

ABSTRACT

The methods of mathematical control theory are widely used in the modern physics, but still they are less popular in quantum science. We will discuss the aspects of control theory, which are the most useful in applications to the real problems of quantum optics. We apply this technique to control the behavior of the two-level quantum particles (atoms) in the modulated external optical field in the frame of the so-called “semi classical model,” where quantum two-level atomic system (all other levels are neglected) interacts with classical electromagnetic field.

In chapter 1 we give some basic definitions, terminologies and preliminary results related to applied control theory.

In chapter 2 we propose a simple model of feedforward (open-loop) control for the quantum particle system, which is a basement for further investigation of two-level quantum particle in the external one-dimensional optical field.

In chapter 3 we demonstrate the possibility to stabilize the probability amplitudes of the upper level for a single quantum two-level atom in a classical optical field with feedback (closed-loop) control scheme.

In chapter 4 an effective quantum particle beam-splitter is realized in the frame of open-loop control scheme. We propose the simple shell model to describe the focusing of cooled atoms in momentum space. We demonstrate for small interaction time that the splitting effect $+40hk$ with summarized relative intensity in both main components is about 50 percent from initial intensity of the atomic beam.