

The impact of the light source movement on the EM properties of light

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Abstract: The size of spectral line shifts, caused by moving light sources, as quoted in various scientific articles, clearly depends on the choice of the measuring instrument. The Fabry-Perot interferometer (FPI) responds differently to the changes of speed of light source as the spectrometer based on diffraction grating. It is possible that these two instruments are not equally sensitive to the frequency as to the wavelength of the light. Moreover, we have to ask ourselves if the moving light source affects the frequency differently from the wavelength of the light. In this case we have to allow the hypothesis that, in accordance with the equation $c = f \cdot \lambda$, the moving light source affects the speed of light.

Key-Words: speed of light, Fabry-Perot interferometer, diffraction grating spectrometer.

1 Introduction

There exist many scientific articles describing measurements of Doppler shift of the spectral lines caused by moving light sources. In this paper we analyse these measurements with an intention to call attention to the remarkable differences between the results, and we propose possible explanation for them.

With the intention to examine the properties of light, we have chosen those moving objects in the universe where the speed of moving light sources is identified by different methods and where the observed speed of light source is fully known.

We have also chosen those moving objects where the light from moving light source may not be disturbed by different phenomena in the universe.

Comets and the solar corona are appropriate objects for the moving light sources. The source of light from these moving objects is strong and well defined. Observation of sunlight and comets has a long tradition.

2 Measurement of spectral line shifts of the light coming from comets and solar flares

The speed of comets is in the range of few dozens of km/s, while the speed of solar flares attains several hundreds of km/s. Each of them emits sufficient light energy which allows successful measurement of spectral lines.

In the articles referenced in this paper we have noticed significant differences between the measurement results of spectral line shifts related to the light coming from moving light sources measured by the interferometers (Fabry-Perot interferometer) [1] on one side and the measurement results of spectral line shifts measured by spectrometers based on diffraction gratings (EIS EUV Imaging Spectrometer) [2].

Differences in measurement results are similar in all occasions. The measurements, described below, can be taken at the same location and the same light source.

The difference between the measurement results can be explained by different sensitivity or diverse nature of instruments, measuring the frequency or the wavelength of the light respectively.

2.1 Measurement of solar flares

Spectrometer based on diffraction gratings is showing the spectral line shifts and is proving that the solar flares are reaching a speed up to several hundred km/s (New techniques for the characterization of Dynamical Phenomena in solar coronal images) [3]. Comparable speed of solar flare was estimated on the basis of visual optical observation of solar flare through the telescope, as it is described in the above mentioned article.

On the other hand, the appropriate spectral line shifts and corresponding speeds of solar flares in the solar corona are not detected by FPI interferometer (Systematic errors in measuring solar magnetic fields with a FPI spectrometer and MDI) [4]. The

spectral line shifts are not presented in this case. It is mentioned in the article that spectral line shifts are not presented due to some systematic error.

However, this result is surprising and deserves further investigation.

Unresponsiveness of FPI interferometer to the light source movement in general is shown in other similar measurements as well. In the literature one cannot find any measurement, where the FPI interferometer detects the movement of solar flares.

2.2 Measurement of the comet

Similar differences are detected in the measurement results of the comet speed, if the comet is observed once by FPI interferometer and another time by the spectrometer based on diffraction gratings.

Spectrometer based on diffraction gratings shows the comet speed in the size of few dozens of km/s (Atomic Oxygen in the Coma of Comets) [5]. Comparable speeds are estimated in the visual observations of the comets.

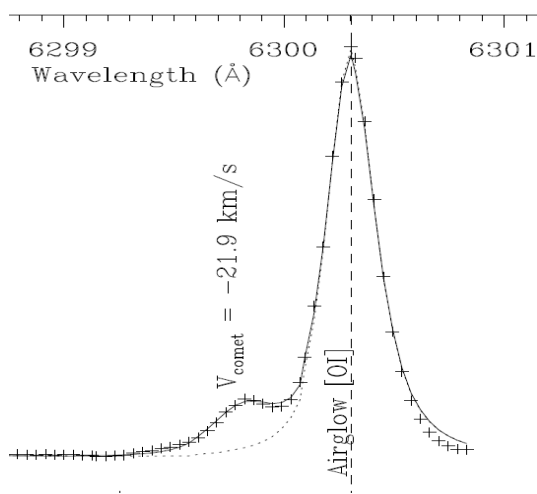


Figure 1

When we direct the FPI interferometer towards the comet, FPI does not show the expected spectral line shift as the result of the comet movement (6300 Large Aperture Photometry of Comet Hale-BOPP) [6]. Figure 1 in the above mentioned article shows the diagram of the measurements of the Hale-BOPP comet head in the year 1997.

The comet represents the moving light source. Consecutively we could expect the spectral line shift in the whole observed light flux coming from the comet. The measurement results taken by the Fabry-

Perot interferometer shows in Figure 1 that only an insignificant part of the light flux at the wavelength of 6300.304 Å causes the shift of the spectral line according to the Doppler law. The main part of the light flux causes no spectral line shift at all.

The author of the article is giving the following explanation. On its way towards the Earth the light from the comet is hitting the atmospheric particles, which absorb the light and immediately after that emit it with different wavelength. This phenomenon is known as Rayleigh scattering [7].

The spread of the wavelength (Rayleigh scattering) is not detected at all in the case where the spectrometer, based on diffraction gratings, is used (GAIA accuracy on radial velocities assessed from a synthetic spectra database) [8].

The reason why the spectral line shift is not presented can be therefore caused only by the properties of the FPI and grating spectrometer and not by the change of the wavelength of the light in the atmosphere on the way from the comet to the measuring instrument.

We can conclude that FPI interferometer does not detect the expected spectral line shifts of the light coming from the fast moving comets, while the spectrometer based on diffraction gratings does detect expected values of the spectral line shifts.

3 Discussion about the results

The measured results of the spectral line shift from moving light source made by FPI spectrometer are taken from [6] and shown in Figure 2.

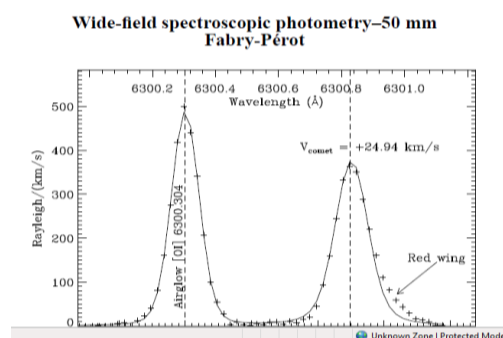


Figure 2

The left peak in the diagram corresponds to the part of light flux where the spectral line shifts depends only on the selected spectral line but not on the speed of comet.

The right peak in the diagram corresponds to the part of light flux where the spectral line shifts

depends on the selected spectral line and also on the speed of comet.

The amount of the light flux in the right peak and in the left peak depends on the selection of the measurement instrument.

The diagram in Figure 1 shows the case where only an insignificant part of the light flux affects the spectral line shift in with regard to the speed of comet.

Different results are obtained in case if the spectrometer based on diffraction gratings is used. In this case the whole light flux has influence on the spectral line shift in accordance with Doppler law. The measurement results show in this case only the right peak without the left peak as it is shown in Figure 2.

In general, different distributions of light fluxes or corresponding peaks are possible, as it is shown for the WHAM interferometer measurement results in Figure 2.

The frequency and the wavelength of light respond differently to the change of the speed of light source

The spectral line shift depends on the frequency or on the wavelength of the light respectively. Because the instruments show two different spectral line shifts measuring the light from the moving light source, we have to describe both of them by its own function. The first spectral line shift, corresponding to the right peak in Figure 2, can be described by the function $f_1(f, \lambda)$ and the second spectral line shift corresponding to the left peak, can be described by the function $f_2(f, \lambda)$.

With regard to the measurement results we can conclude, that the $f_1(f, \lambda)$ is in accordance with Doppler law while the spectral line shift $f_2(f, \lambda)$ depends only on the spectral line selection. For selected spectral line $f_2(f, \lambda)$ is constant and does not depend on speed of light source.

We come to the following conclusion. The function $f_2(f, \lambda)$ does not depend on both variables (f and λ). The function $f_2(f, \lambda)$ depends only on one variable which is either frequency or wavelength and does not depend on the speed of light.

The function $f_1(f, \lambda)$ depends on the speed of light source in accordance with Doppler law what means that the second variable (f or λ) depends on the speed of light.

If the change of the light source speed would affect both entities f and λ , it should affect the value of $f_2(f, \lambda)$ on the interferometer. We can conclude that more in depth study of basic properties of the light is needed.

Does the speed of light source affect the speed of light?

Based on the above mentioned measurements we can propose the hypothesis that the speed of light source affects only one entity of light: frequency or wavelength. The second variable does not change as a function of the light source speed.

According to the equation $c = f \cdot \lambda$, we could expect, that the speed of light source affects the speed of light from the moving light source.

The speed of light from the moving source has not been measured yet directly.

Recognition of this hypothesis requires from us the review of the measurement results related to the speed of light over time.

In the last hundred years we can find many measurements of the speed of light, measured from the stationary light sources that have been executed in different ways (How is the speed of light measured?) [9] All of the measurements have been implemented in conditions, where the light source is stationary regarding the observer. In the above mentioned paper it is recorded that the speed of light has been measured in the following years: 1676; Author: Ole Roemer; Method of Jupiter's satellites, 1726; James Bradley; Stellar Aberration; 1849; Armand Fizeau; Toothed Wheel, 1862; Leon Foucault; Rotating Mirror; 1879; Albert Michelson; Rotating Mirror [10]; 1907; Rosa, Dorsay; Electromagnetic constants; 1926; Albert Michelson; Rotating Mirror; 1947; Essen, Gordon-Smith; Cavity Resonator, 1958; K. D. Froome; Radio interferometer; 1973; Evanson et al; Lasers, 1983; Adopted Value.

Above mentioned measurements does not mention the measurements were the light sources are moving, although for such measurements also there are known technological solutions as a method of measurement¹.

The results of the measurements of the existence of ether, which are more than a hundred

¹ We have considered three measurement methods with regard to the light from the comet or solar flare: (1) autonomous measurement of the wavelength, (2) autonomous measurement of the frequency and (3) laboratory measurements of laser beam interference such as measurement of laser beam reflection from vibratory mirror with a high sensitive Michelson interferometer based on optical fibre.

years old, are known. Michelson and Morley made an experiment, proving if exist the ether as a medium for the transmission of light. Articles are not uniform in this, are the results of these measurements also evident the equal speed of light in all conditions. Contemporary articles and other records (Michelson-Morley experiment - Wikipedia) [11] do not mention the results of these measurements in sense of measuring the speed of light coming from a moving light source.

The measurement of the speed of light from the moving light source that would unambiguously and certainly answer the question on the speed of light from a moving light source has not been performed yet. In all conditions equal speed of light, although it is not unambiguously measured, is the basis for many physical principles. The measurement of the speed of light from a moving light source therefore deserves to be carried out. The results would either confirm or deny the hypotheses that the speed of light depends on the speed of moving light source.

4 Conclusion

Measurement of the speed of light, coming from moving light sources is possible, based on the measurements of the light from sky bodies, in the manner, described in this article, as well as in the laboratory environments (Curtained Universe–Speed of light) [12].

The aim of the paper is to draw attention to inconsistencies in the measurement results, regarding the speed of light coming from moving light source.

Physics requires for its credibility the unambiguous measurement of the speed of light coming from moving sources, which should be performed even in several ways, especially because there are known measuring methods and technology which can carry out these measurements.

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