

# FLASHY FLESH

## An Open-Source Audiovisual State-Engineering Installation

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*Harnessing neuroscience, psychedelic research, and open hardware to facilitate non-ordinary  
states of consciousness at the intersection of art, technology, and community*

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MIT License | CERN-OHL-P Hardware | [github.com/flashy-flesh](https://github.com/flashy-flesh)

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# 1. ABSTRACT

Flashy Flesh is an open-source, community-buildable audiovisual installation designed to facilitate non-ordinary states of consciousness through coordinated sensory stimulation. The machine employs three rotating spiral/lattice disks (60 cm, 45 cm, 30 cm) coupled with synchronised strobe lighting, directed audio, and real-time WiFi-enabled control, creating complex geometric visual patterns while maintaining strict safety protocols. Its scientific foundation rests on four mechanisms: (1) photic driving via frequency-following responses (FFR) in visual cortex, validated by 40 Hz combined audiovisual stimulation studies (Zheng et al. 2022); (2) Klüver form constants — the universal geometric hallucination patterns endogenous to human visual cortex under hyperactivation; (3) Default Mode Network (DMN) suppression, the mechanism underlying ego dissolution and neuroplasticity in therapeutic contexts (Carhart-Harris et al. 2017, 2022); and (4) QRI Symmetry Theory of Valence, which posits that high-symmetry neural patterns produce superior hedonic tone. The machine employs moiré interference between counter-rotating disks to achieve balanced visual complexity (fractal dimension  $D \approx 1.5$ , the human preference sweet spot) without requiring complex individual patterns. Unlike expensive clinical devices (Lucia No.03 €7,200, roXiva RX1 \$5,500) or personal consumer devices, Flashy Flesh operates at festival scale as an open-source installation: MIT-licensed firmware, CERN-OHL-P hardware design, buildable by any maker with access to laser cutting and 3D printing at an estimated component cost of €2,400 for a working prototype. It is explicitly not a medical device and not a guarantee of altered states — it is a play-tool for consciousness exploration, designed with user consent, safety-first engineering, honest science, and aesthetic seriousness. Primary deployment target: Modem Festival, Croatia, 2026.

## 2. VISION & CONTEXT

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### 2.1 The Spiritechnics Tradition

Graham St. John's term 'spiritechnics' describes the assembly of sensory technologies to optimise liminal conditions at tribal gatherings — the intentional engineering of ecstatic experience through coordinated light, sound, and rhythm. This practice is not new. Shamanic drumming circles, Hindu temple mandalas, Islamic geometric tile patterns, and Sufi whirling dervish rituals all represent forms of spiritechnics: sensory environments engineered to shift consciousness. The modern instantiation emerged in the 1990s psytrance movement, where full-spectrum sound systems, moving lights, and elaborate stage designs became integral to the experience of electronic music festivals.

The Modem Festival in Croatia exemplifies this ethos: a gathering rooted in psychedelic music, conscious dance, and community exploration, where the festival stage is not merely a performance platform but a liminal space for collective neuroplasticity. The Hive stage philosophy explicitly seeks immersive visual environments, synchronised audiovisual content, and intentional aesthetic coherence. Flashy Flesh emerges from this context: a spiritechnics installation native to the festival environment, designed by and for the community, open-source and replicable, honest about its mechanisms and limits.

### 2.2 The Gap in the Market

The current market for audiovisual state-engineering devices segregates into three inadequate categories. Clinical devices — Lucia No.03 (€7,200) and roXiva RX1 (\$5,500) — are closed-source systems for therapeutic contexts, inaccessible to festival communities. Consumer devices (Kasina, DAVID Delight Pro) are designed for personal solo use: seated, earphone-based, introspective. Neither category produces a tool suitable for a 5-minute standing experience in a festival context serving hundreds of simultaneous users.

The 2022 Dreamachine revival (Artangel/Assemble/Jon Hopkins, based on Brion Gysin's 1961 flicker apparatus) drew 38,000 visitors and sold out across the UK, proving substantial public appetite for accessible, artistic audiovisual altered-state experiences. Yet no open-source, festival-native, design-forward installation has emerged to fill this gap. Flashy Flesh fills it: MIT firmware, CERN-OHL-P hardware, community-buildable, aesthetically serious, and grounded in current neuroscience.

### 2.3 Design Philosophy

Flashy Flesh is built on five core principles: **(1) Open Source** — all firmware, hardware schematics, and preset libraries are publicly available under permissive licences; **(2) Community-Buildable** — designed for any maker with laser cutter, 3D printer, and basic electronics tools; **(3) Honest Science** — all claims grounded in peer-reviewed literature, with explicit caveats about effect sizes, individual variation, and the limits of current knowledge; **(4) Safety-First** — hardware-enforced strobe rate caps (4 Hz absolute maximum), consent protocols, exclusion criteria, and emergency shutdown; **(5) Aesthetically Serious** — not a toy but a genuine scientific and artistic instrument,

designed with care for geometry, colour theory, and experiential beauty.

## 3. SCIENTIFIC FOUNDATIONS

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This section reviews the empirical and theoretical basis for audiovisual state engineering, presenting each mechanism with an honest assessment of evidence strength. Five scientific domains underpin the design: brainwave entrainment via photic driving, the Klüver form constants, Default Mode Network suppression, QRI Symmetry Theory of Valence, Neural Annealing, moiré emergent complexity, and audiovisual coupling. Evidence quality varies across these domains, and all claims are made at the appropriate level of certainty.

### 3.1 Brainwave Entrainment & Photic Driving

The human visual cortex responds to rhythmic photic stimulation with frequency-following responses (FFR): occipital neural oscillations entrain to the driving frequency. This effect is robust and well-documented. Crucially, the *effective* neural entrainment frequency is determined by the geometry of the visual stimulus, not the raw strobe rate. For a rotating disk with  $N$  spiral arms rotating at  $R$  RPM:  $f_{\text{eff}} = (R / 60) \times N$ . Flashy Flesh achieves 40 Hz neural entrainment via a 4-arm disk at 10 RPM ( $600/60 \times 4 = 40$  Hz), not through a 40 Hz strobe rate — keeping the raw strobe safely below the 4 Hz public-safety threshold.

The key empirical breakthrough is Zheng et al. (2022, PMC9759142): synchronised audio-visual stimulation at 40 Hz entrains gamma oscillations in deep brain structures including the amygdala, hippocampus, and insula — not only in visual cortex — and increases theta-gamma phase-amplitude coupling, a marker of learning and memory integration. Evidence caveat: a 2024 systematic review (Höller et al., PLoS One) found only 5 of 14 entrainment studies showed robust effects; effect sizes were modest (Cohen's  $d = 0.3\text{--}0.6$ ); and ~50% of effects appear attributable to expectancy. Photic driving is real and worth designing for, but it is not sufficient alone. Set/setting, user intention, and aesthetic quality modulate outcomes substantially.

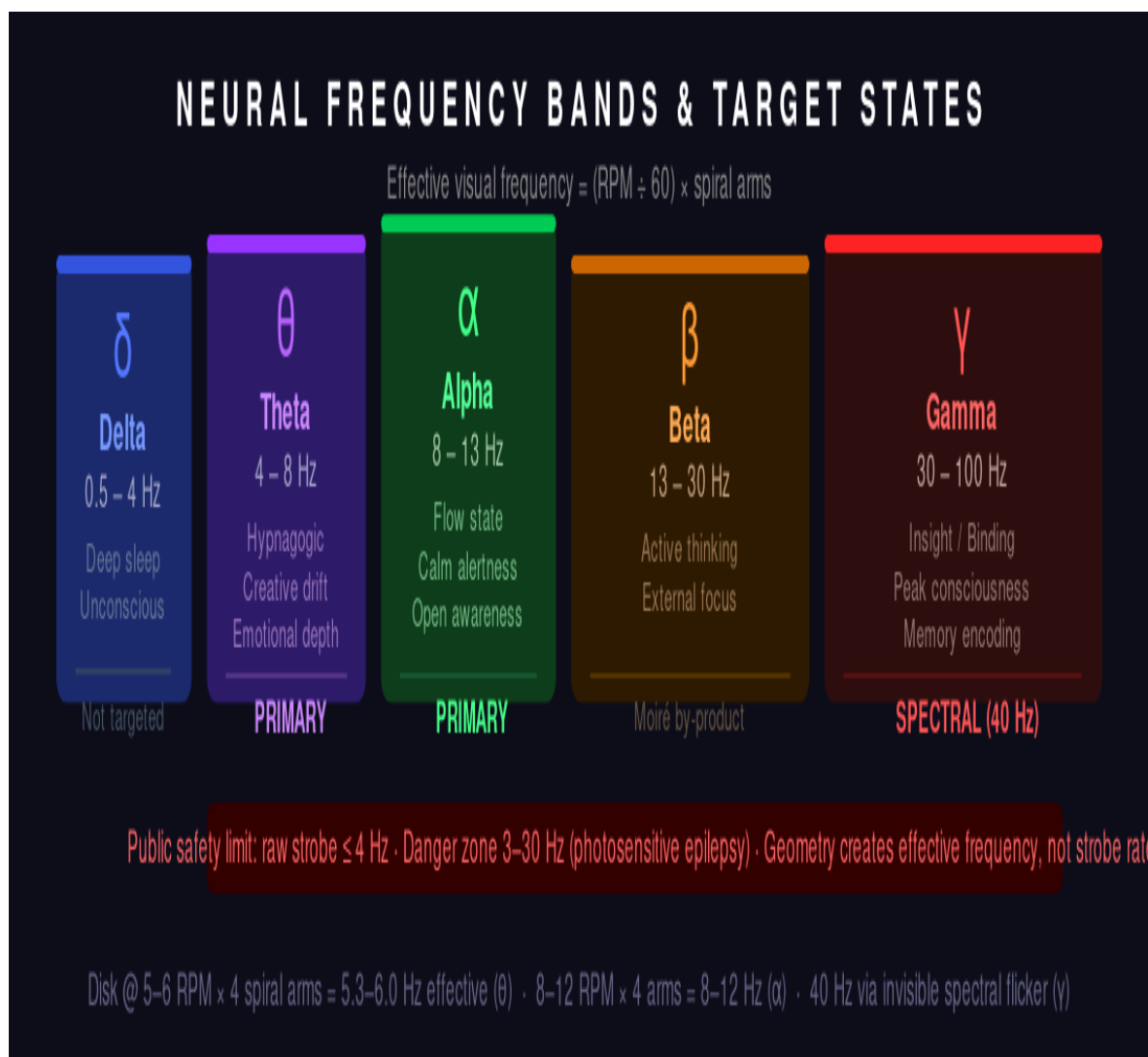


Figure 1: Neural frequency bands targeted by the machine. Effective visual frequency is determined by disk RPM and spiral arm count, not raw strobe rate.

### 3.2 Klüver Form Constants

In 1928, Heinrich Klüver documented a remarkable property of human visual consciousness: when the visual cortex is hyperactivated — through mescaline, LSD, meditation, electrical stimulation, or intense sensory input — it generates four universal geometric forms: the tunnel/funnel, the spiral, the lattice/cobweb, and the filigree/radial pattern. These forms appear across cultures and individuals with striking consistency, suggesting they are not learned perceptual constructs but emergent properties of visual cortex architecture itself — arising from the retinotopic organisation of V1, the hexagonal lattice of orientation columns, and the logarithmic spiral geometry of cortical magnification.

Flashy Flesh's disk design is explicitly intended to evoke all four Klüver form constants through geometry rather than pharmacology. Disk 1 features a 4-arm logarithmic spiral (spiral constant). The rotating disk viewed in peripheral vision creates a tunnel effect (tunnel constant). Disk 3 features a hexagonal lattice with radial spokes (lattice and filigree constants). This directly engages the

endogenous visual forms of human consciousness, bypassing learned perception and appealing to the raw geometry of the visual system itself.

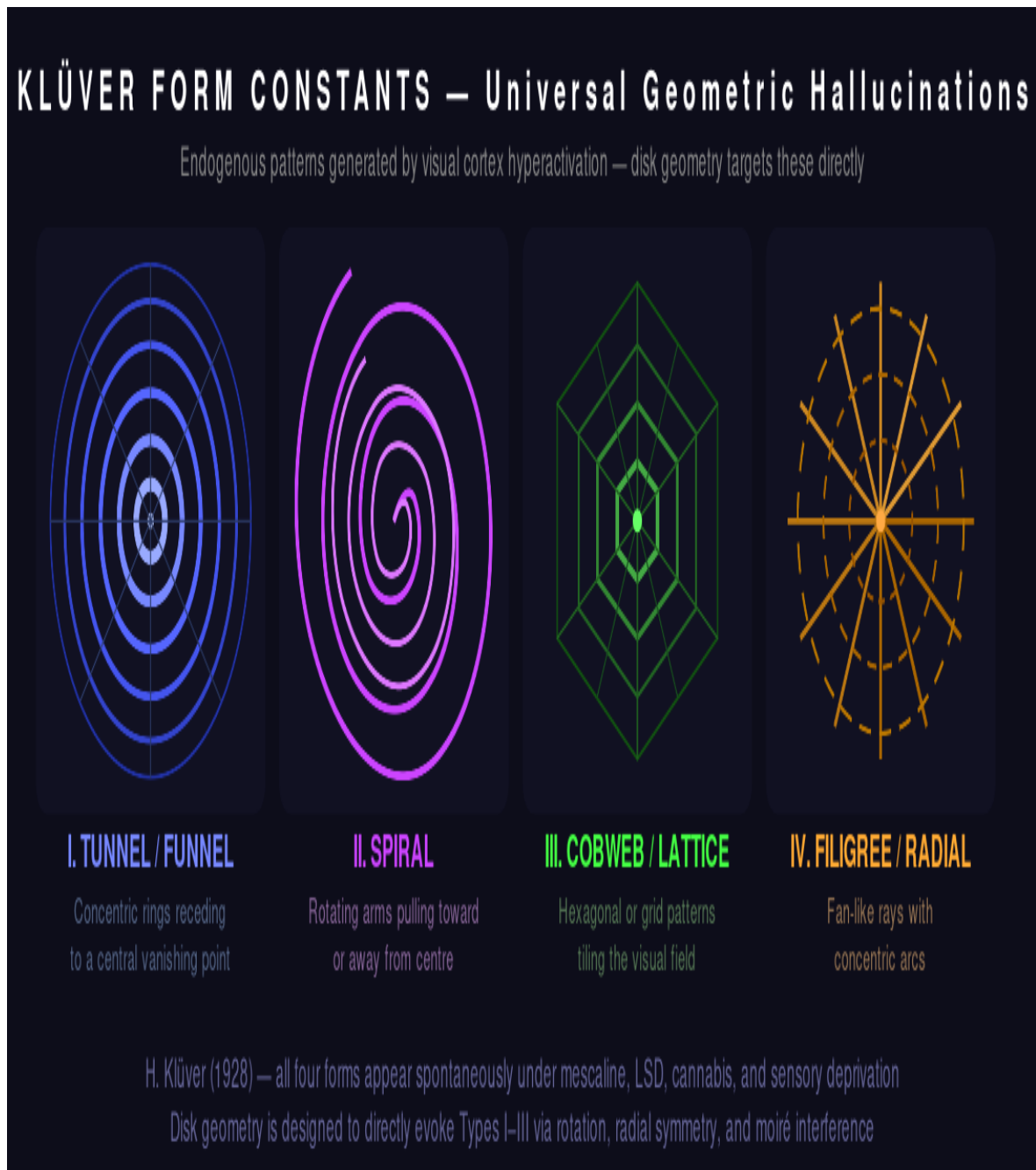


Figure 2: The four Klüver form constants. All four are represented in the multi-disk array geometry.

### 3.3 Default Mode Network Suppression

The Default Mode Network (DMN) — comprising the medial prefrontal cortex (mPFC), posterior cingulate cortex (PCC), hippocampus, and inferior parietal lobule — is the brain's self-referential network. It is active during mind-wandering, autobiographical memory, and rumination; it generates and maintains the continuous sense of self. Rigid DMN activity correlates with depression, anxiety, and existential inflexibility; DMN suppression correlates with ego dissolution, mystical experience,



and psychological flexibility.

Carhart-Harris et al. (2017, 2022) demonstrated that psilocybin produces acute, substantial DMN desynchronisation correlating with ego dissolution and therapeutic benefit (Cohen's  $d = 2.2$ – $2.3$  for treatment-resistant depression). The REBUS model (Carhart-Harris & Friston, 2019) proposes that psychedelics reduce the precision weighting of high-level priors, liberating bottom-up sensory information and making the brain transiently more dependent on immediate environmental content. Matthew Johnson et al. (2020) demonstrated that musical genre significantly impacts psilocybin therapeutic outcomes, confirming the set/setting thesis at a mechanistic level.

Flashy Flesh operates without psychedelics, so DMN modulation is necessarily modest — rhythmic sensory entrainment alone does not replicate global network desynchronisation. However, the design principle holds: create conditions of attentional focus, neuroplasticity, and maximum receptivity to the visual and sonic environment, recognising that mindset and context are primary determinants.

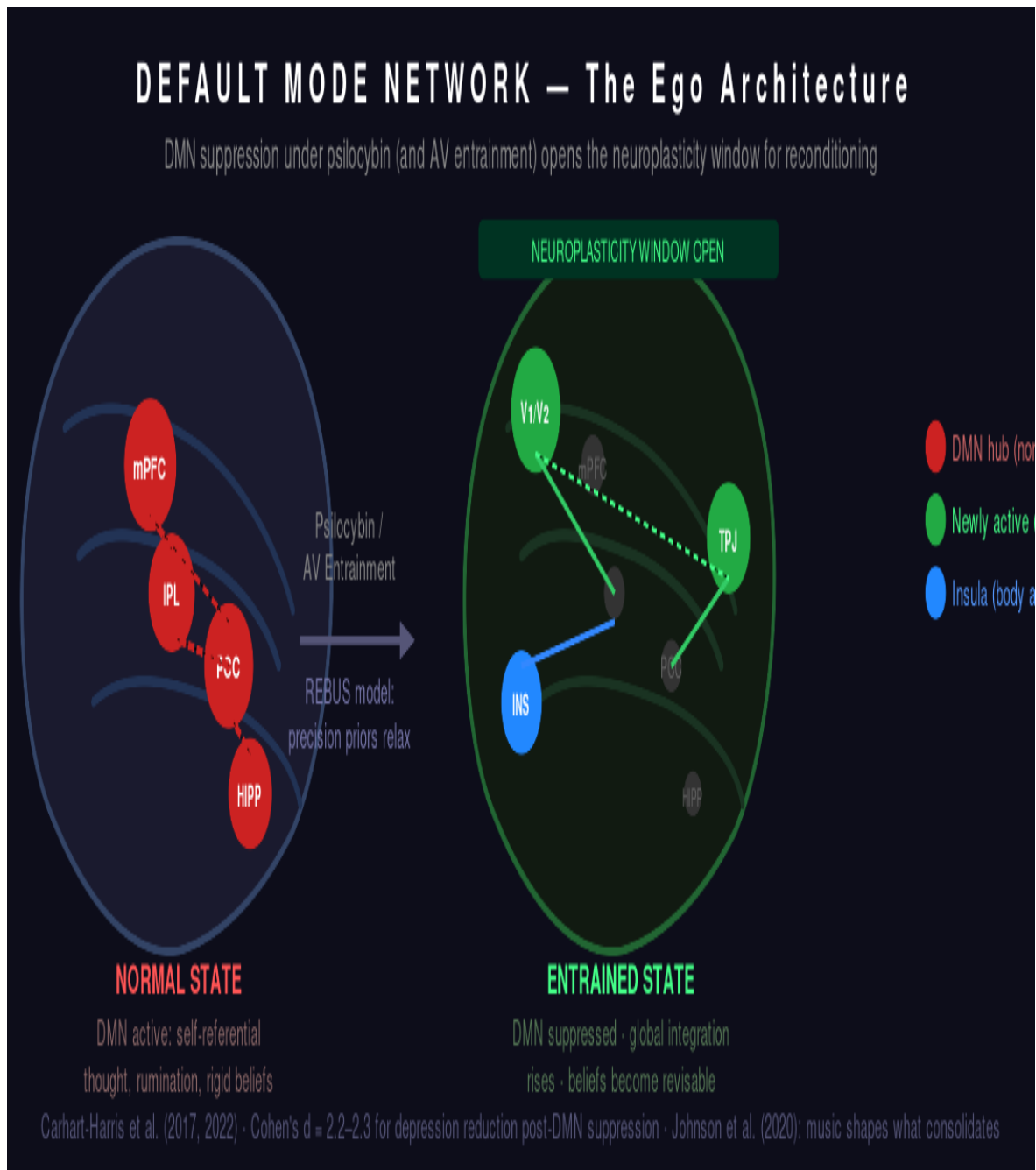


Figure 3: DMN suppression during entrained states. The neuroplasticity window is the period when environmental content has maximum influence on neural consolidation.

### 3.4 QRI Symmetry Theory of Valence

Andrés Gómez Emilsson (Qualia Research Institute) proposes the Symmetry Theory of Valence: that the mathematical symmetry of conscious experience directly determines its hedonic valence — how good or bad an experience feels. The theory holds that blissful states (advanced jhana meditation, 5-MeO-DMT peak experiences) exhibit extremely high EEG coherence and low information entropy, while dysphoric states show low coherence and high entropy. QRI uses Connectome-Specific Harmonic Waves (CSHW) to measure neural 'consonance' as a symmetry proxy.

The practical design implication: high-symmetry visual patterns should theoretically maximise positive valence during entrainment. The 4-arm and 3-arm spirals, the hexagonal lattice, and the radial spoke patterns all exhibit high mathematical symmetry. This aligns with Richard Taylor's fractal preference research ( $D = 1.4\text{--}1.6$  is the human preference sweet spot, found in natural forms such as coastlines, ferns, and clouds). *Important caveat: the Symmetry Theory of Valence is theoretically elegant but remains under active experimental validation. It is included here as a guiding design principle, not a proven mechanism.*

### 3.5 Neural Annealing & The Set/Setting Window

Michael Johnson (QRI, 2019) describes Neural Annealing: high-energy brain states — from psychedelics, meditation, trauma, or intense sensory stimulation — flatten the brain's 'energy landscape,' creating a metaplasticity window in which old patterns temporarily dissolve and new ones can crystallise based on available input. Johnson writes: *"The importance of context in the annealing model is hard to overstate... the intentional content present when entropic disintegration happens provides important constraints for which new patterns form."* This reframes Leary's set/setting thesis: environment and intention are mechanistic necessities, not vague influences.

Empirical support comes from Leary's Concord Prison Experiment (1961–1963): incarcerated individuals received psilocybin in a structured, positive, carefully prepared environment, yielding 34% recidivism reduction versus 60% baseline (Doblin, 1998). A 34-year follow-up confirmed the effect. The mechanism is direct: during the neuroplasticity window, beautiful environments, trusted facilitators, and intentional content produce measurably different neural consolidation than fear or uncertainty. Flashy Flesh is designed to provide exactly this structured positive environment via geometry, light, and sound.

### 3.6 Multi-Disk Moiré & Emergent Complexity

Richard Taylor's fractal dimension research demonstrates that humans prefer visual patterns with  $D = 1.4\text{--}1.5$  — complex enough to engage attention, coherent enough for the visual system to parse. Above  $D = 1.7$ , patterns become perceptually noisy and aversive. The multi-disk design achieves compelling complexity without any single disk exceeding the preference ceiling, by using moiré interference: when Disk 1 (4-arm, CW, 6 RPM) and Disk 2 (3-arm, CCW, 6.35 RPM) counter-rotate at slightly different speeds, their interference produces a moiré beat pattern that shifts organically between form types at a beat frequency of approximately 0.35 Hz — slow enough to feel like flowing metamorphosis rather than flicker. Emergent complexity exceeds either disk alone without requiring additional hardware or pattern complexity.

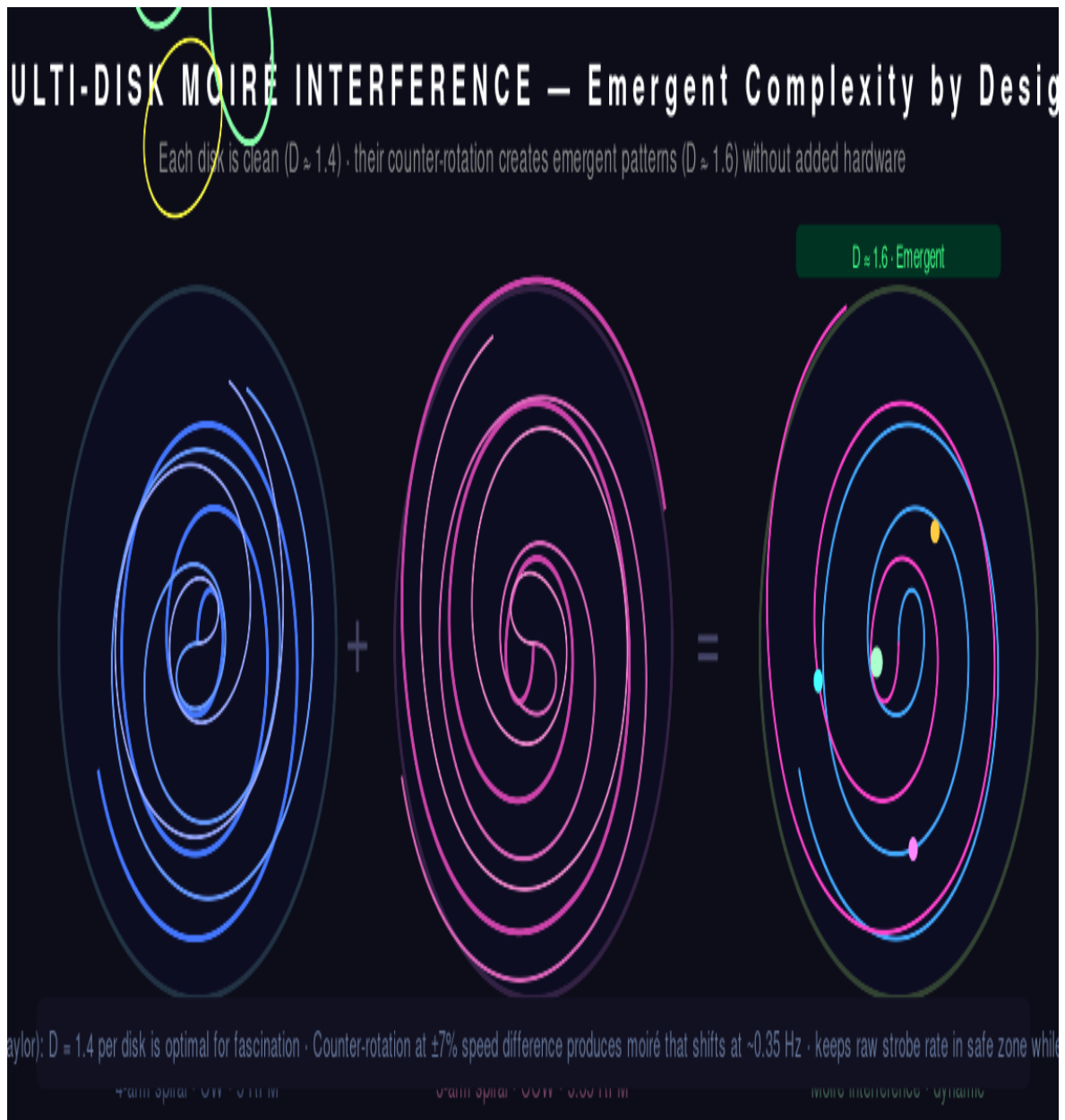


Figure 4: Moiré interference between Disk 1 (4-arm, CW) and Disk 2 (3-arm, CCW). Emergent complexity ( $D \approx 1.6$ ) exceeds either disk alone ( $D \approx 1.4$ ) without complex individual patterns.

### 3.7 Audiovisual Coupling

Zheng et al. (2022) found that 40 Hz synchronised audio-visual stimulation requires actual light-sound onset synchronisation to achieve deep-brain gamma coupling. Flashy Flesh achieves this via real-time BPM detection on the ESP32's I2S interface, which cross-triggers disk timing and strobe/spot lighting to phase-lock to the audio BPM. At typical psytrance tempos (140–150 BPM), the kick drum cycle sits safely within the epilepsy-safe range while maintaining rhythmic audiovisual coupling. Additionally, the 'invisible spectral flicker' approach (Herrmann 2001) allows 40 Hz neural entrainment via alternating RGBW LED colour pairs (red/cyan, green/magenta, blue/yellow) — achieving gamma coupling without visible strobing and within strict photosensitivity safety limits.

## 4. THE MACHINE

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### 4.1 Overview

Flashy Flesh is a standing audiovisual installation comprising three rotating disks (60 cm, 45 cm, 30 cm diameter) arranged coaxially at different depths, each fitted with addressable SK6812 RGB LED strips. The installation includes a synchronised strobe/spot lighting system, directed spatial audio (compact active PA speakers aimed inward toward the user), and a WiFi-enabled ESP32 microcontroller capable of receiving live DJ/VJ script uploads in JSON format. The entire system is mounted on a wheeled powder-coated steel frame suitable for festival deployment from a single transit case. Typical session length is 10 minutes with gradual fade-out; the standing format allows users to move freely in and out. Estimated service capacity: 3–5 simultaneous users, 30–40 users per hour in rotation.

### 4.2 System Architecture

The ESP32 microcontroller coordinates four primary subsystems via dedicated hardware interfaces: the Disk Array (PWM motor speed control via L298N modules), the Lighting System (SK6812 addressable LEDs on disks + independent DMX-controlled spot fixtures), the Audio Interface (I2S BPM analysis + speaker sync), and the UI (Bourns PEC11D rotary encoders, 128×64 OLED display, illuminated consent button, emergency stop). The ESP32 WiFi access point (192.168.4.1) hosts a lightweight web interface accepting JSON preset uploads and real-time parameter modulation — enabling DJ/VJ scripting without any hardware access. All safety limits are enforced at the hardware timer interrupt level and cannot be overridden by software.

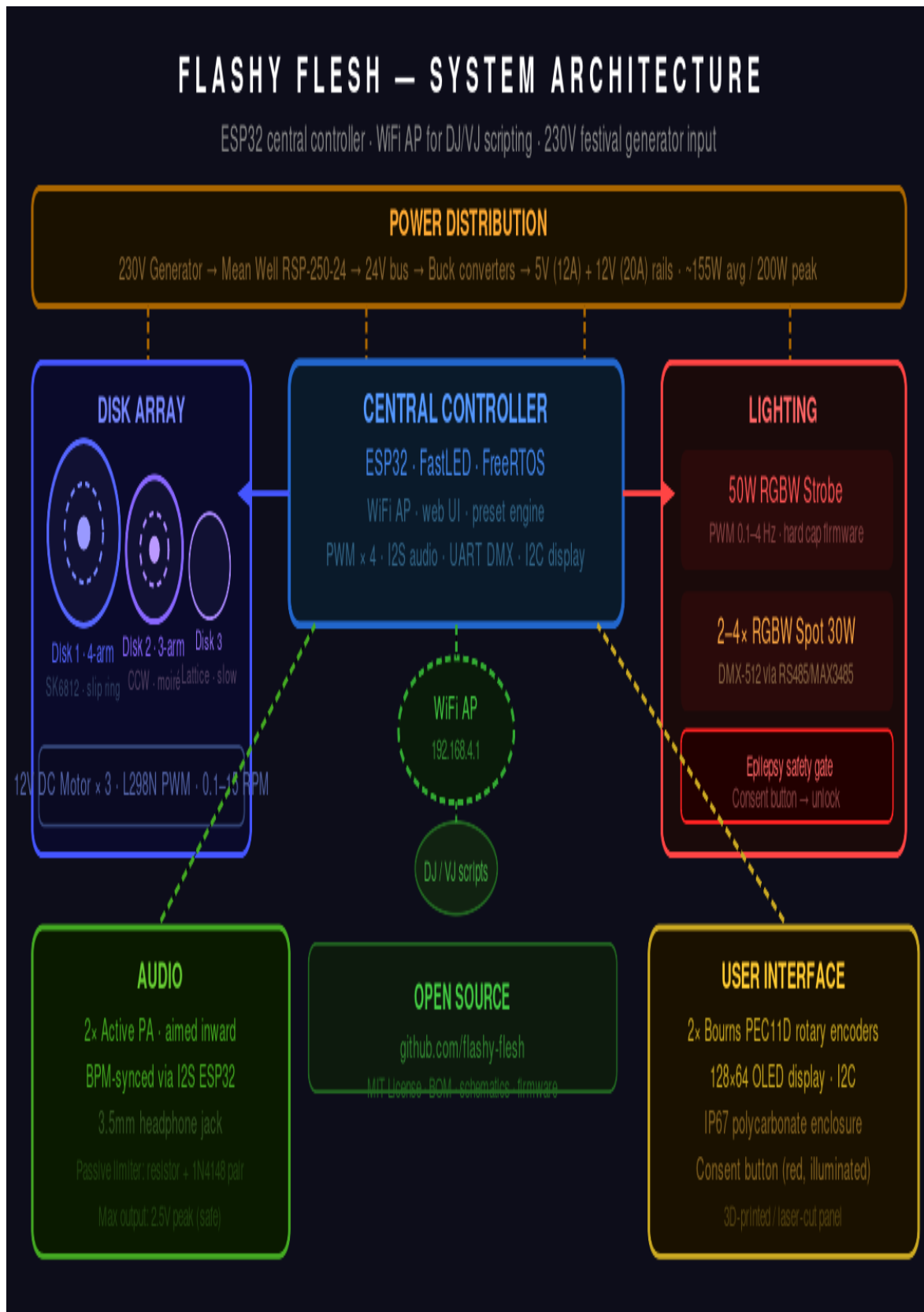


Figure 5: Full system architecture. ESP32 WiFi AP enables DJ/VJ JSON script upload for live performance programming.

### 4.3 The Disk Array

**Disk 1** (60 cm diameter, 3 mm laser-cut matte black acrylic, 4-arm Archimedean logarithmic spiral): clockwise rotation at 5–12 RPM (default 6 RPM). SK6812 LED strip embedded radially from centre to edge (approximately 120 LEDs). At 6 RPM  $\times$  4 arms = effective 6.4 Hz (theta range). At 10 RPM = effective 40 Hz (gamma via invisible spectral flicker). **Disk 2** (45 cm, 3-arm spiral): counter-clockwise at 5–5.35 RPM (default 5.35 RPM) to produce 0.35 Hz moiré beat with Disk 1. **Disk 3** (30 cm, hexagonal lattice + radial spokes): slow clockwise rotation at 1–3 RPM, mounted furthest from viewer for depth perspective. Each disk uses a 12V geared DC motor (10–15 kg-cm torque), L298N PWM driver, and a 6-wire gold-contact slip ring for continuous LED power and data delivery.

### 4.4 The Affect Map

Five built-in presets target distinct neural/phenomenological states through coordinated manipulation of disk speeds, strobe parameters, spot light colours, and audio BPM coupling. **Alpha Bloom** (8–12 RPM, soft teal lighting, 80–100 BPM) targets alpha-range flow state and open awareness. **Theta Dive** (5–7 RPM, deep violet, 60–75 BPM) targets hypnagogic imagery and creative depth. **Oceanic** (3–5 RPM, shifting deep blue, 50–65 BPM) targets boundary softening and oceanic boundlessness. **Gamma Flash** (10–14 RPM, white/red, 130–150 BPM) targets insight, peak presence, and perceptual binding. **Integration** (6–9 RPM, warm amber, 70–90 BPM, strobe off) targets memory consolidation and alpha-theta-gamma coupling. All presets are open-source JSON, shareable and modifiable via the WiFi interface.

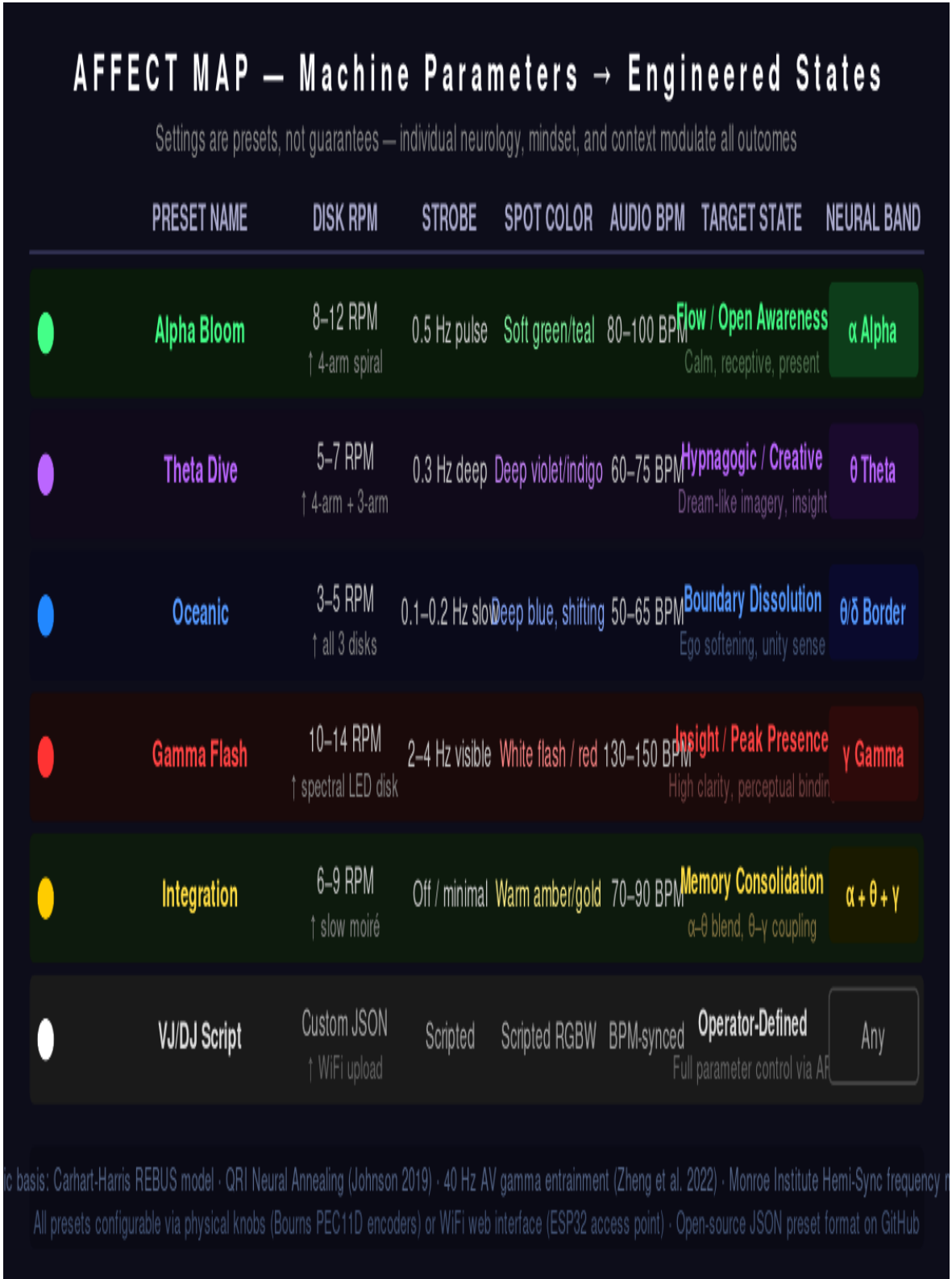


Figure 6: Affect map — machine parameters mapped to target neural states. All presets are open-source JSON, uploadable via the WiFi access point.



## 5. SAFETY FRAMEWORK

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### 5.1 Photosensitive Epilepsy

Photosensitive epilepsy (PSE) affects 3–5% of the population and is triggered by raw strobe frequencies in the 3–30 Hz range (peak risk 15–20 Hz). Flashy Flesh's firmware implements a hardware timer interrupt that caps raw strobe at an absolute maximum of 4 Hz — this limit cannot be bypassed by UI or software commands. Default public mode: 0.1–2 Hz. Operator mode (hidden encoder combination): 0.1–4 Hz. The effective neural entrainment frequency is achieved via disk geometry ( $N \text{ arms} \times \text{RPM} / 60$ ) rather than strobe rate, so the machine retains full neurological efficacy within the 4 Hz safety constraint.

### 5.2 Consent Protocol

All users provide informed consent via an illuminated physical button (red LED, IP67-rated). A 3-second hold is required to activate — preventing accidental triggering and ensuring intentional engagement. Accompanying A4 laminated signage lists exclusion criteria: (1) epilepsy or history of seizures, (2) photosensitive conditions, (3) pregnancy, (4) current psychiatric medication, (5) recent head injury or neurological conditions. Festival deployment requires at least one trained operator present at all times, capable of recognising distress and executing emergency shutdown. The /docs directory includes a printable signage template, an operator training guide, and an incident-response protocol.

### 5.3 Session Design

Default session length: 10 minutes with automated 2-minute gradual fade-out (disk deceleration, LED dimming, strobe fade to off). The standing format is intentionally lower-immersion than supine devices, allowing users to step away at any moment. A clear physical safety zone (1–2 metre radius) is maintained around the disk array. Emergency stop: simultaneous depression of both rotary encoders triggers immediate motor and LED cutoff. Operators carry a wireless key fob with the same emergency function. Post-session, a 5-minute 'integration mode' (amber lighting, slow disk, no strobe) is optionally available to support grounding before re-engaging with the festival environment.

## 6. OPEN SOURCE

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All Flashy Flesh intellectual property is released under permissive open-source licences: **MIT Licence** for all firmware (ESP32 Arduino sketches, preset engine, BPM detection); **CERN-OHL-P (Permissive)** for all hardware designs. The GitHub repository at [github.com/flashy-flesh](https://github.com/flashy-flesh) contains: disk geometry files (SVG/DXF/STL), KiCad circuit schematics, complete assembly guide with BOM, community JSON preset library, operator training guide, and signage templates.

The machine is designed to be buildable by any maker with access to a laser cutter, 3D printer, soldering iron, and standard components available globally. No proprietary or specialist components are required. Estimated prototype build cost: **€1,900** in electronic components and materials, **€500** in fabrication (laser cutting and 3D printing). Total: **€2,400** for a fully working prototype. Shared makespace fabrication is expected to reduce this by 30–50%. The open-source preset system allows DJs and VJs to author custom parameter sequences in JSON and upload them via WiFi during live performance — turning Flashy Flesh into a genuinely programmable live-performance instrument, not just a preset player.

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