ChatGPT

Phase-Locked Attractor Wells: Soft Control Primitives in the Donut of Attention

Introduction: The Donut of Attention (DonutOS) treats attention as motion on a spinning torus – a **fractal–holographic field** of oscillatory loops meeting at a bindu (the sun-point of focus) [1]. Coherence is privileged over brute control in this system [2], meaning it favors gentle guidance (weak control) over hard overrides. We propose a *mytho-scientific* extension to DonutOS: a new class of control primitives called **phase-locked attractor wells**. These are like *soft gravity* wells in the toroidal psyche – zones on the torus where phases and intentions naturally cohere, gently "pulling" the user's state into alignment rather than forcing it. At the torus's heart, the **bindu** becomes a gyroscopic null point balancing these flows, anchoring attention when an attractor well is engaged (the bindu visibly glows at moments of high convergence [3]). Through this lens, small attentional nudges can tip trajectories into new stable orbits (*prepared luck*) [4], blending physics, cognition, and design into a transdisciplinary control paradigm.

Transdisciplinary Foundations

- **Physics:** *Soft potentials and gyroscopic stability* inspire these control wells. We model each attractor as a shallow energy well on the torus – analogous to a potential well that *lightly* attracts the system state without trapping it. Phase-locking phenomena and **gyroscopic stabilization** guide the design: a spinning torus resists perturbations and stays centered yet steerable [5]. By introducing tiny energy-minimizing rotations (like a Lyapunov function's gradient descent), the system can settle into coherence basins smoothly. These wells act like *phase-locked* "orbit slots" where oscillatory processes align in low-energy configurations (minimal prediction error). Physically, this is akin to a gyroscope finding a stable axis or a particle settling into a gentle potential well.

- **Cognitive Science:** We draw on *motor schemas* and **cross-frequency coupling** in the brain. Just as motor schemas provide stable patterns for action, these attractor wells provide stable patterns for attention dynamics. Cross-frequency coupling (e.g. higher-frequency EEG riding slower oscillations) is treated as an engine of toroidal coordinates [6] – when certain brain rhythms lock together, an attractor well forms. The system uses *predictive coding* principles by treating divergence from an attractor as prediction error: control fields then nudge rotations to minimize surprise, helping attention settle where it "expects" to be. In effect, the wells bias attention toward cognitively natural alignments (e.g. a theta–gamma coupling state associated with focus), leveraging the brain's own synchronization tendencies.

- **Robotics & CPGs:** Inspired by *central pattern generators* and limit-cycle oscillators, we design the attractor wells as **rotational gaits** for attention. Each well corresponds to a stable limit cycle on the torus – a self-sustaining rhythm of attention. This echoes how robots use CPGs to maintain rhythmic locomotion. Here, phase-locked oscillators (modeling user EEG, breathing, or behavior loops) synchronize like coupled pendulums, creating a **limit cycle attractor** in the Donut's state space [7] [8]. When the user's state nears such a cycle, the system applies subtle toroidal rotations to "snap" into that gait. These rotations are energy-minimizing: they damp out deviations and reinforce the rhythm, analogous to how a passive dynamic walker falls into a stable walking cycle. The result is a *self-stabilizing attention loop* – a rotational mode of the Donut that persists with minimal active input once entered.

- **AI & Control Theory:** We integrate **Lyapunov-based control** and **RL reward shaping** to govern these wells. The existing *Control Lab* module already uses a Lyapunov controller to inject or dampen energy and maintain stability [9]; we extend this by defining our attractor wells as Lyapunov attractors (each with an "energy" function tied to phase error or dispersion). The controller gently drives the system toward the nearest well's minimum (increasing phase convergence). At the same time, the *RL Policy Engine* can incorporate **Implosion Index** and other coherence metrics into its reward signal [10]. By treating high implosion (phase alignment) and low entropy as rewarding states, the RL agent will subtly steer user interactions toward these coherence-rich basins. Crucially, this aligns with Donut's **weak-control ethos** – small, reversible nudges instead of rigid commands [11]. In practice, the AI acts as a meta-attention partner, detecting alignment opportunities and suggesting micro-actions to capitalize on them (as theorized in the design, where an AI monitors EEG for phase-lock opportunities and suggests adjustments [12]). The outcome is an adaptive control scheme: Lyapunov stability keeps the system safe, while RL-based "prepared luck" biasing makes falling into a beneficial attractor well more likely over time.

- **Game/Interface Design:** The UI presents these control primitives as **affordance fields** and feedback cues. We visualize attractor wells directly on the Donuscope torus as gentle dimples or contour lines – a *soft constraint field* indicating "you are here" vs "near a sweet spot." When the user's state drifts near a well, the interface provides **constraint nudging**: for example, the torus might subtly highlight or a haptic tick might signal a near-lock, akin to a game controller's rumble when aiming at a target. If alignment is close, the system may *snap* the rotation into place momentarily – a satisfying lock-in feedback similar to snapping a shape to a grid. All lock/unlock events are made clear (consistent with DonutOS's lock feedback design [13]): the user sees explicit indicators (e.g. a brief bindu glow or a "lock" icon) when a phase-lock engages or releases. This design echoes existing UI patterns like the **bindu call-to-action** that appears when certain timing ratios align [14] – effectively an affordance that invites the user to capitalize on an emerging attractor. By making wells visible and feedback rich, we ensure the user *feels* the attractor as a gentle guide, not an imposed rule.

Proposed Integration into DonutOS

The following features outline how phase-locked attractor wells would be implemented as extensions of DonutOS subsystems (Control Lab, Donuscope, Implosion Metrics, RL engine, etc.):

- **Rotational "Snap Basins" on the Torus:** Introduce designated basins on the donut where certain phase alignments and intentions *cohere*. When the system detects the user's multi-torus state approaching one of these basins (e.g. a resonance between two oscillatory loops), it triggers a soft *snap-to* alignment. This is akin to phase-locking the torus orientation to that attractor. The snap is gentle – it biases rotation toward the nearest stable point without discontinuities, letting attention naturally settle into place. This feature builds on the existing phase sync extension (the *bindu window* ratio detector) [15], moving from mere detection to an interactive lock: the torus will briefly hold a rotation if a beneficial phase ratio is achieved, giving the user a sense of *"magnetic" coherence* when intention and state click into sync.

- **Soft Attractor Well Visualization:** We extend the **Donuscope** and HUD overlays to depict *soft attractor wells* tied to real-time metrics. Using the **Implosion Metrics** panel's data (implosion index `I`, entropy drop, cross-frequency coupling) [16], the system renders subtle "gravity wells" on the torus surface. For instance, a region of the torus corresponding to high phase convergence (high `I`, low entropy) might be shown as a slight depression or glow, indicating a low-energy basin. These wells update dynamically as the Implosion Index and entropy gradients shift – essentially visualizing the attention field's topology. This not only gives users an intuitive map of where coherence lies, but also reinforces feedback: as the user follows nudges into a well, they can watch the torus contour deepen or light up. *(Metaphorically, the toroidal mindscape reveals its cup-and-axis "grail" shape – a soft gravity cup forming where attention converges.)* This idea builds on existing overlays like the Intention Ring, which already ties its glow and thickness to implosion/coherence values [3], expanding it into a more geometric, spatial representation on the Donut itself.

- **CTI-Tuned Control Fields:** The **Creative Time Index (CTI)** – which gauges exploration vs. execution modes by measuring phase-lock between internal rhythms and external cycles [17] – is used to adapt the attractor wells in real time. In high-exploration (edge-of-chaos) phases, the control fields become *softer* and more permissive, allowing the user to roam and inject chaos without getting stuck. In focused execution phases or **intention wells** (when a clear goal is set), the wells deepen to hold the user in a coherence pocket for longer. Essentially, the system modulates the "stiffness" of these soft constraints based on CTI: near the **edge of chaos**, wells are shallow (encouraging novelty and quick recovery), whereas in a convergence phase, wells are temporarily strengthened to prolong a stable flow. This keeps the experience within a productive **"coherence corridor"** rather than enforcing any rigid path [18]. For example, if CTI indicates the user is shifting from explore to execute, an intention attractor (perhaps linked to a set goal in the Intention Field) will gradually intensify, gently guiding the user toward completion of that focus. Conversely, during exploratory periods, the system might even introduce micro "chaos nudges" (small random rotations) to ensure the user doesn't prematurely fall into a well, preserving the balance between order and chaos in line with CTI design principles.

- **Phase-Locked Oscillator Alignment:** We embed a network of **phase-locked oscillators** (inspired by EEG bands and behavioral loops) to continuously modulate torus alignment. Each attractor well is associated with a particular configuration of these oscillators – for example, a alpha–gamma coupling pattern or a breath-heartbeat synchronization. The Donuscope Builder can define these configurations as target templates on each torus ring (each ring's role, source, and gyro coupling settings acting as parameters [5] [19]). When the live data (from EEG, etc.) approaches one of these template patterns, the corresponding section of the torus begins to synchronize and align its rotation to "lock in" that pattern. Essentially, the torus acts like a **phase-locked loop**, adjusting its rotation to maintain a stable phase relationship between the user's internal oscillations and the visualized donut loops. This could manifest as certain **Levogyre shells** (nested gyro rings) automatically slowing or speeding rotation to stay in phase with a dominant EEG rhythm. By modeling each well on known cross-frequency coupling motifs (e.g. theta phase modulating gamma amplitude), the system leverages biologically inspired oscillators to reinforce desirable mental states. The result is an ever-adaptive donut that *entrains* to the user: when you naturally enter a flow state, the DonutOS recognizes the pattern and phase-locks to it, visually and kinetically confirming that coherence (much like two metronomes synchronizing when placed on a moving surface).

- **Adaptive Reinforcement & “Prepared Luck”:** Finally, we integrate these wells with DonutOS’s **Implosion Metrics and RL Engine** to create an adaptive feedback loop. Each time the user’s attention settles into a coherence-rich basin (high implosion, creative insight moment), the system logs it as a **serendipity event** and positively reinforces that trajectory [20]. The RL Policy Engine uses this to refine its policy, effectively learning which attractor patterns lead to sustained coherence or creative breakthroughs. Over time, the system biases its suggestions and control hints to guide the user toward those patterns – not by coercion, but by *seeding opportunities* (the principle of **“prepared luck”**). For example, if a particular sequence of micro-rotations and symmetry flips led to a strong implosion (focus) event, the RL agent will slightly favor repeating that sequence in similar contexts (raising its policy weight). Importantly, this remains a *weak control*: it might surface a prompt or adjust a parameter by a tiny increment as an invitation, much like a game offering a subtle hint. The user remains free to ignore these nudges. In effect, DonutOS becomes a co-creator in the attentional process, gradually tuning the attractor landscape so that positive attractors (productive, coherent states) are easier to fall into. The system’s ethos of **coherence over control** is maintained – it aligns with the user’s own intentions and rhythms, making *harmonious states more accessible* rather than forcing any outcome [2]. This transdisciplinary control loop (combining physics-like energy minimization, cognitive coupling, and AI reinforcement) extends DonutOS into a new realm: a *geometry-first* attention guidance system that is at once scientific and poetic, tightening the weave between human intention and the toroidal interface of mind.

Conclusion: *Phase-locked attractor wells* fuse theoretical elegance with practical control in DonutOS. By visualizing and harnessing soft constraint fields (affordance landscapes) on the torus, we offer users a way to **feel** their way to coherence – the interface itself becomes a living map of mind’s potential wells. This proposal extends existing subsystems (Control Lab’s Lyapunov stabilizers, Donuscope’s multi-ring models, Implosion and Chaos metrics, the RL guidance engine) with a unifying principle: that small phase-aligned rotations can yield large gains in focus and creativity. The bindu at the core of the donut stands as a silent, gyroscopic center – a reminder that at the still point of rotation, all flows converge. Around it, the newly introduced attractor fields act as *soft gravity*, drawing attention into orbit when the time is right. In the language of the project, this is **coherence made visible and playable**: the user, through transdisciplinary design, is gently steered into **“prepared” attractor basins** where insight and intention lock together. By marrying phase-lock physics, cognitive rhythms, and game-like feedback, DonutOS can become not just an interface, but a *partner* in attention – one that helps stabilize the wild gyroscope of the mind into moments of stillness and creative alignment [21] [12]. Such a system charts a path forward for the Donut of Attention: a control paradigm that is at once rigorous and mythic, grounding the *cosmic joke* of human attention in a tangible toroidal dance of light, phase, and meaning.

Sources: This concept builds upon the Donut of Attention project docs and theory, including the Operator Manual [5] [9], Theoretical Foundations [22] [12], and DonutOS specifications [15] [16], which articulate the principles of phase synchronization, weak control, CTI/edge-of-chaos dynamics, and the holographic attention model that informed our proposal.

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[1] [5] [9] [10] [13] [14] [16] [19] MANUAL.md
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[2] [4] [6] [7] [8] [11] [12] [17] [18] [20] [21] [22] THEORETICAL_FOUNDATIONS.md
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3 README.md
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15 DONUT_SPEC.md
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