IPACO expert report

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Type **IFO**	*Class* **A**	*Explanation* « Ghost-type » lens flare	*Complement*

Document Photos	*Imaging location* Montpellier, France	*Imaging date* August 28, 2017

Photo n° « 2017 08 28 _10h02mn10s »

Photo n° « 2017 08 28 _10h02mn56s»

Photo n° «2017 08 28 _10h03mn26s»

Photo n° « 2017 08 28 _10h12mn42s »

I. Shoot circumstances

The witness photographer transmitted his testimony to the investigator Gilles Munsch, accompanied by the photograph n ° "*2017 08 28 _10h12mn42s*":

"*Over the thirty minutes that I take the same picture of the Sun the same point is always present on the right, invisible to the naked eye because it is behind the mists of Montpellier ... Any idea? Normally it is not the Moon (size, position, brightness). Maybe it was Venus.* "

The investigator checked Venus's position on Stellarium and responded to the witness:

"*Venus was indeed to the right of the Sun but higher, at ~ 1 o'clock and not ~ 3:30. The camera was apparently ~ horizontal. Was it a weather balloon? Or was it a hot air balloon or a gas balloon? What was the exposure time? How long had it been observed? Have you kept the different photos*?

The witness then sent the three additional photos to the investigator, with the following note:

"*Here are my photos, but considering the movement between the first and second, there is little chance that it is Venus*".

II. Camera settings

The camera model that was used was that of the smartphone *ZTE Blade S*. Technical characteristics can be found here.

III. Data examination and hypothesis

Hypothesis

The first hypothesis that was expressed was that of it being the planet Venus.

The luminous dot that changes its position relatively to the Sun in a non-regular manner, makes that hypothesis, as well as that of a balloon, difficult to accept.

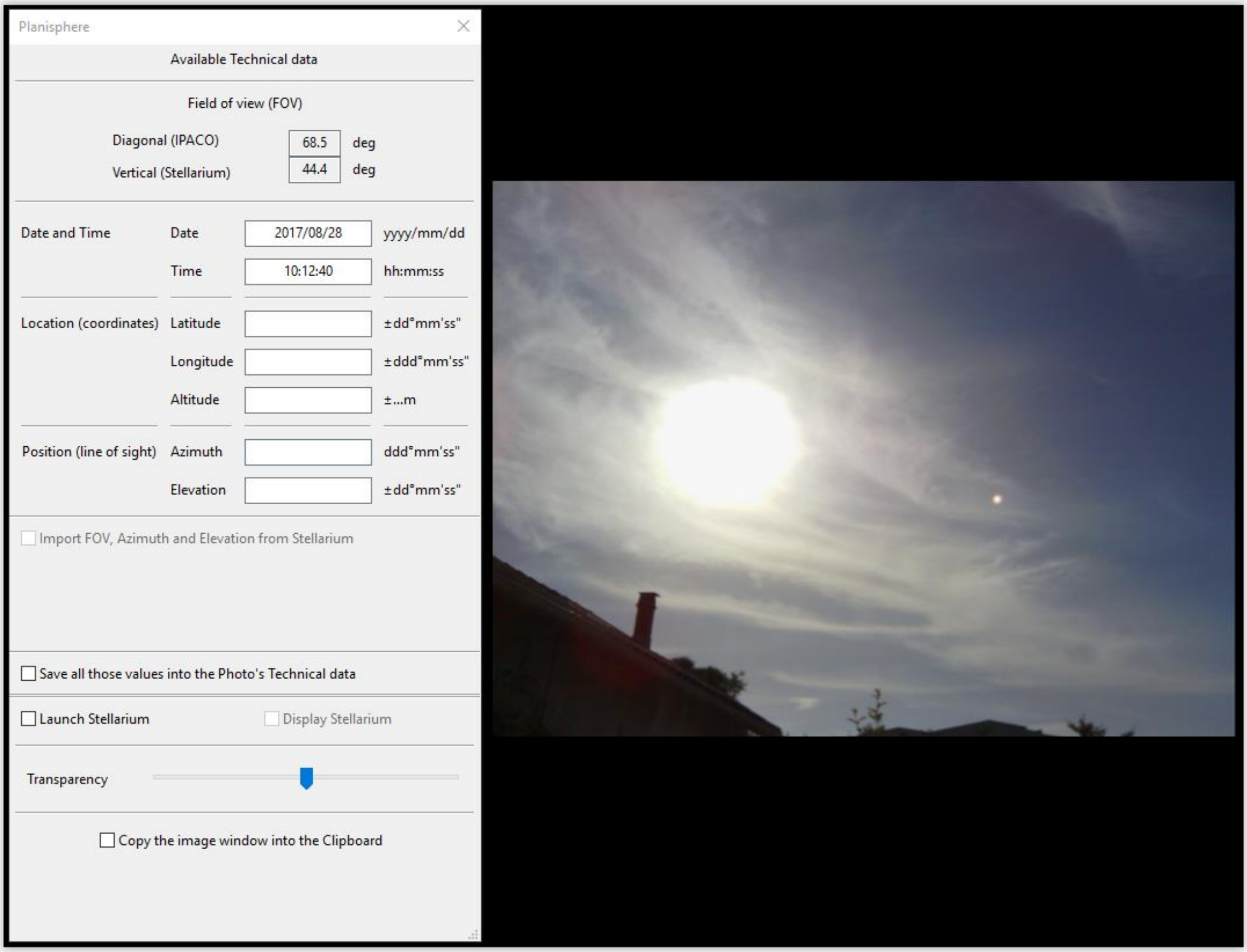
Nonetheless, it is noted that the framing, although it seems similar, is in fact different. It is then easy to note that the optical center of the image is each time located approximately midway between the Sun and the luminous dot.

Use of the tool "Planisphere"

The idea that the point is only the reflection of the Sun in relation to the optical center seems to be self evident.

This hypothesis can be verified further by using the dedicated IPACO *Planisphere* tool which allows an easy use of the Stellarium planetarium software to identify possible celestial bodies observed in a photo.

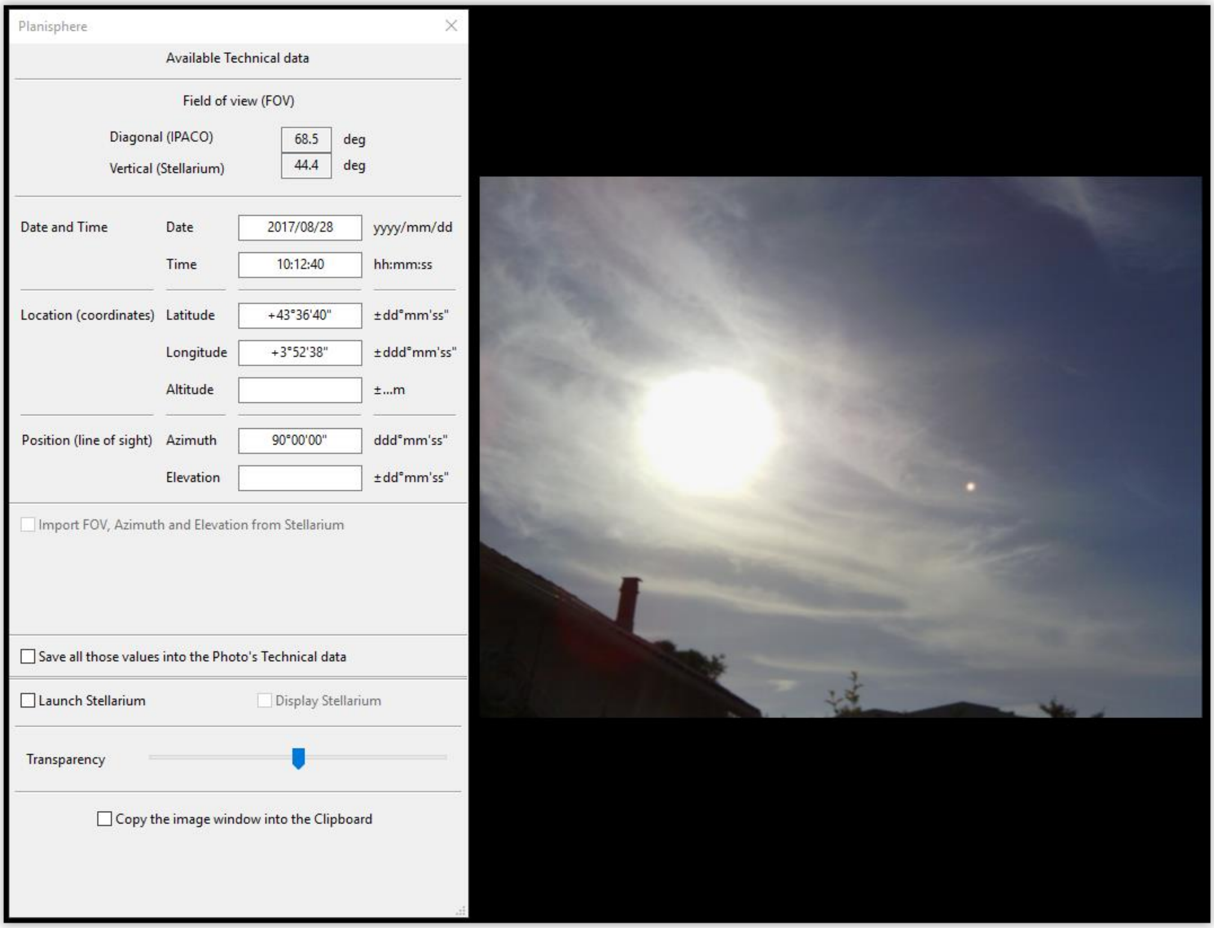
The photo to analyze being displayed, we click on the menu "*Operations / Planisphere*", which makes appear the window Planisphere:



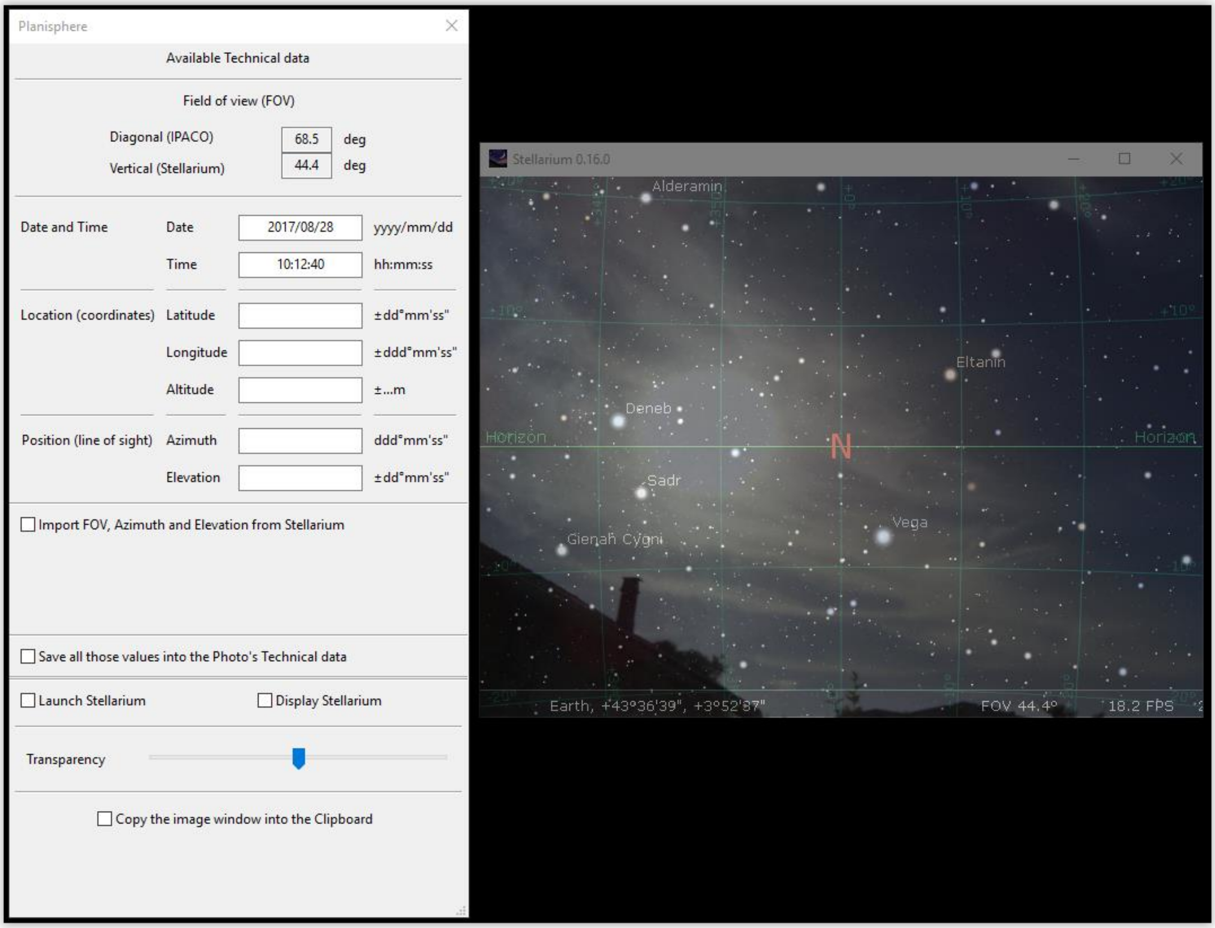
The technical data available with the photo are automatically transcribed, namely the field of view (FOV), date and time of shooting.

The position of the witness being known precisely, it is enough to enter the corresponding coordinates in the boxes "*Latitude*", "*Longitude*" and possibly "*Altitude*" in "*Location (coordinates)*".

Similarly, as the witness knows in which azimuthal direction he took the photographs (towards the east), we can enter the field "*Azimuth*", even approximately, in "*Position (line of sight)*".

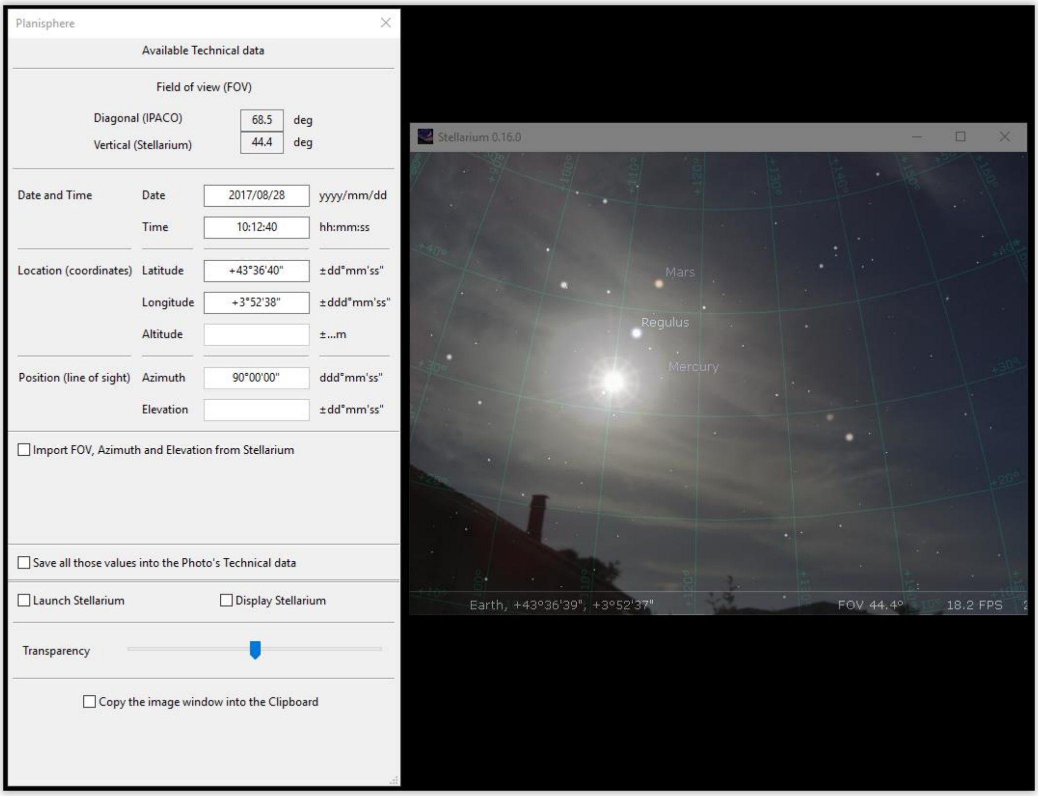


Once Stellarium is launched, we get this:

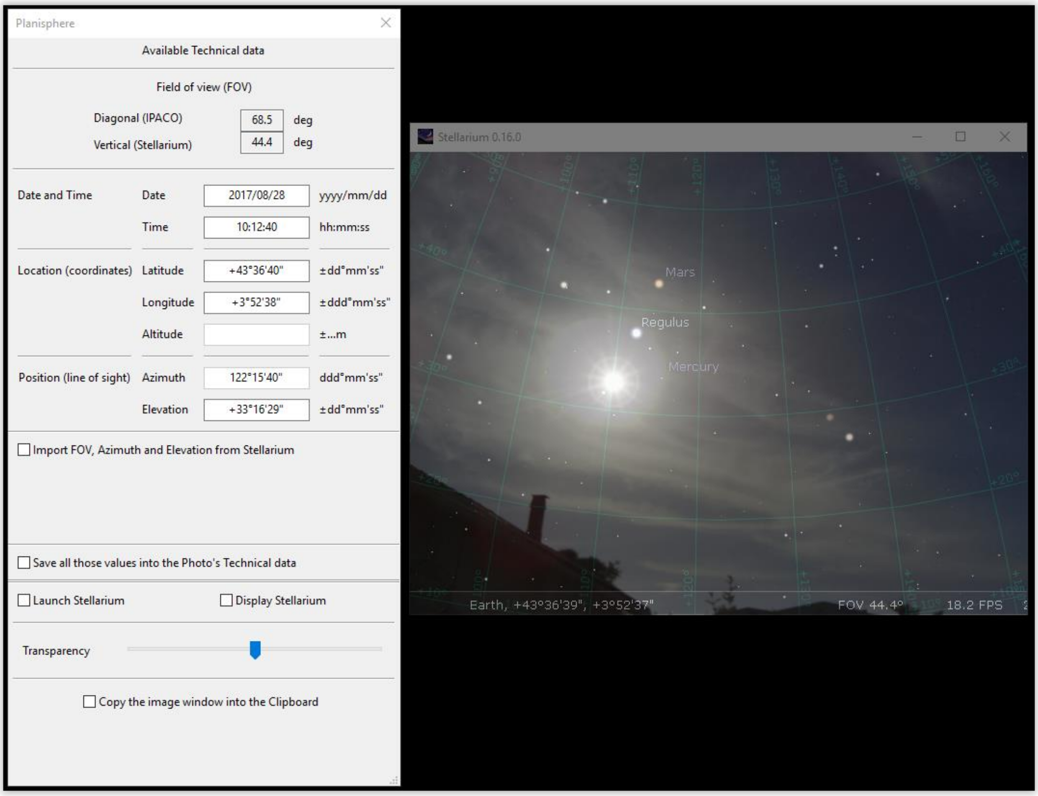


Since the position of the horizon line is not known, it is displayed by default in the middle of the image.

Then, with the arrow keys, we can manage the position of the Sun in Stellarium to coincide with that in the photo:



We can then click on "*Import FOV, Azimuth and Elevation from Stellarium*", which allows us to obtain the true values in azimuth and elevation of the line of sight of the camera (here respectively 122°15'40” and + 33°16'29’’):



Venus lies **outside the field of the image**, at an elevation of about 60 ° and at an azimuth of about 137 °, which definitively confirms that the unknown object cannot be Venus.

Admittedly, the apparent difference in angular diameter between the Sun and its reflection seems to contradict the hypothesis, as they must logically be identical or otherwise similar.

It is here that one must realize that the Sun is observed here through a layer of cirrus and that these clouds produce a halo much larger than the Sun subtends itself.

The simplest way is to check the angular size of this light to compare it with that of the Sun, known as being close to 0.5° of arc.

Measure of the angular size of the reflection

Carried out on the photo "*2017 08 28 _10h12mn42s*" using the function: "*Mensuration-Angle*"

As might be expected at this stage, the size of the reflection is close to half a degree (0.5506 decimal degrees or 0°33'02'' sexagesimal, i.e. similar to that of the Sun (between 0°31'27'' and 0°32'32'').

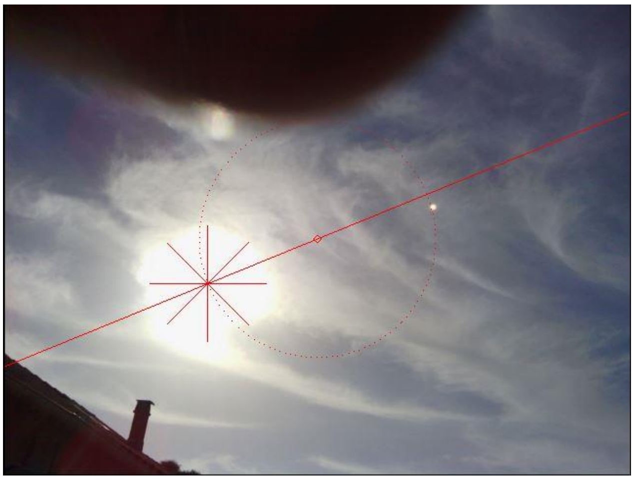
Using the "*Lens Flares*" tool

In the same way, it is interesting to check with IPACO's "*Analysis - Lens Flares*" function what is already visible to the eye, namely the Sun-Reflection symmetry with respect to the optical and/or geometric center of the picture.

N.B.: as the photo has not been cropped, the optical center should logically coincide (or approximately) with the geometric center of the image.

There are two possible procedures: starting from the Sun (here its halo assimilated to a circle) to find the reflection by symmetry with respect to the geometric centre of the image (automatically defined by IPACO during the materialization of the light source by the asterisk), or starting from the presumed reflection to find the direction of the centre of the Sun, meaning to be on the right from the reflection and passing through the geometric center.

For the photo «*2017 08 28 _10h02mn10s*»:



Sun-Flare*: the straight line is passing very close to the flare*

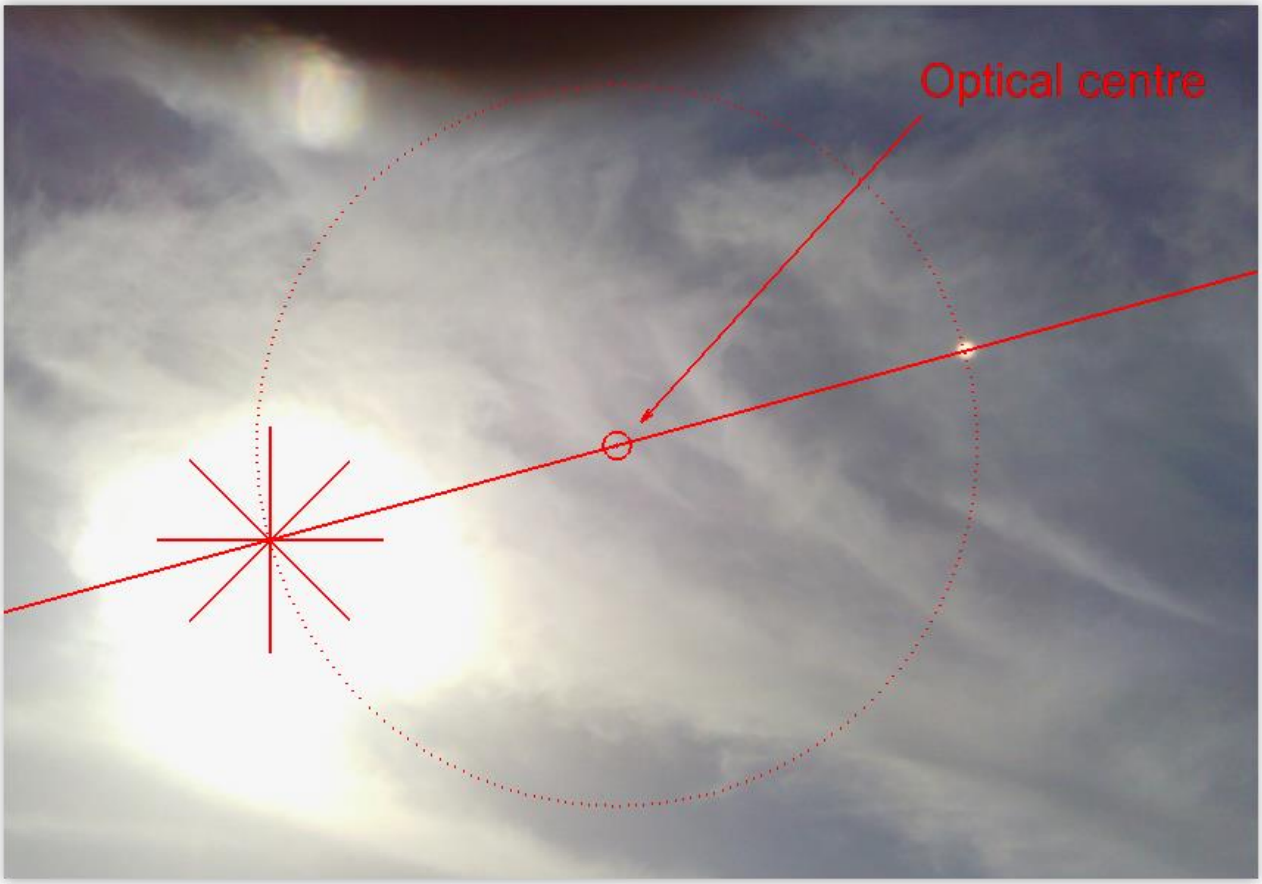
Flare-Sun*: the straight line is passing inside the halo*

The observable error (on the four images) is simply due to two combined factors:

1- The halo is not perfectly centred on the Sun because it depends essentially of the shape of the cloud mantle and of its heterogeneity (as shown by its distorted downward outgrowth).

2- It often happens that the geometric center of the image does not coincide with the optical center, which is probably the case here.

It is possible to correct this last error with IPACO by manually changing the position of the geometric center in order to align the reflection and its light source on the dotted circle, and at the same time to validate the position of the optical center:



For the other images, it is exactly the same.

Although the apparent position of the reflection appears to vary, it always remains in symmetry of the halo with respect to the optical center of the image. It is thus the variation of the framing that creates the illusion of a luminous point changing its relative position with respect to the halo.

<u>Note</u>: it would be logical to think that by playing on brightness and contrast (or other parameters) or by performing a "*radiometric section*" under IPACO (function: "*Mensuration - Radiometric Cross-Section*"), it would be possible to distinguish the position of the Sun within the halo. The idea is good but the image of the halo is completely "saturated", so the operation fails.

IV. Conclusion

Given the objective data provided by examination of the photographic record, we conclude that the "object" present in this series of photographs is a light reflection anomaly, also called "*flare phenomenon factor*" or simply "*lens flare*" caused by the presence of the Sun within the field of photography.

V. Acknowledgements

Thanks to the investigator Gilles Munsch and the witness for their availability and for having provided the original photographs.