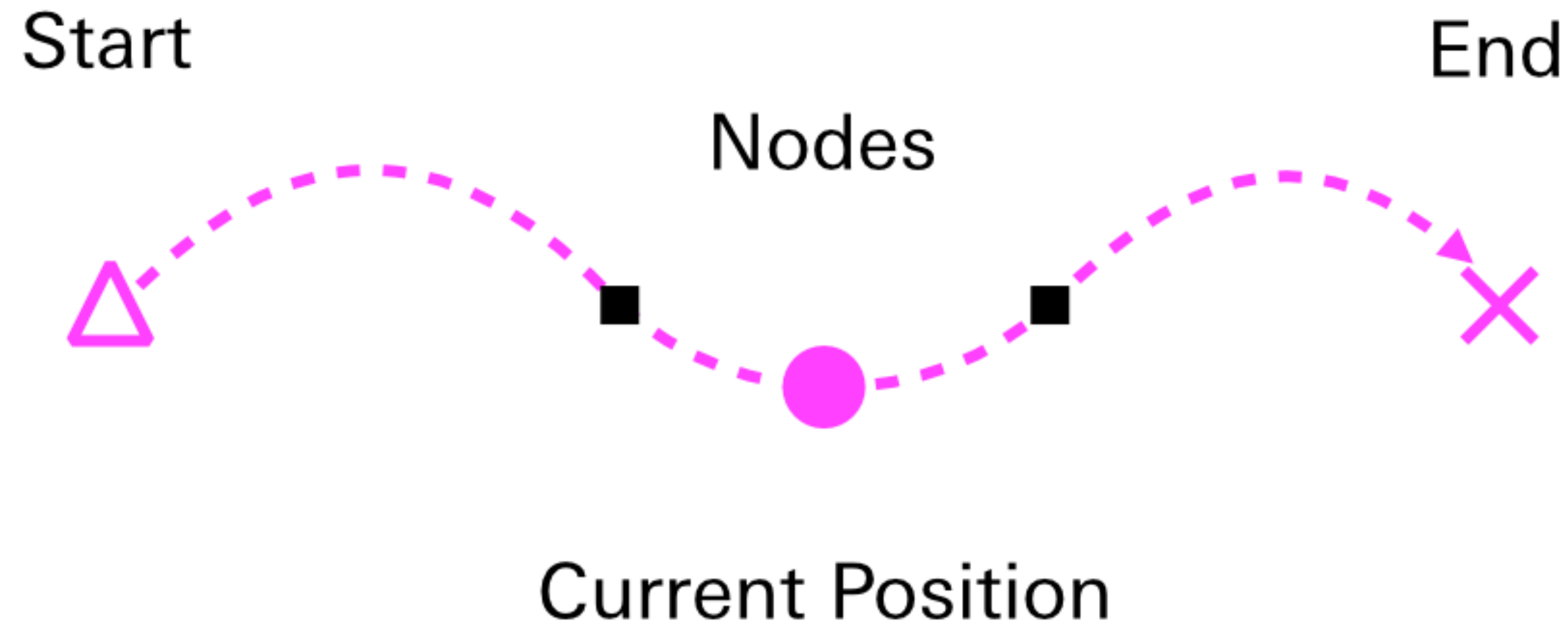
Trajectory (straight)



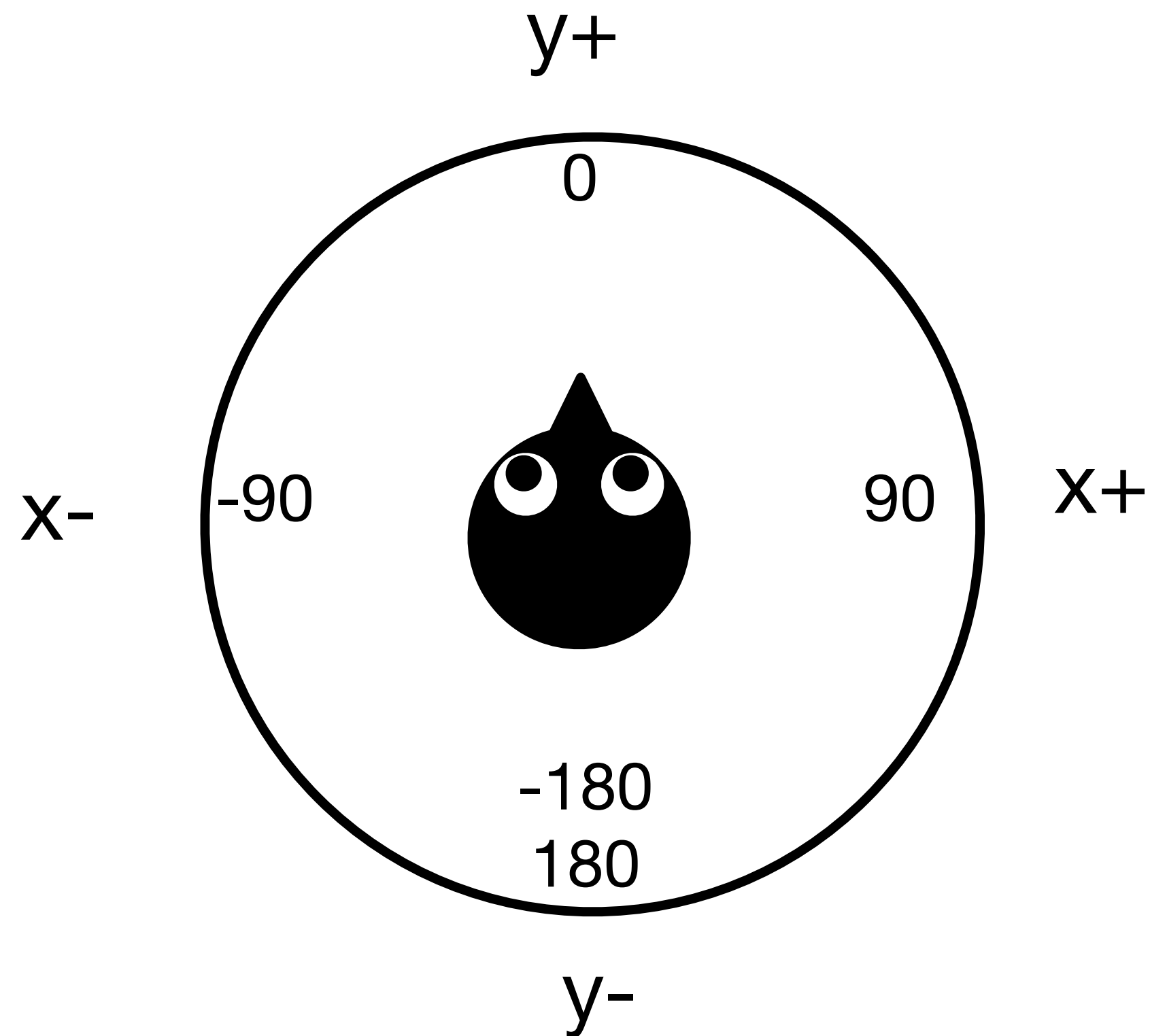
Trajectory (bezier)



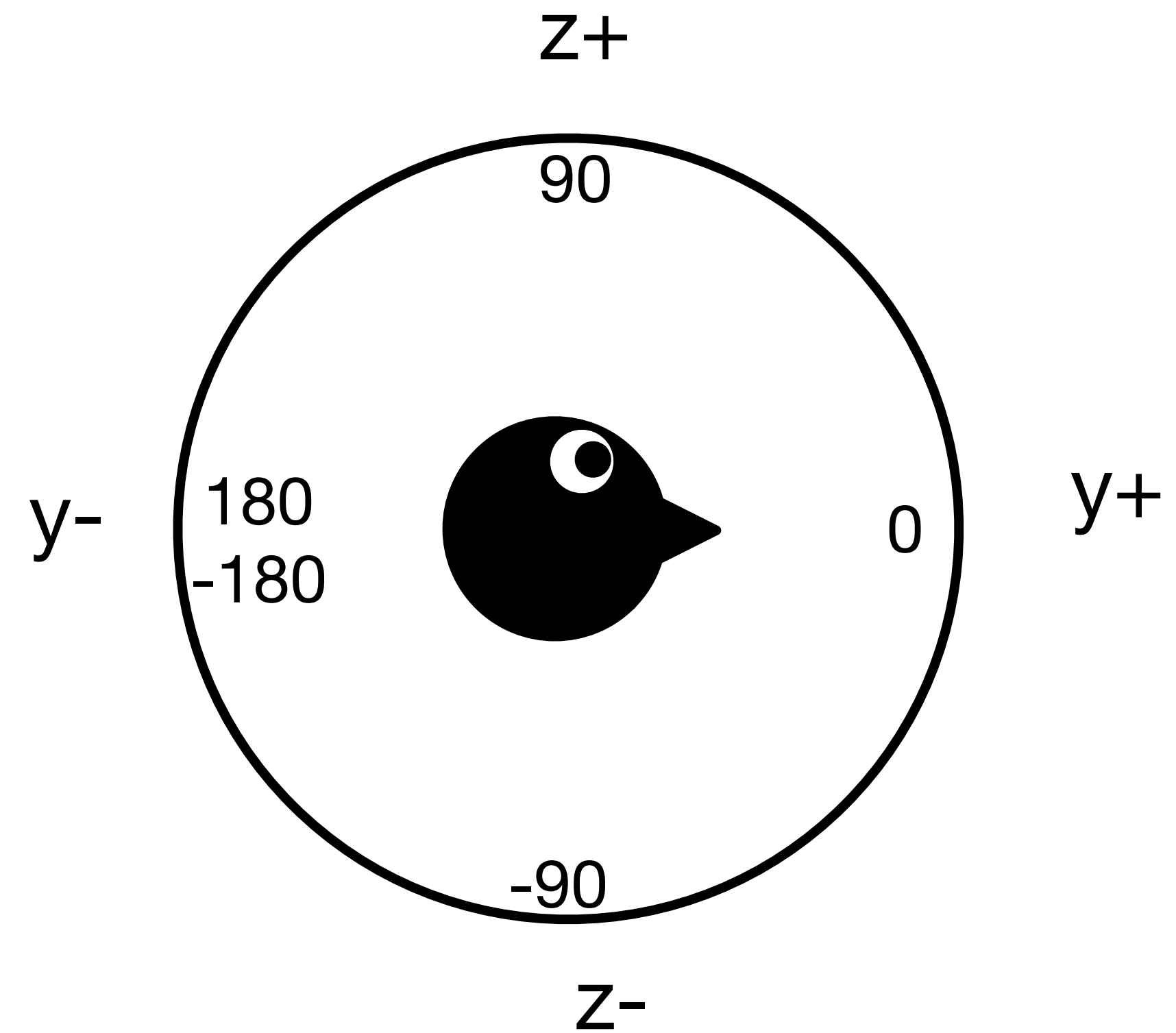
Event Trajectory



Coord System

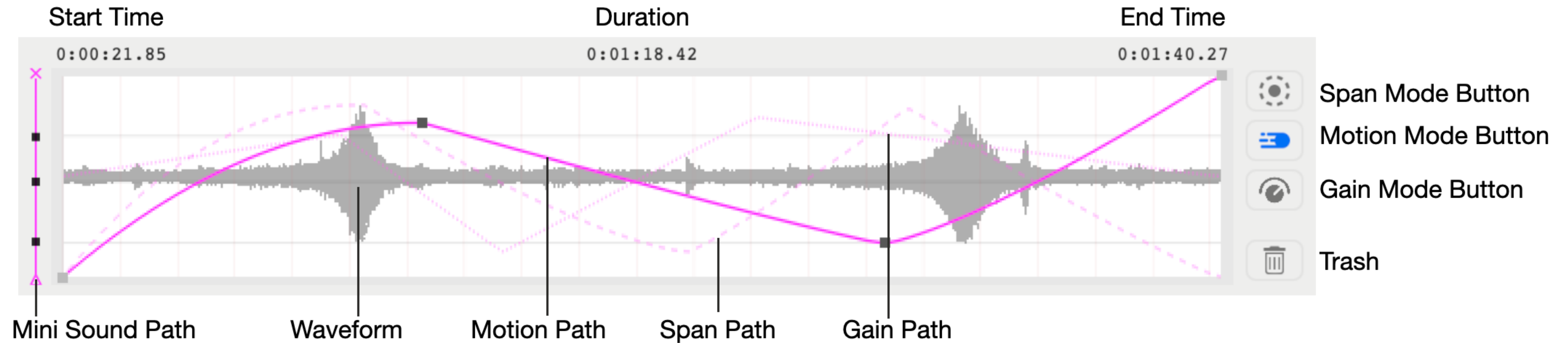


Azimuth



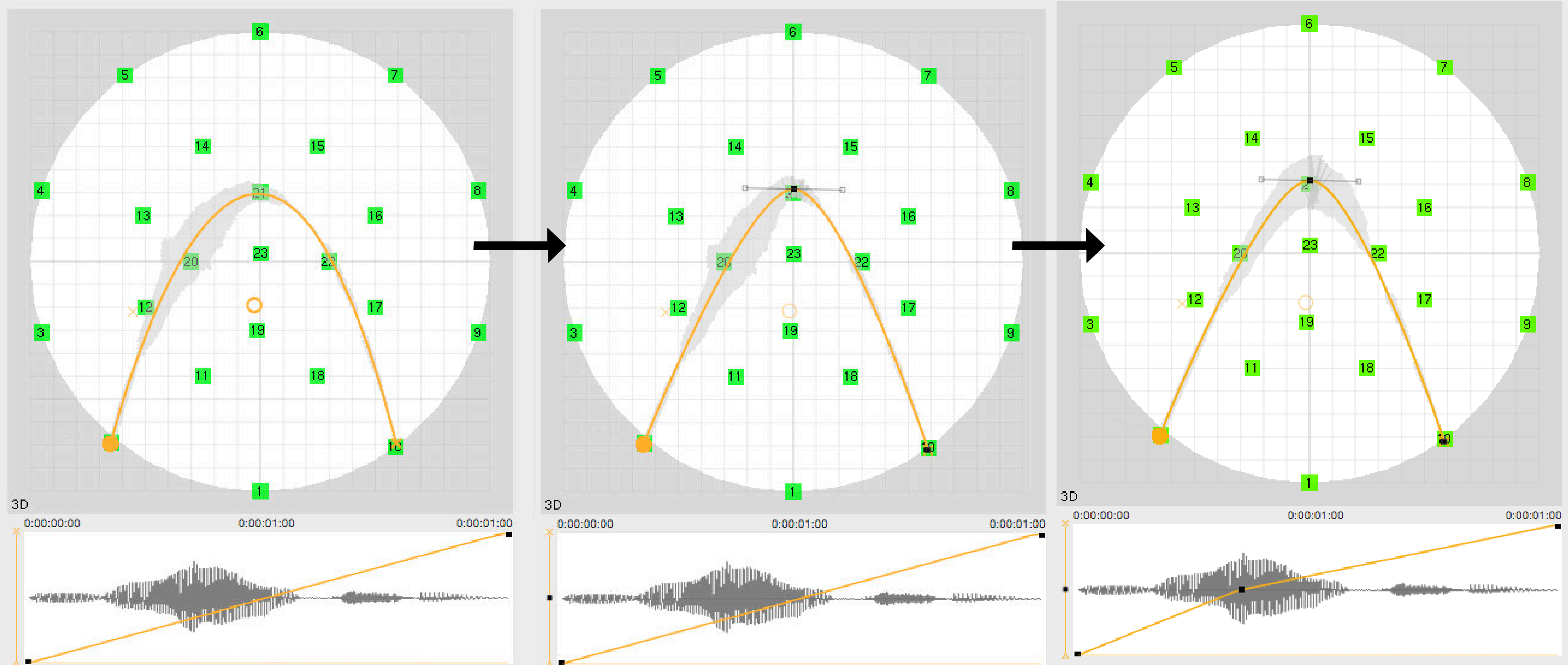
Elevation

Event Motion



Event Motion

Easy to map source file audio events

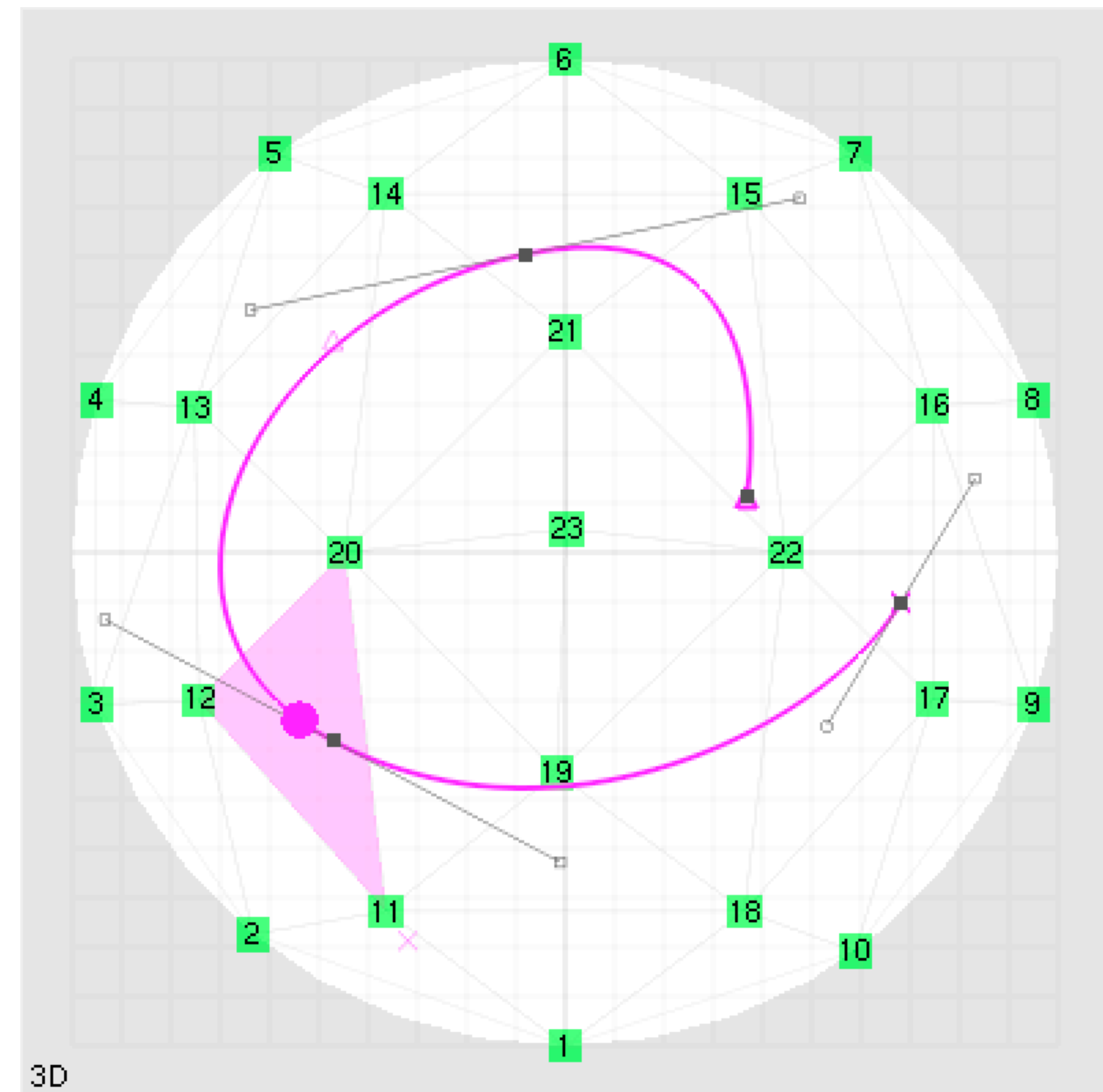


Virtual Speakers

Speaker setup: decouple input source
channel-mapping from physical outputs

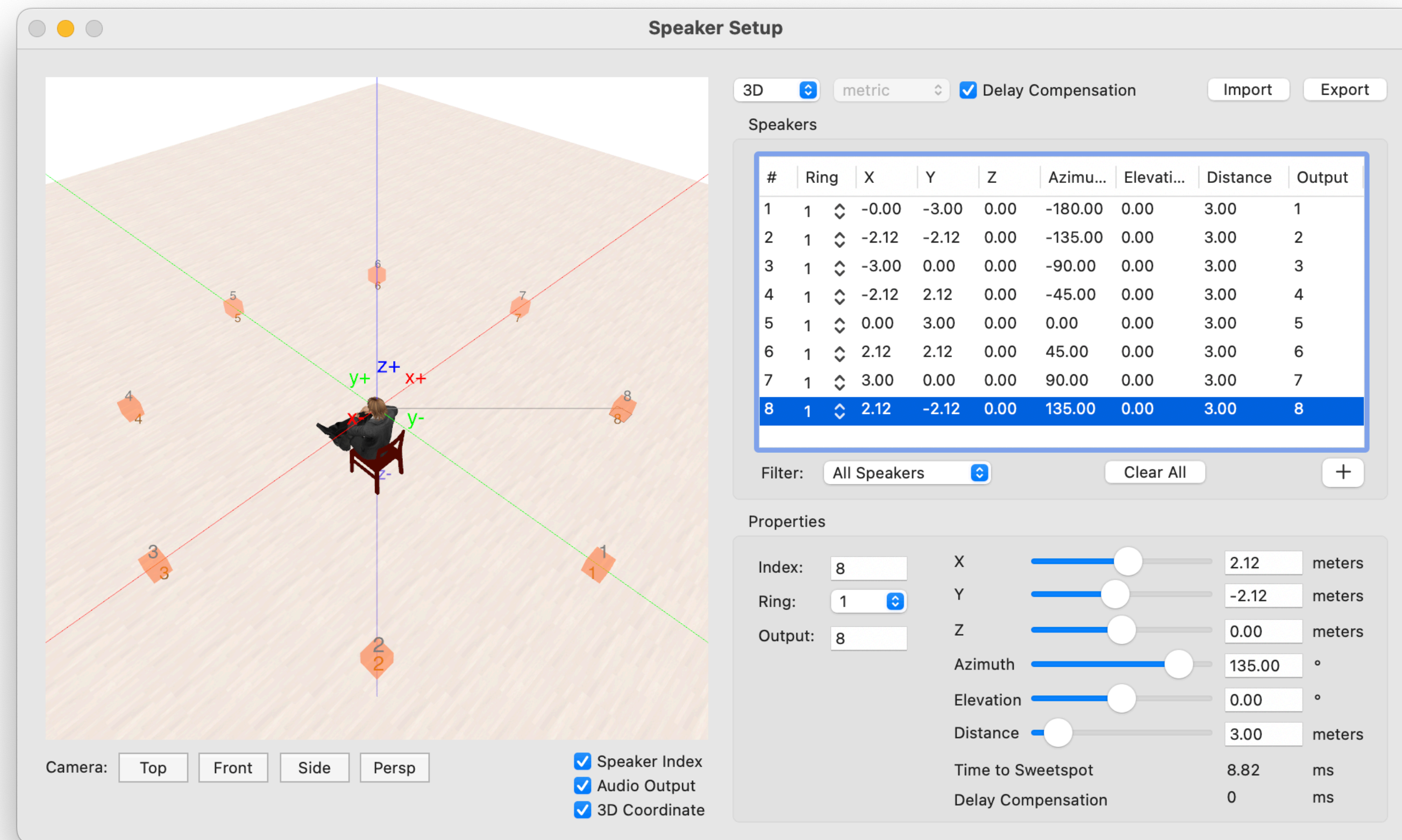
Built-in presets

Example: 25-channel MiniDom



SpeakerSetup

Use included SpeakerSetup app for creating your own speaker setup files



External Control

OSC Receiver:

- transport (playback, rewind, seek, etc)
- ID control
- ID recording
- Group control
- Group recording

OSC Senders: time, transport, ID/Group positions & gains, speaker levels

Mappable OSC Sender message address patterns

Sync: MIDI Time Code (MTC), MIDI Clock

ZirkVideoPlayer



Use included ZirkVideoplayer app to sync video file playback with a Zirkonium piece

OSC Receiver control

Sync: MIDI Time Code (MTC), MIDI Clock

Lower or mute video audio, show timecode

Solid color video blanking

General purpose: can be controlled by other software



Export

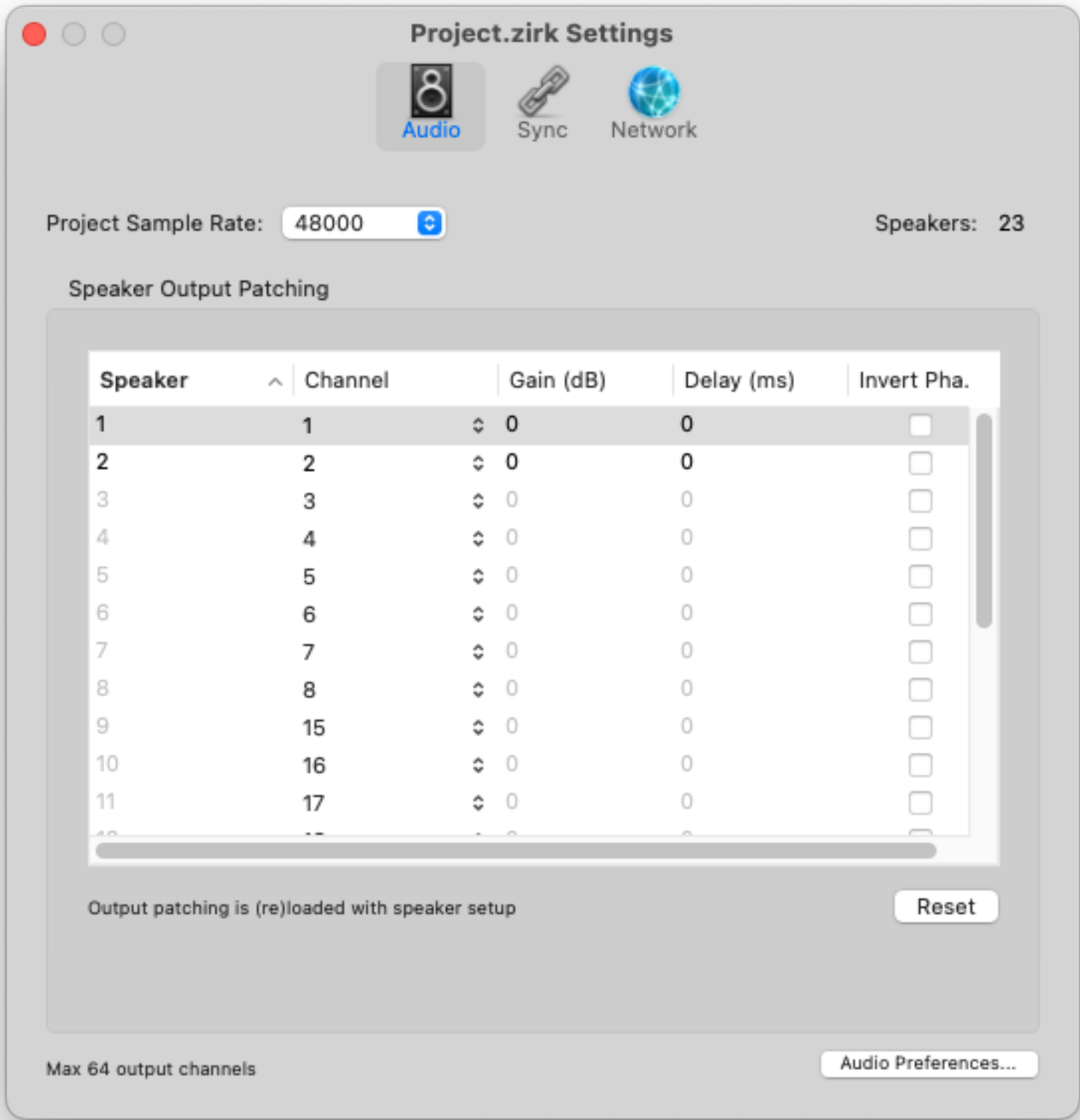
Archive Project: gather project files together into a single folder

Bounce: record to virtual speaker output channels or stereo HRTF

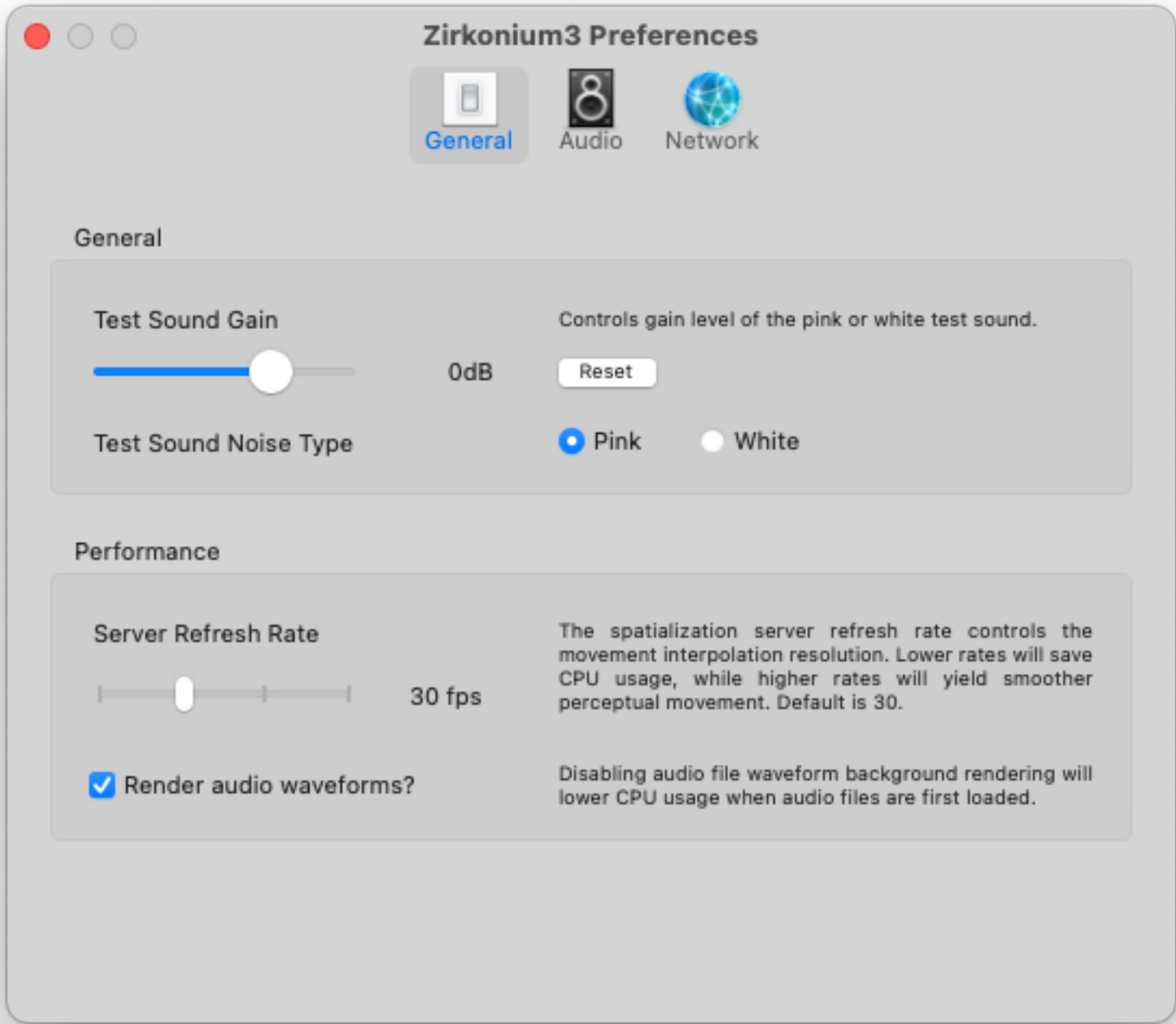
Bounce can be performed offline and/or without updating the GUI for faster processing

Bounce can wait for sync playback start for live recordings

Settings vs Preferences



Project Settings



App Preferences

Auto Versioning

No undo/redo (for now)

Simple automatic timestamp saving ala Touch Designer

- file
- file.2025-05-15_133231
- file.2025-05-15_133731

Pure Data Server



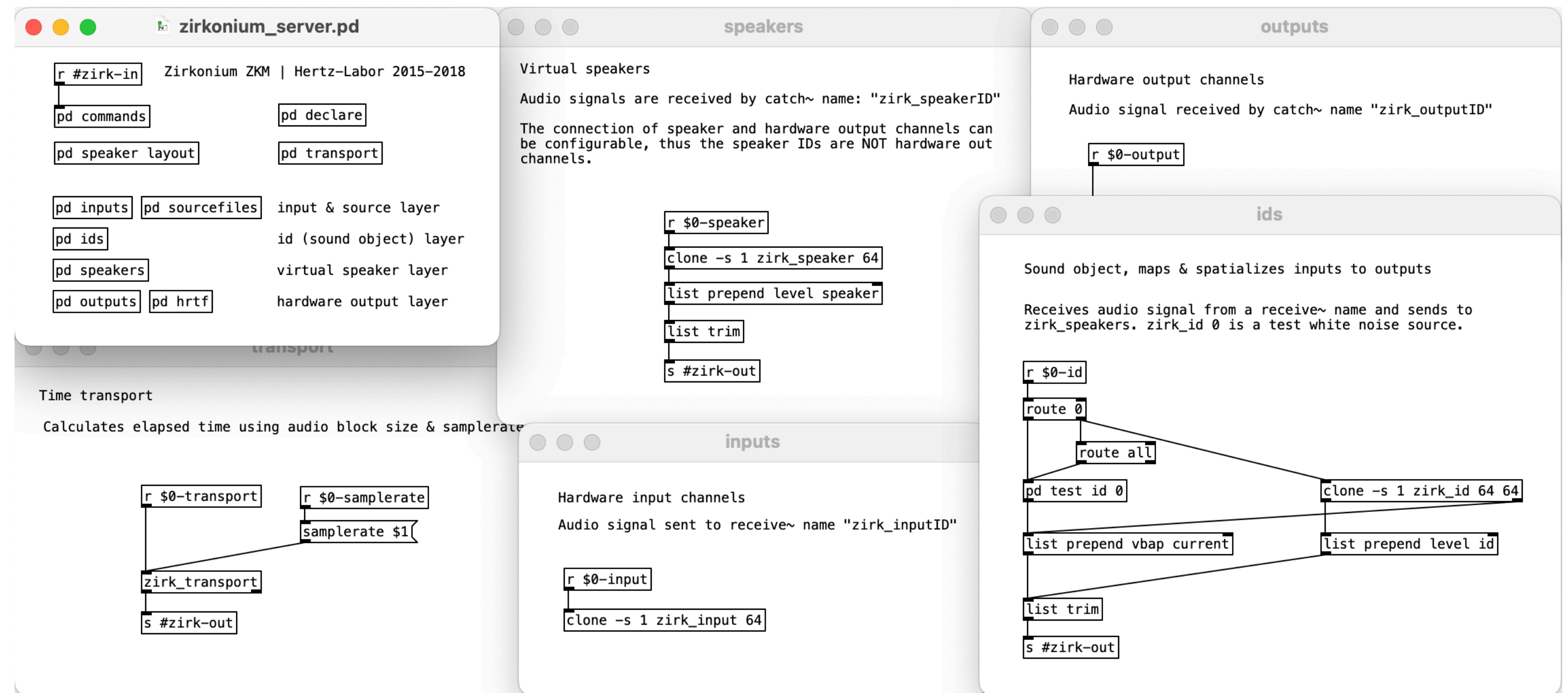
Spatialization engine built using libpd, patches, & externals:

- vbap~ (Ville Pukki)
- HOA (CICM HOA Library)
- earplug~ (Pei Xang)

Open source on Github

Easy Makefile

All objects documented



<https://github.com/zkmkarlsruhe/ZirkoniumSpatializationServer>

Future



Zirkonium 3.8: Classic MK1 project support

Project to be fully open source by summer 2026

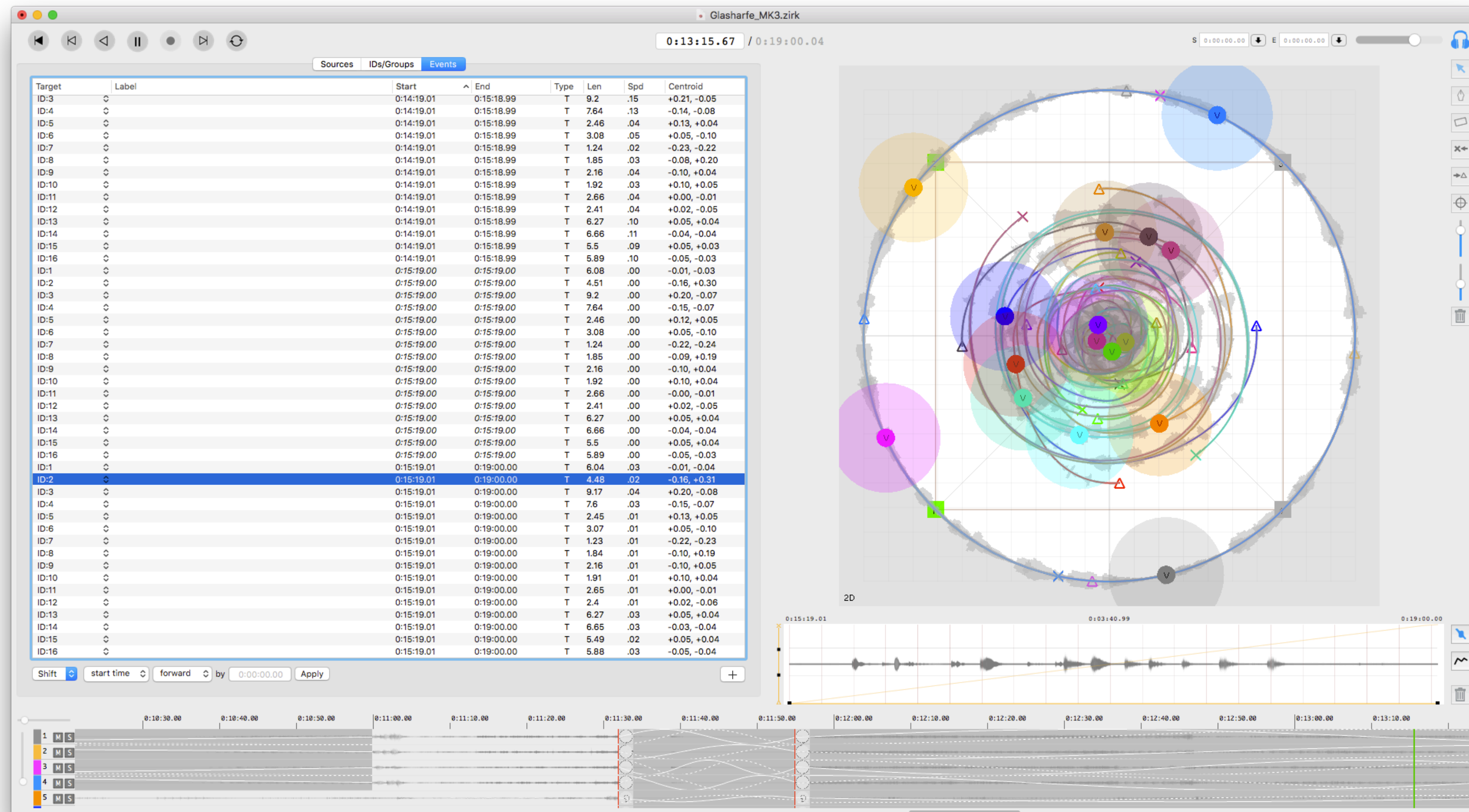
Transition from CoreData project format to documented "universal" XML

Cross-platform command line server wrapper for playback (possible)

Separate core functionality from GUI into "libzirkonium" (possible)

MK1 Support

Glasharfe - Ludger Brümmer



Downloads

Workshop info, links, and download materials at:

class.danomatika.com/workshops/zirkonium

Download Zirkonium 3.7:

zkm.de/zirkonium

Join the mailing list:?

mailer.zkm.de/mailman/listinfo/zirkonium-list



Let's Go!

Example with audio from:
Summertime (excerpt)
by Bolz & Knecht

