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Why a quantum wire can act as an optical amplifier MANVIR KUSHWAHA, Rice University — We discuss the fundamental issues associated with the magnetoplasmon excitations in a semiconducting quantum wire characterized by a harmonic confining potential and subjected to an applied (perpendicular) magnetic field. Essentially, we focus on the device aspects of the intersubband collective (magnetoroton) excitation, which observes a negative group velocity (NGV) between maxon and roton. Consequently, it leads to tachyon-like (superluminal) behavior without one's having to introduce the negative energies. Existence of the NGV is a clear manifestation of a medium with population inversion brought about due to a metastable state caused by the magnetic field that satisfies the condition $B > B_{th}$; B_{th} being the threshold value below which the magnetoroton does not exist. The interest in NGV is based on anomalous dispersion in a medium with inverted population, so that gain instead of absorption occurs at the frequencies of interest. A medium with an inverted population has the remarkable ability of amplifying a small optical signal of definite wavelength, i.e., it can serve as an optical amplifier. Examining the life-time of magnetorotons leads us to infer that relatively smaller magnetic fields are optimal.

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