Perspectives of Bose-Einstein condensates for filtering of light pulses and acceleration of relativistic charged particles

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We discuss some unique electromagnetic properties of ultracold gases of alkali-metal atoms with Bose-Einstein condensates. Our theoretical approach is based on the second quantization method in the presence of bound states of particles and the linear response theory (Greens functions formalism). We show that, basing on peculiarities in the dispersion characteristics of the system, the ultraslow-light phenomenon can be used for filtering optical pulses by multi-component Bose-Einstein condensates. We calculate spectral distributions of the intensity of transmitted pulses and study some effective schemes for obtaining high signal to noise ratios. Obtained dispersion characteristics allow us also to study some effects related to the propagation of relativistic charged particles in a gas with Bose-Einstein condensates. We find that in some particular cases particles not only loose the energy, but can be accelerated by the gas.