Measuring the speed of the solar corona

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Summary

Particle velocities in the solar corona, according to Doppler's law, affect the frequency of light coming from the Sun. Particle velocities, however, do not affect the wavelength of light from the Sun.

If we direct light from the Sun into a diffraction grating, and when it passes, the diffraction grating changes the wavelength of the light. The diffraction grating adjusts the wavelength to the frequency of the light.

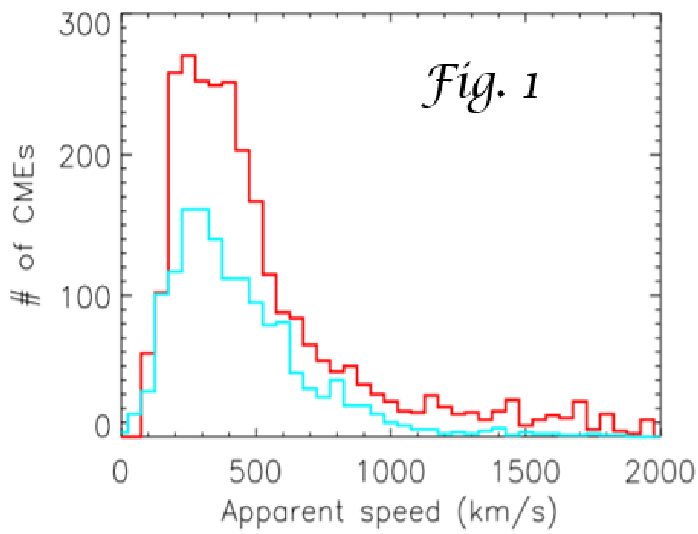
Light leaves the diffraction grating with the frequency as well as the wavelength as determined by Doppler's law. However, such an adapted wavelength is not that one that arrives from the Sun. The motion of particles on the Sun has no effect on the wavelength of light from the Sun.

Introduction

Articles from the second half of the last century highlight measurement results that show that the solar corona is either dormant or very calm. As an example of such an article, let me mention article: Delone, Makarova, Yakunina: "Evidence for Moving Features in the Corona from Emission Line Profiles Observed During Eclipses", Moskva, 1987. https://www.ias.ac.in/article/fulltext/joaa/009/01/0041-0047

Based on the measurements, this article highlights the idea: »It is generally believed that the inner solar corona is static, with no macroscopic movements larger than a few km/s."

Today we know that the plasma velocities in the 'calm' solar corona are in range from 30 km/s to 50 km/s. In the doctoral dissertation of Eva Robbrecht: New techniques for the characterization of Dynamical Phenomena in Solar Coronal Images. Leovenska katoliška univerza, februar 2007. (https://wwwbis.sidc.be/users/evarob/PhD.Robbrecht-Eva.2007-02-27.pdf) in the case of solar flares, the following solar corona velocities are published:

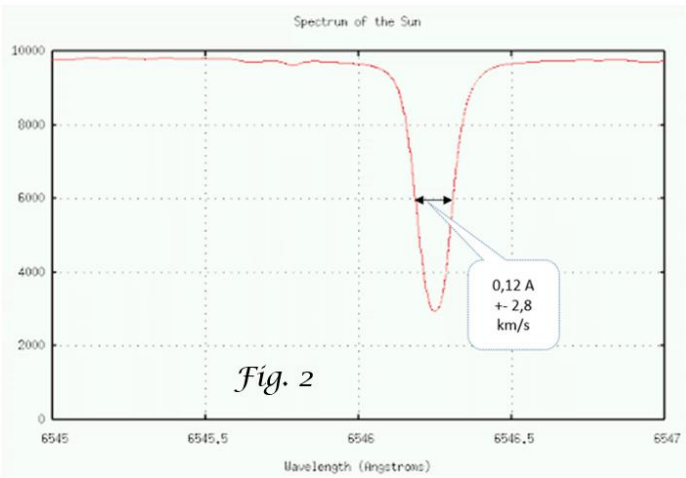


She added an explanation to Figure 1: »We remind that we can only measure the speed component parallel to the plane of the sky. The CACTus distribution corresponds to the red curve, the CDAW distribution is represented by the blue curve.« Let's explore why many astronomers have measured a dormant or near-dormant solar corona.

A modern look at such measurements

Misunderstandings of corona velocity are due to a misunderstanding of the wavelength of light from a moving light source. These questions in physics have never been definitively clarified. They were merely withdrawn into the background. Let me explain it with an example.

Figure 2 shows a typical example of a measured spectral line from the Sun. Measurements is taken from the document: The shape of spectral lines (http://spiff.rit.edu/classes/phys440/lectures/lines/lines.html) There are many similar measurements.



In Figure 2 we can see the double scattering of the brightness of the spectral line according to Gauss 2σ = 0.12 A (Angstrom). The scatter (σ) of the brightness of the spectral line is therefore 0.06 A.

I calculate what particle velocities in the solar corona, according to Doppler's law, create such a scattering of light. To calculate the scattering of the velocity of particles Δv in the solar corona, the equation gives a sufficiently accurate approximation: $\Delta\lambda / \lambda = \Delta v / c$. The calculation shows that the scattering of the wavelengths in Figure 2 gives the solar plasma velocities of 2.8 km / s.

The calculated scatter of the plasma particle velocity is more than a class lower than the published average particle velocities in the 'calm' plasma, where the particle velocities are expected to be above 30 km / s. In the case of solar flares, even hundreds or thousands of km / s.

Influence of particle velocity of the solar corona on the wavelength of light

The velocities of the solar corona particles are unambiguously measured and known. They exceed a few tens of km / s. The diagram in Figure 2 shows the negligible influence of the particle velocity on the scattering of the wavelength of light.

If we do not doubt the above findings based on measurements, then only one conclusion is possible: **Particle velocities have a negligible effect on the wavelength of light from the Sun.** This conclusion come out from a multitude of measurements that are overlooked.

Solar corona velocity measurements

Astronomers contradict the above finding. They say they measure the speed of the solar corona as well as the speeds of other cosmic bodies based on measuring the wavelength of light, which varies according to Doppler's law.

This also applies under certain conditions.

Sunlight can be directed into the diffraction grating. As light passes through the diffraction grating, its wavelength changes.

The speed of the light source affects the frequency of the light. Due to the speed of particles at the source, the frequency of light changes, but its wavelength does not change. As a result, the light arriving does not have the speed of light. The diffraction grating adjusts the wavelength of the light so that the diffraction grating returns the light speed to the light.

The wavelength of light on the diffraction grating changes just enough so that the newly formed wavelength changes according to Doppler's law. However, such a changed wavelength of light is not the one coming from the Sun. The wavelength is changed only by the light leaving the diffraction grating.

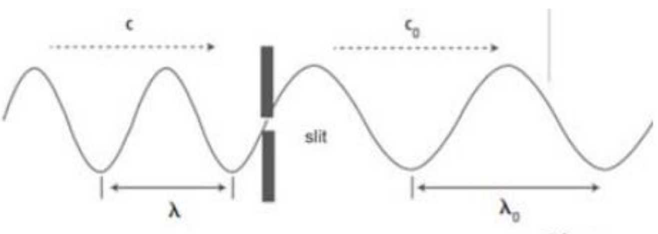
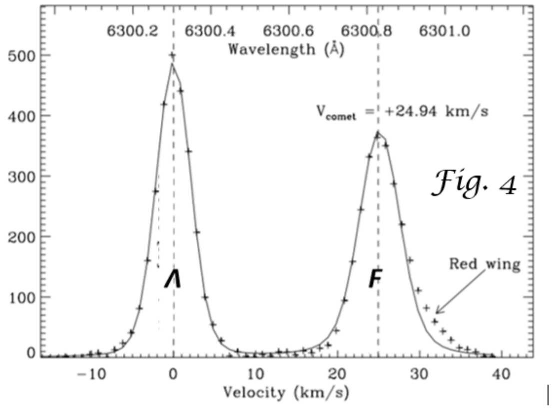


Fig 3

Normally, the diffraction grating is not installed in the telescope on purpose. As a rule, it finds itself unpredictably as a result of such or other mechanical constructions of the telescope.

A mesh is often found in a telescope in order to observe an image of the observed sky object. Even such a mesh, although not entirely, creates the properties of a diffraction grating. As a result, two spectral lines appear on the instrument, as shown in Figure 4. The right peak shows that part of the light whose wavelength is changed by the diffraction grating, and the left peak shows the light which escaped the diffraction grating and has no changed wavelength.



The right peak with an adapted wavelength allows the speed of the observed sky bodies to be measured, as well as the frequency of light, and the left peak confirms that the speed of the source does not affect the wavelength of light coming from the Sun.

In practice, we use instruments that allow either the measurement of one, the other or both peaks of light. This makes it possible to measure the speed of the observed object, as well as to check that the speed of the light source, the light in front of the diffraction grating, does not change its wavelength.

Conclusion

When measuring the wavelength of light on the instrument, we usually observe two spectral lines, as shown in Figure 4. The height of one or the other peak of the spectral line depends on the mechanical design of the instrument. More than the instrument creates the effects of the diffraction grating with its design, the higher the right peak. When we have a diffraction grating systematically built into the instrument, only the right peak appears. However, when no part of the instrument creates the effect of a diffraction grating, only the left tip appears.

The right peak is not observed even when there is too much turbulence at the light source. In this case, the right peak expands so that it becomes unrecognizable.

I have described more about the phenomenon in the literature:

- Measuring the frequency of visible light (http://www.frozman.si/pdf/MFS-E.pptx)
- The frequency of light is measurable (http://www.frozman.si/pdf-hitrost_svetlobe-pdf/the-frequency-of-light-is-measurable/)
- The speed of Mars does not affect the wavelength of light from Mars (http://www.frozman.si/pdf-hitrost_svetlobe-pdf/the-frequency-of-light-is-measurable/measuring-the-light-from-mars/
- The brief explanation of light frequency measurements *(http://www.frozman.si/pdf-hitrost_svetlobe-pdf/the-frequency-of-light-is-measurable/the-brief-explanation-of-light-frequency-measurements/*
- Measuring the velocities of stars (http://www.frozman.si/pdf/Stars.pdf)