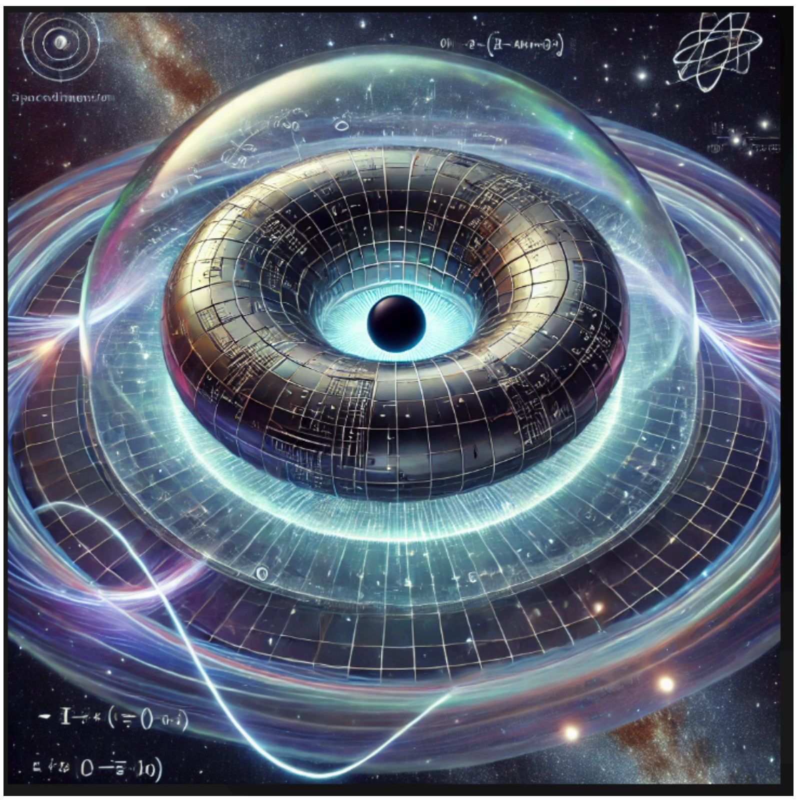
Structural Analysis of Black Holes and Jet Engines:

1) *Quantum Mechanics and Jet Engines (Practical Foundations in Higher-Order Dimensions for Modeling New Reaction Engines, Quantum Propulsion, and Alcubierre Theory) —*

2) *High-Dimensional Structural Frameworks in Black Holes for Designing New Engines Adapted for Outer Space.*



Integrative Structural Framework: Black Hole Metrics and Reaction Engine Components

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Introduction:
This presentation outlines a multidisciplinary approach that integrates advanced metrics derived from black hole physics with state-of-the-art reaction engine design. By leveraging theoretical models—such as the Alcubierre metric, Riemann metrics augmented by quantum algorithms

(including wave radiation equations and quantum portfolio optimization), and Swanlizt metrics—we aim to translate high-dimensional theoretical constructs into practical engine components. These components correspond to parts of a reaction engine, such as turbine structures and thermodynamic layouts, as illustrated in references like Belmonte's work.

Core Components and Metrics:

1. **Alcubierre Metric:**
    - *Overview:* Originally proposed as a warp drive solution in general relativity, here it provides a foundational template for mapping complex spacetime curvature onto engineering structures.
    - *Role:* Serves as the primary metric that anchors the black hole analysis.
2. **Riemann Metrics & Quantum Algorithms:**
    - *Overview:* Riemannian geometry provides the mathematical framework to describe curved spacetime. Coupling this with quantum algorithms—especially those handling wave radiation equations—enables the simulation of high-energy environments.
    - *Role:* These metrics, combined with quantum portfolio optimization algorithms, refine system parameters to ensure optimal performance and stability.
3. **Swanlizt Metrics:**
    - *Overview:* These metrics facilitate the connection between theoretical high-dimensional models and practical engineering applications.
    - *Role:* They define the interface for integrating engine components with black hole metric data, ensuring that both internal and external structures are harmonized.
4. **Engine Component Integration:**
    - *Overview:* Each metric is conceptualized as a series of algorithmic components (imagine a "txt" file) that must precisely interlock with the physical elements of a reaction engine (for example, turbine structure or the engine's thermodynamic layout).
    - *Role:* This step ensures that every theoretical element is mapped to a corresponding engine component, resulting in a unified design that operates efficiently under space conditions.

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1. **Black Hole Metric Structural Diagram:**

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┌─────────────────────┐
│  Alcubierre Metric  │
└─────────┬───────────┘
          │
┌─────────▼───────────┐
│  Riemann Metrics    │
└─────────┬───────────┘
          │
┌─────────▼───────────┐
│ Quantum Algorithms  │
│  (Wave Radiation,   │
│ Portfolio Opt.)     │
└─────────┬───────────┘
          │
┌─────────▼───────────┐
│   Swanlizt Metrics  │
└─────────────────────┘

flowchart TD
    A[Black Hole Metrics<br/>(D-Dimensional, High-Energy)] -->
B[Quantum Algorithms<br/>(Wave Radiation, Portfolio Optimization)]
    B --> C[Reaction Engine Framework<br/>(Rocket Propulsion, Ideal
Engine Design)]
    C --> D[Thermodynamic Components<br/>(Isobaric Structures, 4D
Spatial-Temporal Design)]
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IMAGE

Title: *4D Reaction Engine & Black Hole Metrics Fusion*

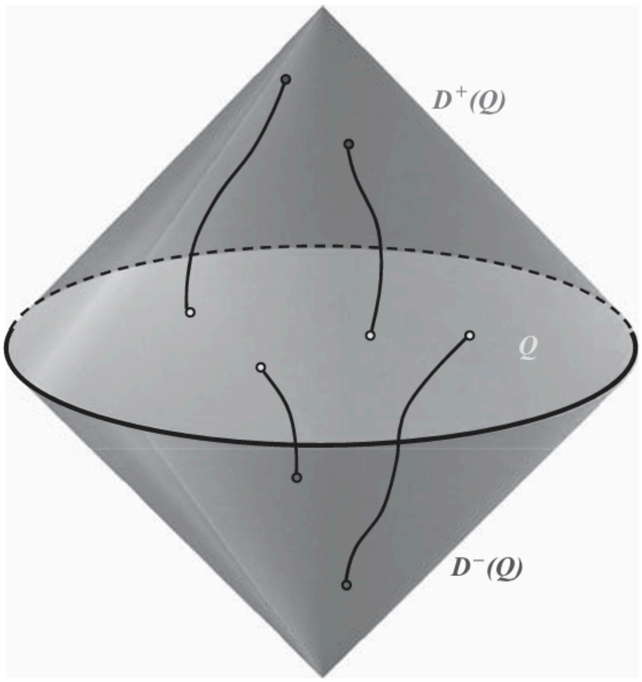
Visual Concept:
Imagine a futuristic, multi-layered holographic display where:

- Background: A dynamic cosmic panorama of swirling nebulae and pulsating energy fields represents the D-dimensional black hole metrics. These cosmic swirls are rendered in deep blues, purples, and neon highlights, evoking a sense of infinite space and complex geometry.
- Central Element: In the foreground, a translucent, multi-faceted geometric structure (reminiscent of a hypercube) rotates slowly, symbolizing the 4D spatial-temporal design.

This hypercube is overlaid with intricate grid lines that pulse with quantum energy.

- Overlay Components: Flowing streams of light and data (representing quantum algorithms like wave radiation and portfolio optimization) interweave around the structure. These streams connect to stylized, digital renditions of reaction engine components (turbines, combustion chambers, and thermodynamic circuits) that are integrated seamlessly into the design.
- Accent Details: Isobaric contour lines and thermodynamic charts appear as subtle overlays on parts of the engine, hinting at precision and the interplay of physics and engineering.
- Overall Aesthetic: The entire scene has a vibrant, neon-lit, cyber-futuristic look, with a 4D depth effect achieved through layered translucency and motion blur that suggests movement through both space and time.

Theory/Black_holes/Jet engines



Space structures & causal sets The chronological future I+(Q) (chronological past I−(Q))ofasetQ is the set of points for each of which there is a past-directed (future-directed) time-like curve that intersects Q. The curve xμ(λ) is said to be causal (or non-space-like) if its tangent vector uμ = dxμ/dλ obeys the condition uμ uμ ≤ 0 at each of its points. A non-space-like (causal) curve between two points, which is not a null geodesic, can be deformed into a time-like curve connecting these points. The causal future J+(Q) (causal past J−(Q))of assetS is the set of points for each of which there is a past-directed (future-directed) causal curve that intersects Q.The Future Cauchy domain D+(Q) (past Cauchy domain D−(Q))

Definition of a covariant derivative Partial derivative ϕ,μ of a scalar function ϕ is a covector. But a second partial derivative ϕ,μν of ϕ is not a tensor. Indeed, one has ϕ ,μν = (ϕ,μ xμ ,μ),ν = ϕ,μν μ ,μ xν ,ν + ϕ,μ xμ ,μν .

The expression describes the tensorial law of transformation of ϕ,μν. This is a general problem: a partial derivative of a tensor is not a tensor. In particular, the partial derivatives of the metric, gμν,α **Expr:** T ναβ = 1 2 gνα,βνβ,α −β αβ,ν .

A data given point the number of independent components ofxρ ,μν is D2(D + 1)/2. The Christoffel symbols have the same number of independent components.One can always find such coordinates near p in which ρμν(p) . = 0. Such coordinates are called Riemann normal coordinates. The tensor T the following combination of its partial derivatives and the Christoffel symbols $\nabla\lambda\, T\alpha\ldots\beta\ldots = \partial\lambda\alpha\ldots\beta\ldots - \rho\alpha\lambda\, T\rho\ldots\beta\ldots +\cdots+ \beta\lambda\rho\, T\alpha\ldots\, \lambda\ldots + \ldots$.

The covariant derivative in Quantum fields(structure)

$\nabla\alpha(\ldots)\equiv(\ldots);\alpha$

Properties of the covariant derivative The covariant derivative possesses the following properties: 1. Linearity: For constants a and b one has $\nabla\mu(aA\ldots\ldots + bB\ldots\ldots) = a\nabla\mu A\ldots$ 2. Leibnitz rule: $\nabla\mu(A\ldots\ldots B\ldots\ldots) = \nabla\mu(A\ldots\ldots)B\ldots\ldots + A\ldots\ldots\ \nabla\mu(B\ldots\ldots)$.

Expr: Tensorial object instead of the metric. the Lie derivative, by using a vector field.

Properties: 3. Commutativity with contraction: $\nabla\mu(A\ldots\beta\ldots$ Lie and Fermi Transport 81 $\ldots\beta\ldots) = (\nabla\mu A)\ldots\beta\ldots\ldots\beta\ldots$.

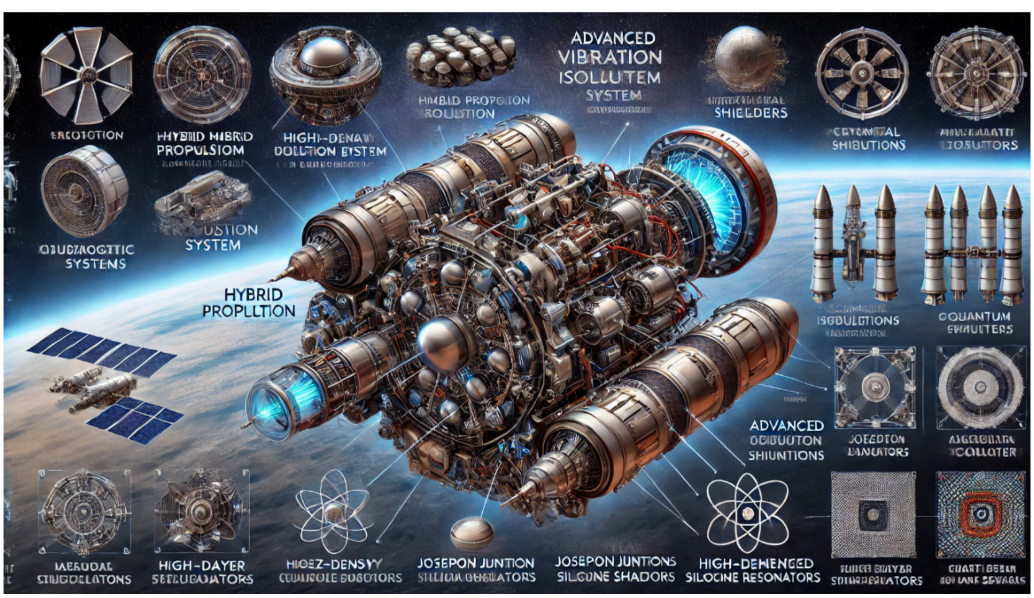
 4. For a scalar field: $\nabla\mu\phi = \phi,\mu$.

5. Torsion free: $\nabla\mu\nabla\nu\phi = \nabla\nu\nabla\mu\phi$. 6. $\nabla\mu\alpha\beta = 0$.

*The expression*s are valid for the Lie derivative . $L\xi A\alpha\ldots\ \beta\ldots = \xi\mu\ \partial\mu\ \alpha\ldots\ \beta\ldots - \partial\mu\iota\alpha\ A\mu\ldots\ \beta\ldots -\cdots+\partial\beta\nu\mu\ A\alpha\ldots\ \mu\ldots +\cdots = \xi\mu\nabla\mu\ \alpha\ldots\ \beta\ldots - \nabla\mu\iota\alpha\ A\mu\ldots\ \beta\ldots -\cdots+\nabla\beta\nu\mu\ A\alpha\ldots\ \mu\ldots +\cdots$

The Lie derivative obeys the following relations 1. $L\xi\xi = 0$; 2. $L\xi(\alpha A\ldots\ldots + \beta B\ldots\ldots) = \alpha L\xi A\ldots\ldots + \beta L\xi B\ldots$ 3. $L\xi(A\ldots\ldots B\ldots\ldots) = L\xi A\cdots\cdots B\cdots$ 4. $L\xi\, L\eta - L\xi L\xi = L[\xi,\eta]$.

Engine Jet examples/ we have to add extra theory / black holes to build another kind of jet engines with theory of design Jet-turbines in spatial orbits & Quantum theory.



Fermi transport:

When both the vector field ξ and the metric g are defined on the manifold one can construct a new useful operation called the Fermi transport. Denote by w a vector wα =ξβξα;β, Then, the following antisymmetric tensor ε(ξ) = sign(−ξμ). Fασ =(αξσ −ξαςσ)ε(ξ), (3.4.10) (3.4.11) is a generator of transformations in the (ξ,w)-plane. When ξ is a time-like vector, this is a boost transformation. Using this tensor one can construct a new operation, called a Fermi derivative.TheFermi derivative FξAα... β... of a tensor field Aα... β... along a vector field ξ (ξμ ξμ= 0) is defined as: F Aα...β... = ξμ ∇ μ α...β... + F A...β... +⋯−Bσβ Aα... σ... +⋯ .

Another Symmetries of the curvature tensor The curvature tensor Aβγδ can be written explicitly Aβγδ = 1 2 g,βγ +gβγ,αδ −gαγ,βδβδ,αγ + g σ βγ σαδ − βδ σαγ

Since Rαβγδ is a tensor it is sufficient to check this relation in any suitable coordinate system. It is convenient to use the Riemann normal coordinates where the Christoffel symbols are:

α	γ
β	δ

D	$D+1$
$D-1$	D

3	2
2	1

Fig. 3.8 The Young diagrams of a shape (2,2) necessary for calculation of the dimension of tensors with symmetries of the Riemann curvature tensor.

The curvature tensor Rαβγδ obeys the following symmetry properties:

6) ç
Aβγδ = Aβ[γδ] = R[αβ]γδ, Aβ Γδ = Γδ Aβ, Rμ[ναβ] = 0.

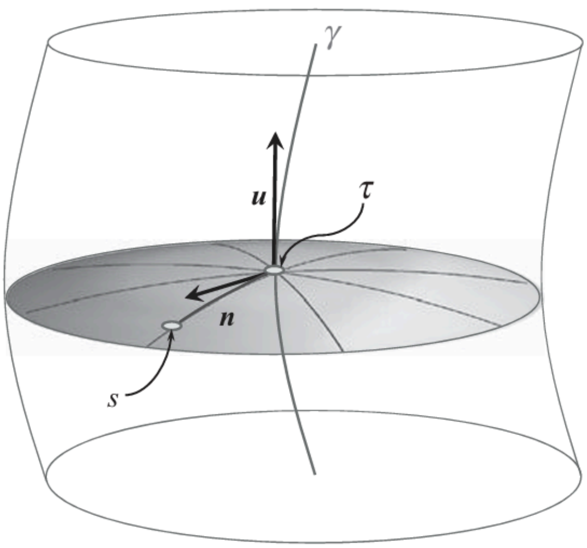
These relations give a complete set of symmetries of the curvature tensor. It is easy to show that Eq. (3.5.10) can also be rewritten in the following two forms: R[μνβ] = 0, eμ1...μD−4ν1ν2ν3ν4Rν1ν2ν3ν4 = 0.

Dimensions: ND[R]= 1 12D2(D2 −1)

Problem 3.5: Forgiven tensor Δαβη,obeying the symmetries Eqs. (3.5.8)–(3.5.10),wedefine new tensors A and S by the following relations.

The Weyltensor & the math property is related to curvatures like Aμαν = 0,i.e. it is a traceless part of the Riemann tensor. This property imposes D(D + 1)/2 Curvature Tensor 87 constraints. Subtracting this quantity from ND[R] we obtain that for D ≥ 3 the total number of independent components of the Weyl tensor is ND[C]= 1 12 (D−3)D(D+1)(D+2). In a four-dimensional spacetime N4[R]=20, In three dimensions one has N3[R]=6, N4[R]=10, N3[R]=6, N4[C]=10. N3[C]=0. (3.5.22) (3.5.23) (3.5.24) This means that in three dimensions the curvature tensor can be expressed in terms of the Ricci tensor and the Ricci scalar..

Showthatina3-dimensional spacetime the Riemann tensor can be expressed in terms of the Ricci tensor, the Ricci Scalar, and the metric as follows: Rαβγδ = gαγ Rβδ+gβδRαγ −gαδRβγ −gβγ Rαδ − 1 2 αβ γδ−βγ R.



The one-parameter family of smooth curves xμ(λ,σ), letλ be a parameter along curves and σ be a parameter enumerating the curves. We denote u = dxμ/d and vμ = dx/dσ. Consider two close curves with the parameters σ and σ + δ ς.Denote M 0 = μ(λ,σ). Consider a parallelogram with the apices at the points (see Figure 3.10) p ↔xμ 0 , pu ↔x 0+uμδλ, pv ↔x 0+μδσ, p↔x μ 0+μδλ+μδσ.

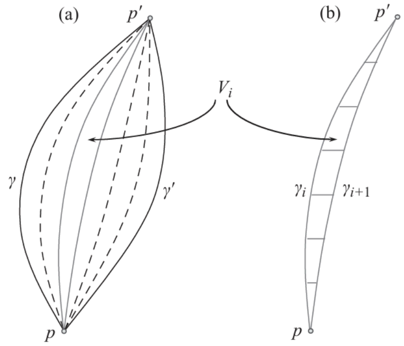
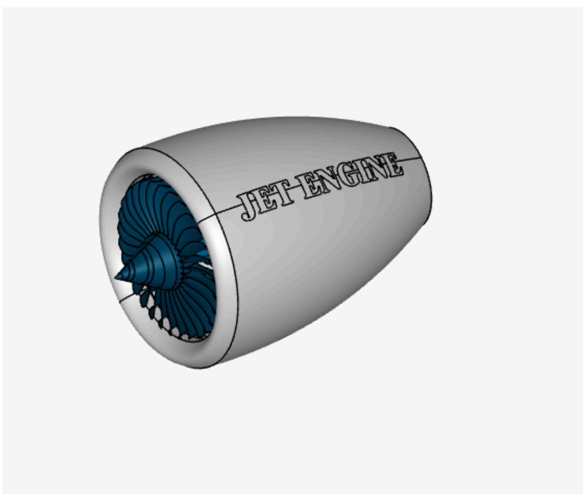


Fig. 3.11 Illustration of the proof of the theorem. The left figure (a) shows a one-parameter family of curves connecting two points p and p' in a simply connected region. The right figure (b) shows a surface element between two nearby curves γ_i and γ_{i+1}.

The Riemannian operator For any two vectors u and v the Riemannian operator R(u,v) acting on a third vector w is defined by the relation R(u,v)w = (∇u∇v −∇v∇u −∇[u,v])w. Let us show that (R(u,v)w)μ = Rμ ναβwνuανβ. The right-hand side of Eq. (3.6.29) is uα(νβwμ;β);α − να(uβwμ;β);α − (uανβ ;α − ναuβ ;α)wμ;β =uανβ(wμ;βα −wμ;αβ) = Rμναβwνuανβ. (3.6.29) (3.6.30) (3.6.31) The last equality was obtained by using the expression Eq. (3.5.5) for the commutator of the covariant derivatives. This proves Eq. (3.6.30). Geodesic deviation equation Consider a one-parameter family of geodesics xμ = xμ(λ,σ), where λ is an affine (proper time) parameter, and σ 'enumerates' the geodesics. Denote by nμ a vector connecting the points of the same λ on two close geodesics with parameters σ and σ + δσ. Since the vector n is 'frozen' into the congruence, it obeys the relation Eq. (3.4.1) Lun =[u,n]=0. Let us use the relation Eq. (3.6.29) taking v = n and w = u R(u,n)u =∇u∇nu−∇n∇uu =∇u∇nu =∇u∇un. (3.6.32) (3.6.33) We used here the geodesic equation ∇uu = 0 and the relation Eq. (3.6.32) that implies that ∇nu =∇un.Using Eq. (3.6.30) one obtains D2nα dλ2 ≡(∇u∇un)α =−Σμυρνησ ν nμ. (3.6.34) The obtained geodesic deviation equation.



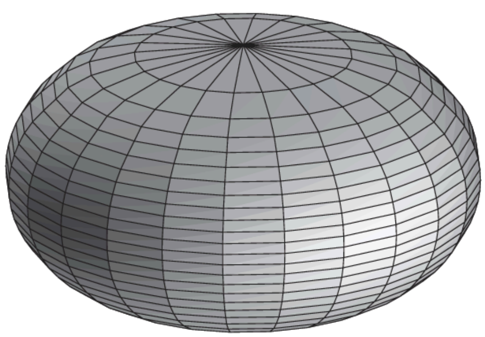
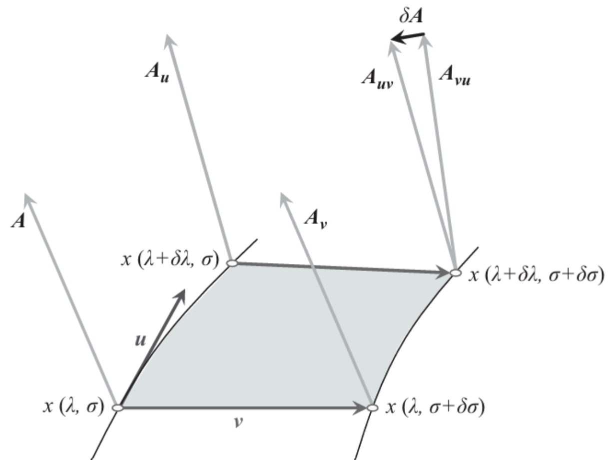


Fig. 8.2 The embedding diagram for a two-dimensional section of the event horizon of the Kerr black hole. The diagram is constructed for the critical value $a/M = \sqrt{3}/2$ of the rotation parameter so that the Gaussian curvature vanishes at the poles.

The length of the equatorial circle $\theta = \frac{\pi}{2}$ for the metric dS^2 is

$$L_1 = \frac{2\pi}{\sqrt{1-\beta^2}}. \quad (8.2.48)$$



Symmetry algebra/vectors for Jet engines imitating the black hole structure:

The Killing vector, that is, the Killing vectors form a linear space. If ξμ and ημ are two Killing vectors, then their commutator ζμ =[ξ,η]μ = ξαημ,α −ηα ξμ,α, is again a Killing vector. To show this, let us use the relations Eq. (3.4.7) Lζ =[Lξ ,Lη]=Lξ Lη −LηLξ . Applying this relation to the metric one obtains Lζg =Lξ Lηg−LηLξg=0. (3.7.5) (3.7.6) (3.7.7) The linear space of the Killing vectors with a product operation defined by their commutator forms the Lie algebra.Let{ξA} (A = 1, ...,r) be a basis in the space of the Killing vectors, then [ξA, ξB]=CCABξC. Here, CCAB are the structure constants obeying the relations CCAB =−CCBA, CE[AB CKC]E = 0.