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Computing continuum quaternionic wave functions for hydrogen

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Over the past few years considerable attention has been paid to the role of the Hydrogen Continuum Wave Functions (HCWFs) in quantum theory. The HCWFs and their applications to electron-atom collisions, cold atom physics and atomic ionization in strong laser fields played a key role in this development. The HCWFs arise via the method of separation of variables for the time-independent Schrodinger equation in spherical coordinates. The HCWFs are composed of products of a radial part involving associated Laguerre polynomials multiplied by exponential factors and an angular part that is the spherical harmonics. In this talk, we extend the continuum wave functions for hydrogen to Quaternionic Analysis (QHCWFs). In particular, the underlying functions are of three real variables and take values in the quaternion algebra. We prove that the QHCWFs are orthonormal to one another. The representation of these functions in terms of the HCWFs are explicitly given, from which several recurrence formulae for fast computer implementations can be derived. A summary of their fundamental properties and further computation of the hydrogen-like atom transforms of the QHCWFs are also discussed.

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