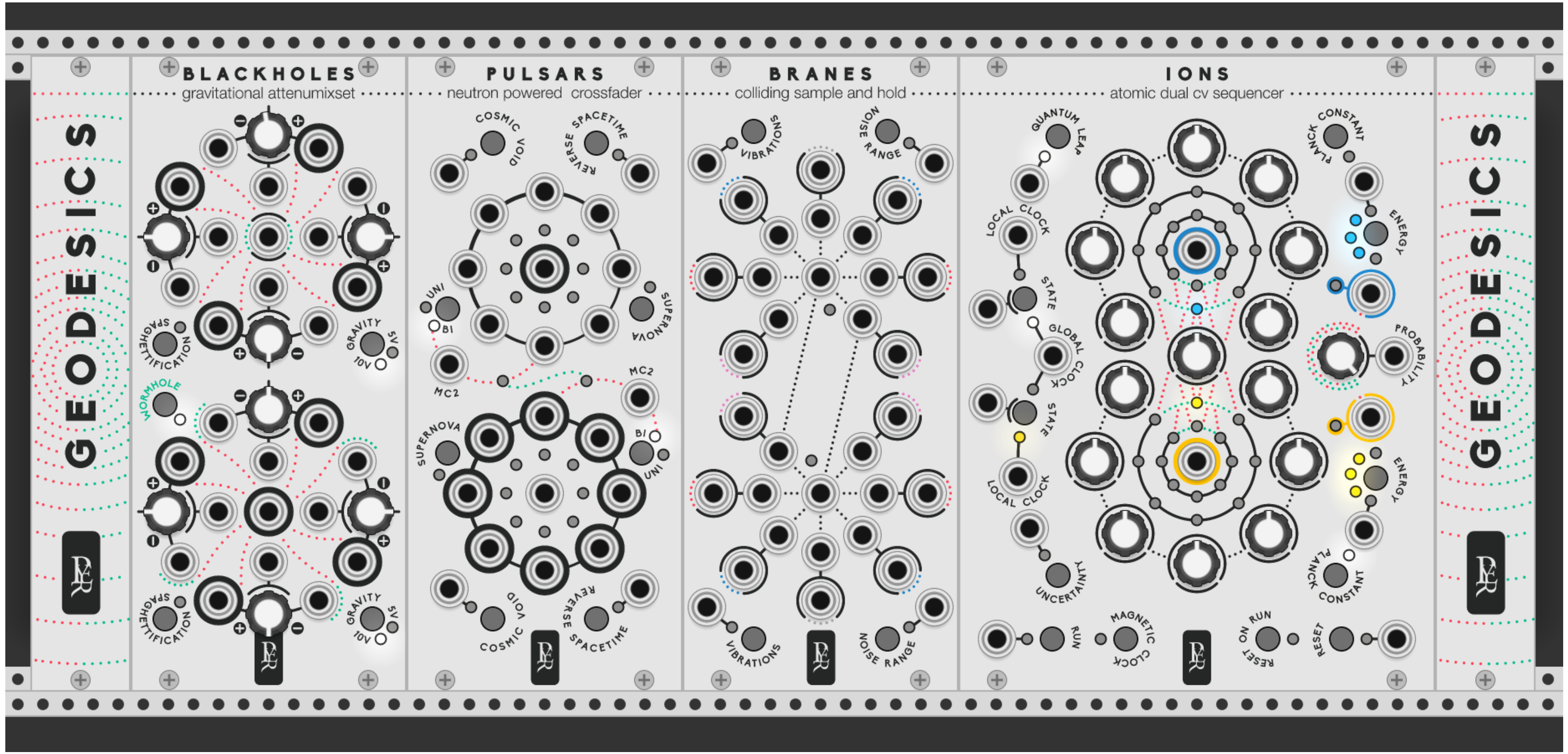


# GEODESICS

A modular collection for VCV rack by Pyer & Marc Boulé

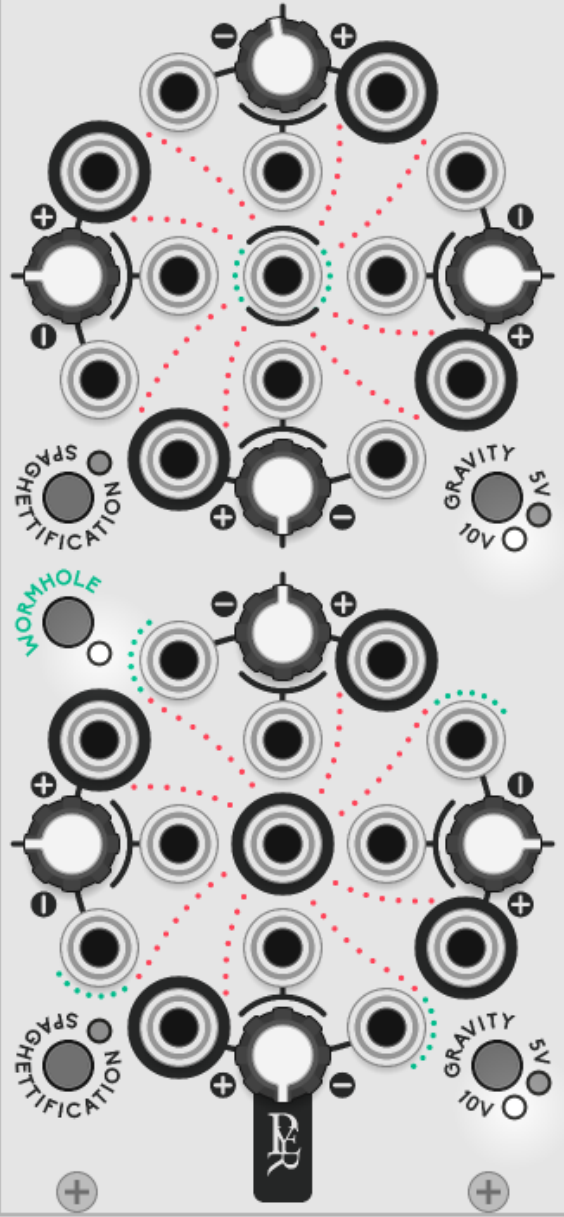


User Manual - version 0.6.4



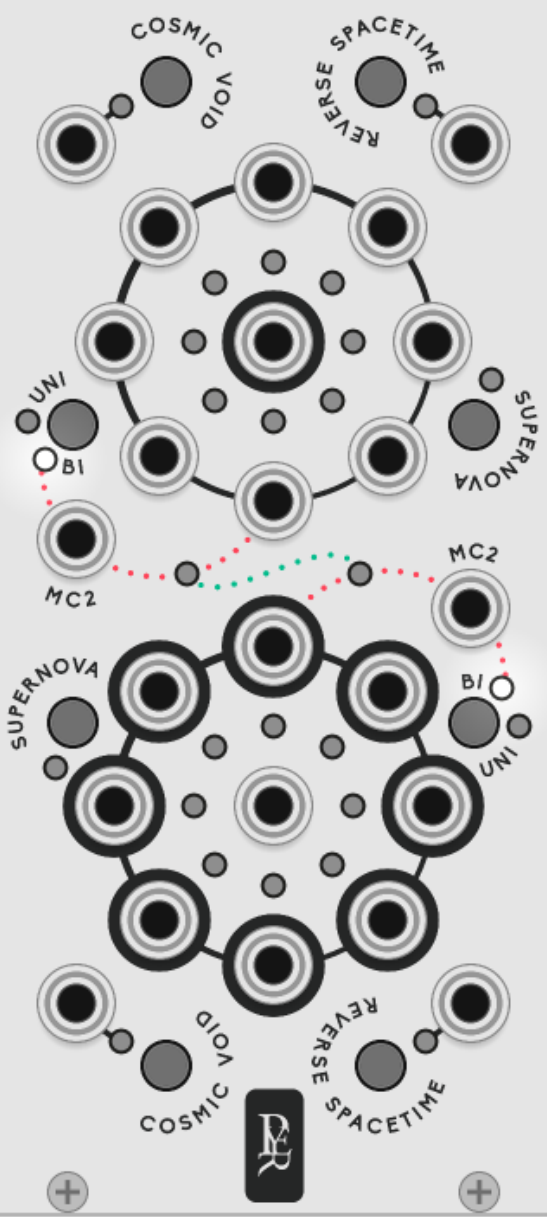
**BLACKHOLES**

gravitational attenuator



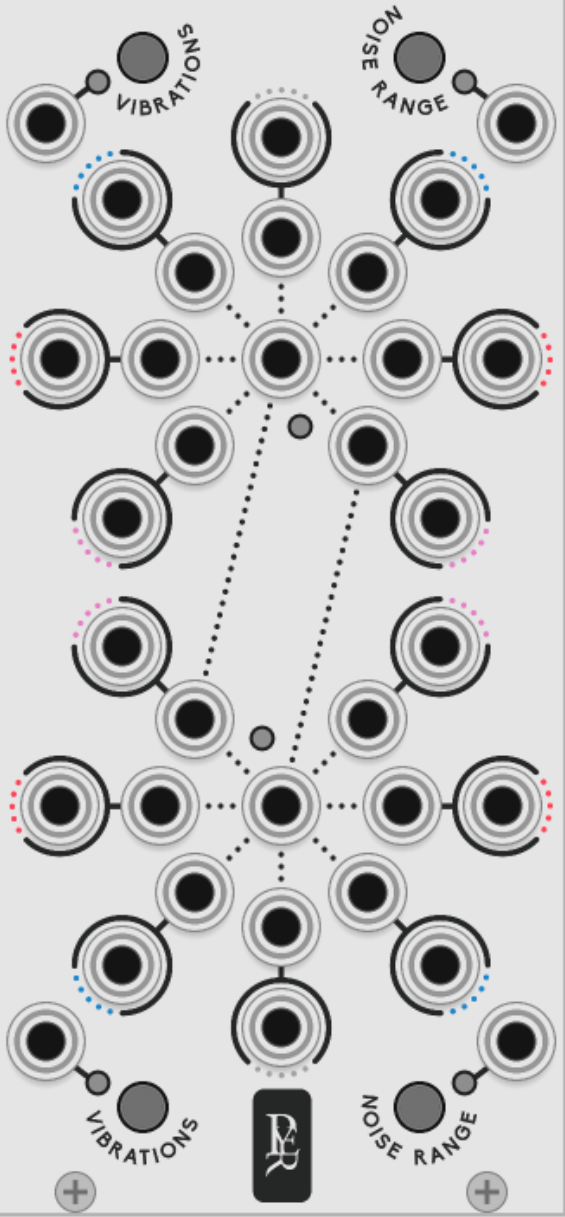
**PULSARS**

neutron powered crossfader



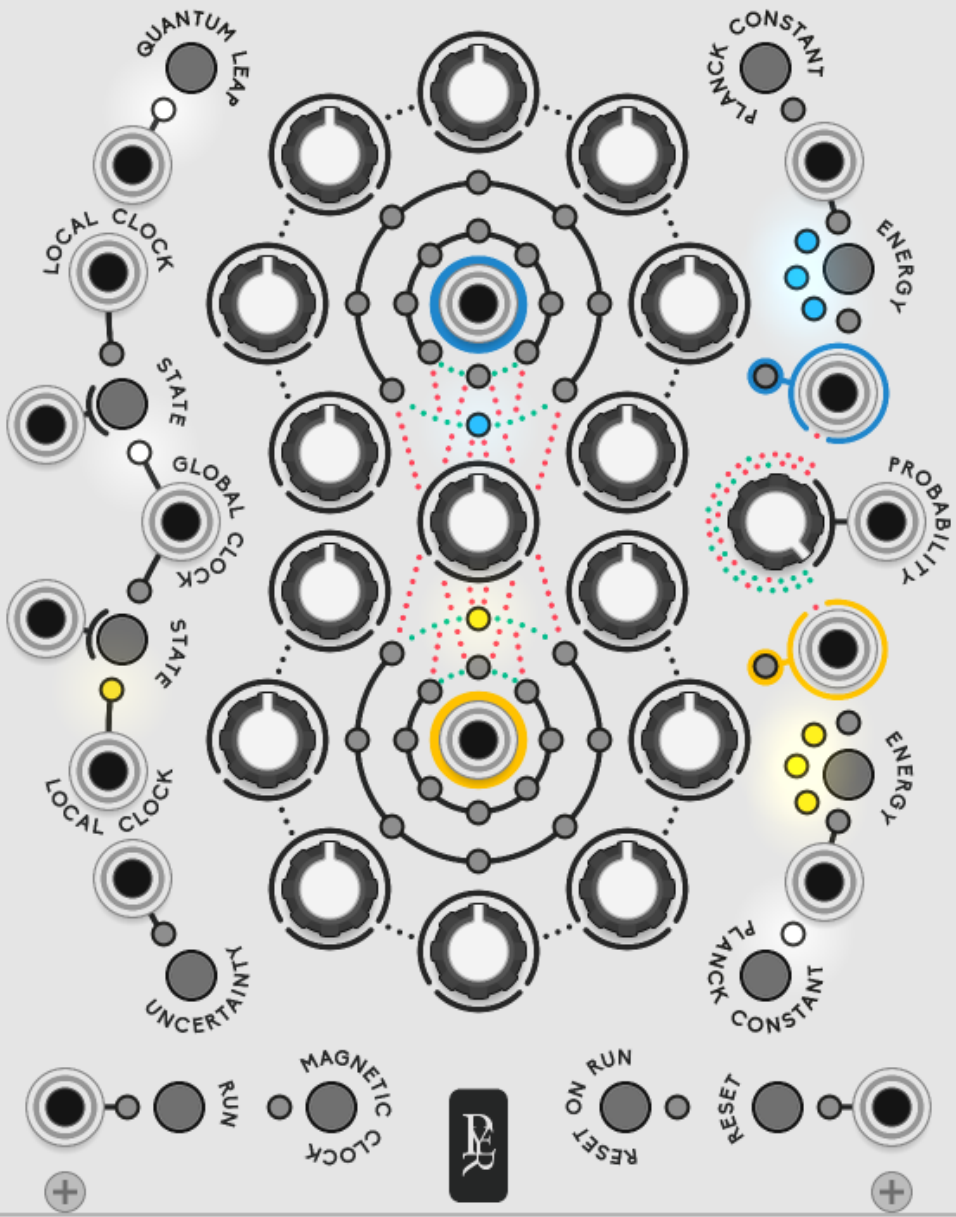
**BRANES**

colliding sample and hold



**IONS**

atomic dual cv sequencer

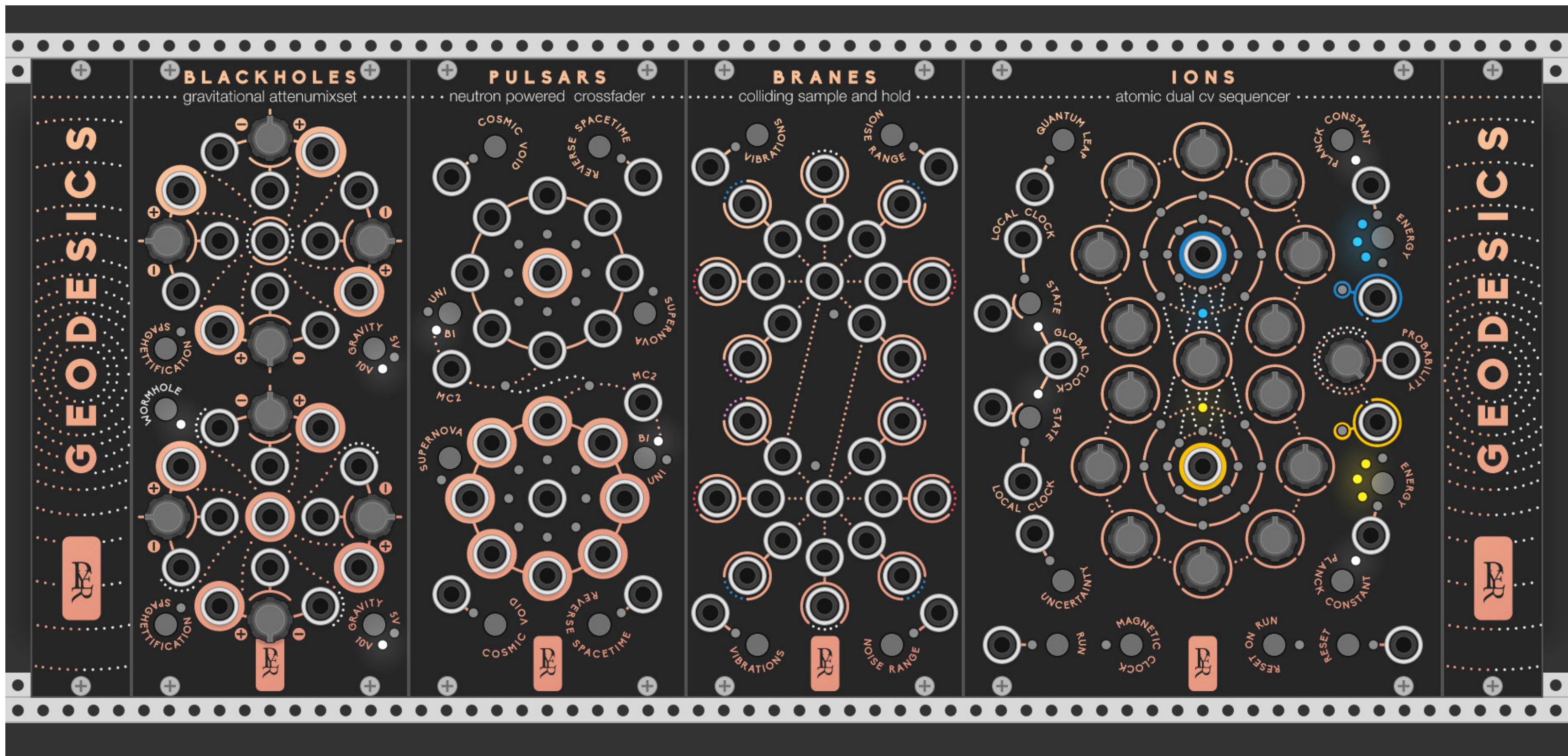


GEODESICS

GEODESICS







# PHILOSOPHY

science inspires music

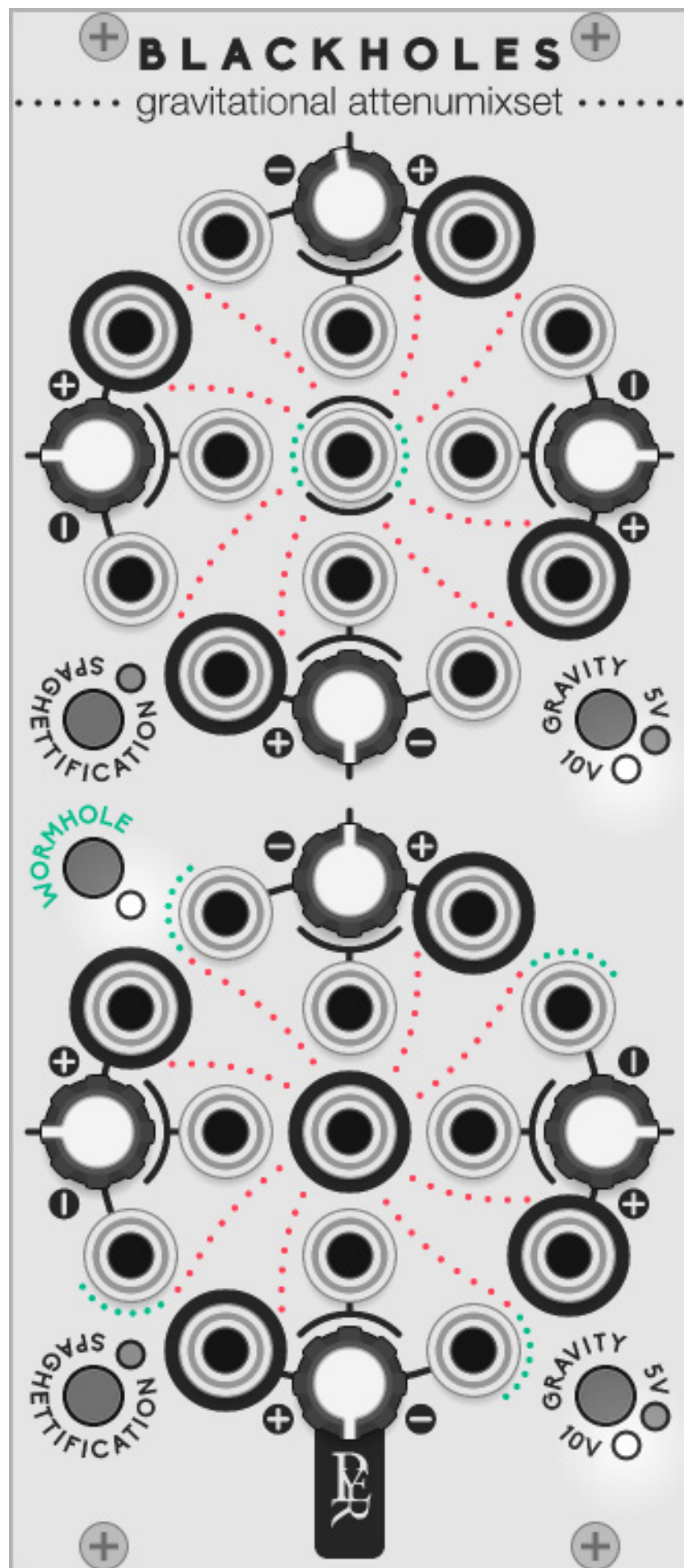
The modules are loosely inspired by astronomic events and physical theories. The goal is just to see how science can inspire us to create new music.

Every module must be feasible in the hardware world, interacting elements must be only knobs, buttons, LEDs and serigraphy. Right click must be avoided as much as possible.

For a more immersive concept, every parameter displayed uses terms related to the scientific phenomenon that inspires the module. It might be confusing at first but that's why this manual is here.

While a lot of advanced science is involved, the final purpose is to create musical and creative instruments, effective and friendly to use.



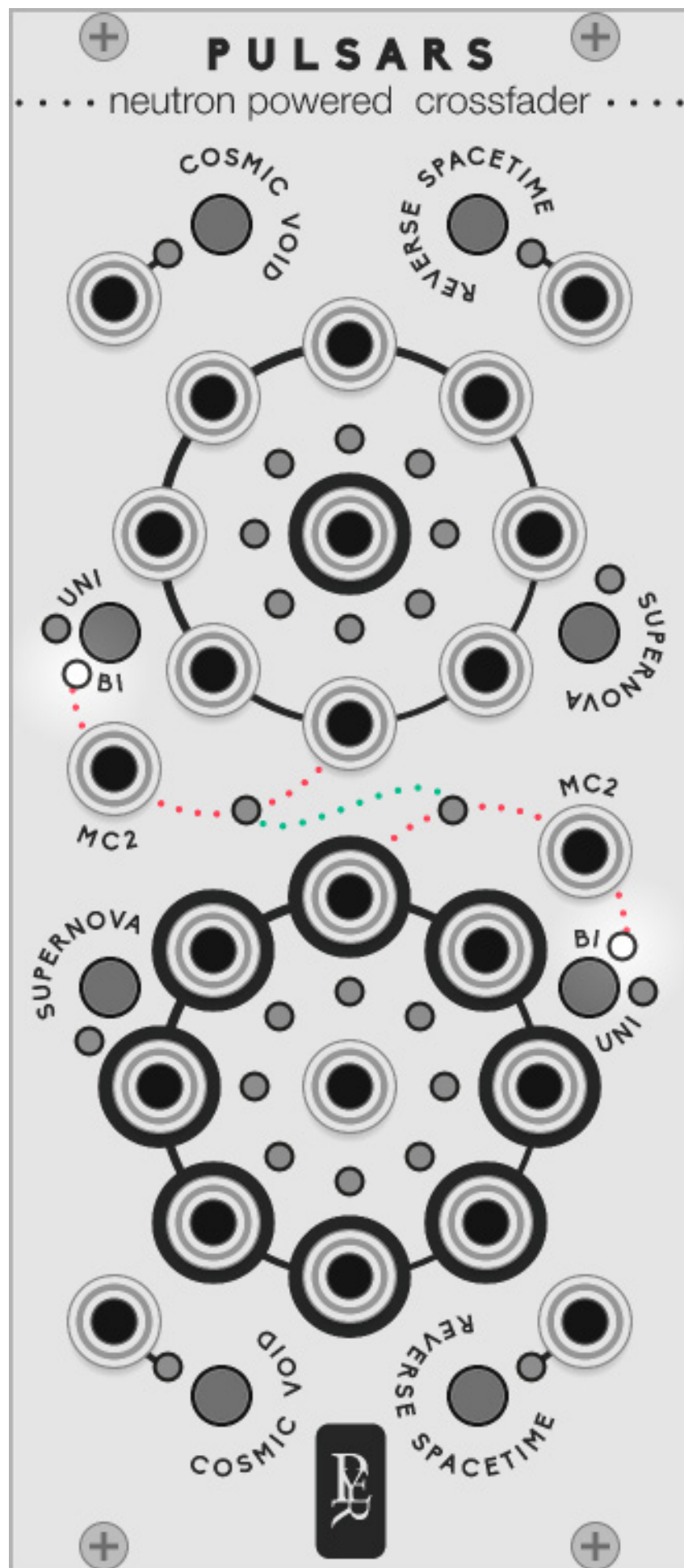


# BLACK HOLES

gravitational voltage controled amplifiers

A black whole attracts everything that gravitates around its centre, even audio and CV signals...

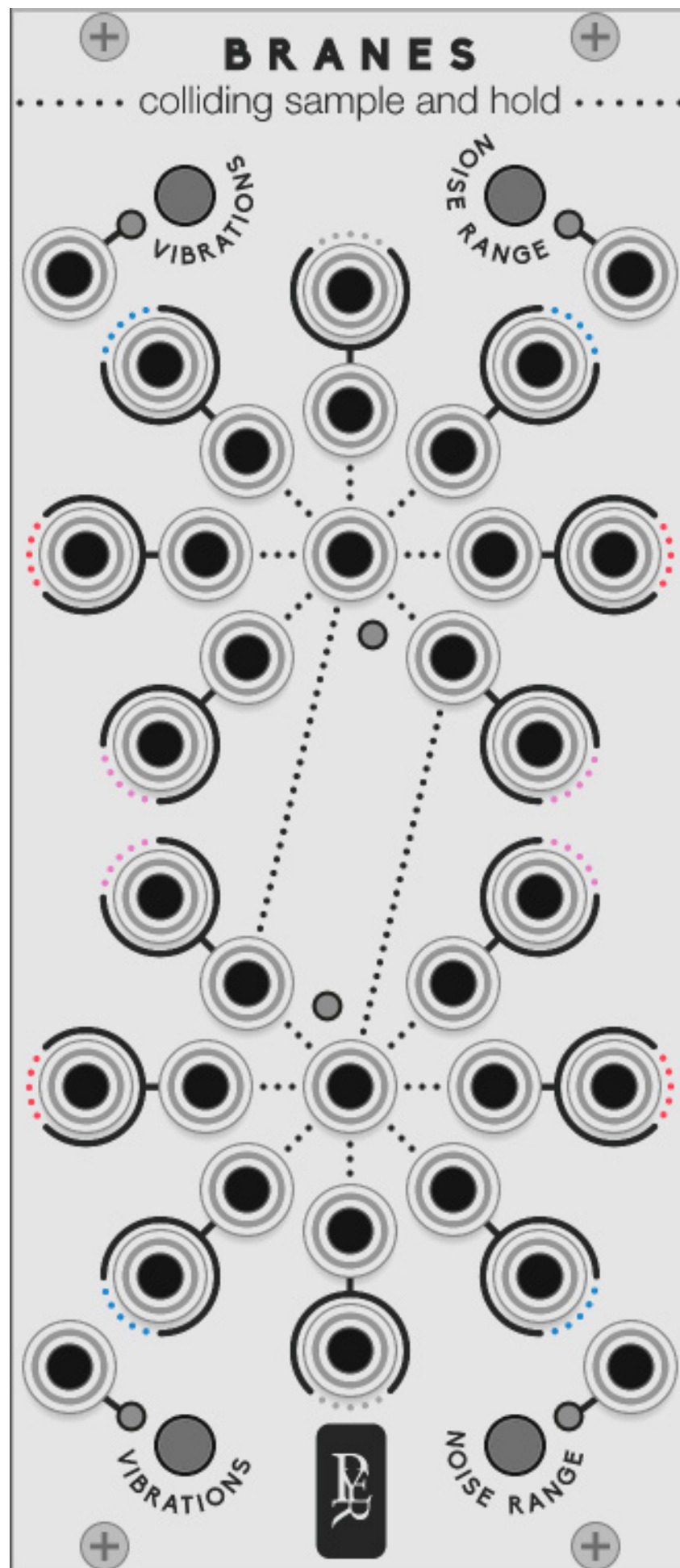
**BLACK HOLES** is 8 vcas in two groups of 4, it's also two mixers with 4 channels each.



# PULSARS

neutrons powered rotating crossfader

A pulsar is a star rotating around its axis and emitting very high and precise frequencies on its spinning axis. **PULSARS** is a rotating 8 to 1 and 1 to 8 selectors with crossfade in between each signal. It can be used to create cross fade mix of audio, complex wave tables with CV, standard sequential switch or extreme effects when turning at audio-rate speed.



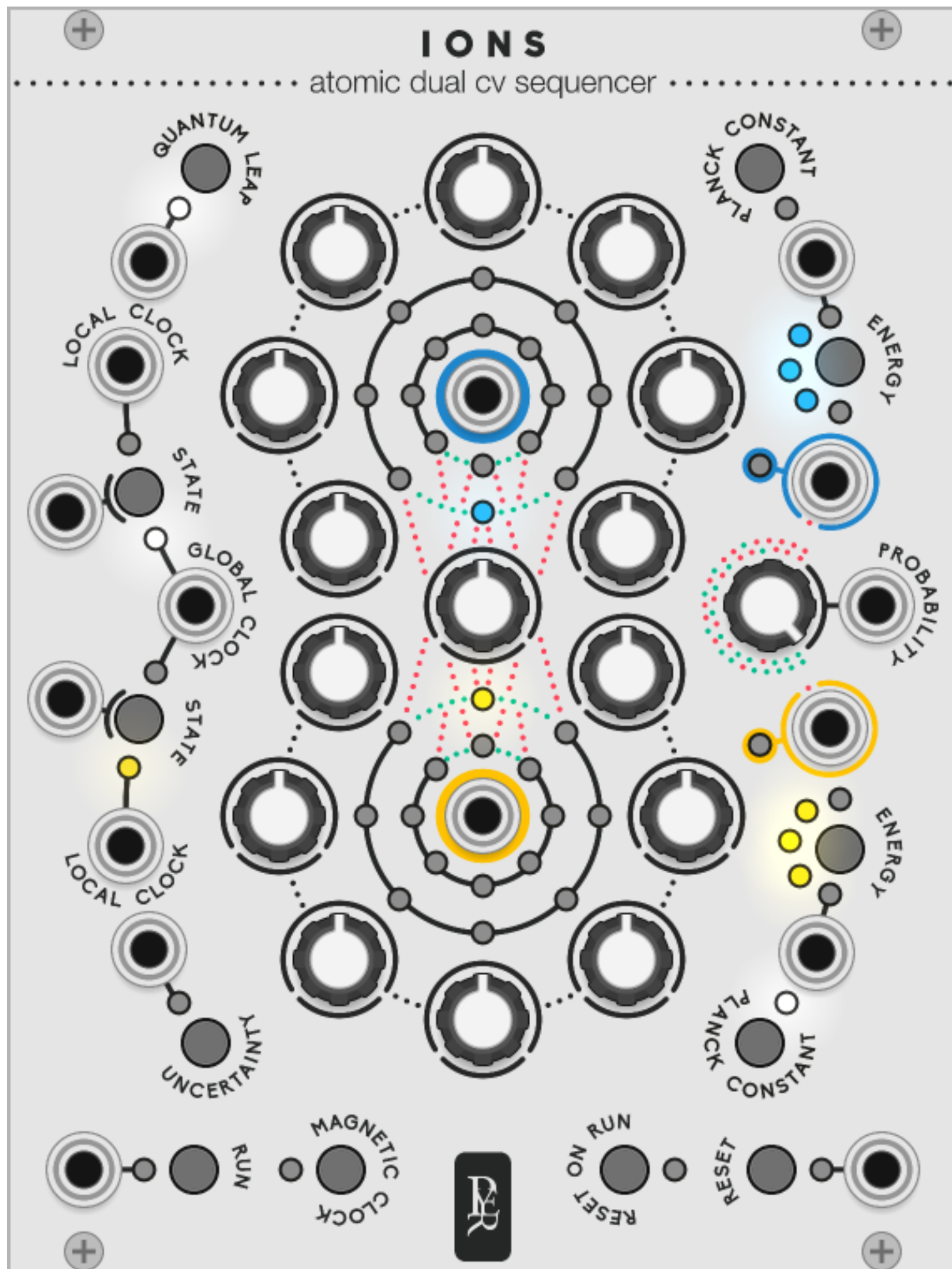
## BRANES

colliding sample and hold

Branes are multidimensional objects involved into the ekpyrotic universe theory that describes two parallel universes colliding to create our world...

**BRANES** is 2 groups of seven S&H driven by the same trigger source. Two of them receive added trigger clocks for polyrhythmic effects.





# IONS

atomic duophonic voltage sequencer

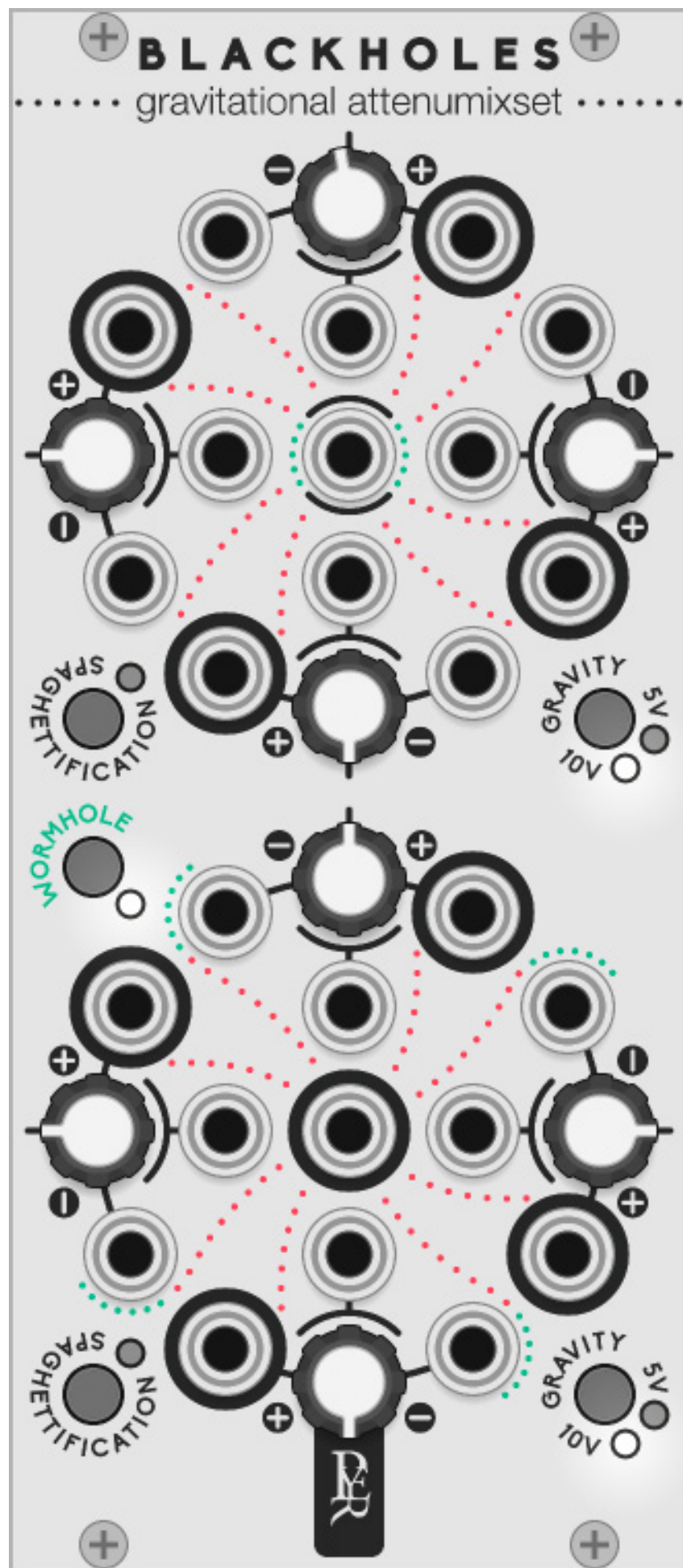
An Ionic bond describes two atoms that exchanges electrons.

**IONS** is a two voices sequencer. While each voice has its own sequence, they can exchange their sequences as easily as an electron can jump from one atom to another.



# GEODESICS

In Depth Concept

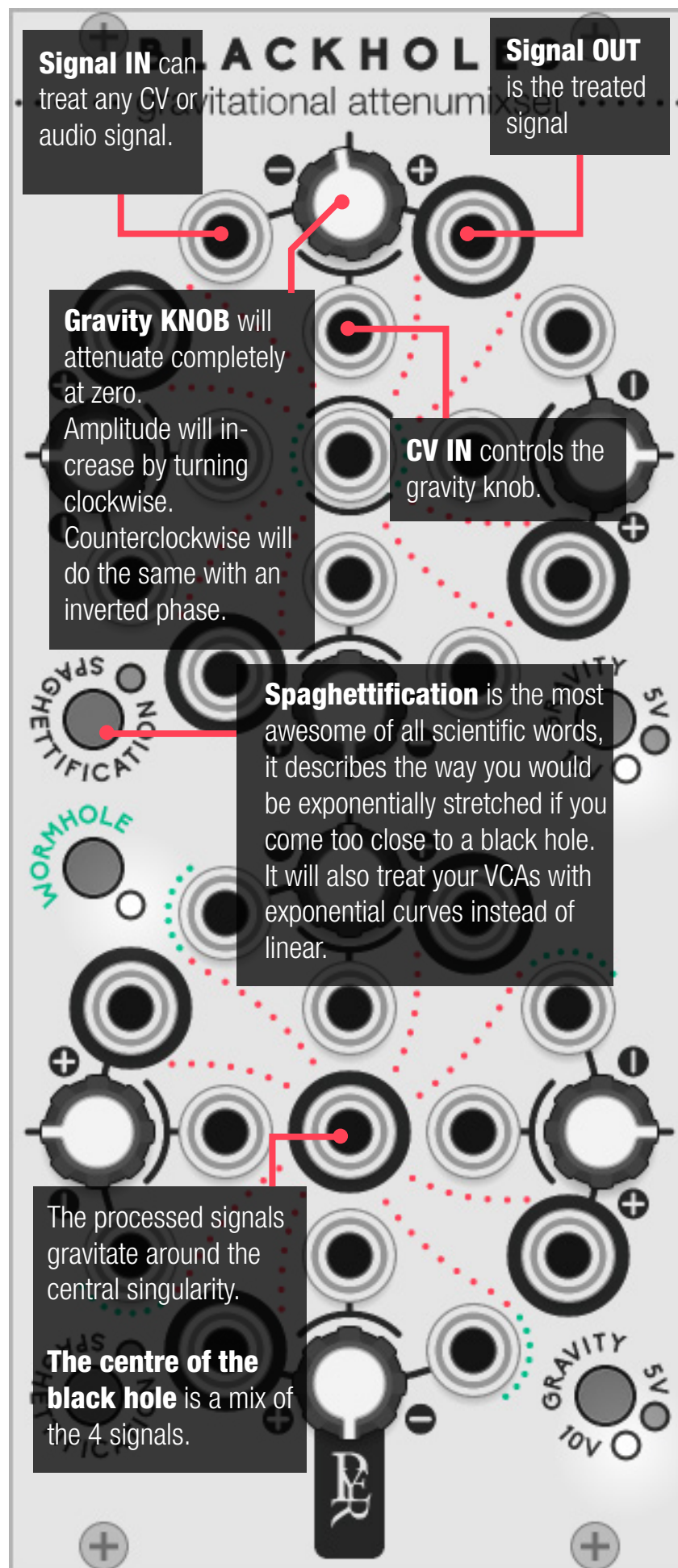


# BLACK HOLES

gravitational voltage controled attenuumixset

A black whole attracts everything that gravitates around its centre, even audio and CV signals...

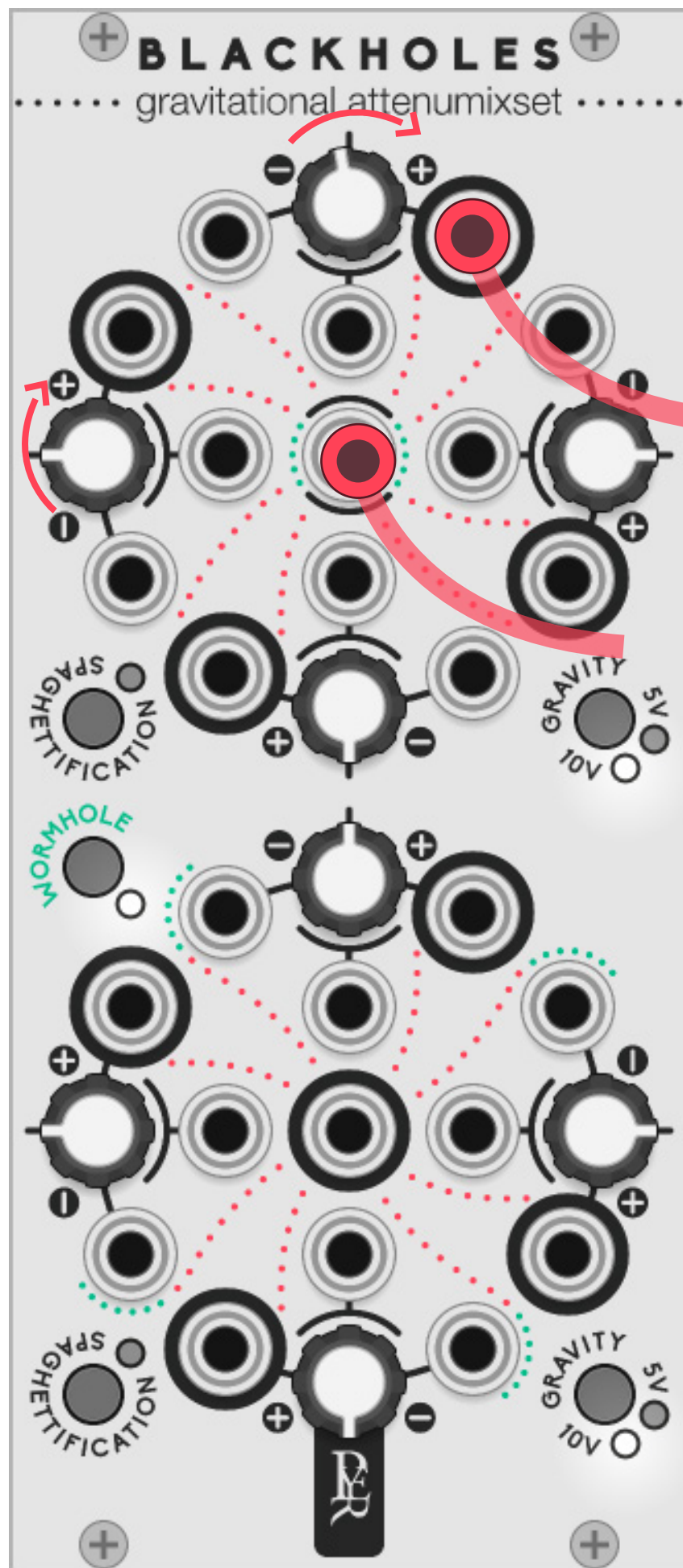
**BLACK HOLES** is 8 vcas in two groups of 4, it's also two mixers with 4 channels each.



# BLACK HOLES

gravitational voltage controlled attenuumixset





# BLACK HOLES

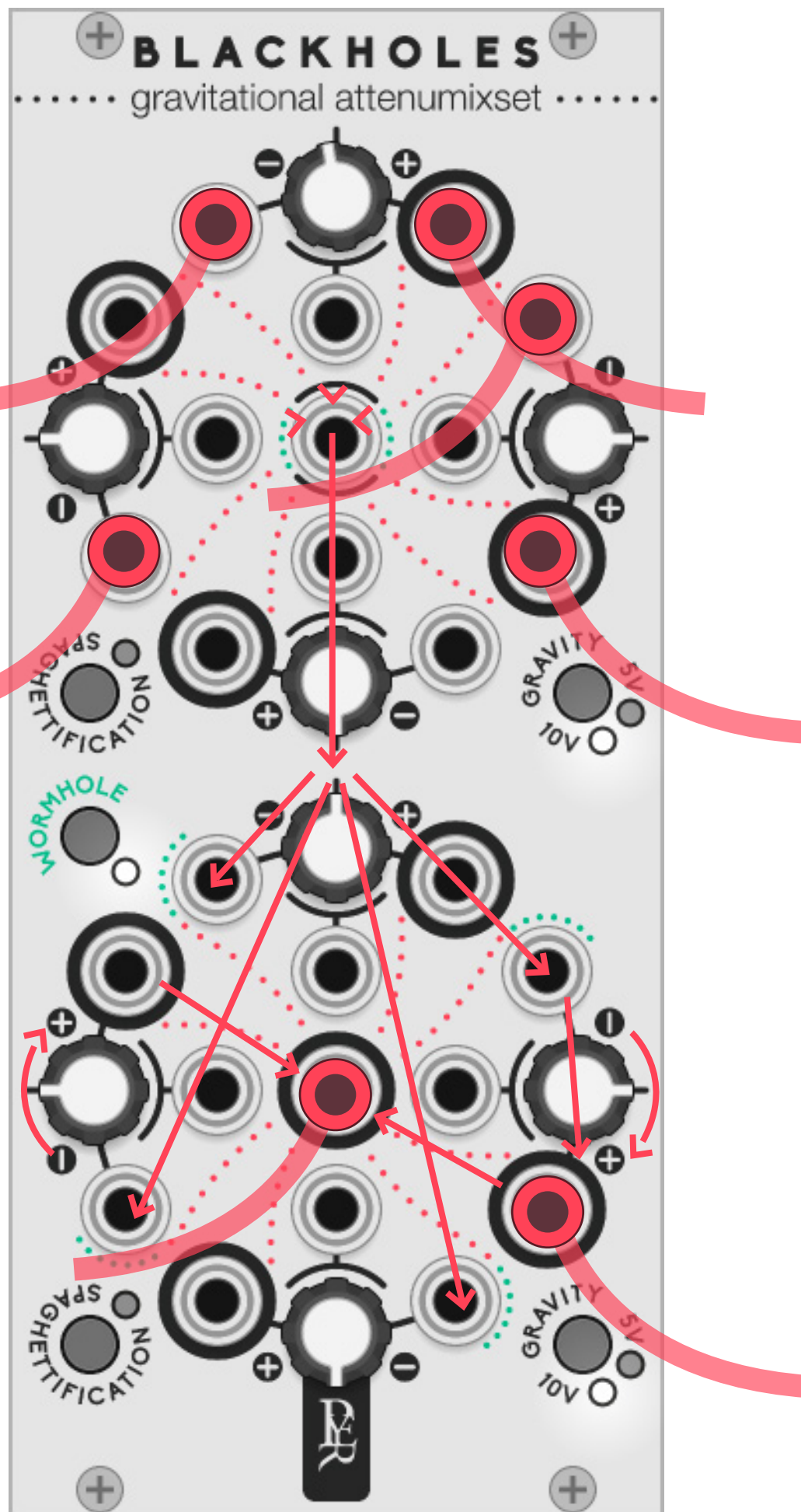
gravitational voltage controlled attenumixset

## Mass control

When no input is plugged in, the knob acts to the output as a fixed CV generator. The centre still acts as a mixer. The values of the gravity knobs are all summed up in the mixer.

## Gravity control

The modulation input can be set to  $\pm 10$  volts for envelope and gate sources, or  $\pm 5$  volts for LFO and VCO sources.



# BLACK HOLES

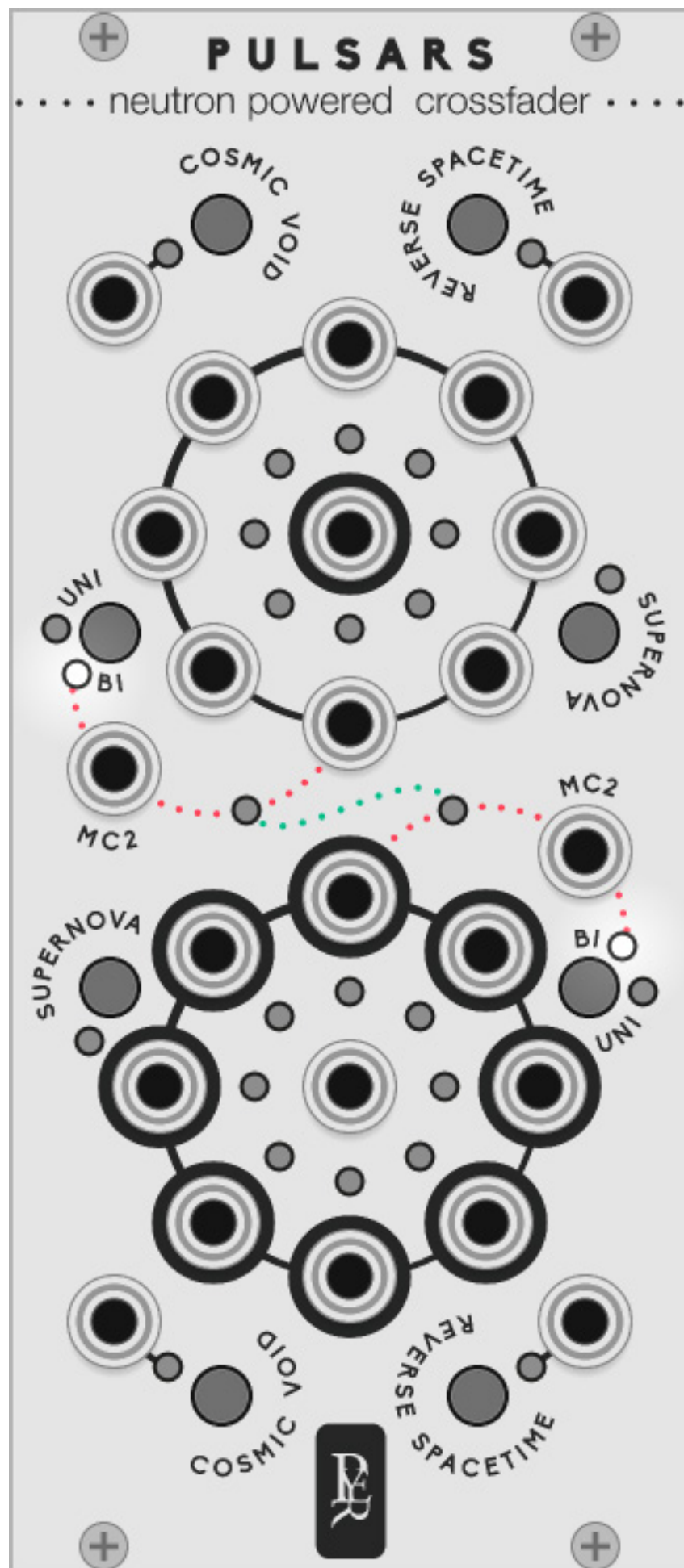
gravitational voltage controlled attenuumixset

## The Worm hole

No one knows what is inside a black hole. Some people think there could be a worm hole to a "white hole" that ejects everything the black hole has absorbed...

Black Hole 2 can become a white hole. The mixed signal from Black Hole 1 travels through the wormhole and feed the unused inputs of Black Hole 2. It then becomes a 1x4 multiplier. The signal can be treated differently by each output. The worm hole can be closed if needed with the button.

The mass control combined with the worm hole trick will manage both amp and offset of an external signal.

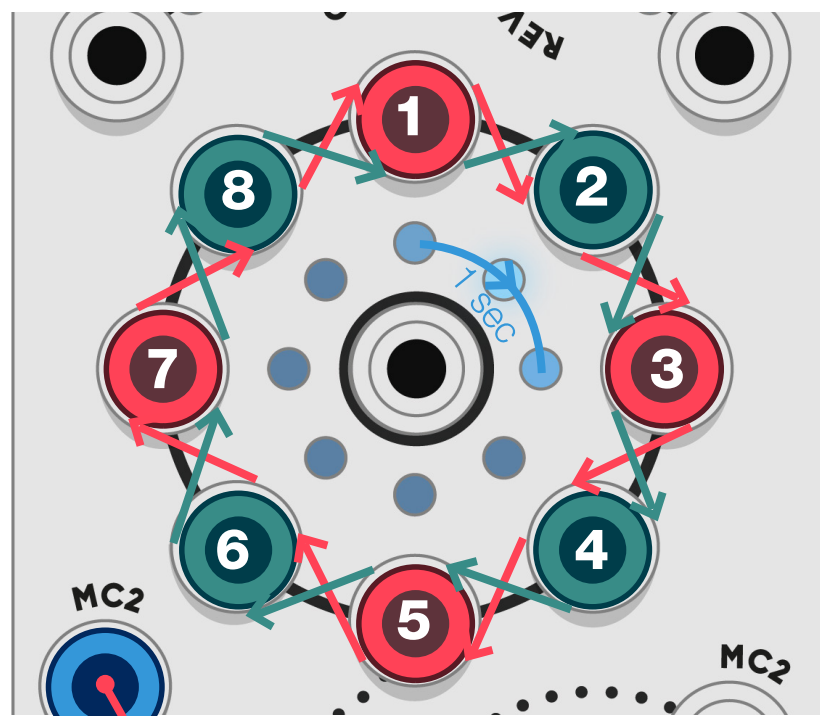


# PULSARS

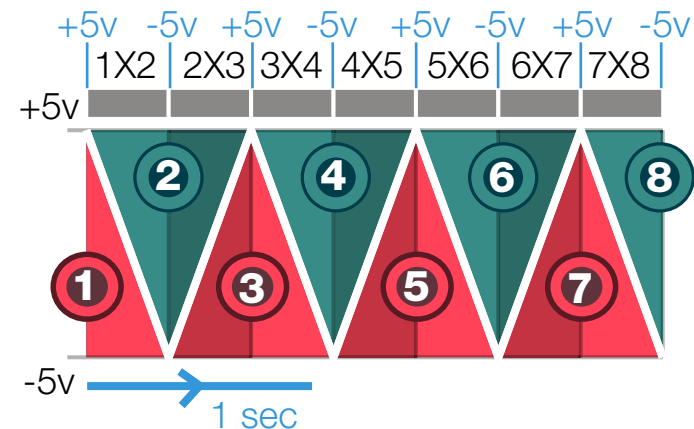
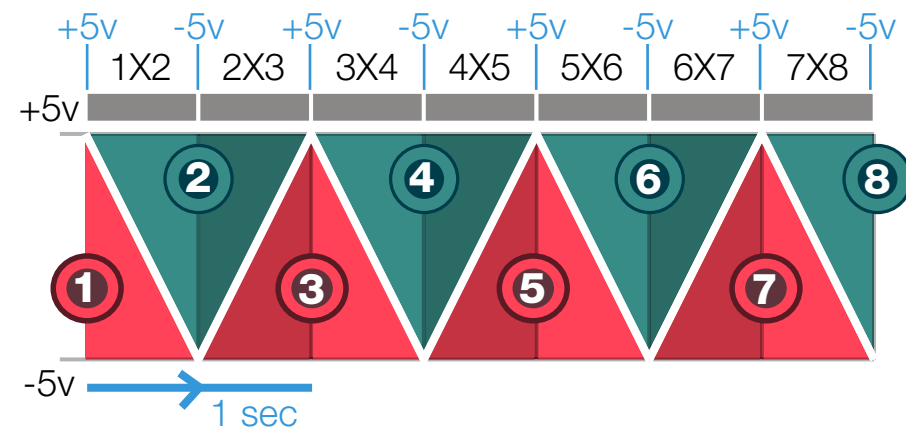
neutrons powered rotating crossfader

A pulsar is a star rotating around its axis and emitting very high and precise frequencies on its spinning axis. **PULSARS** is a rotating 8 to 1 and 1 to 8 selectors with crossfade in between each signal. It can be used to create cross fade mix of audio, complex wave tables with CV, standard sequential switch or extreme effects when turning at audio-rate speed.





white line on the graph +/- 5 volts



At each peak, PULSAR starts another crossfade sequence. Any value between +5 and -5 will be interpreted as a mixed value between the first and the second source.

The speed of the sequence is defined by the rate of the MC2 Signal.

# PULSARS

neutrons powered rotating crossfader

MC2 is the energy needed for a pulsar to spin on itself.

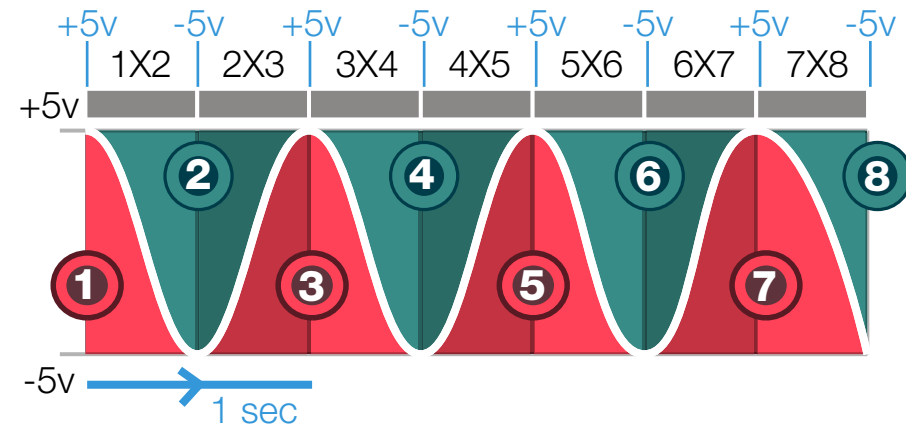
Pulsars needs a 5v binaural CV signal to power its rotation (**MC2 IN**). When no MC2 is connected to the second pulsar, they are both driven by the first MC2

The first connected cable defines the start of the cycle

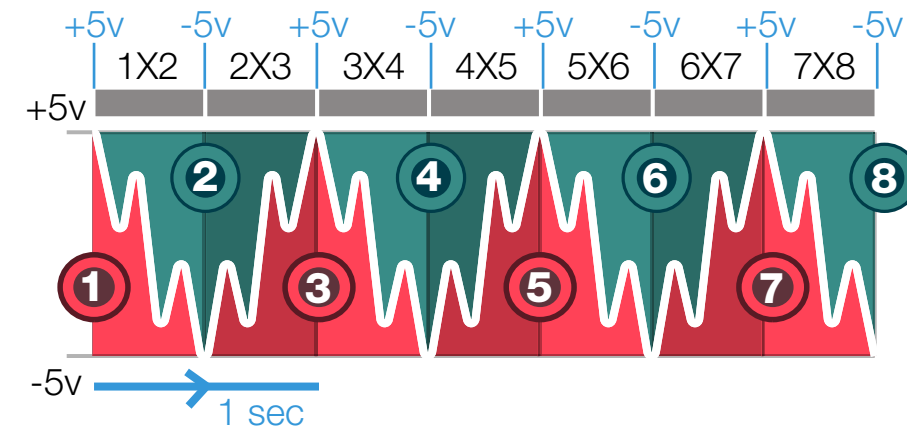
The rotation starts at **source 1** when it receives +5v.

It will reach **source 2** when it receives -5v

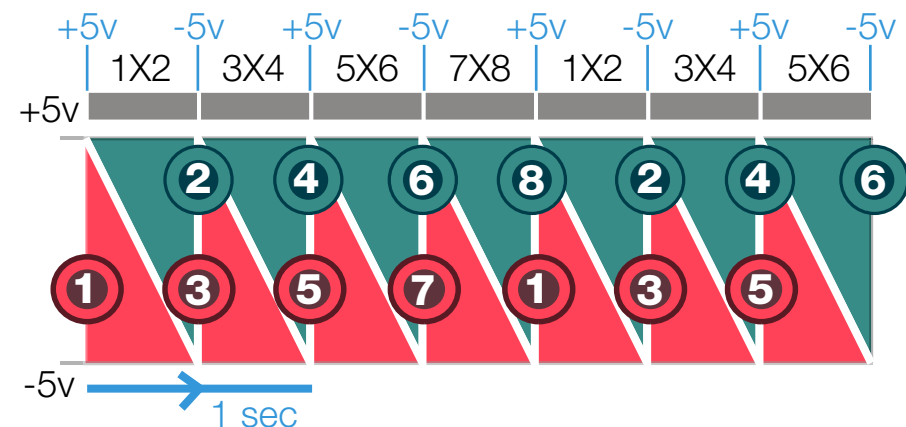
It will reach **source 3** when it receives +5v...



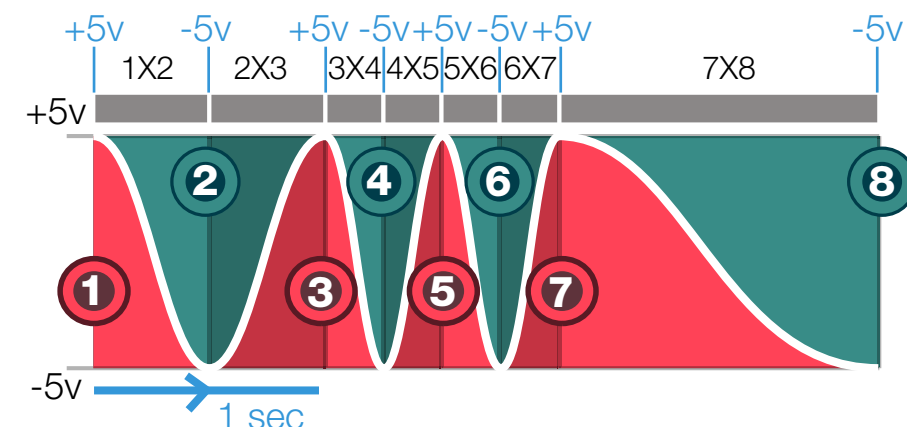
**A triangle wave** will make linear crossfade, while a **sine wave** will create an exponential cross-fade



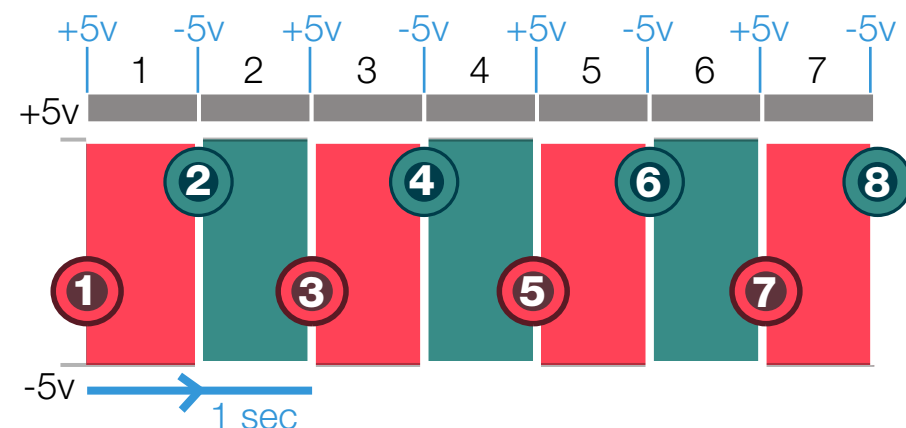
**A folded wave** source will create backwards and forwards effects



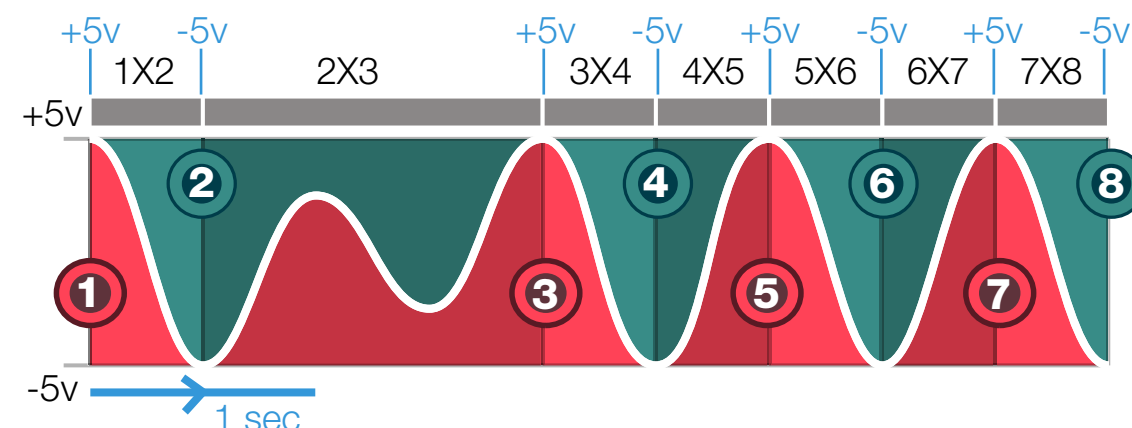
**A sawtooth wave** will switch from one step to another without transition



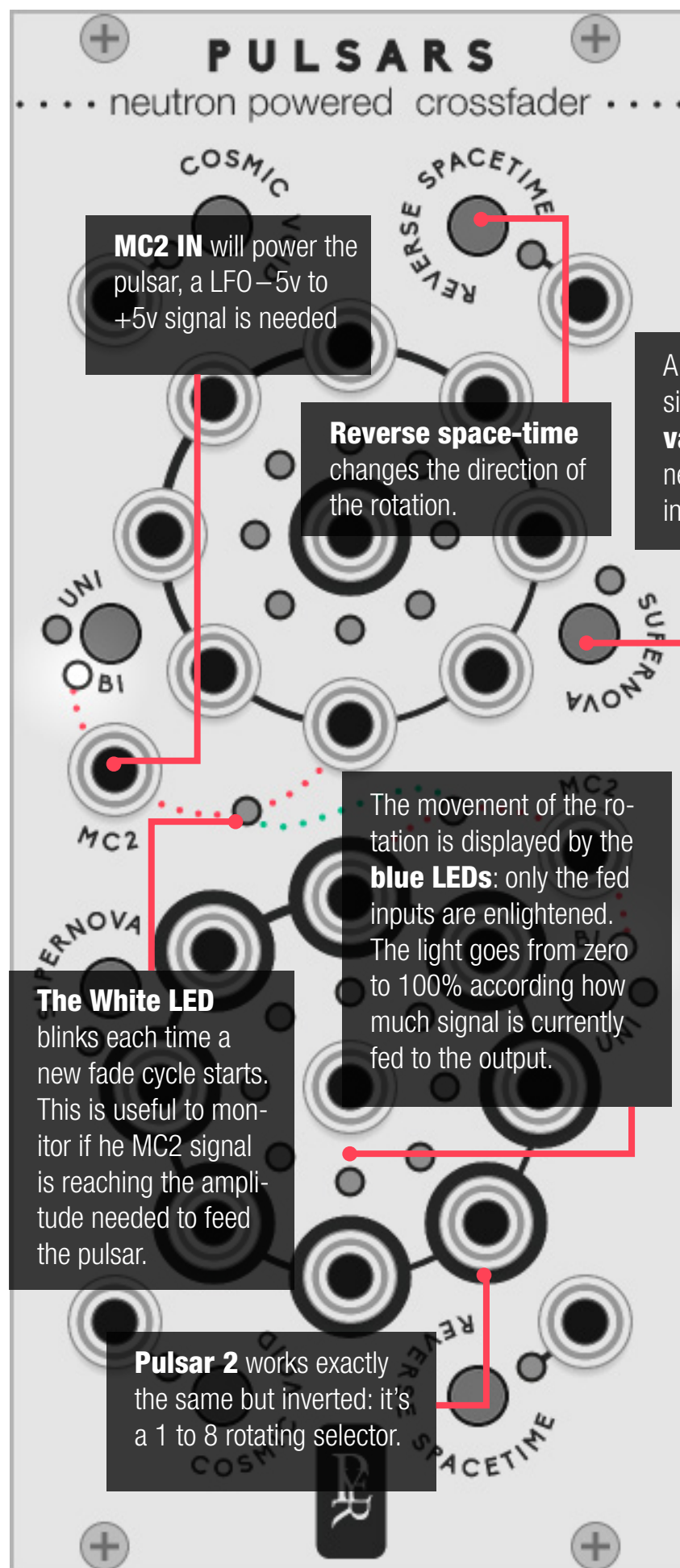
**Modulating the rate** of the signal will make some steps shorter and can create some rhythmic variations



**A square wave** won't create a cross fade effect, it can then be used as a standard sequential switch.



**Modulating the amplitude** of the signal can create some interesting rhythmic effects as it only switches to the next step when it reaches +/- 5 volts.

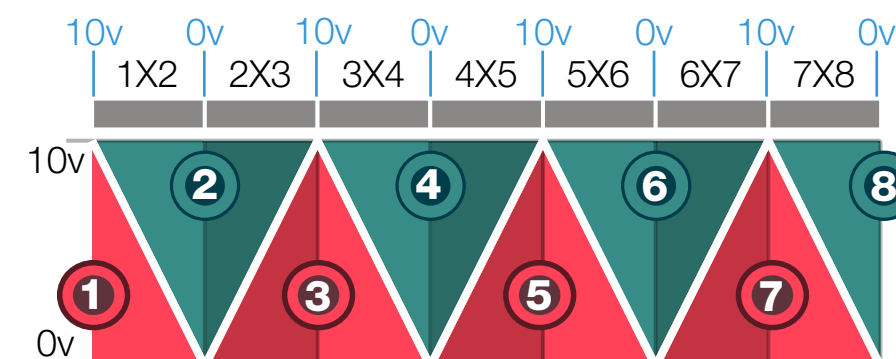


# PULSARS

neutrons powered rotating crossfader

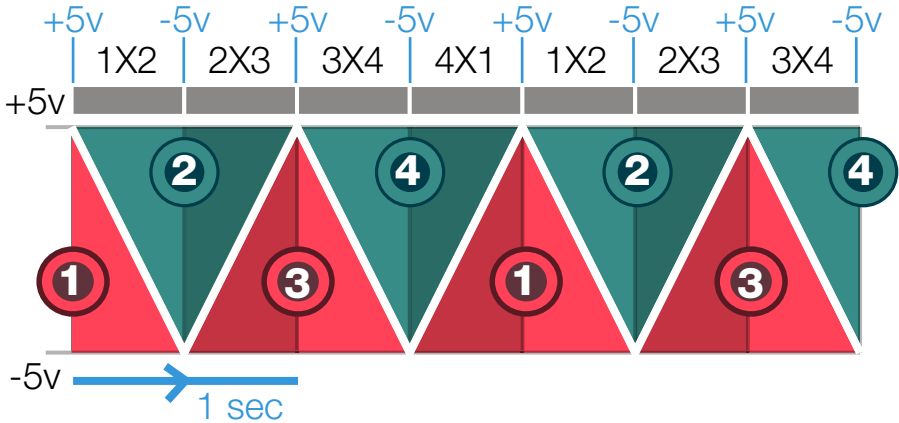
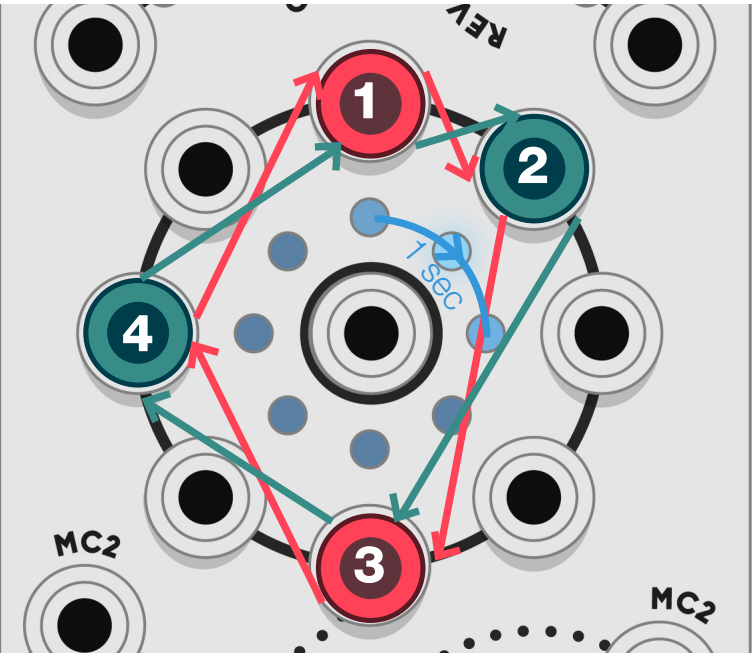
## Unipolar - Bipolar

The MC2 is set to receive a  $\pm 5\text{V}$  bipolar signal. When configured to Unipolar, This will set the MC2 to receive a 0/10V to react with envelope generators. A new cycle will be started each time the MC2 Signal reaches 0 or 10 Volt.

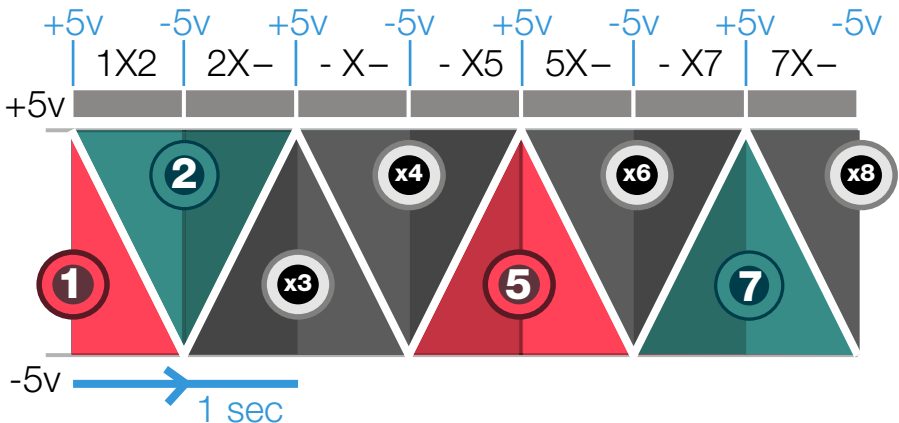
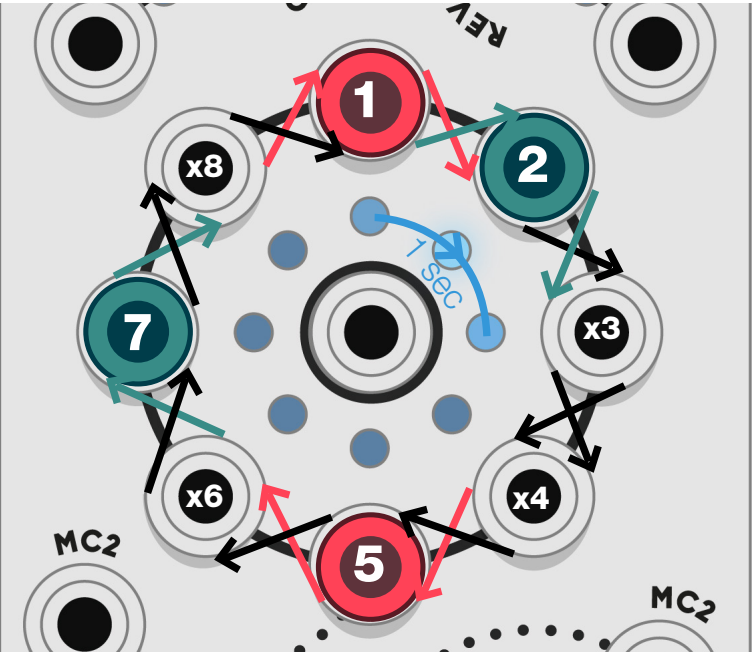




Cosmic void mode **OFF**



Cosmic void mode **ON**



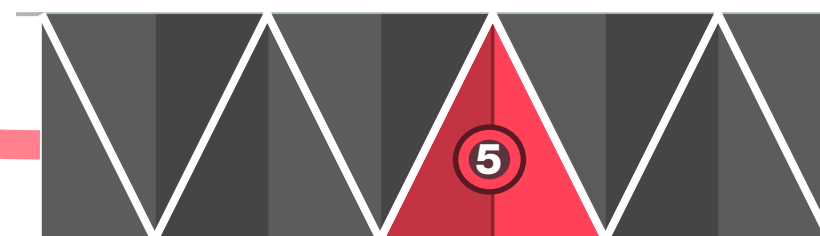
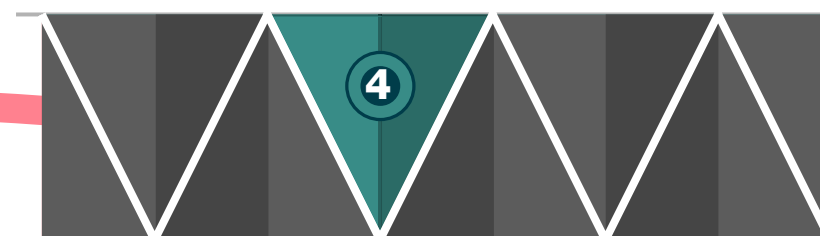
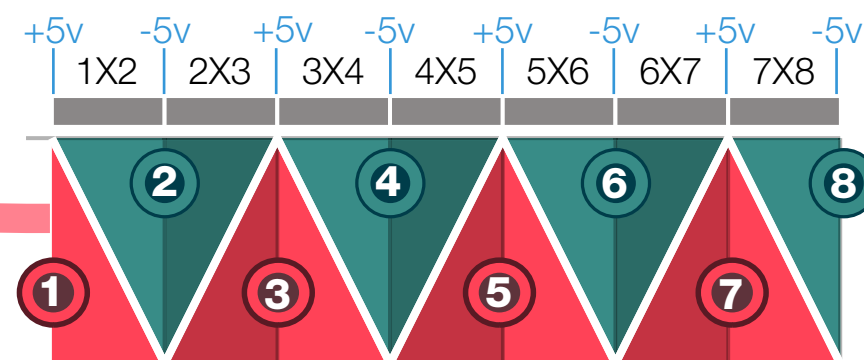
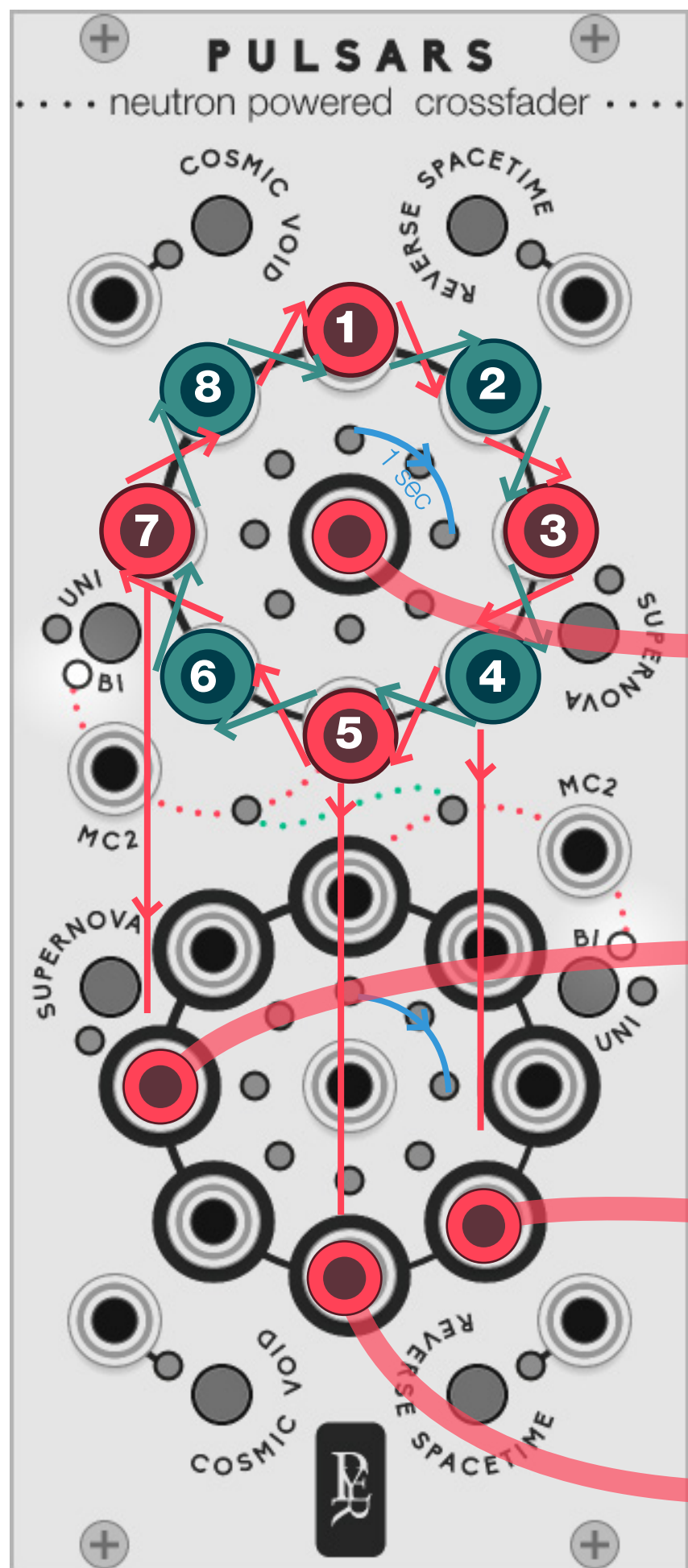
# PULSARS

neutrons powered rotating crossfader

## Cosmic Void mode

By default, Pulsars takes only account of the fed inputs, wherever they are plugged along the way. If only 3 inputs are fed, Pulsar will be a 1 to 3 switch.

When the cosmic void mode is on, PULSARS take account of the empty inputs, it will always be a 1 to 8 switch, and if it goes through a non-fed input, it will send a zero volts signal. This mode is useful to create rhythmic or tremolo effects.

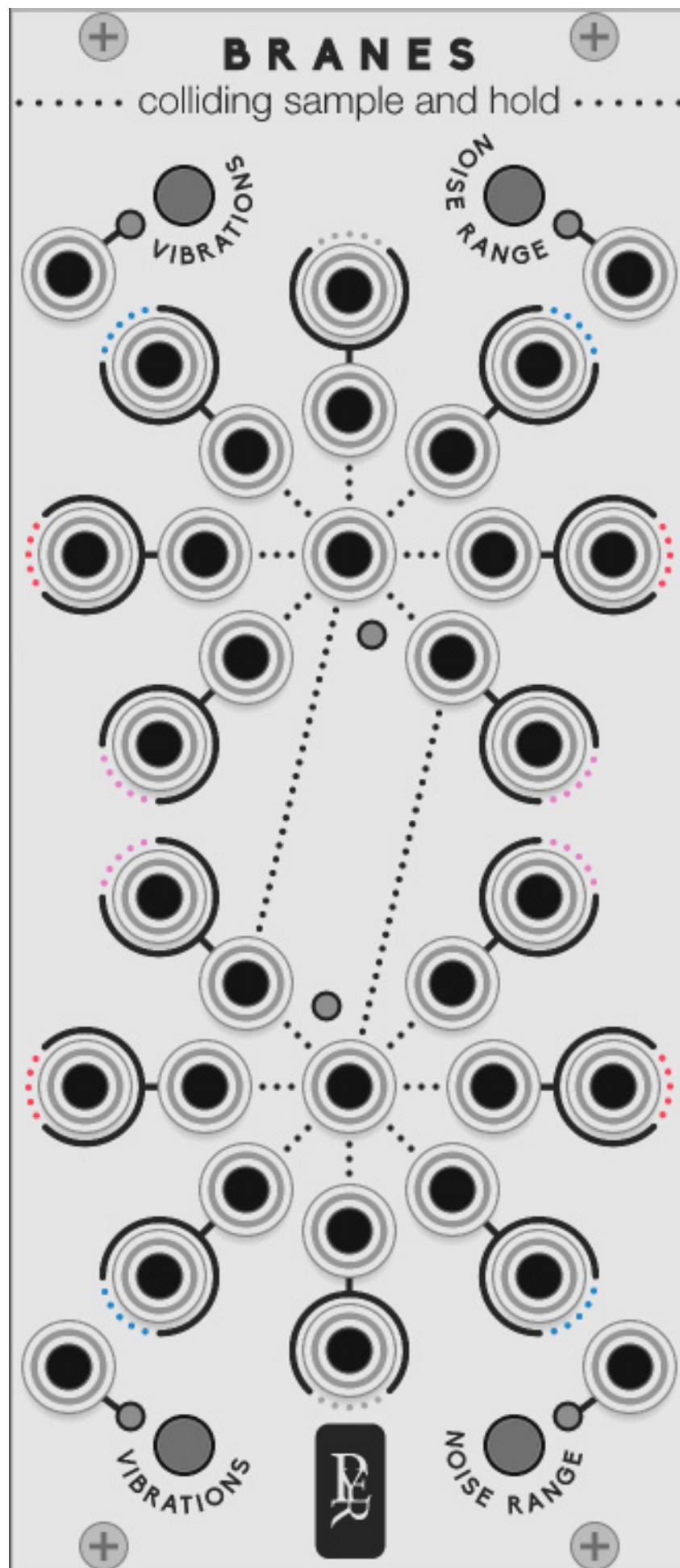


# PULSARS

neutrons powered rotating crossfader

## Multidimensional trick

If no input is connected to Pulsar 2, it will send the separate input of Pulsar1 amplified by its rotation. This is useful if you want to have stereo effect of post treatment of each source.



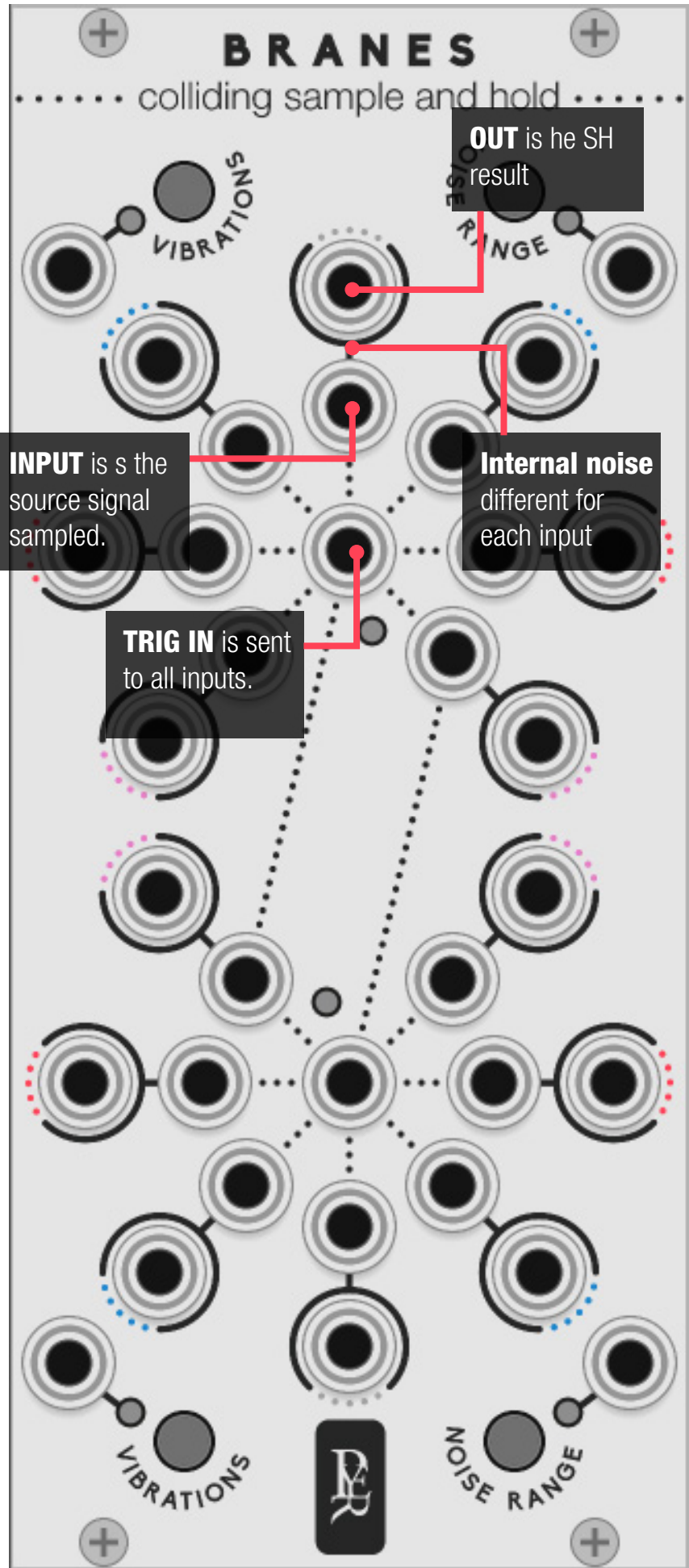
## BRANES

colliding sample and hold

Branes are multidimensional objects involved into the ekpyrotic universe theory that describes two parallel universes colliding to create our world...

**BRANES** is 2 groups of seven S&H driven by the same trigger source. Two of them receive added trigger clocks for polyrhythmic effects.





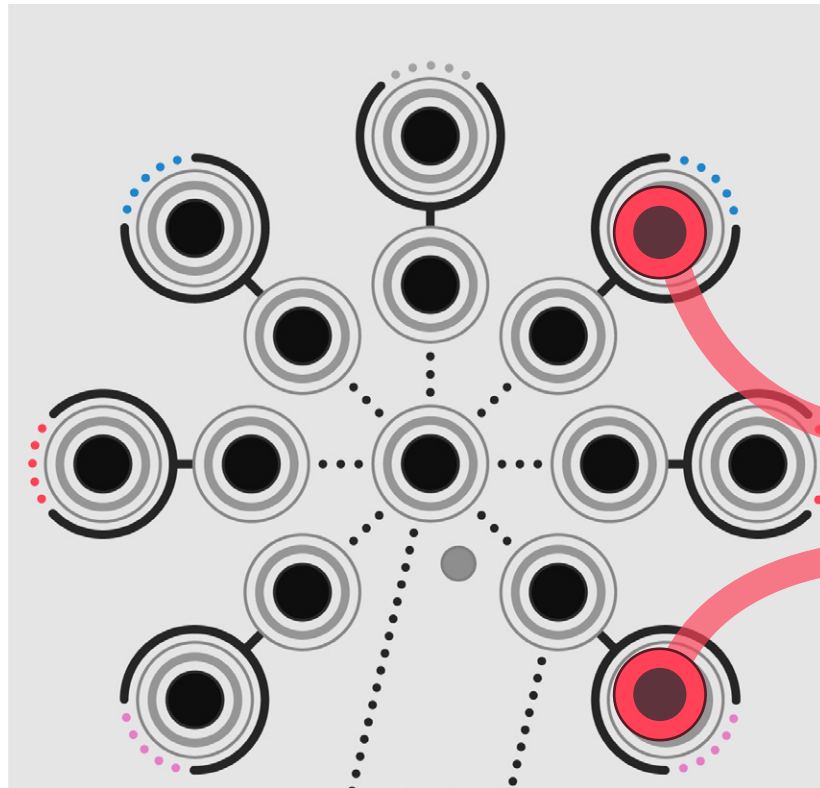
# BRANES

colliding sample and hold

The Idea came from the Buchla Music Easel with its 4 uncorrelated random sources: random and different

Each output has its own internal noise generator, with different colours so you can have 7 different random CV driven by the same trigger without any external input.

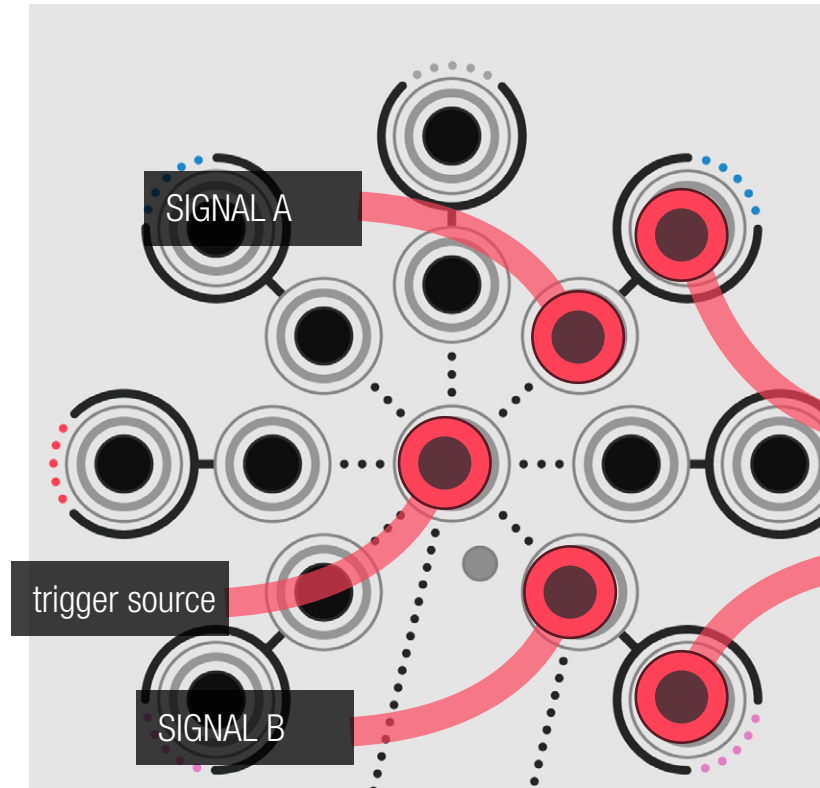
The noise generator is bypassed when an input source is connected.



When no trigger or input source is connected: The outputs are just noise sources, different kinds of noise for each.

Blue noise

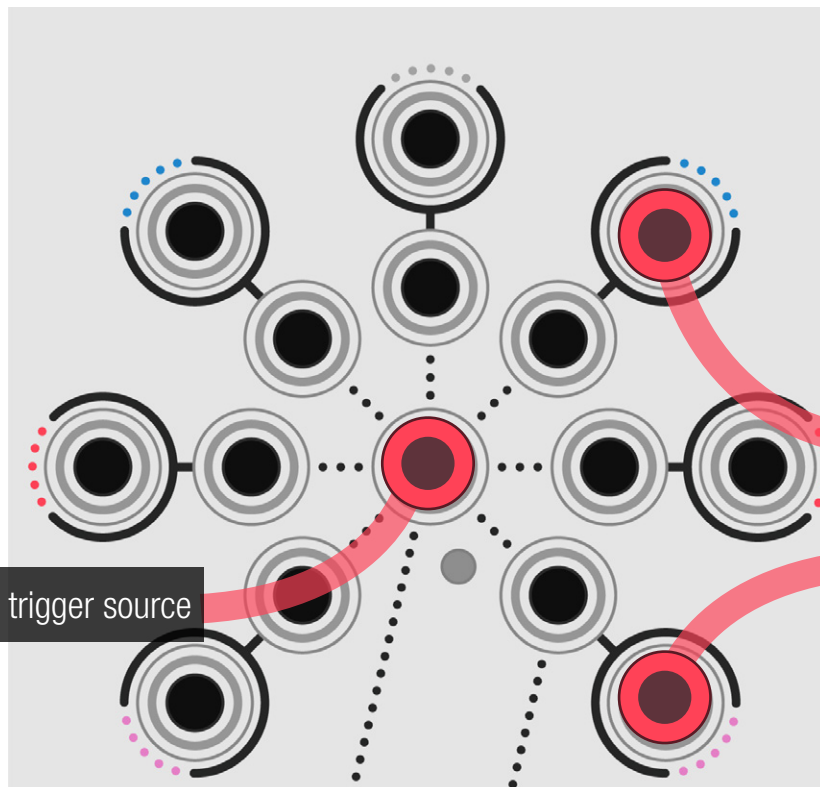
Pink noise



When a trigger and an input are connected, the noise generator is bypassed, and the S&H uses the input as material.

SIGNAL A  
based S&H

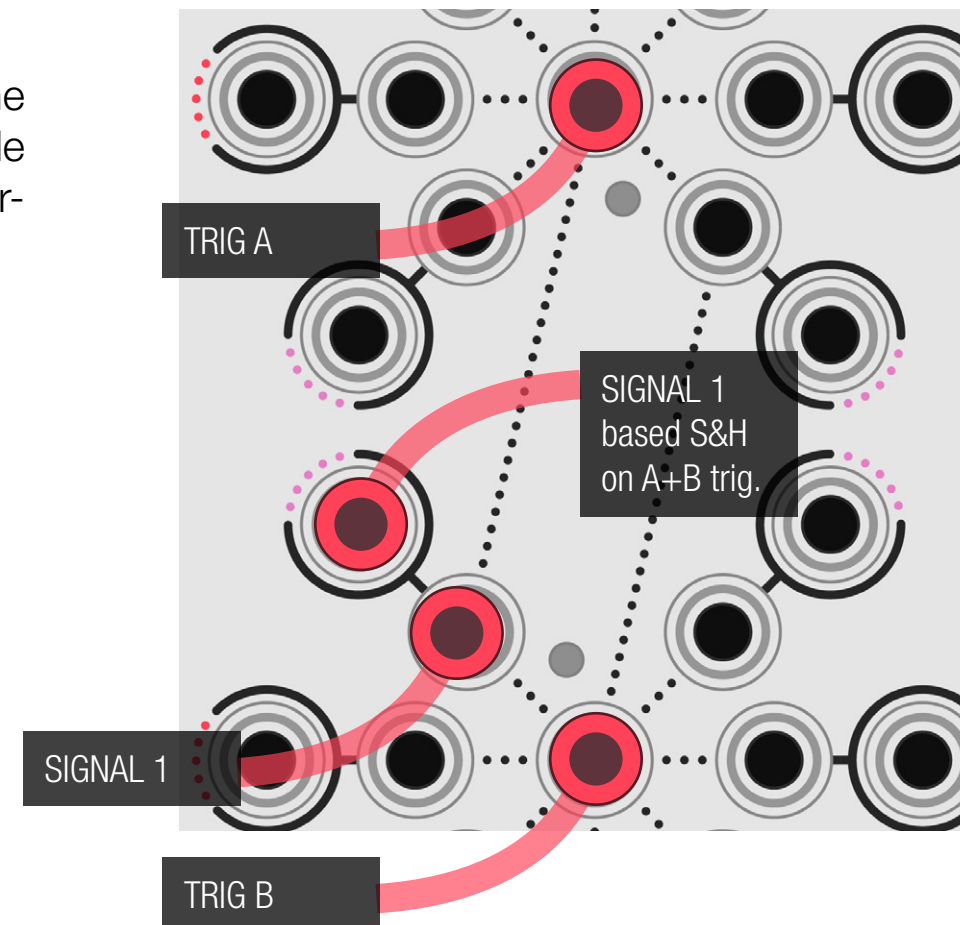
SIGNAL B  
based S&H



When a trigger is connected, the outputs use the trigger to sample and hold their internal noise generator and send random CV.

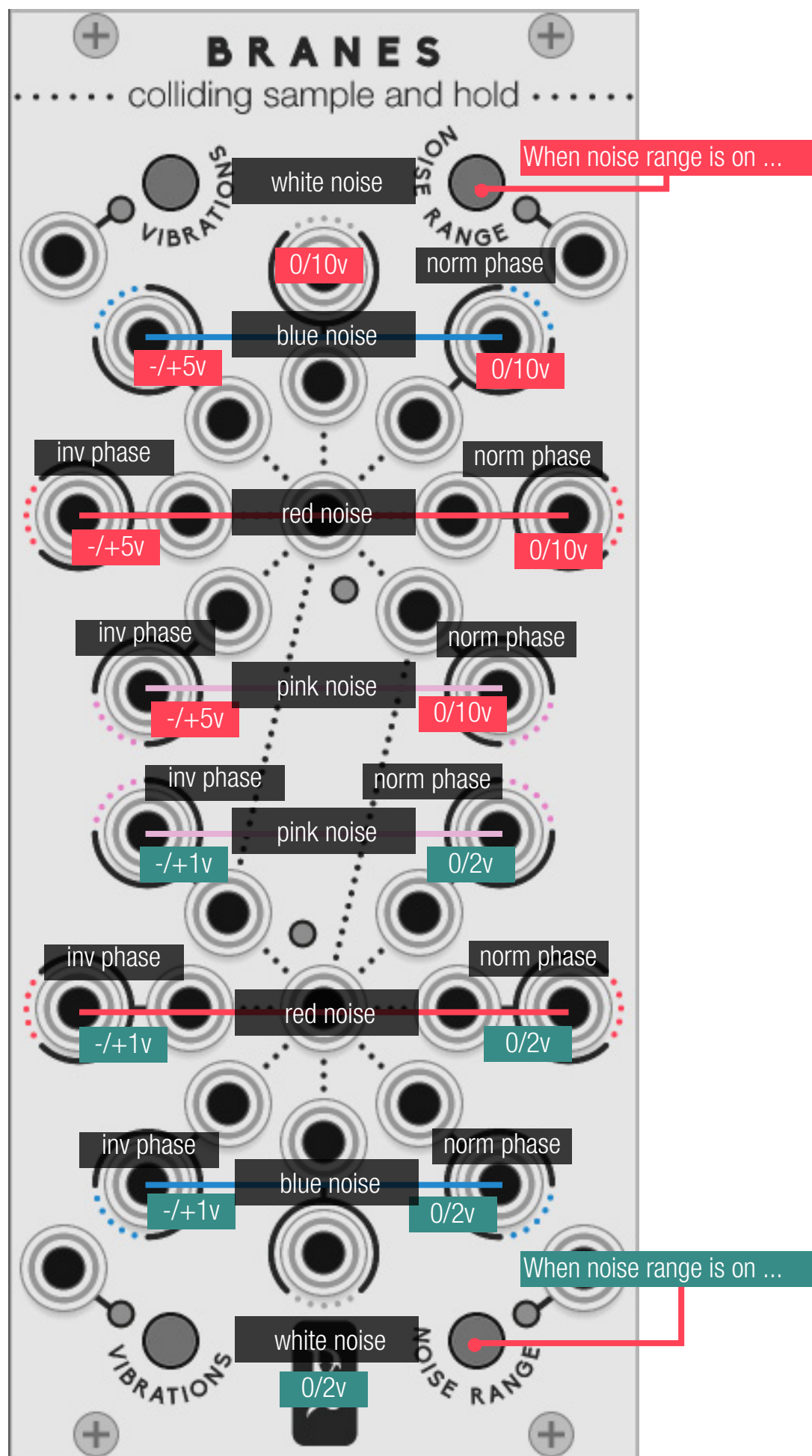
Blue noise  
based S&H

Pink noise  
based S&H



## The two Colliding S&H

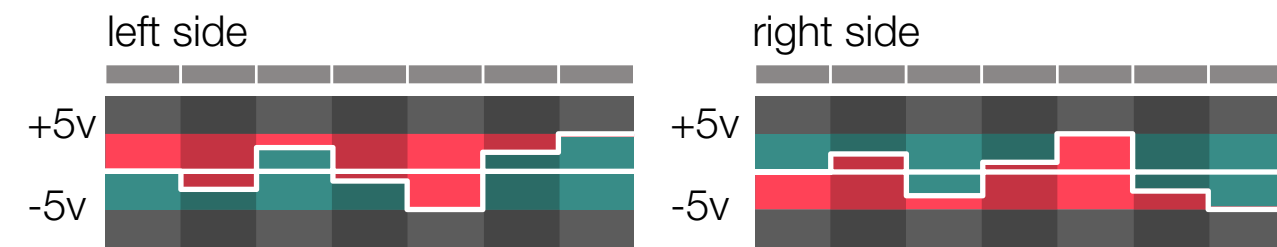
They work as expected, but their trigger source is an addition of the two trigger sources. It allows you to create polyrhythmic melodies.



## The inverted phase noise generators

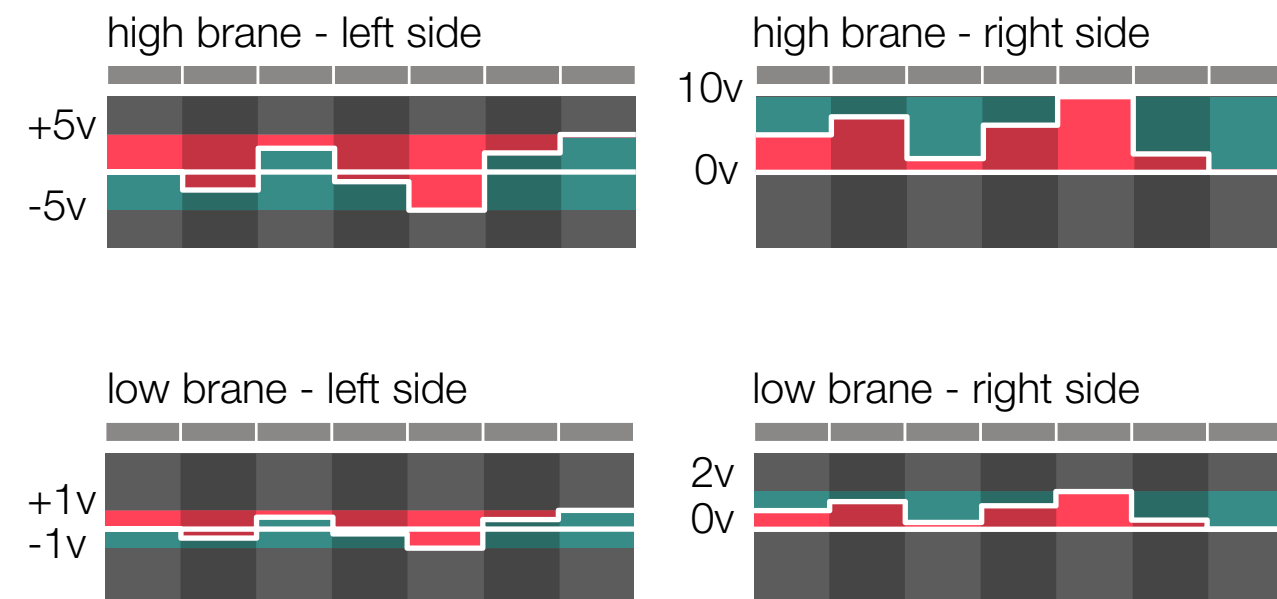
Every noise generator on the left-hand side is the inverted phase version of the right-hand side.

It is not really useful as a noise source, but when the noise is sampled, every left-hand side output will provide the opposite value of the right-hand side.

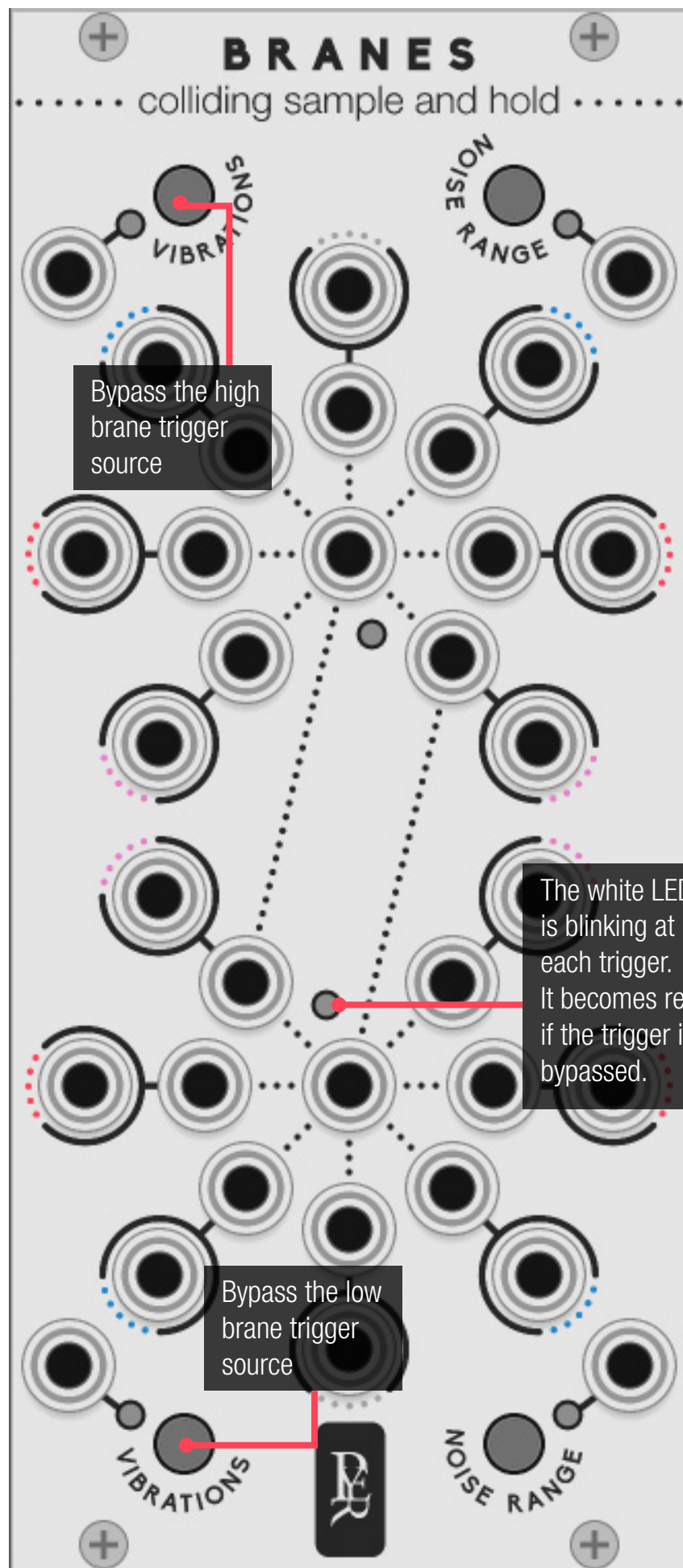


## Range noise button

The noise generators are emitting signals from -5 to +5 volts, so will be the sampled signal. This can be too wide for pitch control, or too small for 0 to 10 volts modulation input. While this is usually fixed with an external VCA, the noise range button will change the range and offset of each noise generator according to the following rules:







# BRANES

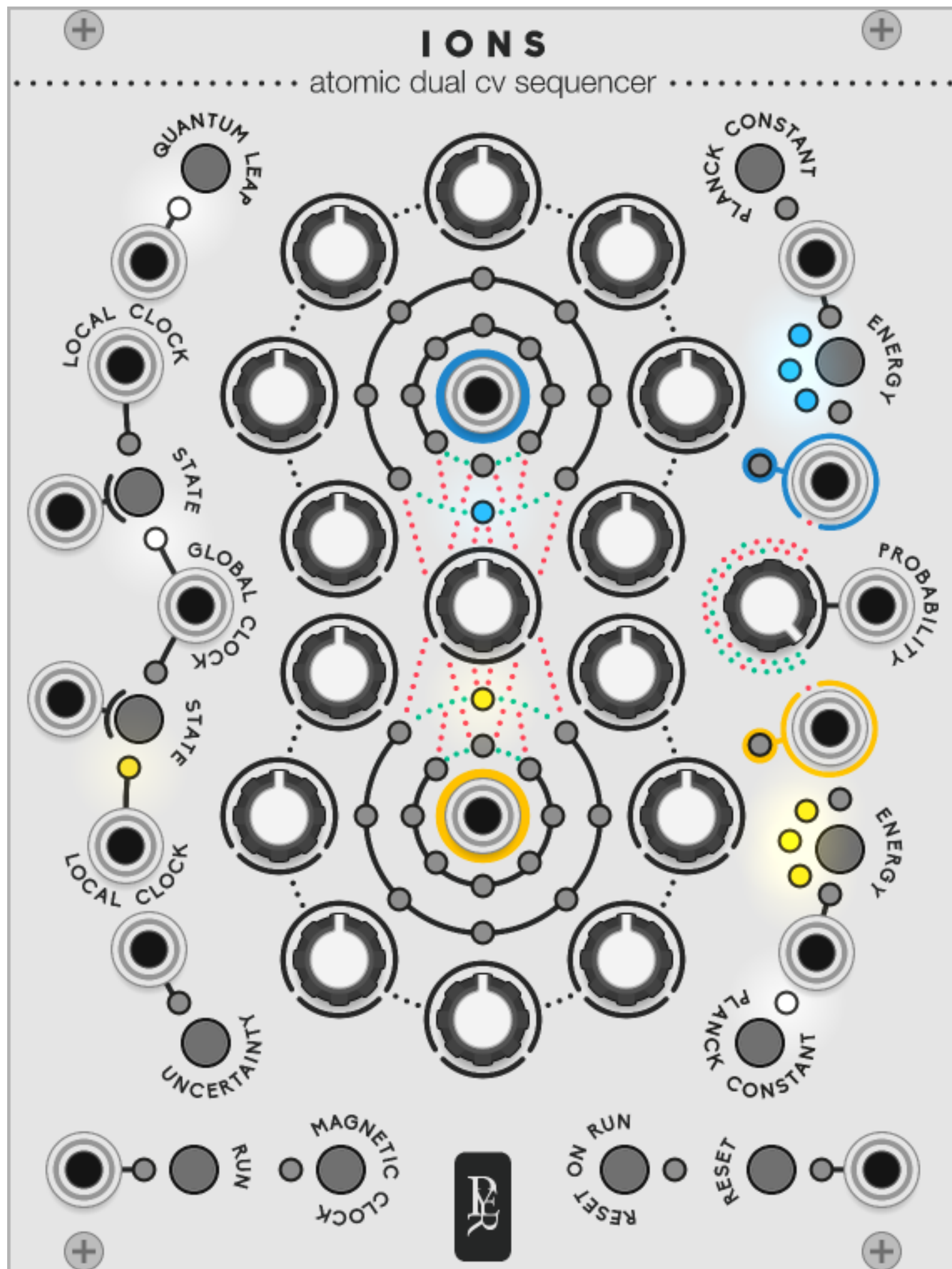
colliding sample and hold

## The vibrations button

When the trigger source connected, the vibration button lights on: the brane starts to vibrate and to sample the signals on every trigger. When the vibrations are bypassed, every output will send the unsampled source input or noise.

This is useful to switch between the original signal and the quantised one.

It can also be used to momentary bypass one of the two triggers of the colliding outputs.

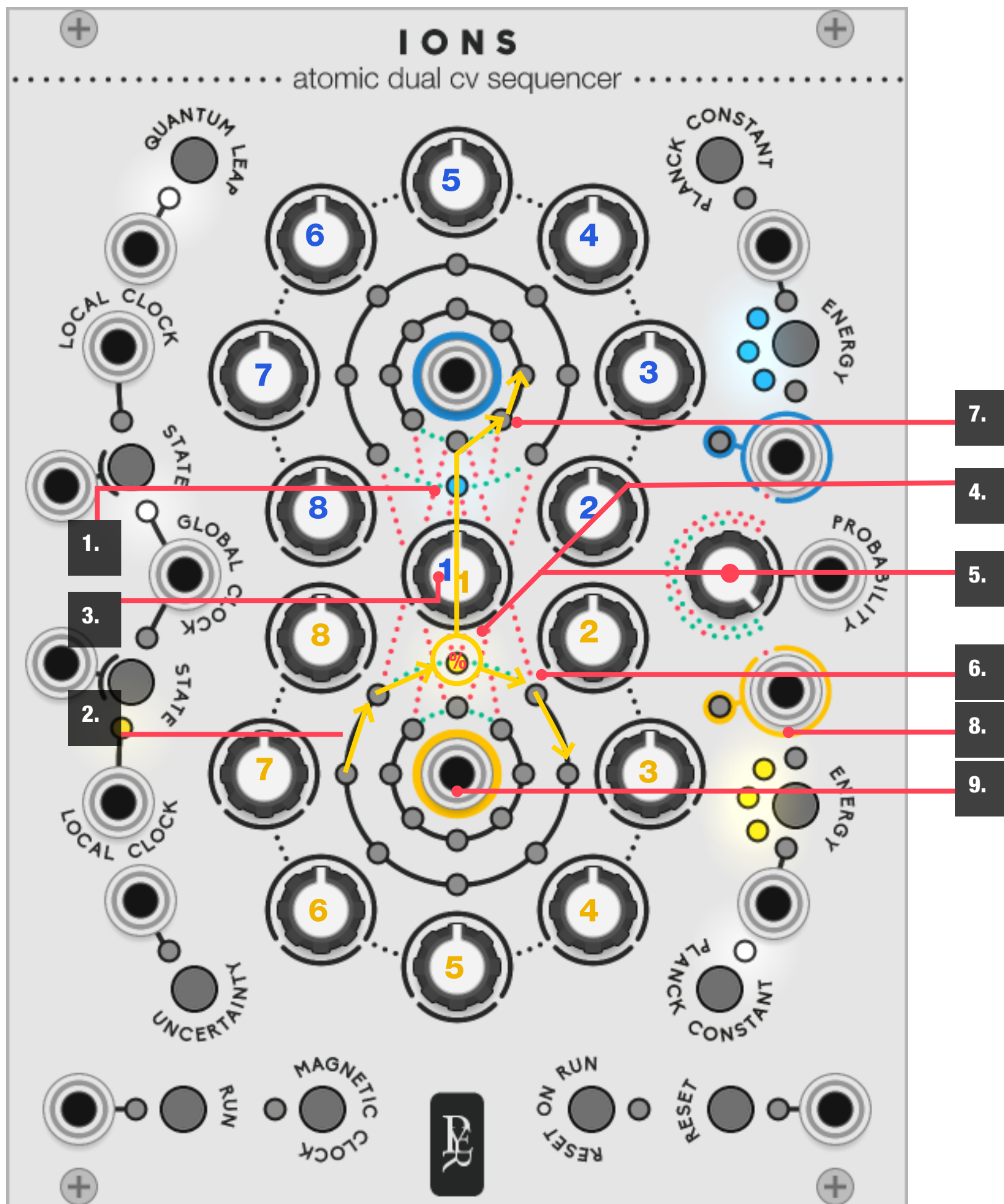


# IONS

atomic duophonic voltage sequencer

An Ionic bond describes two atoms that exchanges electrons.

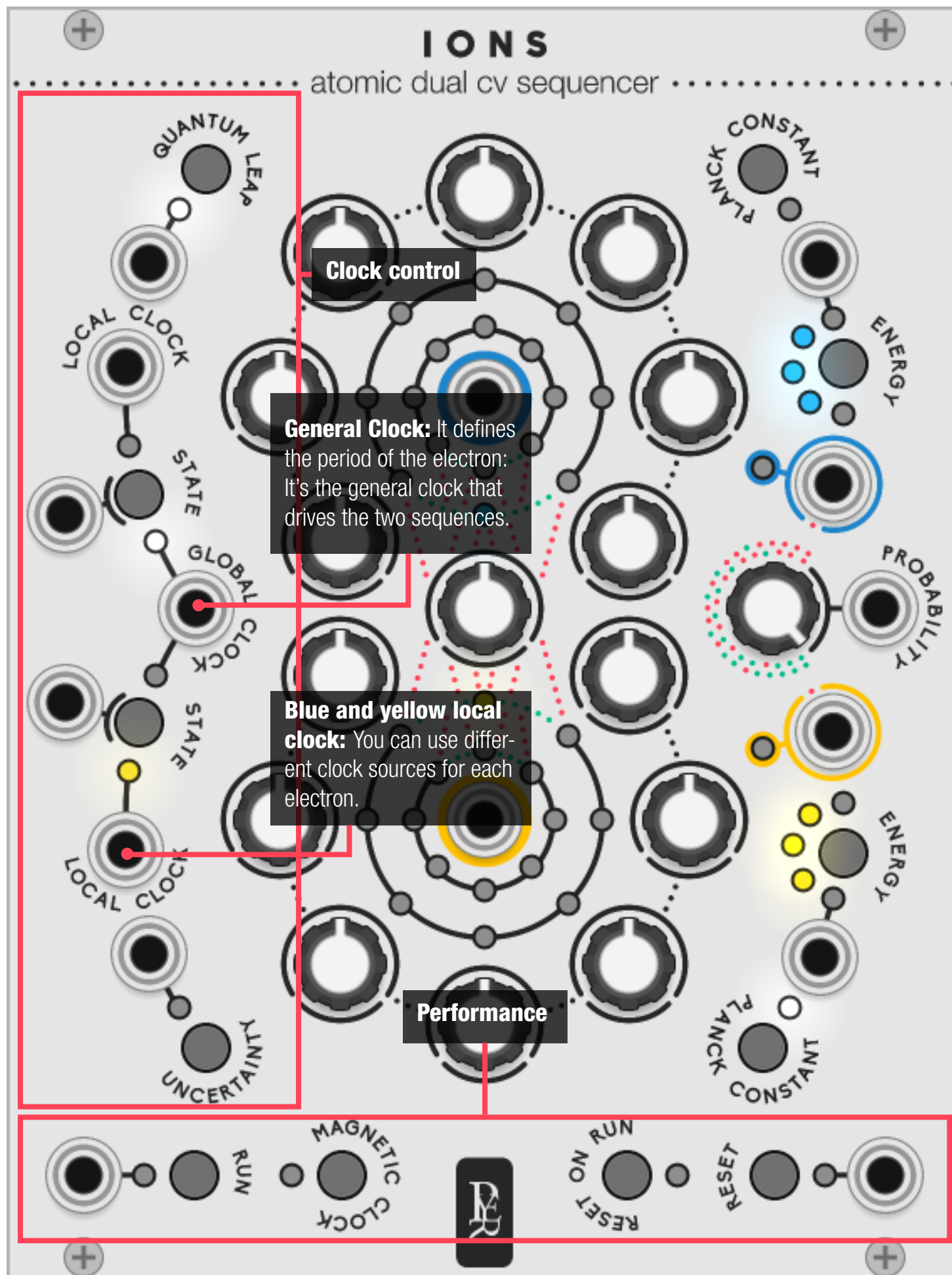
**IONS** is a two voices sequencer. While each voice has its own sequence, they can exchange their sequences as easily as an electron can jump from one atom to another.



### How it handles the sequence

1. The two CV voices are the blue electron and the yellow electron, they each gravitate around their blue and yellow core (CV OUT).
2. The electrons are both cycling through their own 8-step sequence.
3. They share the first step of their own sequence.
4. Each time they pass through step 1, they have a **probability to switch to the other core** and run on through the other sequence. The electron still emits from its original output, but it steals the notes from the other sequence.
5. The probability to switch is controlled by the probability knob. And can be automated. While they share the same probability knob, they don't have the same engine, so they might be both together on the same core.
6. With a **probability of zero**, they will never switch and always stay a proper 2 voices **8 steps seq.**
7. With a **probability of 100**, they will always switch and always stay a proper 2 voices **16 steps seq.**
8. A trigger is emitted each time an electron jumps from one atom to another.
9. The Core is always linked to the original electron. The yellow core is always emitting the CV values that the yellow electron is passing through, even when it gravitates around the blue core.





## How it handles the clock:

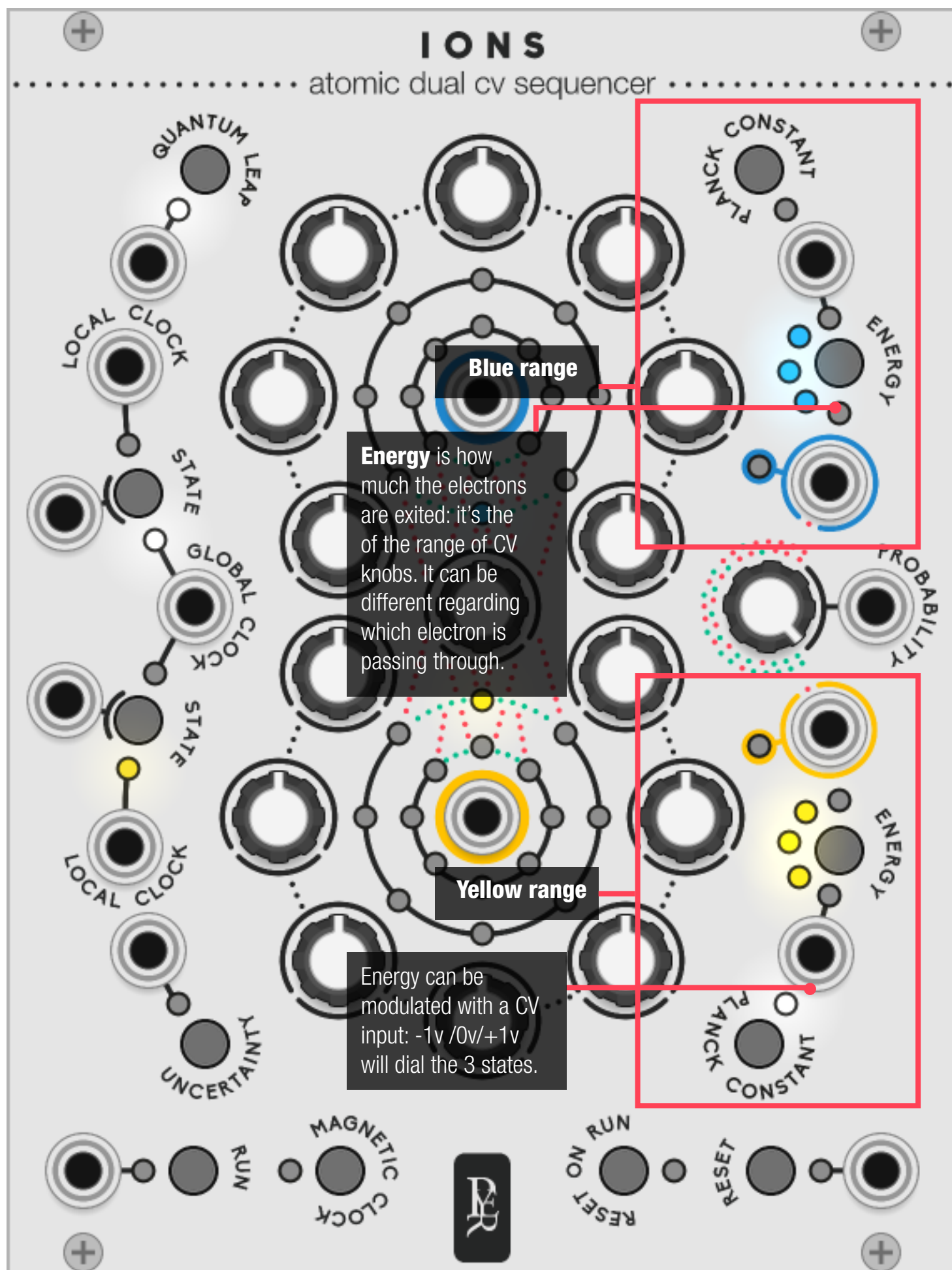
IONS does not have an internal clock. You can use a clock for driving both sequencers at the same time, or a different clock for each sequencer ... or both at the same time.

**The State button:** in our world, nothing can be two opposite things at the same time. But in the quantum world, an electron can have one status, or another ... or both at the same time.

The state button cycles between 3 stages: each electron can be driven by the global clock, or their own clock ... or the addition of both, for polyrhythmic effects.

**State Mod** can be modulated with a CV input: -1v will use the local clock. +1v will use the global clock. Anything in between will use both clocks

**The magnetic clock** will excite the electrons in an alternative way: It's a manual clock. It is active when the experiment is not running, to set the CV value step by step. It is also active when the experiment is running, to interact with the sequence manually, adding a bit of human mess.



## How it handles the CV values:

**Energy** is the range of the CV knobs. Each electron has its own energy setting. When passing through a CV step, the blue electron can interpret the value with a different range than the Yellow one would do if it passes through the same step. The behaviour of energy is depending on the Planck constant.

**The Planck Constant:** In 1900, Max Planck discovered that the electrons were not sharing energy on a smooth and continuous way, but by very small bits: "quanta". The Planck mode will quantise the CV output and modify the energy behaviour.

When the **Planck constant is OFF**, IONS is a smooth CV sequencer with Energy defining the range of CV:



-/+ 1 volt



-/+ 5 volts



-/+ 10 volts

When the **Planck constant is ON**, IONS is a chromatic sequencer with Energy defining the range of CV:



1 octave



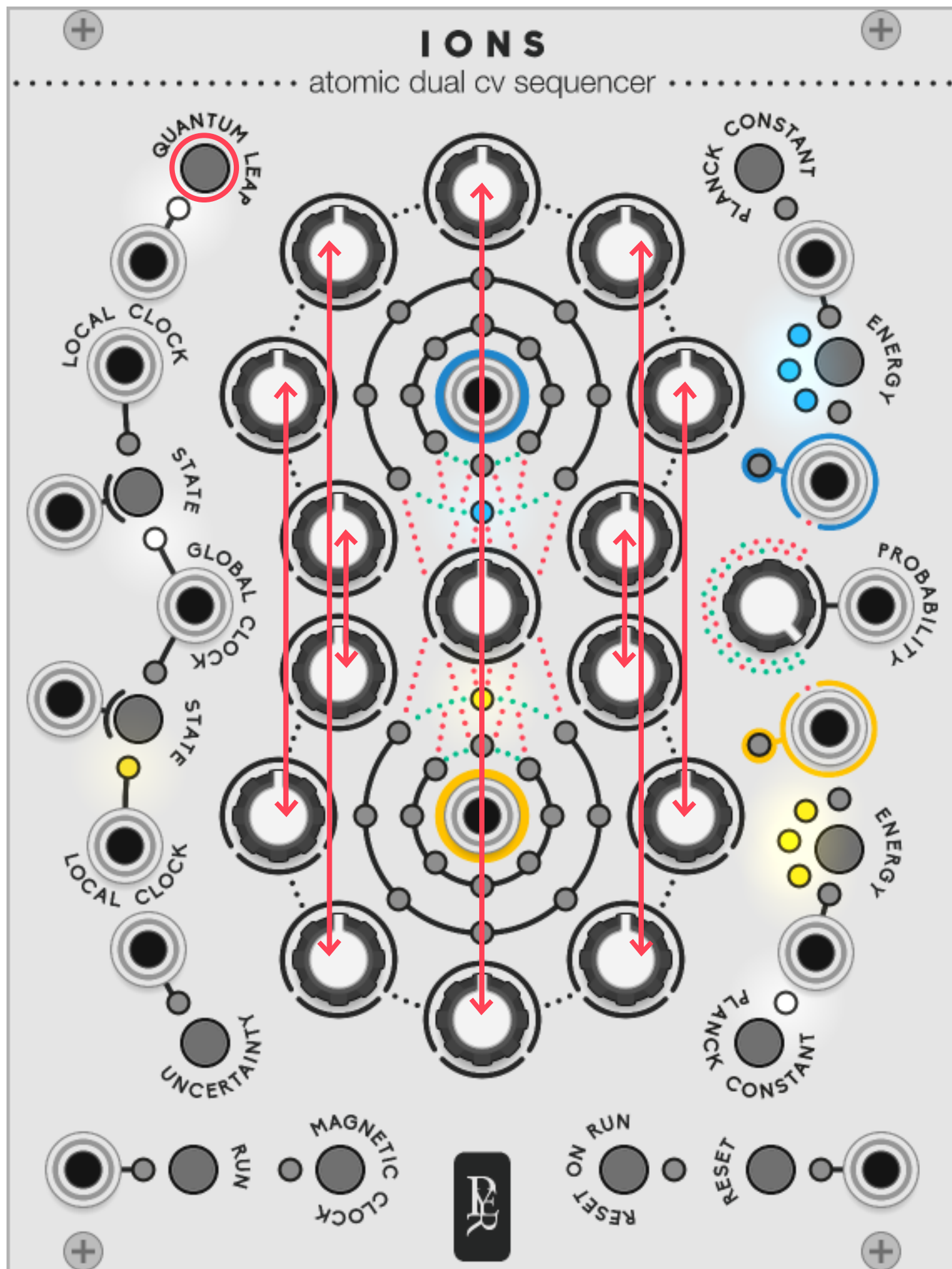
3 octaves



5 octaves

The planck constant can be set for each channel separately to generate both a melody and a free cv sequence at the same time.





## Alternate Modes

**Quantum leap** introduces a strange effect from quantum physic. Every step can be a gate to switch to the other core. By a smart automation of the probability knob, you can run an 8 step seq and decide to steal some notes from the other seq to have some variations.

**Uncertainty principle.** In quantum mechanics, Heisenberg discovered that there is no way to know with certitude both the speed and the position of a particle. Uncertainty will add different flavours of randomness in the position of the electron.

- Every trigger sent by the local clocks will move the electrons forward on a random number of steps (small values are more likely, for musical purposes).
- Every trigger sent by the reset button will place the electrons in a random place in the sequencer.
- Every trigger sent by the global and magnetic clocks will continue to work normally, one step at the time.

With Uncertainty mode ON, 4 levels of randomness can be achieved:

- **Order:** using only the global clock will move the electrons on a regular step by step way.
- **Casual random:** using both global and local clock input, with a regular clock on global and an occasional clock on local (divided, gate sequence or even manual trigger) to have some random jumps in a regular sequence
- **Linear random:** using only the local clock to have a forward random walk.
- **Chaos:** sending a clock into the reset input to have a complete random sequence. In this case, the jump probability becomes useless.



# G E O D E S I C S

A modular collection for VCV rack by Pyer & Marc Boulé

Geodesics has been created on July 2018 by **Pierre Collard** (industrial and graphic designer based in Brussels) and **Marc Boulé** (developer and creator of Impromptu Modular based in Montréal).

Just like many projects within VCV rack, Geodesic is also a community effort and it would not have been possible without the help of many users, composers and developers participating one way or another to enhance the quality of the project.

Among them we would like to adress a special Thanks to **Omri Cohen, Georg Carlson, Xavier Belmont, Steve Baker, Marc Demers, Adi Quinn, Ben De Groot, Carbonic Acid** and **Martin Luders**.

We also would like to thank the following composers for making the collection alive with some great pieces of music: **Ghalebor, Omri Cohen, Espen Storo, Stephen Askew, Dave Phillis, Latif Karoumi, Synthikat, Georg Carlson Ben de Groot, Lars Bjerregaard, Richard Squires, Lorenzo Fornaciari, Adi Quinn, NO rchestra, Ablaut, Poxbox23** and **Ananda Bhishma**.

## Geodesics links

[www.pyer.be/geodesics](http://www.pyer.be/geodesics)  
[vcvrack.com/plugins.html#Geodesics](http://vcvrack.com/plugins.html#Geodesics)  
[github.com/MarcBoule/Geodesics](https://github.com/MarcBoule/Geodesics)

## Creations from composers using Geodesics:

[youtube.com/playlist?list=PLRtQ40UnfnbX-wlJ-ni1ZG2RjnzLqrMqyF](https://youtube.com/playlist?list=PLRtQ40UnfnbX-wlJ-ni1ZG2RjnzLqrMqyF)

## Tutorials on Geodesics by iOmri Cohen:

<https://www.youtube.com/playlist?list=PLiECaNQx-239te8e0gmcC9PIbYXQ2K-7RC>

## Marc's work links

[github.com/MarcBoule/ImpromptuModular](https://github.com/MarcBoule/ImpromptuModular)

## Pierre's work links

[forum.cockos.com/showthread.php?t=135021](https://forum.cockos.com/showthread.php?t=135021)

