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Infinite-dimensional bi-complex Hilbert spaces

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This paper begins the study of infinite-dimensional modules defined on bi-complex numbers. It generalizes a number of results obtained with finite-dimensional bicomplex modules. The central concept introduced is the one of a bi-complex Hilbert space. Properties of such spaces are obtained through properties of several of their subsets which have the structure of genuine Hilbert spaces. In particular, we derive the Riesz representation theorem for bi-complex continuous linear functionals and a general version of the bi-complex Schwarz inequality. Applications to concepts relevant to quantum mechanics, specifically the bi-complex analogue of the quantum harmonic oscillator, are pointed out.

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