World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Mirror-Like Effect Based on Correlations among Atoms

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Abstract : The novel idea to use single atoms as highly reflecting mirrors has recently gained much attention. Usually, to observe the reflective nature of an atom, it is required to couple the atom to an external medium such that a directional spontaneous emission could be realized. We propose an alternative way to achieve the directional emission by considering a system of correlated atoms in free space. It is well known that mutually interacting atoms have a strong tendency to emit the radiation along particular discrete directions. That relieves one from the stingy condition of associating the atomic system to another media and facilitates the experimental implementation to a large degree. Moreover, realistic 3-dimensional collective emission can be taken into account in the dynamics. Two interesting spatial setups have been considered; one where a probe atom is confined in a linear cavity formed by two atomic mirrors and, the other where a probe atom faces a chain of correlated atoms. We observe an evidence of the mirror-like effect in a simple system of a chain of three atoms. The angular distribution of the radiation intensity observed in the far field is greatly affected by the atomic interactions. Hence, suitable directions for enhanced reflectivity can be determined.

Keywords : atom-mirror effect, correlated system, dipole-dipole interactions, intensity
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020