Doppler law and the wavelength of light

The research initiative

Franc Rozman

Physical measurements show an apparent inconsistency. One of the wavelength measurements shows that the speed of the light source does not affect the wavelength of the light. Other measurements, in contrast, show that the speed of the light source affects the wavelength of the light. The question of the different results of measurements is not discussed in physics. In this paper, I highlight the need to identify seemingly conflicting measurement results and to propose research that will unambiguously explain this apparent discrepancy.

Introduction

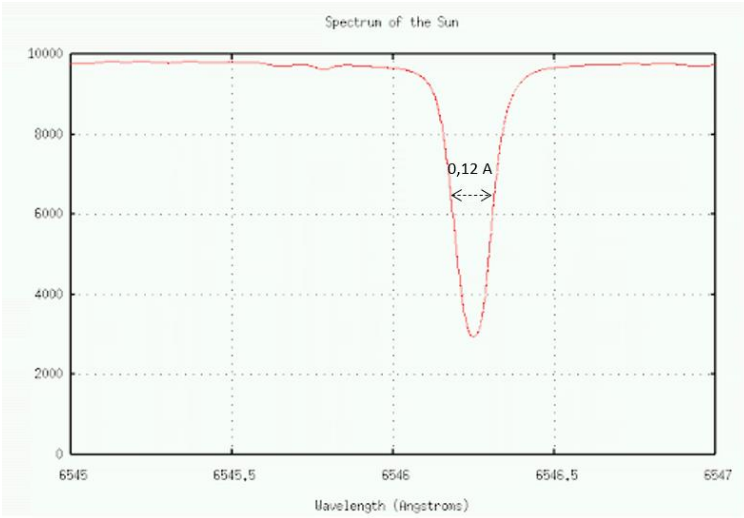
There are different methods of measuring the wavelength of light in the literature, performed with different wavelength measuring instruments. On some wavelength measuring instruments, we measure that the wavelength of light varies with the speed of the light source according to Doppler's law. I mark these measurements in this document with M1. On other measuring instruments, we measure that the speed of the light source does not affect the wavelength of the light. I mark these measurements with M2.

As a rule, the literature describes in detail the instruments and measurements of M1, which show the changing wavelength of light depending on the speed of the light source. These measurements are widely known in physics, so I do not pay special attention to them in this paper.

Measurements of M2 showing the wavelength of light, where the wavelength of light does not change depending on the speed of the light source, are described less frequently. M2 measurements are even pushed into the background, often even silenced.

Let me therefore highlight one of the measurements of M2, where the speed of the source imperceptibly affects the wavelength of light. In the literature, we find such a measurement described in the article 'The shape of spectral lines'[1]. The measurement measures the shape of one of the spectral lines in the light coming from the Sun. In the concrete measurement the spectral line occurs at the wavelength of 6546.25 A (A - angstrom physical unit for measuring light wavelengths 10^{-10} m). The measured spectral line width is 0.12 A.

[1] The shape of spectral lines (http://spiff.rit.edu/classes/phys440/lectures/lines/lines.html)



Based on Doppler's law, the very narrow width of the spectral line can only be explained by very small particle velocities in the solar corona, which do not exceed a few km/s. The measurement would be in accordance with Doppler's law with a very calm or dormant solar corona. Physical science has already encountered this question.

The measured light comes from the solar corona, where the light-emitting particles move at speeds of a few tens of km/s and more. Particle velocities during solar flares reach hundreds of km/s. We do not detect a subdued solar corona where the velocities of the particles in the corona would not reach at least a few tens of km/s. The velocities of the solar corona are explained in ‘New techniques for the characterization of Dynamical Phenomena and Solar Coronal Images’.[2]

Impact of particle velocity on M1 measurements or on M2 measurements

Measuring instruments M1, where the wavelength depends on the speed of the light source, according to Doppler's law[3], stretch the spectral line by one or more A (angstrom), that is, over the entire range of wavelengths in the figure. The spectral line extends to tens of the widths of the spectral line in the figure. Particle velocities on the Sun change throughout the measurement time, which changes the width and shape of the spectral line during the measurement.

The M2 measuring instrument creates the thin spectral line as shown in the figure. All moving particles create the spectral line at the same wavelength, regardless of their velocities. The width and shape of the spectral line does not depend on the velocity of the solar corona particles.

The result of the measurement is very different in both cases. The spectral line is ten times or more wider in the case of M1 than in the case of M2. In the case of the M1 measuring instrument, the shape and width of the spectral line changes during the measurement, depending on the velocity of the solar corona particles. In the case of M2, the spectral line is narrow and shape-stable, regardless of the particle velocities. The measurement shows that in the case of measuring M2, the velocity of the particles has an imperceptible effect on the wavelength of light.

---

[2] Eva Robbrecht: New techniques for the characterization of Dynamical Phenomena in Solar Coronal Images. Catholic University of Leoven,februar 2007. (https://wwwbis.sidc.be/users/evarob/PhD.Robbrecht-Eva.2007-02-27.pdf)

[3] https://en.wikipedia.org/wiki/Relativistic_Doppler_effect

The question of apparent contradiction

The light at the entrance to the measuring instrument cannot have different (M1) and the same (M2) wavelengths at different speeds of the light source at the same time. The wavelength is either the same at all speeds of the light source or follows the speed of the light source according to Doppler's law. The reason for the different measured results is in the construction of the measuring instrument. In one of the measurement methods, the measuring instrument changes the wavelength of light, either unifying it (M2) or adapting it to Doppler's law (M1).

We observe even more, in certain measuring instruments the spectral line can appear in the form of two spectral lines, one of them follows the laws of M1 and the other the laws of M2. One spectral line indicates that the speed of light does not affect the wavelength of light, and the other spectral line indicates that the speed of the light source affects the wavelength. We measure the same light from the same light source. This can only be understood in that the measuring instrument changes the wavelength of part of the light and part of the light remains intact.

Research risk

In physical science, it has happened and continues to happen that we intentionally or unintentionally overlook measurement results that are inconsistent with our beliefs. However, such an approach does not contribute to the development of science. The described measurement results are a measured fact and only a consistent explanation of these results can contribute to the progress of science.

The goal of the research

One measuring instrument (M1) shows different measurement results than other measuring instruments (M2). In the research we want to explain how these measuring instruments differ from each other in construction.