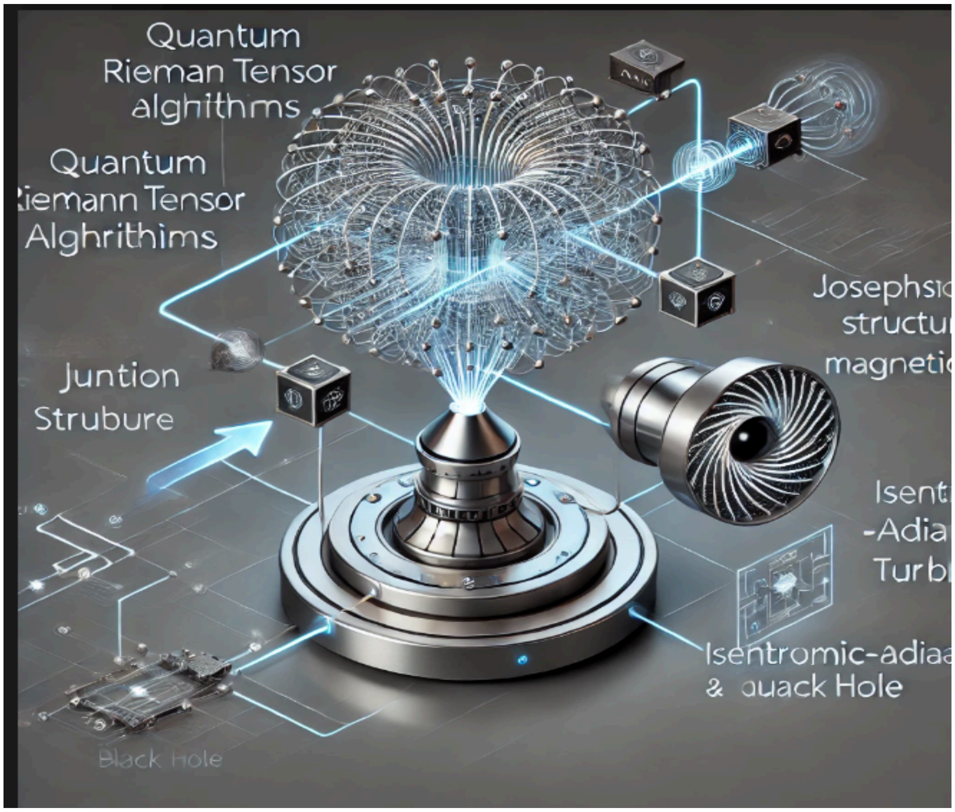
Dimensions for designing engines, Riemann tensors of stellar winds (algorithms)



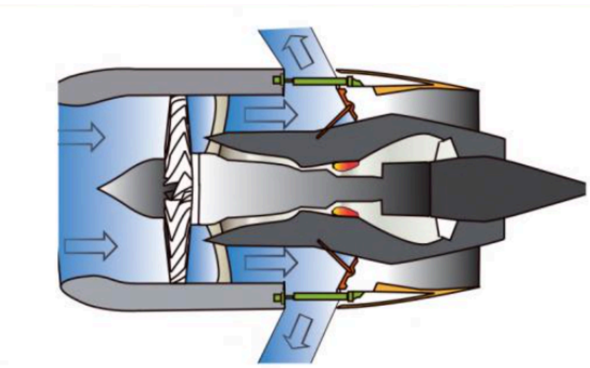
Timelike Curves (CTCs) allow people to "travel to the past." At first glance, this seems like an obvious implication, since (on sufficiently large scales) one may view a timelike curve as the worldline of a hypothetical spaceship traveling through spacetime.

A Godel-type universe is a rotating universe that admits CTCs. We work in a cylindrical coordinate system $\{t,\phi,r,z\}$, where $t \in R$ is a time coordinate, $\phi = [0,2\pi]$ is the cylindrical angle (with $0 \equiv 2\pi$), $r \geq 0$ is the distance from the cylindrical axis, and $z \in R$ parametrizes the axis. For the physics we are interested in, it will suffice to postulate the following general metric:

$g(\partial\mu,\partial\nu) =$ A(r) B(r) 0 0 B(r) C(r) 0 0 0 0 1 0 0 0 0 1 , with $\partial\mu =$ ∂t $\partial\phi$ ∂r ∂z , where A, B, C are generic functions of r.

Godel's metric can be expressed in the above form [24, §5.7], with A=−1, B= √ 2sinh2r, C=sinh 2−sinh 4r

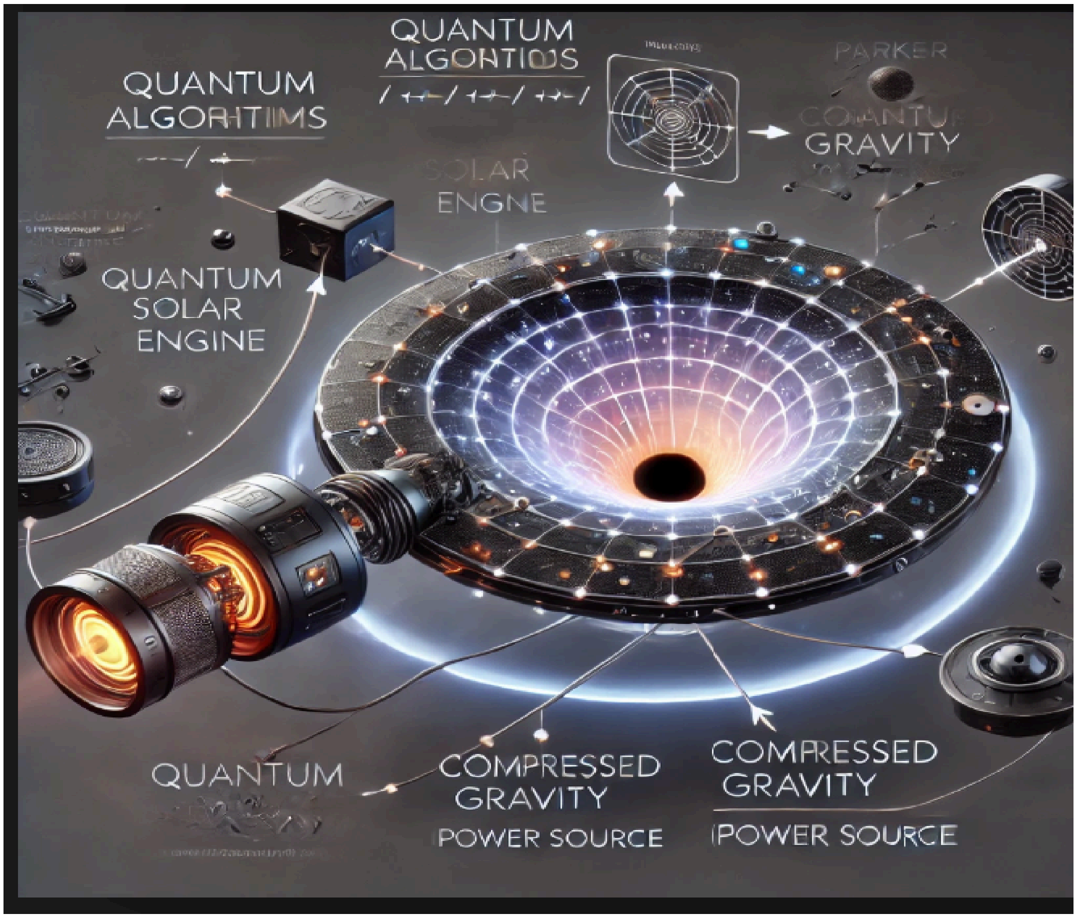
An insightful thermodynamic perspective was proposed in [2]. Let us briefly review the main idea. We begin by noting that, according to our current understanding of physics, entropy increase is the only physical law that allows us to establish a fundamental distinction between past and future [3, 4]. This provides us with a local criterion to determine the direction of time. Specifically, if a thermally isolated system (see [5, §11] for an operational definition) occupies an event xxx in spacetime, the "future" lightcone at xxx is the one pointing in the direction of increasing entropy of such a thermodynamic system.



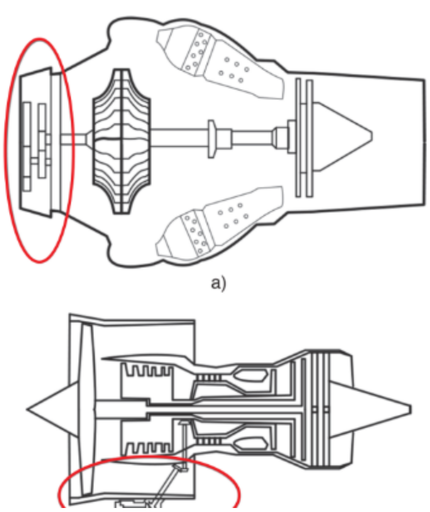
I want a connection node to be the entropic arrow of time (gray arrows) along a CTC. The positive direction of the arrows follows entropy increase, i.e., dS("arrow")>0dS(\text{"arrow"}) > 0dS("arrow")>0. These time arrows must flip somewhere along the CTC, because dSdSdS is an exact form, i.e., dS=0dS = 0dS=0. Indeed, there must be at least two points x0x_0x0 and xfx_fxf where **dSdSdS** changes orientation.

The idea here is to explore the interactions of Dimensions for designing engines, Riemann tensors of stellar winds (algorithms) within the context of a black hole to observe how to build a new object or a different spatial architecture based on connection points.

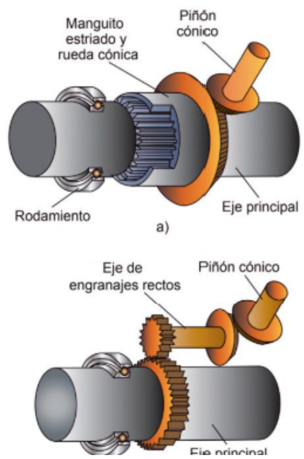
To design **engines** with different dimensions and new energies or quantum metabolisms to construct spatial architectures. These are the minimum and maximum entropy events, marking the beginning and the end of two parallel histories (blue and green) of the same spaceship.



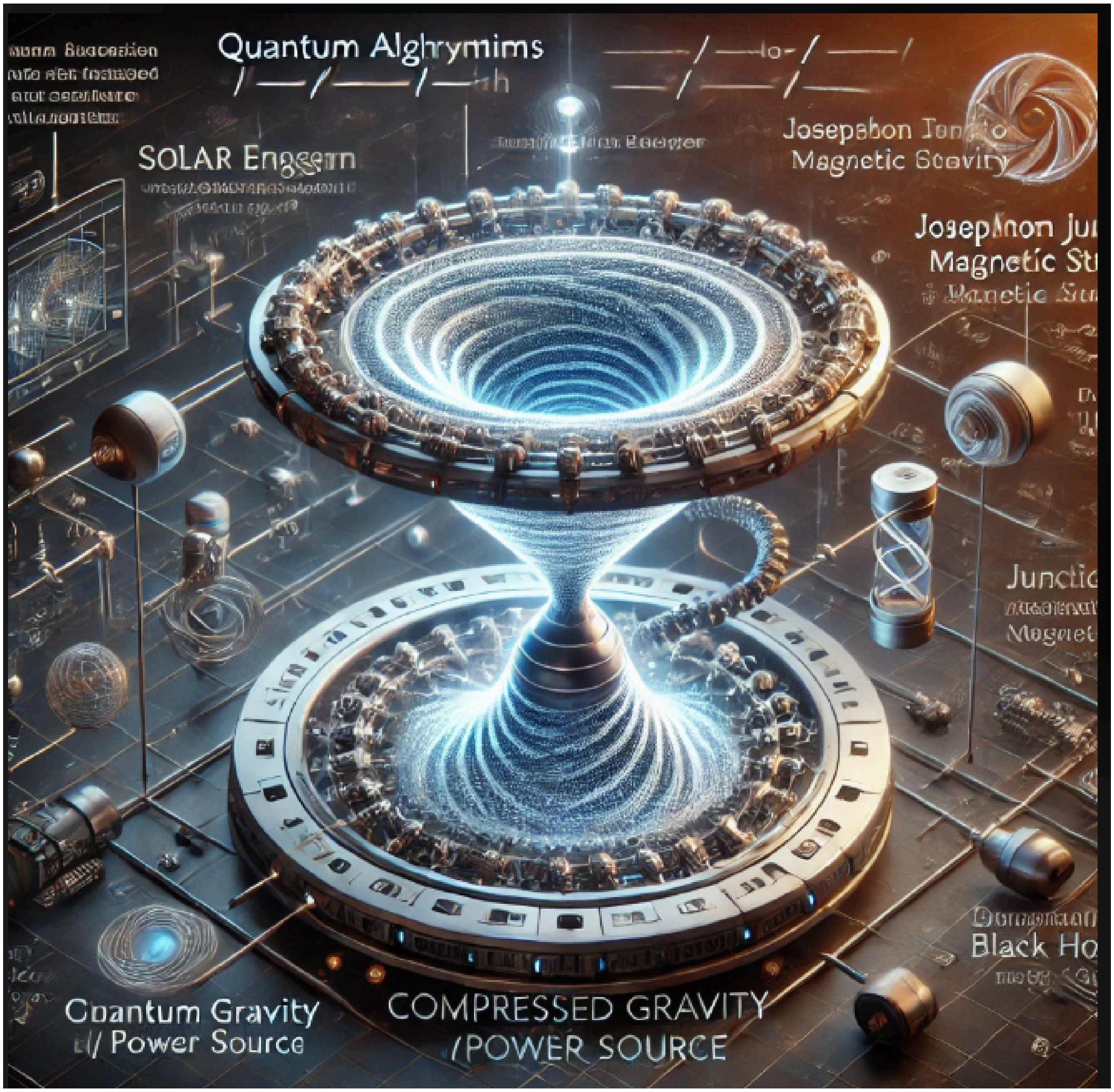
Rienmannian geometry(D) manifolds number/dimensions combined with Timelike Curves (CTCs)



Let us briefly review the main idea. We start by noticing that, according to our current understanding of physics, entropy increase is the only physical law1 that enables us to draw a fundamental distinction between past and future [3, 4]. This gives us a local criterion to determine the direction of time. Namely, if a thermally isolated system (see [5, §11] for an operational definition) occupies an event x in spacetime, the “future” lightcone at x is the one that points in the direction of increasing entropy of such a thermodynamic system. Let us apply this principle to a **CTC.**



SPONTANEOUS INVERSION OF THE ENTROPIC ARROW OF TIME In this section, we show that the thermodynamic picture illustrated in figure 1 (and introduced in [2]) is valid (at least in axisymmetric universes), and follows directly from equation (10). In the following, we will model the spaceship as an idealized box with perfectly reflecting walls. This is necessary, because the second law of ther modynamics applies only to thermally isolated systems, to which we can assign a Hamiltonian



Timelike Curves (CTCs) allow the possibility of "traveling to the past." At first glance, this appears to be a straightforward implication, as a timelike curve on a sufficiently large scale can represent the worldline of a hypothetical spaceship navigating across spacetime. The foundation of this concept lies in the interplay between thermodynamics and geometry, specifically leveraging the entropy arrow of time as a local and global criterion to study temporal behavior.

An insightful thermodynamic model [2] establishes that entropy increase serves as the only physical law distinguishing the past from the future [3, 4]. A thermally isolated system at spacetime event xxx determines the "future" lightcone by aligning it with the direction of increasing entropy. This entropy-driven criterion forms the basis for understanding the structure and dynamics of CTCs within complex systems like black holes.

Entropic Arrow of Time on CTCs

The entropic arrow of time is represented by grey arrows along a CTC. The positive orientation of these arrows corresponds to an increase in entropy, dS(arrow)>0dS(\text{arrow}) > 0dS(arrow)>0. However, due to the nature of dSdSdS as an exact form (dS=0dS = 0dS=0), there must exist at least two critical points (x0x_0x0 and xfx_fxf) where the entropy flips orientation. These points are essential for defining minimum and maximum entropy events along the CTC, effectively marking the boundaries between parallel histories.

- **Connection Node**: The entropic arrow at these nodes serves as a transition mechanism where one timeline evolves into another. These points are not only thermodynamic boundaries but also potential loci for energy and dimensional interaction, which can be exploited for engine design.

Dimensions for Designing Engines

The Riemann tensors of stellar winds provide a mathematical framework for analyzing energy flow and momentum distribution near black holes. These tensors encode the curvature of spacetime, which can be repurposed to design engines capable of extracting energy from extreme astrophysical phenomena.

1. **Energy Harvesting from Black Holes**: By aligning engine dimensions with the entropy gradient in spacetime, new energy-efficient architectures can be built. The interaction between CTC nodes and Riemann tensors can lead to innovative designs that leverage the Penrose process or frame-dragging effects.
2. **Quantum Metabolism of Engines**: The engines could incorporate quantum-level processes that mirror entropy fluctuations. This would create a metabolic-like mechanism, where energy transformation is directly tied to changes in spacetime curvature.
3. **Architectural Adaptations**: Engines designed in multiple dimensions (e.g., 4D and higher) could operate on varying energy scales. These architectures would exploit the localized energy densities near black holes and stellar winds, transforming gravitational energy into usable thrust for advanced spacecraft.

Riemann Tensors and Stellar Wind Algorithms

The use of Riemann tensors extends beyond curvature analysis. Algorithms developed to model stellar wind interactions could serve as computational tools to predict and manipulate energy exchanges near singularities. These algorithms would enable:

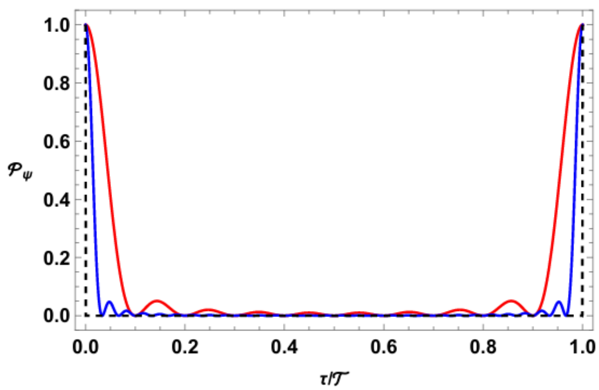
- **Simulating Stellar Wind Patterns**: Predict the trajectory and energy transfer of stellar winds interacting with the event horizon of a black hole.
- **Optimizing Energy Efficiency**: Use tensor-driven algorithms to optimize engine performance by reducing energy losses during entropy transitions at CTC nodes.
- **Designing Spatial Architectures**: Leverage stellar wind simulations to construct space habitats or energy-absorbing structures capable of sustaining operations in high-energy environments.

Parallel Histories and Entropy Events

The minimum and maximum entropy events define the beginning and end of two parallel timelines (blue and green) for the same spaceship. These parallel histories provide a unique opportunity to design engines and architectures capable of sustaining operations across fluctuating energy states.

1. **Timeline Synchronization**: Develop systems to stabilize energy fluctuations between the two timelines, ensuring the spaceship can transition smoothly between entropy states.
2. **Architectural Resilience**: Build multi-dimensional structures that adapt to entropy changes, ensuring continuous operation regardless of temporal orientation.
3. **Novel Energy Sources**: Exploit entropy reversals at x0x_0x0 and xfx_fxf to develop engines powered by the opposing entropy gradients.

FIG. 2. Spontaneous decay and later recombination of an unstable particle traveling on a CTC, according to equation (14), with Z=10 (red), Z=30 (blue), and Z → +∞ (dashed). PΨ(τ) = |⟨Ψ|e−iHτ |Ψ⟩|2 = 1 Z2 2 1−e−i2πZτ/T 1−e−i2πτ/T , T , the particle is spontaneously reconstructed, over the same time that it took for it to decay. This mechanism is a direct consequence of the discretization (10) of the energy levels, and it does not require us to fine-tune the initial conditions. The same qualitative behavior is observed with different choices of ⟨Ψ|Pn |Ψ⟩.


1.0
0.8
0.6
0.4
0.2
0.0
$\mathcal{P}_\psi$
0.0
0.2
0.4
0.6
0.8
1.0
$\tau/\mathcal{T}$