

Projective Geometry and the Origins of the Dirac Equation

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Abstract:

Several authors have attempted to make a connection between Dirac's q -number theory and his knowledge of projective geometry, but in the AHQP interviews conducted by Kuhn where this connection is first made, Dirac denied any connection to his early work in non-commutative algebra. Instead Dirac consistently emphasized the value of projective geometry as a means for visualizing quantities in Minkowski space-time, which suggests that he may have found these techniques useful in his derivation of the electron equation and first encounters with Dirac spinors.

Existing accounts of the origins of the electron equation rely almost exclusively on Dirac's later testimony and the published paper of 1928. However, there exists a series of rough calculations that reveal the first stages of his recognition of the explicit form of the equation he sought. This manuscript was found among the archival material held by the FSU at Tallahassee, where Dirac spent his final years. The first page contains a statement of the general form of the relativistic linear wave equation, and twenty-two pages later Dirac finds an explicit representation of what are now known as the Dirac matrices.

The appearance within in this manuscript of what is obviously projective geometry on a number of pages provides good evidence that Dirac was using these techniques at the time of his discovery, although the precise role within the derivation remains unclear. However, the historical relevance of this document is clearly evident, and so provides an unprecedented opportunity to corroborate and challenge the existing accounts of the path taken by Dirac in his discovery of the electron equation.