MAY 2023

MAKE NOISE ZINE

#5

soundhack SPECTRAPHON

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The Spectraphon has two nearly identical sides, A and B, which oscillate in one of two ways: Spectral Amplitude Modulation (SAM), or Spectral Array Oscillation (SAO). In SAM, instead of oscillating at all times like an analog VCO, sound at the Spectraphon's input is used to modulate the amplitude of a set of harmonics. In SAM the Spectraphon can be sequenced and frequency modulated like any VCO. At any time the current spectrum can be used to create an Array for later use in SAO mode where the Spectraphon oscillates at all times, with the spectrum at the Odd and Even harmonic outputs being drawn from those stored Arrays.

The Slide and Focus controls are mode-dependent: in SAM, they determine how the Spectraphon responds to sound at the input for Spectral AM, while in SAO, they are used to modulate the Array.

In either mode (SAM or SAO), the Partials control works as a combined amplitude and timbre gate for the Odd and Even harmonic output and the FM Bus will create high definition internal frequency modulation from the opposing side of the Spectraphon. The two sides can also interact via the internal FM Bus, the Follow and Sync modes, and by patching them together.

Features:

- Dual Digital VCO with eight simultaneous outputs, as well as two audio inputs, two gate inputs and ten CV inputs
- Built on Make Noise's new digital hardware platform, the most powerful digital module we have yet created
- Coded by Tom Erbe of soundhack
- Spectral Amplitude Modulation (SAM) creates spectral oscillations based on continuous analysis of the audio at the input
- Spectral Array Oscillation (SAO) creates spectral oscillations based on stored sets of spectra called Arrays, which are created in the SAM mode
- Each of the two VCOs operates independently in SAO or SAM, in any combination
- High definition internal Frequency Modulation Bus with easy access to Harmonic Ratios via the Tuning Beacon
- Sub-Oscillator/CV outputs give access to unique sub-oscillator shapes, envelope following, or clockable modulation sources
- Sine and Sub operate independent of FM Bus modulation.

The Make Noise/soundhack Spectraphon is a dual Spectral Oscillator coded by Tom Erbe of soundhack. It uses real-time spectral analysis and resynthesis to create new sounds from those that already exist. It is inspired by classic electronic musical instruments of the past, including spectral processors, additive synthesis, vocoders, and resonators especially the Buchla 296 and Touché, but it takes a physical form more resembling the classic analog dual complex oscillator in the lineage of the Buchla 259 and the Make Noise DPO.

The Spectraphon is the first module to be built by Make Noise on its new digital hardware platform. This hardware, engineered by Jeff Snyder and Tony Rolando, provides more i/o at higher resolutions, and a lower noise floor than we have ever had access to in a digital module, allowing us to unleash Tom Erbe's DSP code to a previously unattainable degree.

Width: 34hp / Power: 230mA @ +12V, 55mA @ -12V / Module Depth (incl. power cable): 36mm

When did the idea for the Spectraphon first materialize?

No idea exactly. Tom's always talking about "...spectral this, spectral that... here a spectra, there a spectra..."

You and Tom have been collaborating for years on module designs and concepts— what is your process of working together (in person, over email, etc).?

All of the above. We do a lot of emails. Thousands. Within each development period we work in some in person development time because there are things that happen when meeting and working together, in person, that cannot happen when working remotely. We also do some of the dreaded Zoom or facetime meetings. Those come in handy when Walker and myself are trying to provide Tom with behavioral examples.

The Spectraphon is capable of a huge variety of tones— how would you describe the sound of the Spectraphon

Spectraphon is not characterized by a monolithic tone, but instead by the process through which it achieves infinite tone mutation.

The layout of the module strikes a nice balance between the familiar (DPO-esque arrangement of the two halves) and the new (controls such as Partials, Focus, etc.). What were some of your design goals in representing the unique feature set of the Spectraphon on its panel while still feeling approachable and familiar?

Since it is two very similar halves, I tried to make the layouts as symmetrical as possible. As always tried to maintain the standard Make Noise parameter placements to facilitate patching within the MN system and most importantly I included proper attenuverters and level shifting, something that is sadly missing from small modules being released these days. I don't like having to patch something as universally necessary as control attenuation and inversion.

What are some of your favorite types of sound sources to modulate against the Spectraphon's oscillator in SAM mode?

I usually patch Side A Sine into Side B SAM and sequence the two sides independently. Human Voice is also wonderful patched into SAM mode.

Between either oscillator being able to function in SAO and SAM mode independently as well as its assignable CV outs per oscillator, the Spectraphon covers a ton of ground for a single module and yet each bit of functionality feels essential in use. How did you landed on this particular collection of functions?

We arrived at SAO after failing to achieve SAM in a way that was intuitive enough to get functional sounds. Later Tom got SAM working so well that it became the primary use for the module, but since SAO was also fully developed and sounding good, we thought it was well worth including, especially since you could use one side ib SAO to patch into the other in SAM. The additional CV Outs were added as an options since the module is quite large and in a smaller system we thought these would be appreciated. In large systems I imagine most will leave these set to the Sub option.

What other Make Noise modules pair well with the Spectraphon?

Analog filters or LPGs are a must so QPAS, Optomix, LxD. Also modulation is a must so MATHS. The random CVs produced by the Spectraphon itself are great IMO, but if you wanna use the subs instead, a Wogglebug is helpful. Finally, some way to mix and potentially panning if working in stereo so X-PAN.

Which composers from the past would you have liked to have heard work with the Spectraphon?

Raymond Scott seemed to be reaching in the direction of something like a Spectraphon. I think he could have done something pretty interesting with it.
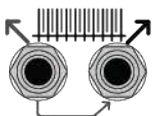
What were some of your influences for the concepts behind the Spectraphon?

Back in the 80s/90s, when I worked at the Center for Contemporary Music at Mills College, I was able to play with the Buchla Touché quite a bit. I really liked its combination of waveshaping and frequency modulation, and I've spent quite a bit of time studying its design. Also, I adapted some ideas from the Harald Bode Klangumwandler/Frequency Shifter which was documented by Rebekkah Pavlov in eContact a few years ago (https://econtact.ca/13_4/index.html). Finally, I have two of the original Buchla Spectral Processors in my studio, I really liked the even and odd outputs, the unusual and rich sound palette, as well as its ability to both analyze and process sounds. I definitely learned a lot just playing with that module.

Spectral Oscillators are new concepts in modular synthesis— how did you decide which parameters to incorporate into the module's design?

I built the basic oscillator a couple years ago, at the start of the pandemic. Most parameters came by just playing with it, but some came naturally from the structure of the oscillator. For instance, the partials control is not opening a filter or fading in successive sine waves, but is using a rather complex type of modulation on the oscillator core. This results in a very musical change when "partials" is changed. The harmonic shaping is performed by a shifting harmonic array, and controlled by the shift and focus parameters. Finally, I found I could also use the spectral oscillator to extract harmonic amplitudes from an external sound. This can be done cleanly with precision, or with a lot of intermodulation depending on the slide and focus controls. I always like my parameters to have a lot of range - from subtle to extreme.

One important distinction between the Spectraphon and other Soundhack/Make Noise collaborations (such as the Morphagene, Mimeophon and Echophon) is that this module does not record sound but instead deals with the creation and utilization of harmonic arrays. Can you talk a bit about the possibilities that this opens up in terms of sound design and sonic interaction?

Any synthesis technique that uses a large number of internal parameters can create some very complex and detailed sounds. Tony and I talked about ways to modulate the harmonic arrays over at least a year. We finally were both happy with the method of using external sounds to modulate the oscillators and collecting those modulations (along with the variations slide and focus create) into the spectral arrays. My description is pretty abstract, Make Noise will no doubt have some great youtube videos illustrating this.

The operation and implementation of FM on the Spectraphon is unique— both the resolution of the frequency modulation and the non-circular nature of the FM Bus. How did you arrive at the sound of the Spectraphon's FM?

I love chaotic circular FM - ever since I saw Xavier Rodet demonstrate it on a NeXT workstation. However, in this case, I wanted both oscillators to have a more stable FM timbres. To have A modulate B while B modulates A, I had to play a little trick to avoid circular chaotic modulation.

Is the process of driving a Spectraphon's oscillator with the spectra of another sound analogous to convolution?

They are related. In convolution all partials (both harmonic and inharmonic) have their amplitudes multiplied and phases summed. On the Spectraphon harmonic partials are used, and phase is only used to get a complete amplitude measurement. They do intersect in that they both can create rich, multi harmonic sounds.
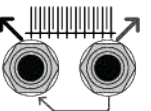
Our new 4-Zone Bus Board!
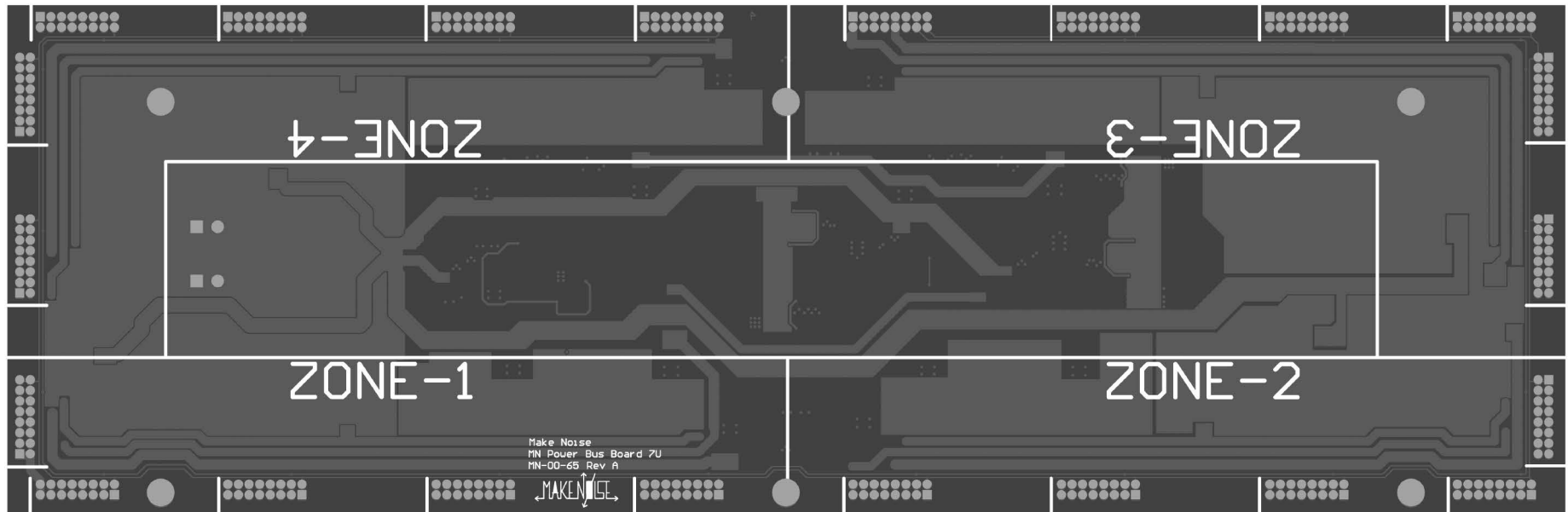
Our unique 4-Zone design divides power into four isolated Zones, with 4A of output divided across four distinct Zones, allowing for both considerably more available power and lower inter-module crosstalk!

- 34 total headers (vs. 18 on current bus board)
  - Zone 1 = 8 headers
  - Zone 2 = 9 headers (1 used for CV Bus)
  - Zone 3 = 9 headers
  - Zone 4 = 8 headers
- All Zones are isolated from each other and and can provide:
  - 1A @ +12V (4A total, vs. 1.4A total on current bus board)
  - 500mA @ -12V (2A total, vs. 1A total on current bus board)
- 5V rail is distributed to all Zones and can provide:
  - 1A @ +5V
- Shipping this summer!

JEFF SNYDER
ON SPECTRAPHONE
HARDWARE DEVELOPMENT

The Spectraphon is designed around brand new digital hardware— what are some of the benefits that this new technology affords the module?

The hardware really allows for extremely fast computation on a processor that is still running "bare metal" (without operating system overhead). It's got an excellent architecture for tightly coupled memory and the chip we are using includes a decent amount of on-chip flash memory to store quickly accessible lookup tables so that we can do more efficient processing.

What were some design benchmarks that were in place when designing the Spectraphon (i.e. noise floor, resolution, feature set, etc.)?

We were aiming for a much better noise floor compared to earlier modules, and we especially focused on eliminating periodic noise, which is heard as humming or buzzing pitched sounds rather than a white-noise background. The most egregious sources of periodic noise in this kind of digital module are usually clock noise from the microcontroller's own changes in power consumption through the audio frame, and clock noise from communication with peripherals such as external memory ICs and SD cards. I spent a lot of time doing careful routing of the analog and digital signals on the board to minimize that kind of bleed and the result was very successful! This thing is very quiet and has a great dynamic range.

We also wanted to experiment with having more than 2 audio outputs, as well as DC-coupled outputs running at audio rate, so we used an 8-output audio CODEC IC. The majority of audio codecs are 2-in/2-out, so this design choice opened up some very interesting possibilities for this and future Make Noise modules.

The Spectraphon was in development for quite some time— how did the hardware evolve over that stretch?

There was a lot of back and forth between Tony, Tom, and me as we figured out what was needed. This was my first time working with Make Noise, though I have been a fan for a long time and own many Make Noise modules, so it was great to be in discussion with Tony over design philosophy and how to make this hardware brain really serve the Make Noise way of doing modular stuff. Tony has strong design goals and guidelines that unify the module line, such as using an attenuverter on every input whenever possible, and always coupling any manual button with a gate input for maximum patchable flexibility. Much of the challenge with this module was balancing module panel size with features. How many parameters should we really expose on the panel? How can we make sure such a large module justifies its size with usefulness and power? These questions led to variations over the course of the design. I designed the brain board to be smaller than previous Make Noise digital brain boards, even though the Spectraphon had plenty of space for a larger brain board, to leave open the option of using it as the core of a much smaller module in the future.

The Spectraphon utilizes an entirely new development board for Make Noise digital modules. How did that design evolve and what are the advantages of this new design over previous Make Noise digital voice boards (in terms of processing power, I/O options, etc.)?

This one runs at a much faster clock rate, meaning more raw computing power, and as mentioned earlier, has much better noise specs. The 8 DC-coupled audio-rate outputs are combined with 8 DC-coupled audio-rate inputs, which opens up options for doing digital processing of input audio with multiple channels of synchronized audio rate control. That's very unusual in the modular synthesizer world.

ARTISTS' THOUGHTS ON
SPECTRAPHON

In the last 48hrs I have used Spectraphon in tandem with a toy piano, contact mics, trumpet, voice, radio, and an Autoharp—and I'm just getting started. I'm sharing this because it's rare to find an instrument (or module) that inspires so much creative curiosity, and Spectraphon truly feels like a playground for sonic adventurers.

Being able to analyze and resynthesize the spectra of any sound to create your own sounds on Spectraphon feels like a generous invitation to approach anything and everything like a musical instrument. Once those spectra are stored into Spectraphon, it's easy to precisely tune, manipulate, and morph between them to create endless timbres.

It's super exciting to see concepts from early Buchla designs carried on and re-imagined in innovative ways, and to see a creative take on additive synthesis and resynthesis in Eurorack format.

I feel like I'm interacting with sound in a completely new way, and I'm hearing sounds I've never heard before.
-Sarah Belle Reid

A handful of Spectraphons are already out in the world! Check out what people who have played them are saying about our new dual spectral oscillator:
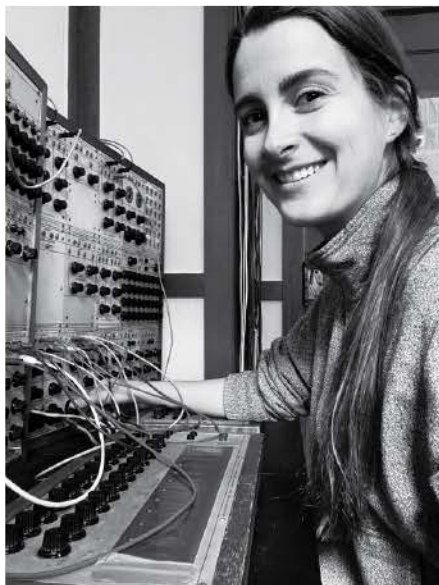
"Yes, the Spectraphon is a pretty huge module, but so is the sound. I rarely found so many sweet spots in such a short amount of time like with this module. It is a fantastic sound design module for sure, highly recommended!"
-Panic Girl

"Spectraphon has the unique ability to be several wildly different sounding sound sources and processors all at once. From low end dirge, crisp FM, to gorgeous glassy tones, this thing does it all in one box with it's own modulation possibilities. Fantastic and novel approach to digital oscillators"
-Brett Naucke

"You can get a world of sound from a complex oscillator, but never before have your dual VCOs been spectral processors, oscillators or both. Spectraphon is voltage controlled impressionism, rendering loose and colorful brush strokes from any audio source. It's a 'changeling.'"
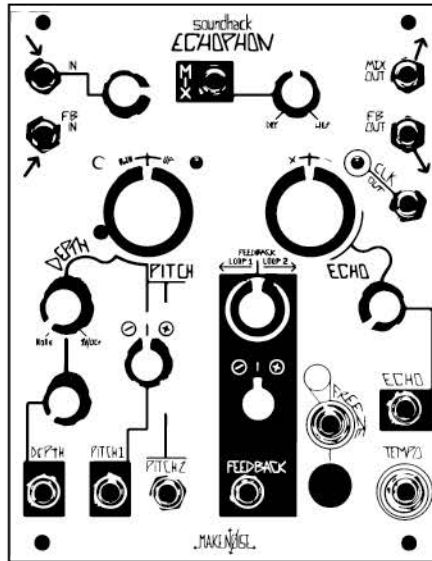**-Robert Pabst (Cinematic Labs)**

soundhack

The Spectraphon is a collaboration between Make Noise and Tom Erbe (Soundhack), and it marks the sixth Make Noise module to feature Soundhack on its faceplate! Take a trip with us down memory lane as we revisit the results of Tony & Tom's collaborative history:
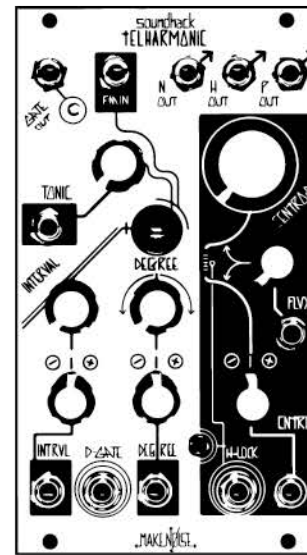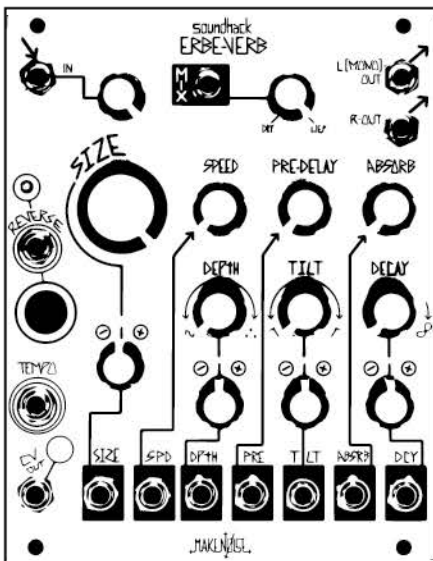
tELHARMONIC (2015)

Three digital synthesis engines covering a massive array of sounds (and electronic music history), the tELHARMONC was inspired by Thaddeus Cahill's Telharmonium (1897), "Analog 1: Noise Study" by James Tenney, (1961) and early commercial digital synthesis (1980s)

Echophon (2012)

Inspired by the Tempophon tape based pitch and time modulator, the Echophon features a v/oct-tracking pitch shifter, patch-able feedback loop and Hold function, the Echophon was one of the first modules of its kind when it made the Eurorack scene in 2012.

Morphagene (2017)

A tape music studio in a module, the Morphagene allows for the recording, splicing, organizing, time stretching (and more) of audio signals in stereo (without the use of razor blades!!)

Erbe-Verb (2014)

A "mode-less," continuously variable reverb algorithm, the Erbe-Verb allows for complete customization **and modulation** of traditional reverb parameters such as Size, Color and Absorb all under complete voltage control!
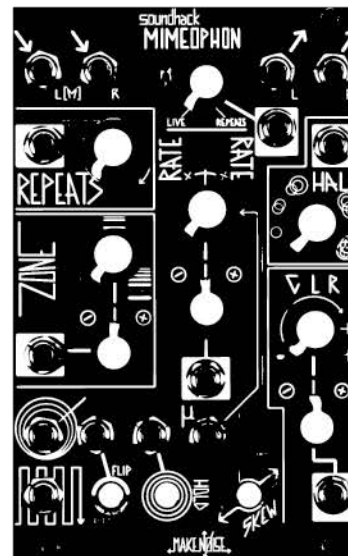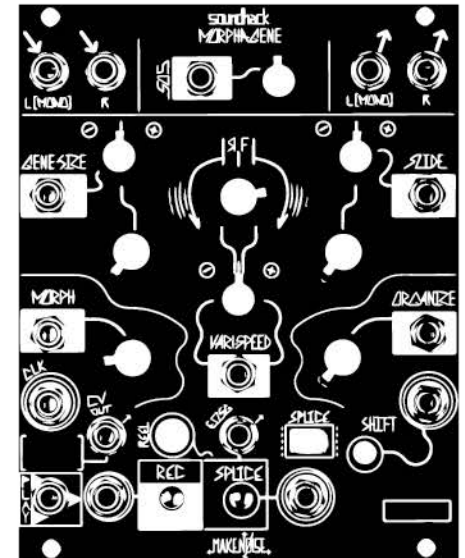
Mimeophon (2019)

A stereo color sound repeater, the Mimeophon creates digital echoes across seven Zones of time ranges, with filtering and reverb in its feedback, along with stereo offsets, all under voltage control!

WHAT IS THE MA KE NOISE CREW LISTENING TO?

Devin
Graham Lambkin - "Salmon Run"
Magic Tuber Stringband - "Tarantism"
Universal Cell Unlock - "Level Repulsion"

Rodent
Depeche Mode - "Momento Mori"
Tony Rolando - "Absent from the Void"
Frontline Assembly - "Tactical Neural Implant"

Lewis
Landon George - "Red-Tailed Hawk"
Nilüfer Yanya - "Painless"
Thin Lizzy - "Live and Dangerous"

Lee
George Strait - "Nobody In His Right Mind Would've Left Her"
"Return Of The Living Dead" theme
Project Pat - "Life We Live"

Walker
De La Soul - "Buhloone Mindstate"
Tyondai Braxton - "Telekinesis"
Lucrecia Dalt - "¡Ay!"
Fever Ray - "Radical Romantics"

Kelly
Vivien Goldman - "My Bestie & My Bff"
"Treatment 1" by Tony Rolando, unreleased
Amadou & Mariam - "Bofou Safou"
Here's one more just for fun: "Untitled One" by King Britt & Tyshawn Sorey

Jon
Elder - I"nnate Passages"
La Unión - "El Maldito Viento"
Mammoth Volume - "The Cursed Who Perform the Larvagod Rites"

Bayley
Cabo Boing- "Real Gems for Little Jewels"
Macula Dog- "Orange 2"
Mas Guerrero- "Hired Goons"

Natasha
Oksana Linde - "Aquatic and Other Worlds"
Wajeed - "Memoirs of Hi-Tech Jazz"
Kelela - "Rave"n

Newt
More Eaze - "oneiric"
Omodaka - "ZENTSUU: Collected Works 2001-2019"
Rosalía & Rauw Alejandro - "RR"

Jake
Ryuichi Sakamoto - "12"
Kate NV - "WOW"
Carmen Jaci - "Happy Child"

Tony
Romance - "In My Hour Of Weakness, I Found A Sweetness"
Eluvium - "(Whirring Marvels In) Consensus Reality"
Andy Loebs - "Hyperlink Anamoorphosis"

Pete
Cosey Mueller - "Irrational Habits"
Anadol - "Uzun Havalar"
Alice Coltrane - "Turiya Sings"

STREGA
MUSICA

DOWNLOAD STREGA MUSICA TODAY!

"Strega Musica" is a free collection of music on Bandcamp created with Strega, an instrument designed in close collaboration between Make Noise founder Tony Rolando and Alessandro Cortini.

It features exclusive tracks by Abul Mogard, Ben Frost, Caterina Barbieri, Daniel Avery & Manni Dee, Hiro Kone, Daniel Miller, Robert Aiki Aubrey Lowe, Julianna Barwick, Kali Malone, Marta Salogni, Alessandro Cortini and Tony Rolando!

Use this QR code or head to https://makenoisemusic.com/strega-comp for a free download!

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