Light and gravitation from Newton to Einstein

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Abstract: How was treated the propagation of light after Newton, before Einstein? From the second half of the 18th century to the early 19th century, the Newtonian theory of propagation of light, a perfectly consistent application of the *Principia* to light was developed by John Michell (1724-1793) and then many philosophers. It was as well a classical relativistic optics of moving bodies.

In the context of Newton's *Principia*, light corpuscles were treated in the very same way as material particles. Thus they were subject to the Galileo-Newtonian kinematics: light velocity was *not* a constant. Light corpuscles were also subject to the Newtonian dynamics, in particular to two forces, the long-range gravitational force and the short-range refracting force acting on a glass, a crystal.

Snell-Descartes' sinus law implies that greater is the incident velocity of light, lower is the refraction angle on a prism. Thus the measure of the refraction angle is a measure of the incident velocity of light, a "method" due to Michell. In 1786 Robert Blair applied Michell's method to light kinematics and addresses in a very clear way what we call the Doppler effect.

The effects of gravity on light in a Newtonian context are qualitatively similar to those predicted by general relativity much later. In 1784 Michell predicted the slowing-down of light by gravitation, and inferred the existence of dark bodies as Pierre Simon Laplace later called them; they are black holes's cousins. In 1801 Johann Georg von Soldner calculated the deflection of light by gravitation, an effect half than that predicted by general relativity in 1915.

Many philosophers and physicists had interest in Michell's project, Henry Cavendish, William and John Herschel (father and son), Nevil Maskelyne, Soldner, Laplace, François Arago, Armand Hyppolyte Fizeau, to name a few. It consists in a significant body of work that constitutes a preamble – but not a way – to Einstein's relativity. It illuminates the questions that special and general relativities solved. It offers a surprising analogy, an instructive parallel with many physical effects of general relativity.

After the emergence of Fresnel's ondulation theory in the 1820th the Newtonian theory of propagation of light will be forgotten. An almost complete oblivion that persisted to this day.

Keywords: light, gravitation, Newton, Einstein

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