

## **Abstract**

Dynamical decoupling (DD) and Decoherence free subspace (DFS) are powerful techniques in quantum computing aimed at enhancing fidelity by mitigating the detrimental effects of noise and environmental interactions. In quantum systems, noise and decoherence can degrade the coherence of quantum states, leading to errors and reduced computational accuracy. DD employs carefully designed sequences of control pulses to periodically intervene and counteract these undesired interactions, while DFS utilizes subspace encoding techniques to protect quantum information from decoherence. To evaluate and compare the fidelity achieved by DD and DFS, this paper presents a series of experiments considering the effect of time and the number of qubits. The experiments provide valuable insights into the performance of both methods under different conditions. By systematically examining the fidelity results, the impact of time and the scaling behavior with increasing qubits can be assessed. The experimental findings showcase the effectiveness of DD in reducing the impact of noise and extending the coherence time of quantum states. By strategically manipulating the quantum system, DD minimizes error accumulation and preserves the integrity of fragile quantum information. It is observed that the decrease in fidelity with increasing  $t$  is relatively small and gradual. Despite being outperformed by DD, the DFS method exhibits robustness and maintains a high degree of fidelity even in the presence of extended time durations.

**Keywords** : quantum computing, fidelity, dynamical decoupling