Studies of Spin-1 Tunneling on IBM’s Quantum Computer

Kh. P. Gnatenko

Professor Ivan Vakarchuk Department for Theoretical Physics,
Ivan Franko National University of Lviv,
12, Drahomanov St., Lviv, 79005, Ukraine

We present quantum protocols of the explicit observation of spin-1 tunneling and splitting of energy levels as a result of tunneling on a quantum device [1]. Spin-1 can be realized with two spins-1/2. Namely, spin-1 operators can be represented with two 1/2 spin operators. We use this representation to model the operator of evolution with Hamiltonian which describes single-spin tunneling on a quantum computer. The energy level splitting is observed on the basis of the detection of energy levels of the Hamiltonian on IBM’s quantum computer, ibmq-bogota [3]. For this purpose, an algorithm for the detection of the spectrum of spin systems proposed in [2] is used. We also study the evolution of the mean value of the z-component of spin-1 on the quantum computer to detect oscillations of spin-1 between the states $|1\rangle$, $|-1\rangle$. The results of quantum calculations are in agreement with the theoretical ones. We observe explicitly spin-1 tunneling on ibmq-bogota [1].

References