3. Fine dust via the “foucault test.

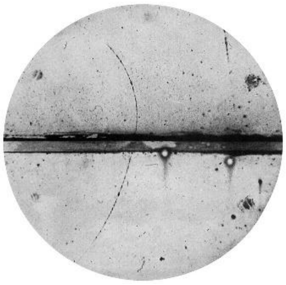
Content

3.1. No excessive expectations

As mentioned, every human being is said to be surrounded by an aura, a number of increasingly rarefied layers, not all of which are of an optical nature. Only the least tenuous layers, according to some, could be optically perceived under well-defined conditions. This is also to say that expectations in such a strictly scientific investigation cannot be too high. But even the slightest indication of the existence of an aura seems to us a highly significant fact, and this for its scientific, philosophical and, yes, even religious consequences. Seers and visionaries tell us that an aura exists and that it can be quite large in some people. If we can prove even a minimal amount of these claims in a way acceptable to everyone, then their claim gains in probability.

So what can we expect? A clue? A glimpse of it in a play of light and darkness? Surely that would be a start. Let us delve for a moment into what seems realistically possible.

Refer, for example, to the conscious nebula chamber, also called a “will-o'-the-wisp vessel[1] ” It is a scientific instrument that has been of historical importance in the development of particle physics. In 1911, the inventor C. Wilson succeeded in using it to photographically record the orbit of an electron, among other things.



Such a vessel is filled with vapor. Extremely small moving particles attract the vapor molecules in it and thereby make their trajectory visible. Anyone ignorant of all this will notice in the photograph in question only a faintly curved line that seemingly has hardly any significance. Those who know the whole story see in it an impressive practical confirmation of a theory that has been sought for years.

Or do we compare it to ultrasound, a technique based on ultrasound, which knows how to distinguish the soft and hard parts in the human body. Whoever unprepared e.g. looks at the picture of lungs, or of a child not yet born, hardly knows how to interpret the results. It takes some searching. It is completely different for a specialist who can interpret such an image almost by sight.

Therefore, it is best to begin our optical search for the possible existence of fine dust with somewhat tempered expectations. Fortune and Brennan already pointed out to us the difference in seeing with our cones and our rods. The cones help us distinguish colors in daylight, the rods are there when we want to observe in dim light. It is nice to read that astronomers also take this into account when they scan the night sky through their binoculars. They talk about dark habituation, an adaptation of the eye to the darkness of the night. In a fascinating text by the astronomer J. Van Gastel[2] we read that this habituation can last up to more than half an hour. This time interval we really want to keep in mind and respect in order to see what shows up in our viewer in the twilight darkness. And here we encounter an element that carries a certain subjectivity : the sensitivity of the eye. It may vary from one person to another. Some are more likely to notice something than others. But this should not stop us from carrying out our experiments with care.

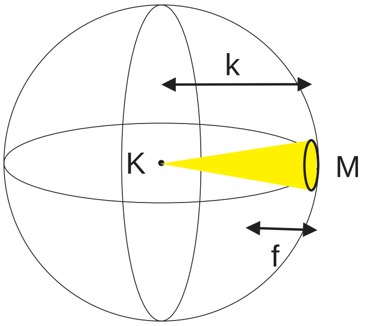
3.2. Curvature point and focal point

Let us start with the effective construction of the setup required to perform the foucault test. The test was described by French physicist Léon Foucault in 1858. It reveals errors created during the “grinding” of spherical mirrors to within a fraction of a wavelength of light. It is pretty much the standard test, and is known to all amateur mirror grinders. By the deliberate technique of grinding two disks of glass on top of each other, with a mixture of hard grains between them, the upper disk of glass gradually becomes convex, and the lower one concave. Once finished, the latter will be coated with a reflective layer and eventually serve as a mirror for our viewer.

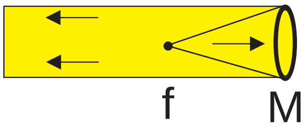
Here the already ground hollow glass disc is exposed from its “curvature center. We will clarify this in a moment.

The drawing below represents a perfect sphere. Its circumference consists of a layer of glass. K (the capital letter) is its center. In this point there is a small light source. From here we illuminate part of the circumference, indicated by the yellow diverging beam.

The space on the sphere, indicated on the right by the black small circle and the capital letter M is our glass disk that later becomes the concave or spherical mirror. Its center K is also the center of curvature of the glass disk M. The distance from K to M, represented by the lowercase letter k, is the curvature distance. It is said that the glass disc M, or later the finished mirror M (from Mirror), is at curvature distance here. In this position, all diverging rays after reflecting on M, will converge at that same point K.



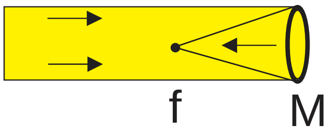
Illustrate the distinction between the curvature distance and the focal length. The focal length f of the mirror M is equal to half of the curvature distance k. The drawing below illustrates that a mirror M or a lens L illuminated from the focal point will reflect light rays parallel to it.



Or conversely, a parallel beam directed at the mirror M, will converge at the focal point.

This occurs in a newton telescope (see the drawing below on the left).

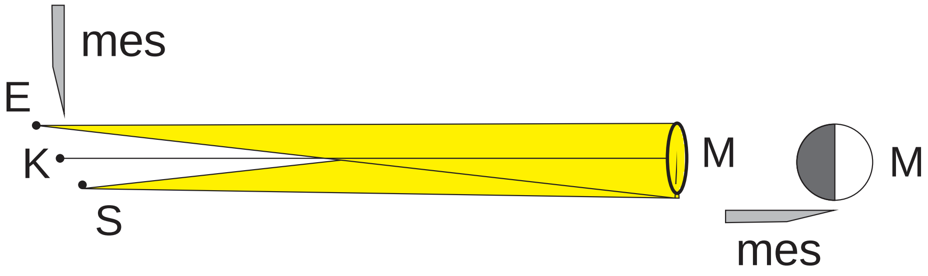
A parallel beam of sunlight directed at a lens converges in a small plane. This becomes so hot that we burn a piece of paper with it.



3.3. The foucault setup on the optical bench.

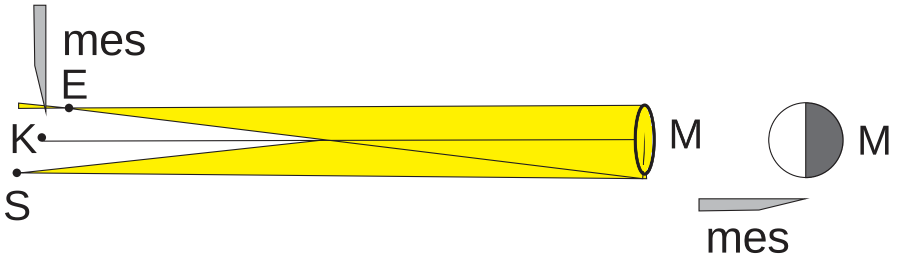
When performing the foucault test, light will be illuminated (almost) from the curvature point, as shown on the glass sphere higher in this text. After reflection on the glass disk, it will again (almost) converge to this curvature point K.

The foucault test consists in cutting this converging cone near the convergence point K with a knife. In the process, strings of light and shadow appear which, if interpreted correctly, reveal possible errors in the glass disk and provide a clue to eliminate them. Clarify below the principle of this test.

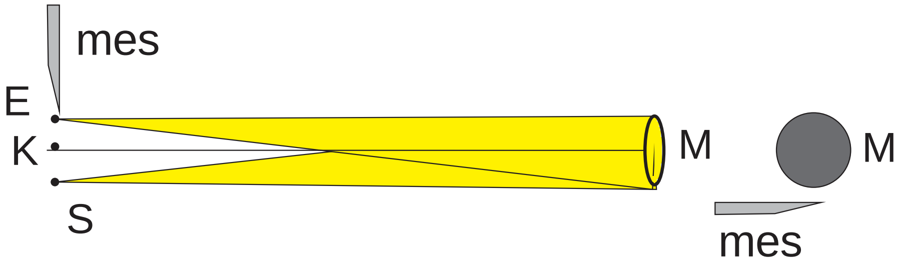


In the image above, a top view, the mirror M is diverged from the light source S (Source). The point S is close to K, but just next to it. In the drawing above, this point S is closer to the mirror than the curvature point K. The light reflects off the mirror M and converges at the point E ('E' of Eye).

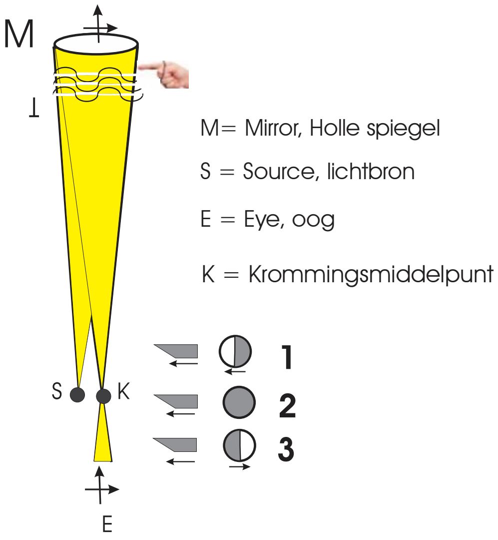
According to the mirror formula 1/f = 1/v + 1/b, the light will converge in E, just beyond the curvature point. At the height of K, the blade is gradually pushed into the light beam. If at that place the light beam has not yet converged completely, in other words, if all the light rays at the height of the knife have not yet converged into one “point,” then from E one sees the mirror, which we see here in front view, gradually darken from left to right. This is : along with the movement of the blade. Because of this, one knows that S and E are not at curvature distance from M. S is too close to M. To remedy this, the point light source S must be placed further from the mirror M. Or, which amounts to the same thing, the mirror must be slightly further from the point light source. This is done in exaggeration in the following drawing.



In the image above, the mirror is again illuminated from S. However, S is further from the mirror M than the center of curvature K. The light from S reaching the mirror M reflects and converges before the center of curvature K in E. But this means that the light diverges back beyond E. Light propagates rectilinearly. The knife first cuts the light rays that do not come from the left, but from the right. We see this again in front view on the far right. One knows that S is too far from the mirror.

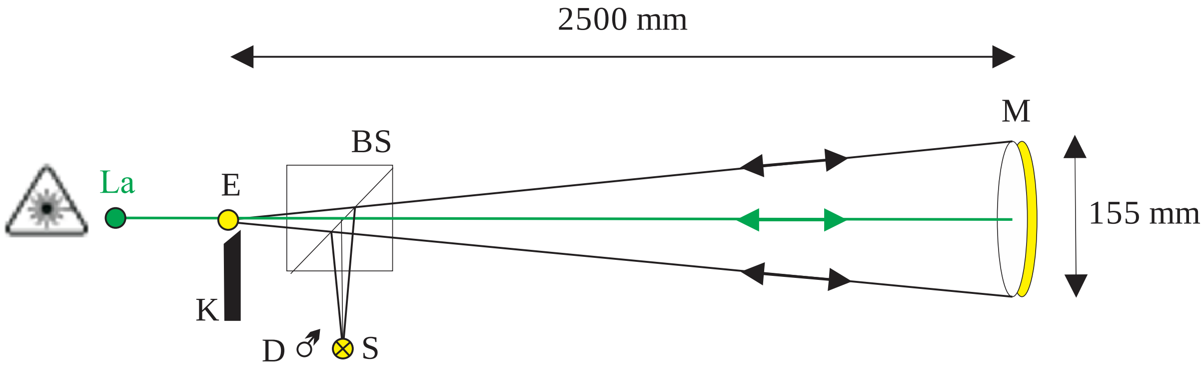


Tenslotte staat S ter hoogte van het krommingspunt K. De weerkaatste stralen convergeren netjes in E. Het mes in de lichtbundel zal nu de spiegel M niet eerst van links naar rechts of omgekeerd, maar wel geleidelijk op het hele oppervlak verduisteren. We zullen deze laatste situatie aanwenden om onze spiegel zoveel mogelijk op krommingsafstand te plaatsen. De drie verschillende situaties worden hieronder in één tekening samengevat.



If the mirror is beautifully spherically ground, and one brings the blade into the light path at the level of the curvature point K, then disturbances in this path will cause a play of light and shadow. Dark wisps and turbulences show themselves in the light path. This is what so-called “Schlierenphotography” is based on. However, this is out of the scope of our theme. We will not use the knife any further.

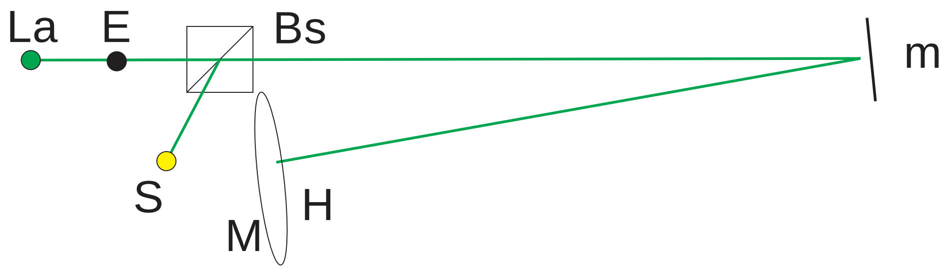
What will we do then? We keep the setup but work on-axis. This means that we place our concave mirror (M) at curvature distance (2500 mm) from both our light source S ('S' from Source) and the site of observation ('E', from Eye, eye). For this we use a beamsplitter, a transparent cube with a half-permeable mirror in it diagonally, ('BS', 20mm²) and align with a laser ('La').



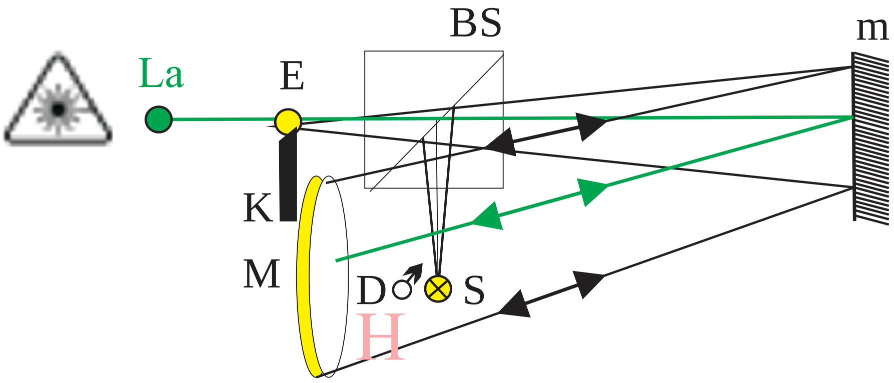
The laser is located behind the observer so that the observer can never look into the blinding and harmful laser light. From our light source (a 25-watt bulb equipped with a dimmer, D), light travels from one end of a fiber optic to the “point” opening (a thin piece of metal with a 0.3-mm opening in it, made with an acupuncture needle) at the other end of the fiber. The fiberglass is not shown in the drawing, which gives a top view. From there the light goes diverging through the splitter to the mirror, and then after reflection, converging to the eye E. To position the mirror M at its correct curvature distance we use the knife K ('K' from Knife, knife) entirely analogously as it is done in the foucault test.

3.4. We look at our own hand.

Halfway through the setup, we provide another plane mirror m (far right in the drawing below) that reflects light in the direction of the observer. Imagine that schematically below, using only the laser light.



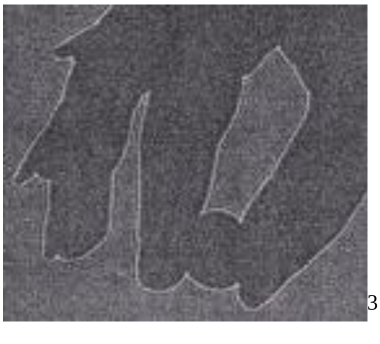
The concave mirror is then just in front of and at the height of the observer's chest. The observer can then hold his own hand (H) just in front of (not against!) the hollow mirror while looking at it through the splitter. If we represent the setup with diverging and converging light beams, we obtain what the drawing below shows.



Our setup will be in a totally darkened room. 'Dark' means that it makes no difference whether we keep our eyes open or closed; everything remains inky black. After everything is aligned with the laser, we take enough time to let our eyes get used to the darkness. Afterwards, we place our hand in front of the mirror. We first illuminate the mirror with maximum brightness. We see the hand, illuminated, against the background of the mirror. That's all there is to it. Give us a colored drawing of each situation below.

Then we gradually dim the light intensity to just short of zero while continuing to look at the hand. We gently move the fingers back and forth. If our eyes are sufficiently adjusted to the darkness, we have the impression that a faint, barely noticeable and misty mass surrounds our fingers and gently moves with them, albeit with some delay.

The latter is not without significance because it tells us that this is not a possible diffraction. In diffraction, light waves deflect past an impenetrable obstacle. The picture below shows such diffraction. Indeed, one sees a thin and evenly delineated band next to the hand and the marble. The band is very thin and follows without the slightest delay any movement of the hand.

[3]

However, the image in our foucault setup is so faint that the inexperienced viewer will not notice much. We cannot entirely disagree with the critics who claim that there is hardly anything to see. For many, this is certainly not hard scientific evidence. Looking further.

Assume that the first layer of fine dust deflects the light even though we hardly see it. In our setup, light passes through this assumed fine dust around the hand twice. Once diverging, once converging.

3.5. A multiple perturbation

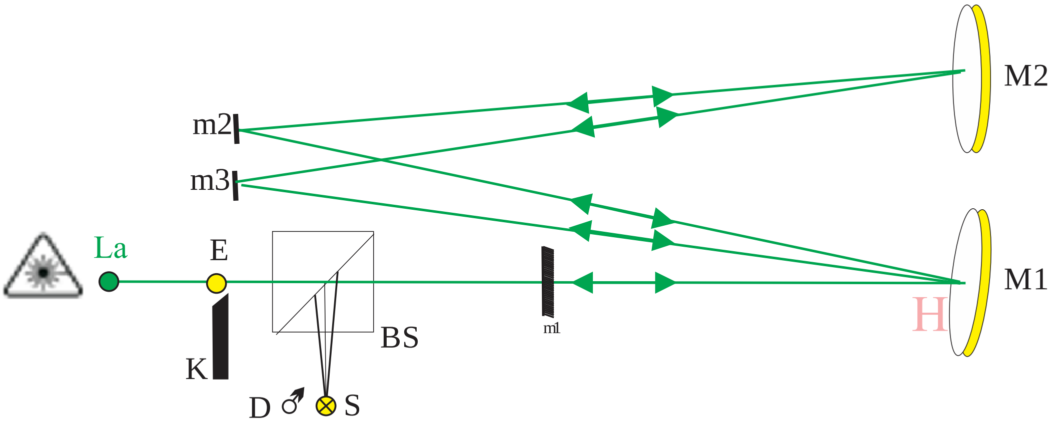
Nothing prevents us from placing in our setup a second hollow mirror M2 with a similar aperture (also at curvature distance). Consider the drawing below. We have still drawn the large plane mirror m1 between Bs and M1, but no longer the ray path reflected on it. This is to simplify the drawing. Of course, the hollow mirror M1 remains near the observer so that he can bring his hand in front of the mirror while looking. This is still indicated by the drawing of the plane mirror m1, although the ray path has not been drawn.

The light passes from S through Bs to M1, m2, M2and back to m2, M1, Bs and E. We notice that the hand (H) is now four times traversed by the light, something that compared to the previous arrangement, doubles the perturbation. One can see that the arrangement becomes off-axis. The converging light directed toward the small plane mirror m2 (the lowercase 'm') theoretically creates a parallax. However, if one places mirror m1 and splitter as close together as possible, i.e., only a few mm, this parallax, at a curvature distance of 2500 mm, is negligible.

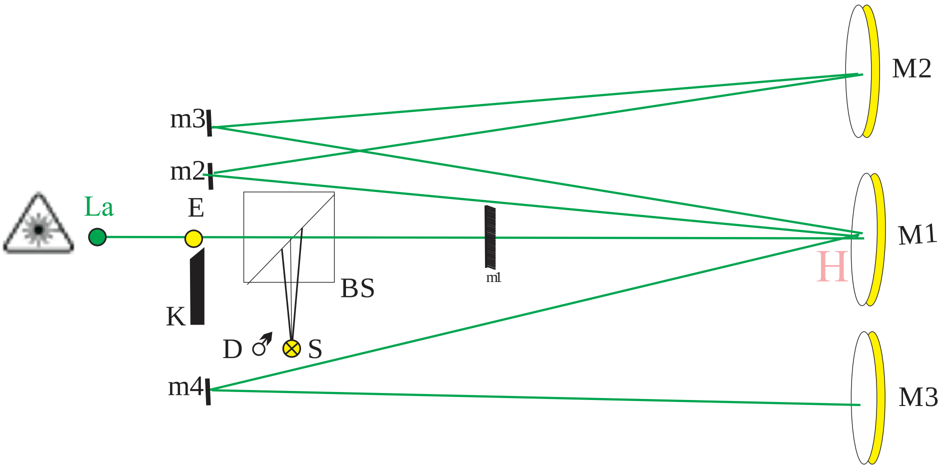
Give our eyes enough time to adjust to the darkness. If we now look again, the layer around our hand already becomes much brighter. We also see somewhat more clearly a number of almost transparent faint wisps of warmer air rising from the hand. It looks somewhat like the projection of the vapor of boiling water illuminated by the sun. As expected, those wisps are not bright white-black contrasting. Indeed, we are not working with the knife. They are not images the “Schlieren photography” shows us.

One can design setups with 2 or more concave mirrors where the light passes through the hand a greater number of times still. We show some of them schematically below. We have not built them ourselves (yet?). Here the light from our laser already travels a great distance and diverges more and more, something that makes adjustment and alignment quite difficult. If we do want to build this setup, we may need a more powerful laser beam.

In the first setup below, the light passes through the hand 6 times. To simplify the drawing, we have omitted the diverging and converging light beams and limited ourselves to representing the laser beam. The light passes through the arrangement as follows : S, BS, M1, m2; M2; m3, M1, Bs, and E. The drawing gives an impressive parallax, but practically m2 and m3 can be brought very close to the splitter.

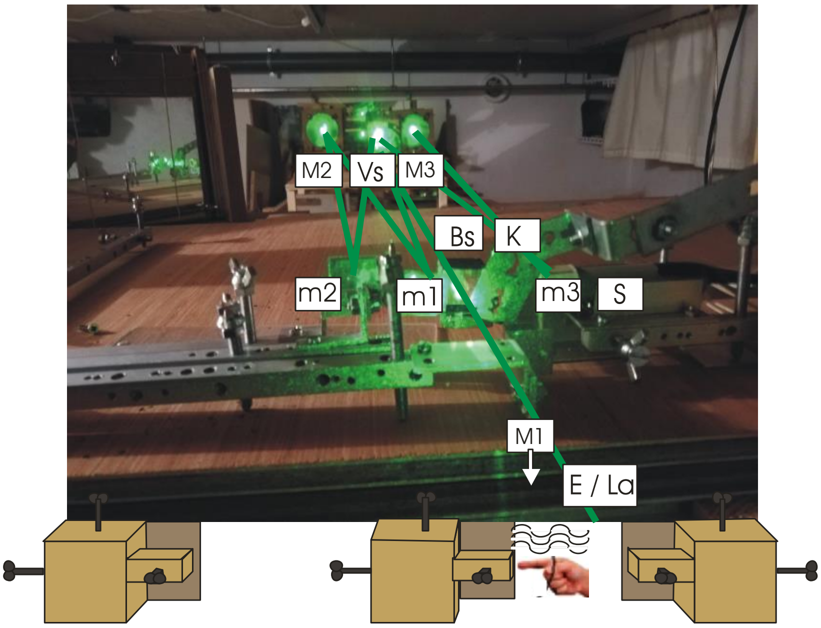


In the following design, the light passes through the hand 8 times. The light path goes from S, BS, M1, m3, M2, m2, M1, m4, M3, m4, M1, m3, M2, m2, M1, Bs and E.



4.6. a view of the optical bench

Practically, built on the optical bench, the setup looks like the photo below shows all this. The large mirrors M1, M2 and M3 are mounted on trolleys at the back, and these are fitted with beams just below the surface of the optical bench so that the mirrors can be turned forward, backward and a little to the left or right from the observer's position. The laser lines were added to the photograph afterwards.



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[1] https://nl.wikipedia.org/wiki/Nevelvat

[2] file:///C:/Users/Walter/Desktop/opica%20nieuw%202024/donkeraanpassing.pdf

[3] Photo, see : Diffraction, Hecht optics, Addison Wesley Publicing company, p. 392