Study of Gravitational Perturbation Generated by High Power Laser Light

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Gravitational waves were predicted by Einstein 3 years after he published his theory of General Relativity [1]. A century later, the LIGO [2] and VIRGO interferometers were finally able to detect the gravitational waves coming from the coalescence of two black holes. With the existence of these waves now proven, they must be studied in order to understand better the nature of gravity and how it affects physics.

However, these observations depend on the occurrence of intense astrophysical phenomena. It would therefore be interesting to be able to generate and detect gravitational waves in the laboratory in order to have greater freedom in the choice of the situations observed. Unfortunately, the acceleration of matter in the laboratory does not appear to give enough space-time distortion to be detected [3,4].

Starting from the idea initially introduced by Tolman in 1931 [5], we focus on the generation of gravitational waves by single intense light. This alternative source for gravitational wave generation has some advantages, including moving at the same speed as the gravitational wave, allowing coherent generation not possible with matter [6]. High-power lasers could therefore prove to be the devices of choice in an experiment to generate and then detect a gravitational deformation. This approach would alleviate many constraints on the observation of intense astrophysical phenomena and improve the current understanding of general relativity. We propose to present the first results on the gravitational deformation generated by a cylinder of light. Our model can also be applied in an astrophysical context, in particular to gamma-ray burst (GRB), to estimate the gravitational perturbation in the vicinity of such high power GRB.

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