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Spherical Geometry of Two Qubit Unitary Operators. DMITRY USKOV, Tulane University, RAVI RAU, Louisiana State University — Geometric and algebraic properties of the SU(4) group of two-qubit transformations are much richer than corresponding properties of an arbitrary SU(N) group because there exists an accidental isomorphism between the SU(4) Lie group and the Spin(6) Lie group (a spinor form of orthogonal rotations in Euclidean 6-dimensional space). We exploit this property to construct a new set of [Spin(n+1)/Spin(n)]×Spin(n) fiber bundles, embedded in the SU(4) manifold and to identify relevant holonomies. Geometrically these fiber bundles are even simpler than fiber bundles supporting Berry and Wilczek-Zee non-Abelian phases. It is well known that construction of the Bloch Sphere is based on the SU(2)=Spin(3) Lie group isomorphism. Since quotient spaces Spin(n+1)/Spin(n) are n-dimensional spheres S^n, the chain of embedded subgroups Spin(3), Spin(4), Spin(5) allows to complete the Bloch Sphere construction for the SU(4) case by a combination of spheres of higher dimensions S^3-S^4-S^5. As an example we derive a set of linear dynamic equation for generalized S^4 Bloch sphere, describing an evolution of a 4-level quantum system.

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