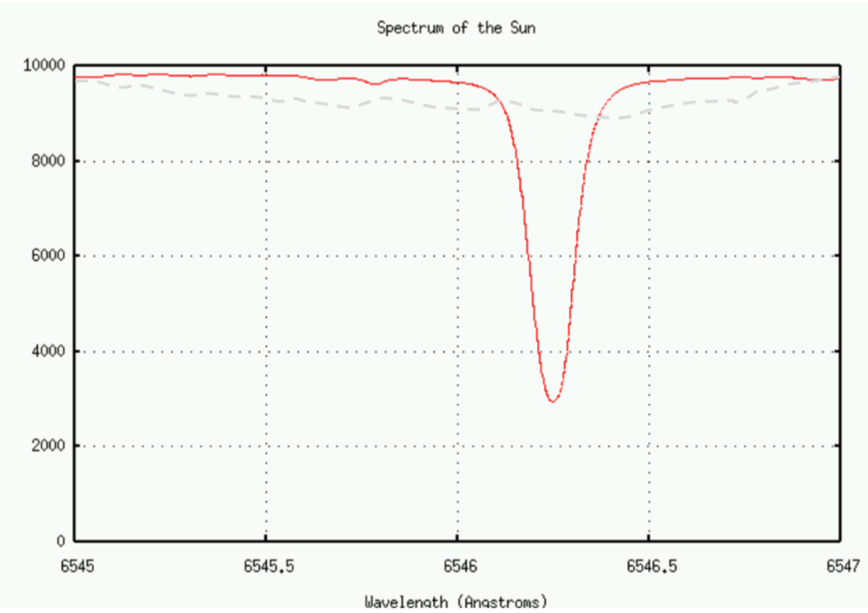
Measuring the velocities of stars

Preface

The speed of the star is measured based on the red shift of the spectral line. Based on the redshift, we measure also the gravitational redshift. The article reveals how it is possible to recognize both: the speed of the star and its gravitational field (the mass of the star) based on the same measured parameter.

Spectrum of the Sun

The diagram[1] in the figure shows the typical shape of the measured spectral line in light from the Sun.



The width of the spectral line is about 0.15 A. According to Doppler's law, such a spectral line width is possible only at solar plasma velocities in the solar corona that do not exceed a few km/s.

The velocities of the molecules in the solar corona are at least ten times higher. Such velocities of light sources would mean, according to Doppler's law, an extension of the spectral line as shown by the drawn gray dashed line on the diagram. Depending on the disturbance in the measurement and the even more pronounced curve due to the even higher velocities of the molecules in the solar corona, the spectral line should be completely unrecognizable.

However, this does not happen. The spectral line can be unambiguously measured as show the red line in the diagram.

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

Separate measurements of the frequency and wavelength of light

In the light, both the frequency and the wavelength are changing. Some instruments are more sensitive on the frequency of light, others on the wavelength of light. Sensitivity on frequency and wavelength depends on the design of the instrument and has not yet been explored. The principles of instruments and measurement are explained in the book: "Merim frekvenco svetlobe" [2].

Frequency-sensitive instruments are useful for measuring the frequency shift of the spectral line in the case where all molecules of the light source move at similar speeds. This means for measurements of solar flares, where the instrument is aimed directly at the solar flare. In this case, the shift of the spectral line shows the speed of the solar flare.

However, when such an instrument is aimed at the entire Sun, where very different solar plasma velocities occur, the instrument fails. The gray dashed line on the diagram is so indistinct that we overlook it.

Other instruments are sensitive to the wavelength of light. In this case, we notice a recognizable spectral line, as shown by the red line on the diagram, even if we point the instrument at the entire Sun. Different velocities of molecules at the source do not distort the shape of the spectral line.

The non-influence of the speed of the light source on the shape of the spectral line can only be explained in such a way that the speed of the light source does not affect the wavelength of the light. The speed of the light source affects the frequency of the light, but not its wavelength.

Measuring the speed of stars

The frequency shift of the spectral line according to Doppler's law makes it possible to measure the speed of a light source. For example, we can measure the velocities of solar flares when we direct the instrument into it, where particles travel at similar speeds. However, we cannot measure, for example, the speed of the whole Sun relative to the Earth. Different particle velocities obscure the shape of the spectral line due to turbulence.

Similar turbulence occurs on all stars. Large turbulences also occur on the surfaces of distant stars, similar to the Sun. Consequently, we cannot measure the speed of the stars relative to the Earth.

Measurement of gravity or mass of stars

In the other case, we can measure the gravitational red shift based on the wavelength shift of the spectral line from the Sun. The velocity of the particles does not disable the measurement of the wavelength shift of the spectral line.

The change in the wavelength of the spectral line from the Sun was measured[3]. Its value is approximately 630 m/s. In a similar way, we can measure the gravitational shift and thus the mass of other stars. In this case, based on the measurement of the wavelength and not the frequency.

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[2] http://www.frozman.si/book/merim-frekvenco-svetlobe/

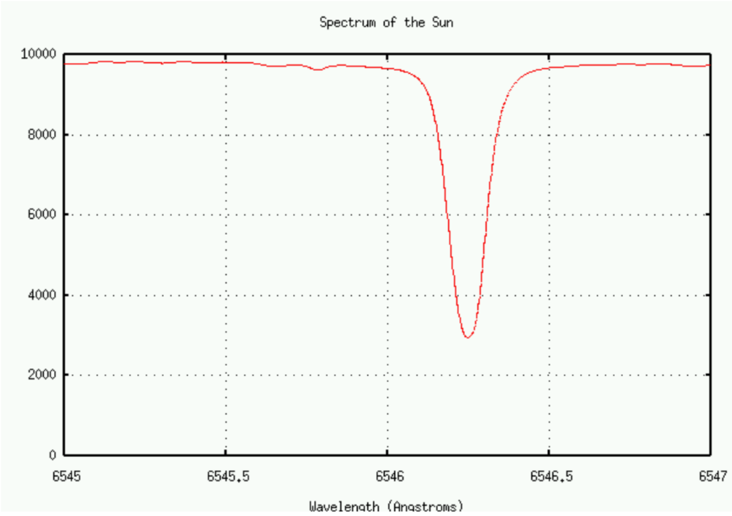
[3] L. A. Higs: *The solar redshift*; http://adsabs.harvard.edu/full/1960MNRAS.121..421H

Measuring the wavelength shift of the spectral line instead of frequency can give us misunderstanding the result. Based on the measurement the wavelength, we could conclude that the Sun is moving away from the Earth at a speed of 630 m/s, which is not true. Based on the shift of the wavelength of the spectral line, we can estimate only the gravitational shift of the spectral line and the consequent mass of the Sun. Similarly, based on the wavelength, we cannot measure the speed of other stars.

Conclusion

One parameter is not enough to measure speed and gravity. If we know only one parameter of light, frequency, or wavelength of the spectral line, we cannot know whether the red shift of the spectral line is due to the motion of the star or due to gravity. The answer to this question can therefore only be given by separate measurements of the frequency and wavelength of light.

The understanding of the expansion of the universe is based on the understanding of light. Maybe the universe is not expanding. The universe may not need dark matter for its structure. Perhaps our idea of the existence of dark matter is due to a misunderstanding of the properties of light.



6546 6546,5 8/28 = 0,286 0,143 A

v/c = 0.143 / 6546 v = 6,5 km/s