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When is a "wavefunction" not a wavefunction?: a quantum-geometric reinterpretation of the Laughlin state[1] F.D.M. HALDANE, Princeton University — The Laughlin state is the fundamental model for the description of fractional quantum Hall (FQH) fluids and was presented as a "lowest Landau-level (LLL) Schrödinger wavefunction", i.e., of the form $f(z_1,\ldots,z_N)\exp-\sum_i z_i^* z_i/2$, where $z_i = (x_i + iy_i)/\sqrt{2}\ell_B$, and $|z_i - z_0|^2 =$ constant is the shape of a Landau orbit. Its characterization as a LLL wavefunction was generally accepted without question, and leads to "explanations" of its success in terms of judicious placement of its zeroes. However, the Laughlin state also occurs in the n=2 LL, and now has been found in Chern-insulator lattice systems. Numerical studies confirm that (without direct reference to which LL is partially-occupied) its success can be explained solely in terms of the short-range repulsion between the non-commuting guiding centers of Landau orbits. These (as a "quantum geometry") do not by themselves have a Schrödinger (as opposed to Heisenberg) description. A reexamination shows that the variable "z" describes the shape of an emergent geometry of the FQH fluid derived from the Coulomb interaction, not the Landau-orbit shape, and that the holomorphic function is a coherent state representation of a Heisenberg state, not a Schrödinger wavefunction.

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