1.5: Formal definition of a complete, orthonormal basis set

Consider a basis set \(|i_n\rangle\). It is orthonormal if \(|\langle i_n | i_m \rangle = \delta_{mn}|\). It is complete if any wavefunction can be written as \(|\phi\rangle = \sum_n c_n |i_n\rangle\) and the \(c_n\) are uniquely defined. If the wavefunction cannot be so written, the basis set is incomplete, if there exists more than one possible set of \(c_n\), the basis set is overcomplete. Choosing a basis set in a Hilbert space (see 1.7) is analogous to choosing a set of coordinates in a vector space. Note that completeness and orthonormality are well defined concepts for both vector spaces and function spaces.