Gauge Groups and Wavefunctions - Balancing at the Tipping Point

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"What the Hell is Going On?" is Peter Woit's 'Not Even Wrong' blog post of July 22nd[1], a commentary on Nima Arkani-Hamed's view of the present barren state of LHC physics[2], the long-dreaded Desert. According to Woit,

"...HEP theory has been in the wrong basin of attraction for quite a while...Arkani-Hamed is right to identify the 1974 GUT hypothesis as the starting point...HEP theory has progressed historically by identifying new more powerful symmetry principles. The move in 1974 was to go beyond the SM symmetries by picking a larger gauge group, then breaking it at a very high energy scale with new scalar fields. The history of the last 43 years is that this idea isn't a successful one: as this talk shows, it leads to an empty theory that explains nothing. Can one find different new ideas about symmetry that are more promising?"

Roots of the quandry are fundamental, branching deep into the measurement problem[3] and the enigmatic unobservable character of the wavefunction, confusion generating an ongoing proliferation of quantum interpretations[3–8].

Ultimately, symmetries of any quantum model are those of its wavefunctions and their interactions. Historically this places Arkani-Hamed's starting point long before the 1974 shift of S-matrix theory from nucleon to Planck scale, before Dirac and Schrodinger and Heisenberg and invention of the wavefunction, to Clifford and Grassman and Hamilton and invention of the invertible algebra of the wavefunction[9–11]. And yet further back, much further.

Dwelled upon long enough, one arrives the point, line, plane, and volume elements of Euclid[12], in modern times taken to be fundamental geometric objects of Clifford algebra, of the background independent[13] eight-component Pauli algebra of 3D space[14], taken here to be the vacuum wavefunction[15].

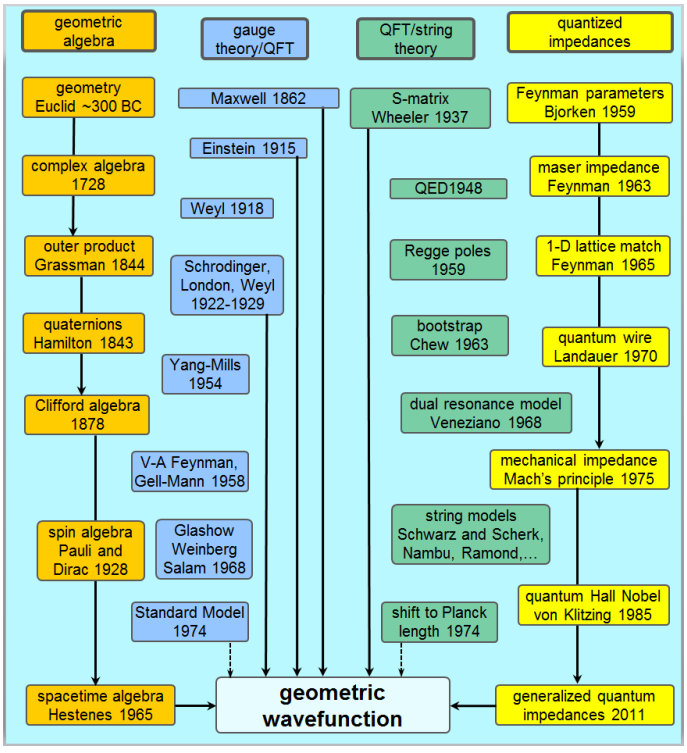

FIG. 1. Four Threads of the Geometric Wavefunction. Concepts essential for the model are connected by heavy black arrows. Possible connections between the model and the remaining concepts of gauge/QFT/string theory remain to be explored.

Endowed with quantized electric and magnetic fields (five fundamental constants input by hand, no free parameters), and setting the scale of space by the electron Compton wavelength (one of the five), interactions of these electromagnetic geometric wavefunctions generate observables, the massive particle spectrum[15, 16].

Interactions are modeled by geometric products, generating the 4D Dirac algebra of flat Minkowski spacetime[17], the particle physicist's S-matrix in the language of geometric Clifford algebra[18]. The model is naturally gauge invariant, finite, and confined[15].

Defining one of the two interacting wavefunctions at the Planck length reveals an exact identity between gravity and electromagnetism[19, 20]. This gives the same S-matrix proven effective for the unstable particle spectrum, in this case for the interaction between any massive particle and the Planck particle event horizon[21]. It presents a second origin of mass, one that parallels calculation by geometric wavefunction electromagnetic field energy[18, 22].

It also shifts one's concept of the 'gauge group'. Standard model gauge particles maintain phase coherence between point particle quarks and leptons. Extending the wavefunction beyond point particles and gauge bosons to the full eight-component Pauli algebra of 3D space permits direct interparticle wavefunction interaction. The phase information is contained in the 4D pseudoscalar of the Dirac algebra S-matrix. The 'gauge bosons' become elements in the S-matrix[23].

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[3] https://en.wikipedia.org/wiki/Measurement_problem

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