

# Abstract

The main focus of this thesis is to study the nonclassical and phase properties of a family of engineered quantum states, most of which show various nonclassical features. The beauty of these states is that these states can be used to establish quantum supremacy. Earlier, a considerable amount of works has been reported on various types of quantum states and their nonclassical properties. Here, complementing the earlier works, the effect of non-Gaussianity inducing operators on the nonclassical and phase properties of displaced Fock states have been studied. This thesis includes 6 chapters. In Chapter 1, motivation behind performing the present work is stated explicitly, also the basic concepts of quantum optics are discussed with a specific attention on the witnesses and measures of nonclassicality. In Chapter 2, nonclassical properties of photon added and subtracted displaced Fock states have been studied using various witnesses of lower- and higher-order nonclassicality which are introduced in Chapter 1. In Chapter 3, we have continued our investigation on photon added and subtracted displaced Fock states (and their limiting cases). In this chapter, quantum phase properties of these states are investigated from a number of perspectives, and it is shown that the quantum phase properties are dependent on the quantum state engineering operations performed. In Chapter 4, we have continued our investigation on the impact of non-Gaussianity inducing operators on the nonclassical and phase properties of the displaced Fock states. In Chapter 5, we have performed a comparison between two processes that are used in quantum state engineering to induce nonclassical features. Finally, this thesis is concluded in Chapter 6, where we have summarized the findings of this thesis and have also described scope of the future works.

*Dedicated to my parents for their unconditional love and support.*