# A Bottom-up 'Game of Lie' Cellular Automaton Evolution in Killing Root Space $A_3$ Both Nucleating and Crystallizing the Complete Atomic Realm

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**Abstract.** As a budding cardiologist (see https://www.ncbi.nlm.nih.gov/pubmed/?term=trell+e) in the early 70.ies attempting to apply rotational transformations to electrocardiography (ECG) but not helped out by the textbooks on Lie algebra, I decided to go back to his Norwegian Ph.D. thesis *Over en Classe geometriske Transformationer* from 1871[1,2] and managed to trace an original in the Oslo University library and get a photocopy of it. I soon realized that it was a veritable treasure, waiting in its vault and ready to follow; not directly to ECG of course, but to the universal "nature of Cartesian geometry".[Ib.] Why then so forgotten? At the dissertation process "his latest insights….expressed in a radically new language…was difficult for his audience…: not one… had understood a single word of it".[3] So the thesis went down to the faculty archives to lie in oblivion for the coming hundred years. It was a marvel, therefore, to see how basic and simple it stands forth today in its pragmatic descriptive physical stature with the tenet that space is matter and matter is space and mutually filling each other from the smallest to the largest scale in both a physical and mathematical sense: "The Cartesian geometry, namely, translates any geometric theorem into an algebraic one and thus…of the geometry of space a representation of the algebra of three variable quantities" where both the algebraic and "geometrical transformation…can be perceived as consisting of a transition from a point to a straight line as element…through a particularly remarkable transformation" (where) "the theory of main tangential curves can be brought back to that of rounded curves" so that the "Plücker line geometry can be transformed into a sphere geometry", i.e., its "straight lines of length equal to zero"…"into the sphere's rectilinear generatrices" (= infinitesimal generators in present terminology) "where x,y,z are perceived as parameters, dx, dy, dz on the other hand as direction-cosines". Even though the zero length linear element there is equally "infinitely small" as an "infinitesimal sphere" point, it has the vital difference from this that it is a line and therefore can concatenate with its likes with partial derivative properties to carry out, "in that we restrict ourselves to linear transformations of r the corresponding transformations of R: all movements (translation movement, rotation movement and the helicoidal movement), semblability-transformation, transformation by reciprocal radii, parallel transformations etc" both as "partial differential equations of the first order" and physical "geodetic curves" under the "general equation system f(x,y,z,dx,dy,dz) = 0" and its "spatial reciprocity" that "relative to the given line complex" in x,y,z "unambiguously corresponds a certain curve-net" in the "line element (dx,dy,dz)". On the infinitesimal level it translates to the neighborhood and commutation relations of the respective Lie algebra which by iteration as a virtual cellular automaton outlines its global geodesics. In SU(3), covering the atom and elementary particle realm, this encapsulates to a three-dimensional $R^3 \times SO(3)$ wave-packet cell whose "enveloped"[1,2] $A_3$ Killing root space diagram and lattice entirely by itself crystallizes the central nucleon domain and in further simulations replicates the internal spectroscopy of this as well as its baryon, meson and lepton elementary particle transformations, surface muon events and external space-filling as the periodic system.