

## **Causality, Special Relativity and Non-existence of Material Particles of Zero Rest Mass**

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**Abstract :** It is shown that causality, the principle that cause must precede effect, leads inter alia, to highly significant result that the velocity of a material particle cannot be even equal to that of light. Consequently, combined with special relativity, it leads to the conclusion that material particles of zero rest mass cannot exist in nature. Thus, causality, a principle without which nature would be incomprehensible, combined with special relativity, forbids the existence of material particles of zero rest mass. For instance, the neutrinos, as is now known, are material particles of non-zero rest mass. The situation changes when we consider the gauge particles. In fact, when the principle of causality was proposed, the concept of gauge particles had not yet been introduced. Now we know that photon, a gauge particle with zero rest mass does exist in nature. Therefore, principle of causality, as generally stated, is valid only for material particles. For gauge particles, in order to make the statement of causality consistent with experiment, it has to be modified: The cause should either precede or be simultaneous with the effect. Combined with special relativity, it allows gauge particles of zero rest mass.

**Keywords :** causality, gauge particles, material particles, special relativity

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