RAGNAMUS

PHYSICS I - QUANTUM MECHANICS

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Introduction

This is based off notes from various quantum mechanics books.[1]

[1] R. Shankar. *Principles of Quantum Mechanics*. Plenum Press, second edition, 1994. ISBN 0-306-44790-8

Notation

Braket notation will be used. Summation convention will be used. Typically scalars are represented with lower case characters, indices are also lower case and typically i, and vectors are upper case. Operators are greek upper case and their corresponding vectors are greek lower case.

Vectors and Dirac Notation

Vectors in quantum mechanics will be written in Dirac's braket notation. Vectors occupy a linear vector space $\mathcal{V}$. The following axioms apply:

Axiom 1. *The addition of vectors $|A\rangle + |B\rangle$ produces a new vector that lies in the vector space $\mathcal{V}$.*

Axiom 2. *The scalar multiplication of vector $|A\rangle$ with scalar a produces a new vector that lies in the vector space $\mathcal{V}$.*

Axiom 3. *Scalar multiplication is distributive both ways:*

$$a(|A\rangle + |B\rangle) = a\,|A\rangle + a\,|B\rangle$$

$$(a+b)\,|A\rangle = a\,|A\rangle + b\,|A\rangle$$

Axiom 4. *Scalar multiplication is associative, $a(b\,|A\rangle) = ab\,|A\rangle$.*

Axiom 5. *Addition is commutative, $|A\rangle + |B\rangle = |B\rangle + |A\rangle$.*

Axiom 6. *Addition is associative, $|A\rangle + (|B\rangle + |C\rangle) = (|A\rangle + |B\rangle) + |C\rangle$.*

Axiom 7. *There exists a null vector, call $|0\rangle$, such that $|A\rangle + |0\rangle = |A\rangle$.*

Axiom 8. *There exists an inverse vector for each vector such that $|A\rangle + |-A\rangle = |0\rangle$.*

Define linear independence as:

Definition 1. *The set of vectors is linearly independent if the only way to satisfy*

$$a_i\,|i\rangle = |0\rangle$$

is the trivial setting of all coefficients to zero.

One can define a set of linearly independent vectors as basis vectors and write any arbitrary vector in that vector space in terms of those basis vectors

$$|A\rangle = a_i\,|i\rangle \tag{1}$$

Bibliography

R. Shankar. *Principles of Quantum Mechanics*. Plenum Press, second edition, 1994. ISBN 0-306-44790-8.