STARDUST @ HOME

Patientia Humilitas Perseverantia

RARI NANTES IN GURGITE VASTO

Virgilio, Eneide, 1, 118

Thoughts on dusting

some considerations during Phase 2

McAngus

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1 ON FOCUSING

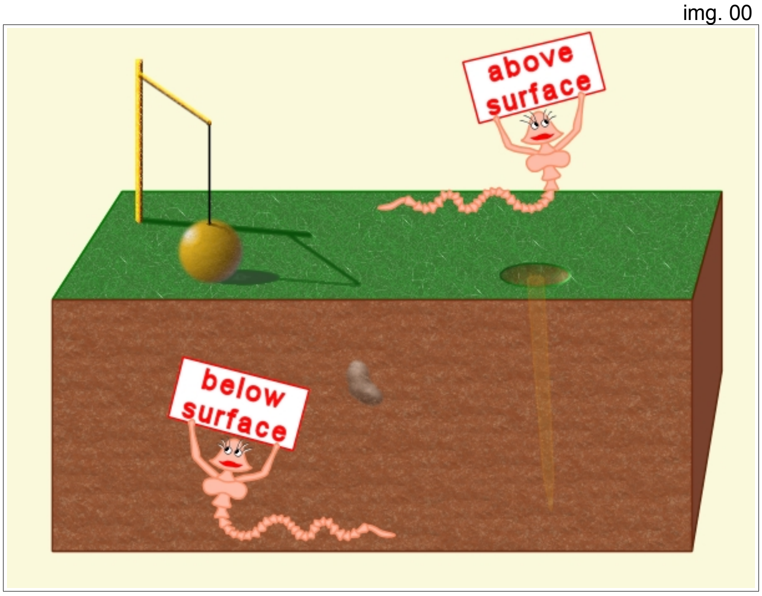
1.1 Aerogel transparency – the ball, the stone, the rod

The aerogel transparency is the main property of this material that allows us to focus an object.

It is worth recalling that our eyes automatically focus the object that we are observing, while any optical instrument (for example a simple camera) must be adjusted depending on the distance that exists between it and the object that you want to focus on.

Once adjusted optics on the focus plane, all that stands before and behind the plane will be out of focus, as more as we move away from the set plan focus.

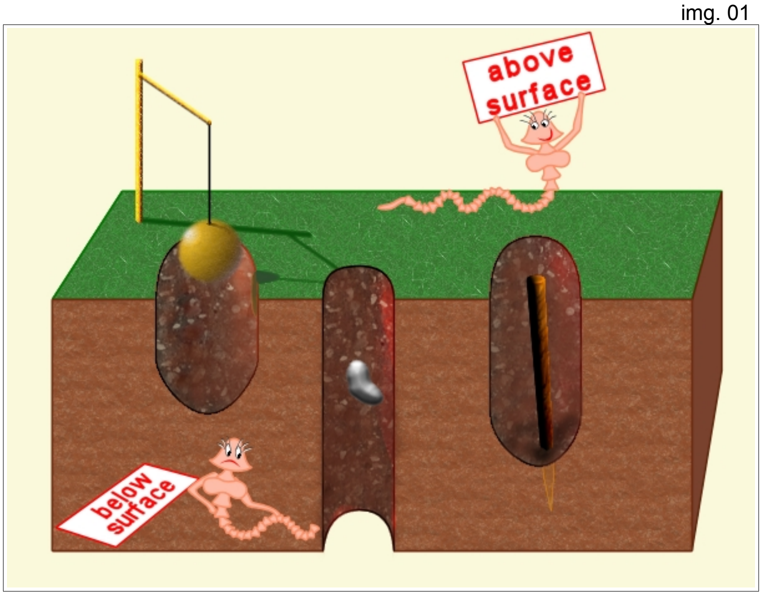
img. 00



A grain of dust on the surface is like a ball situated on the ground. An inclusion, a scratch or other deformations of the aerogel, are comparable to a stone which is located inside the ground. In both cases, if you dig the ground around them, below you will find nothing.

One track, indeed, is like a rod stuck in the ground. If you dig the ground around it you will always find another piece of rod until it will overcome its length.

img. 01

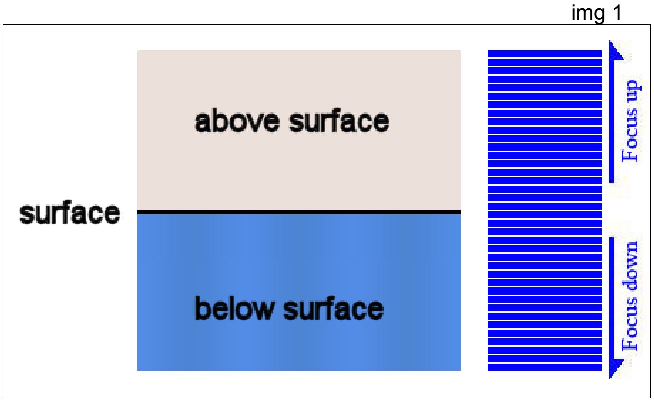


2 THE FOCUS OF THE SURFACE

2.1 Surface location

The position of the surface is extremely variable.

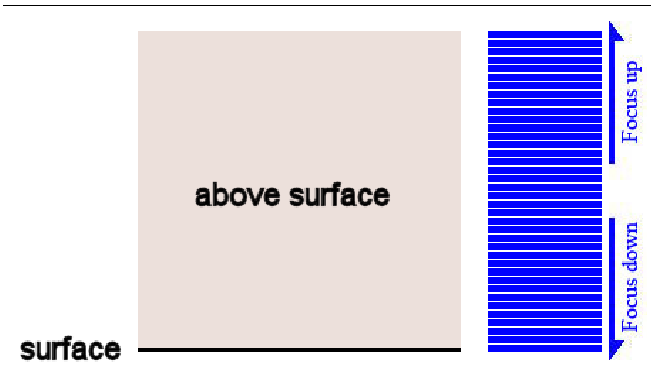
img 1



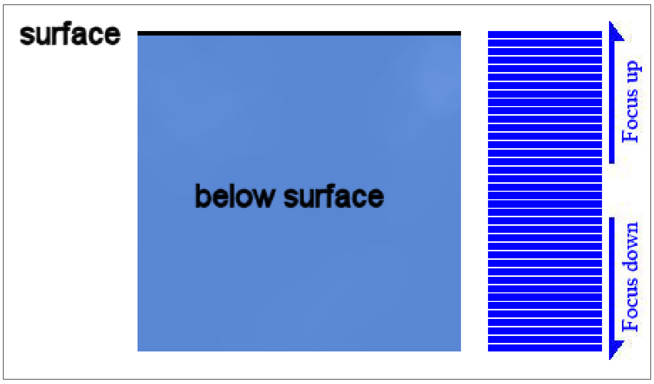
Surface “in focus” at the middle of the blue bar.

Surface “in focus” at the extreme positions (img 2 and 3).

img 2



img 3



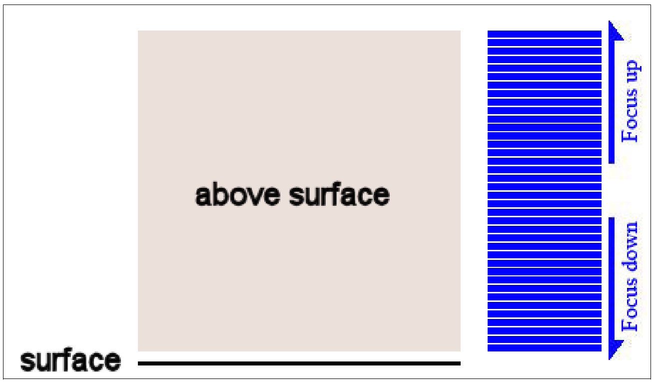
Therefore, in the above images the surface goes always in focus.

Remarks: *a) img 1 and 3 it is possible to detect a track;*
b) img 2 it is not possible to detect a track.

2.2 “Bad focus”

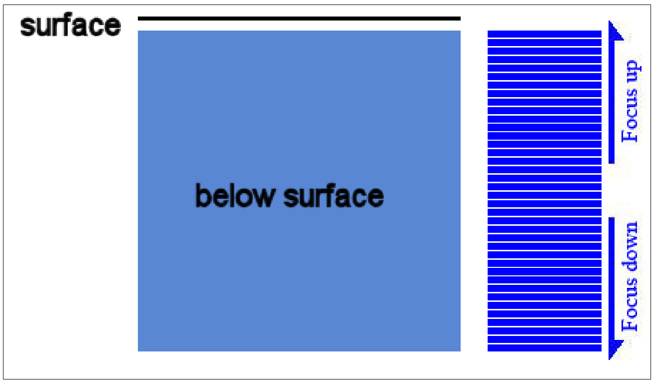
Surface “in focus” is not present in the following movies.

img 4



BAD FOCUS

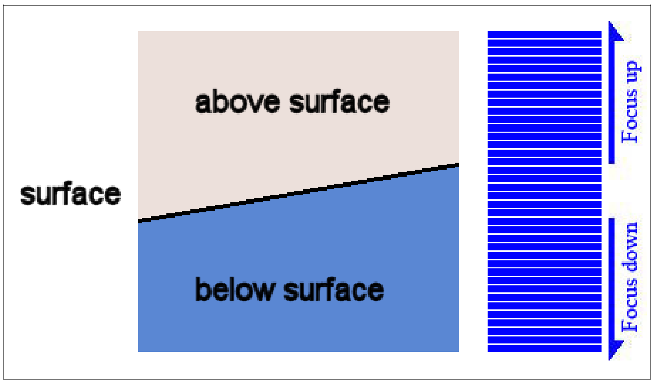
img 5



Remarks: *a) img 4 it is not possible to detect a track;*
b) img 5 it is possible to detect a track.

2.3 Tilted surface

img 6



2.4 The “hell” of the wavy surfaces

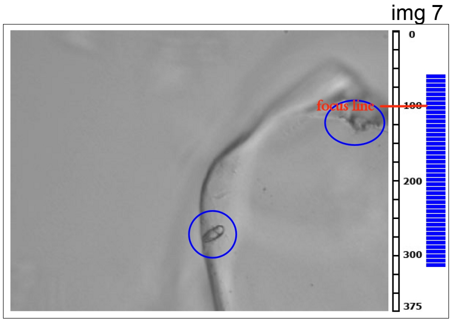
In the case of a wavy surface it can be very difficult to locate the focus of the surface, because the various planes of the surfacel go in focus at different positions on the blue bar.

Movie 6840488V1, is it a simple case?

The first problem is the interpretation of the position of the light source.
In img 7 and 8 our brain interprets as the light source is located on the right, while in img 9 and 10 it appears as on the left side. (typical optical illusion in the microscopy observation).

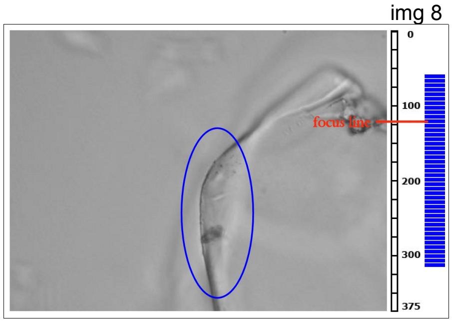
Also, if the scanner has the ability to focus almost the entire thickness of the aerogel, the bottom right corner of the movie (which it is not possible to focus) could be the bottom of the wavy surface of the aerogel.
In this case, the surface would have only a ripple but it would not be tilted (as suggested by the grains of dust marked in orange that go in focus together with the surface).

img 7



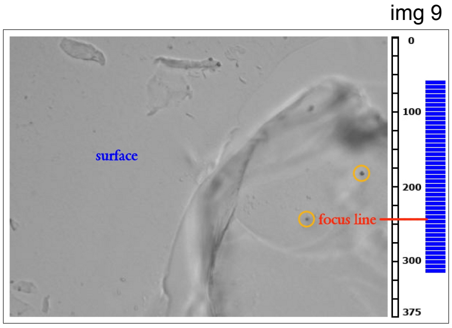
focus on the top of the wave

img 8



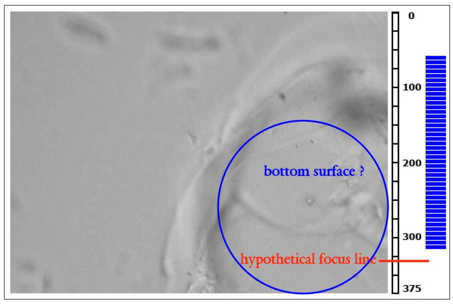
focus on the face of the wave

img 9



focus of the surface

img 10



the area within the blue circle is out of the focus

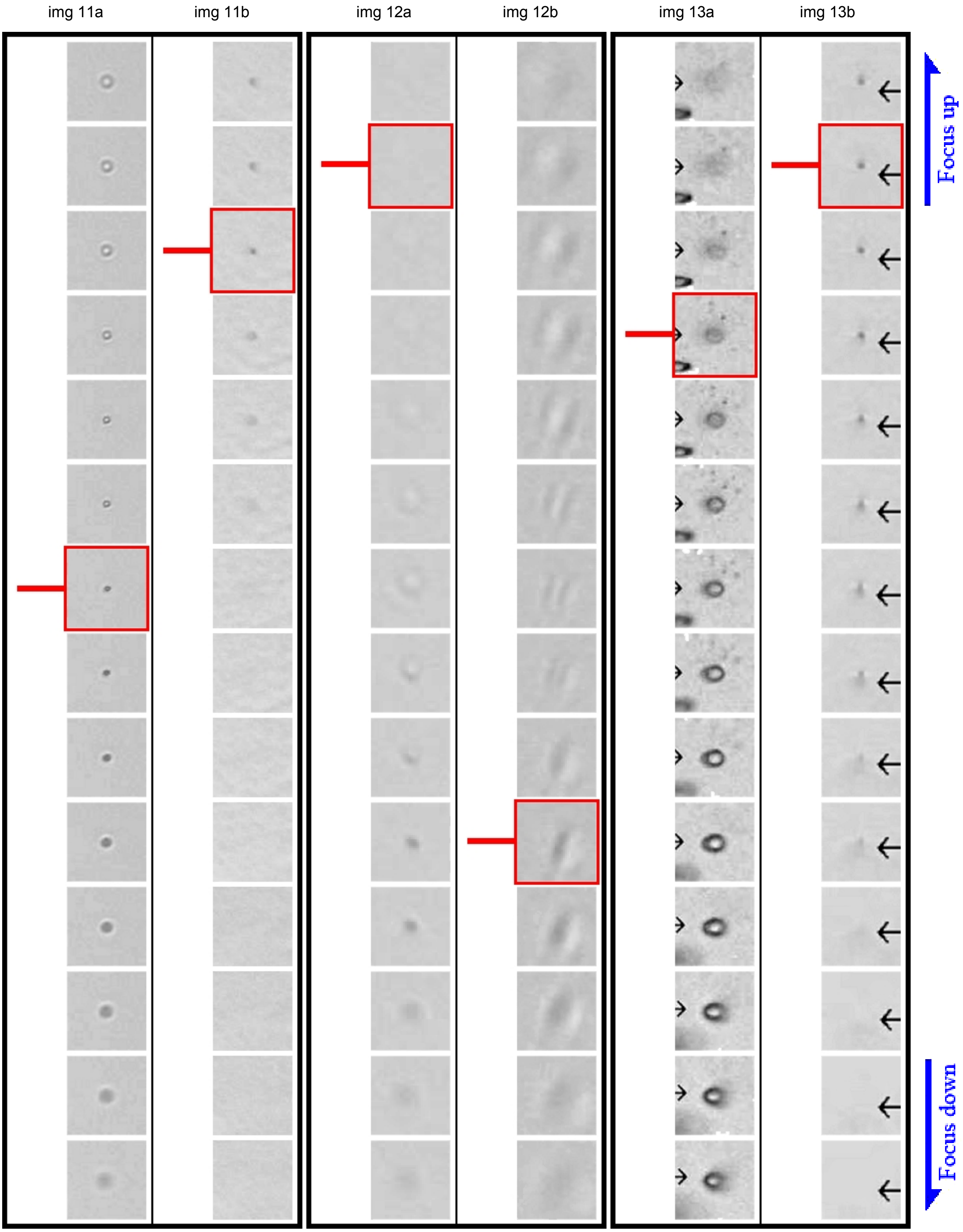
3 THE FOCUS OF THE OBJECTS

3.1 Focus types

Each object goes in or out of the focus by its own feature

Three ways of focusing: the grain spheric and oblong..............(img 11);
the circular and elliptical concavity .....(img 12a – 12b);
the track...(img 13a – 13b).

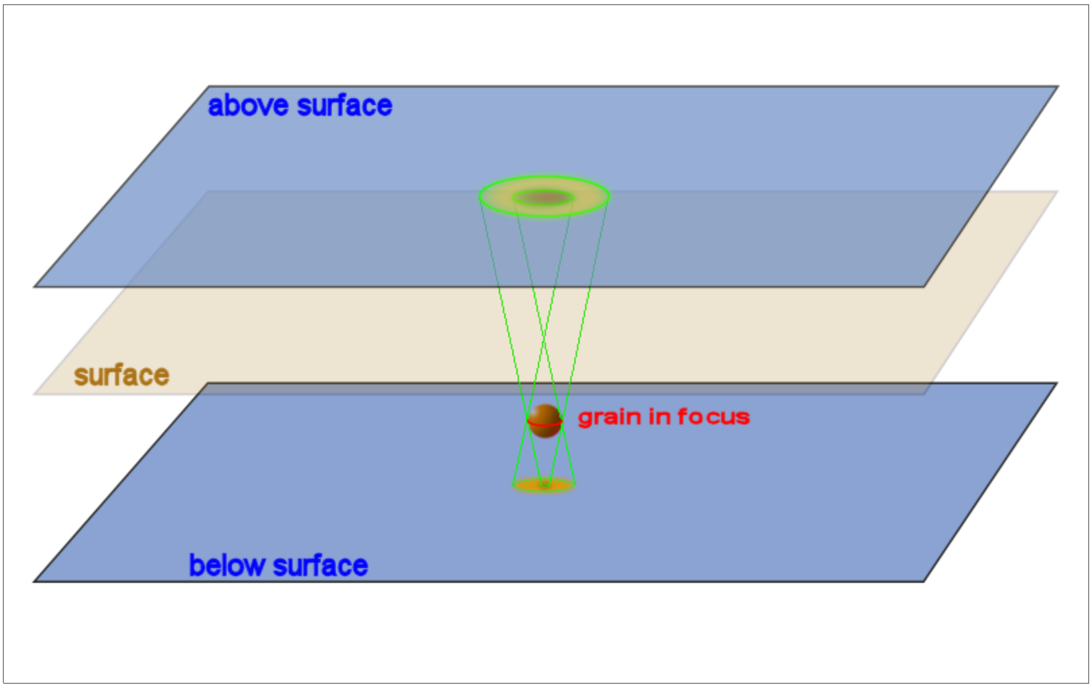
The red squares indicated the surface in focus.



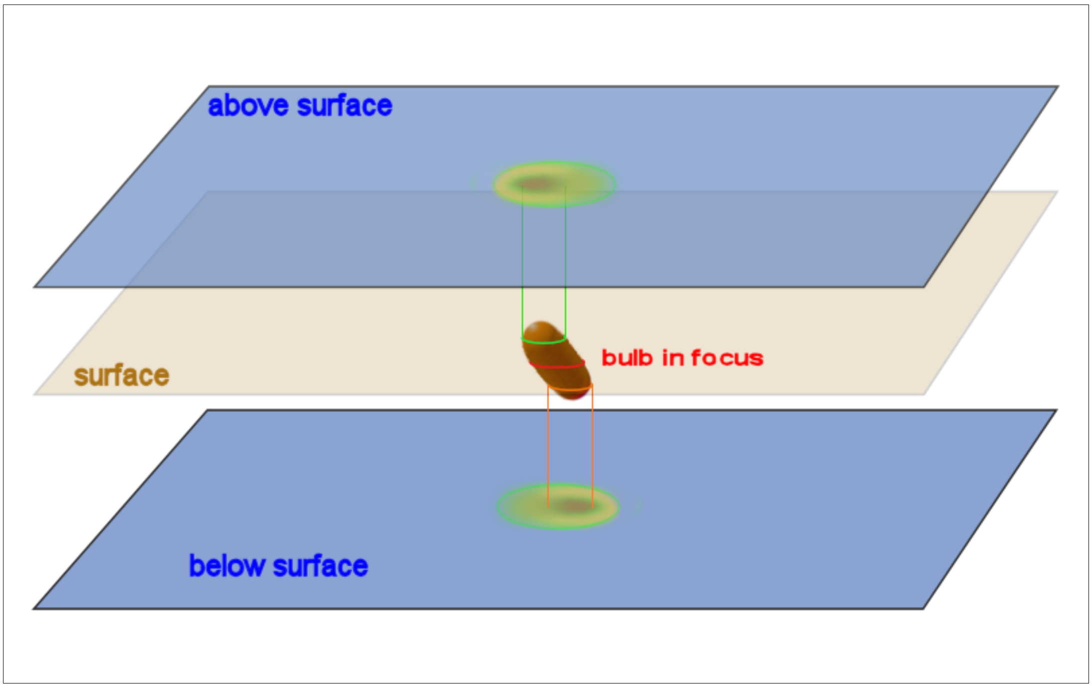
3.2 A brutal semplification

Below the three-dimensional representation, very elementary and schematic, of the way to go in and out of focus of the grains that we saw in the images 11a and 11b.

Img 11a/3D



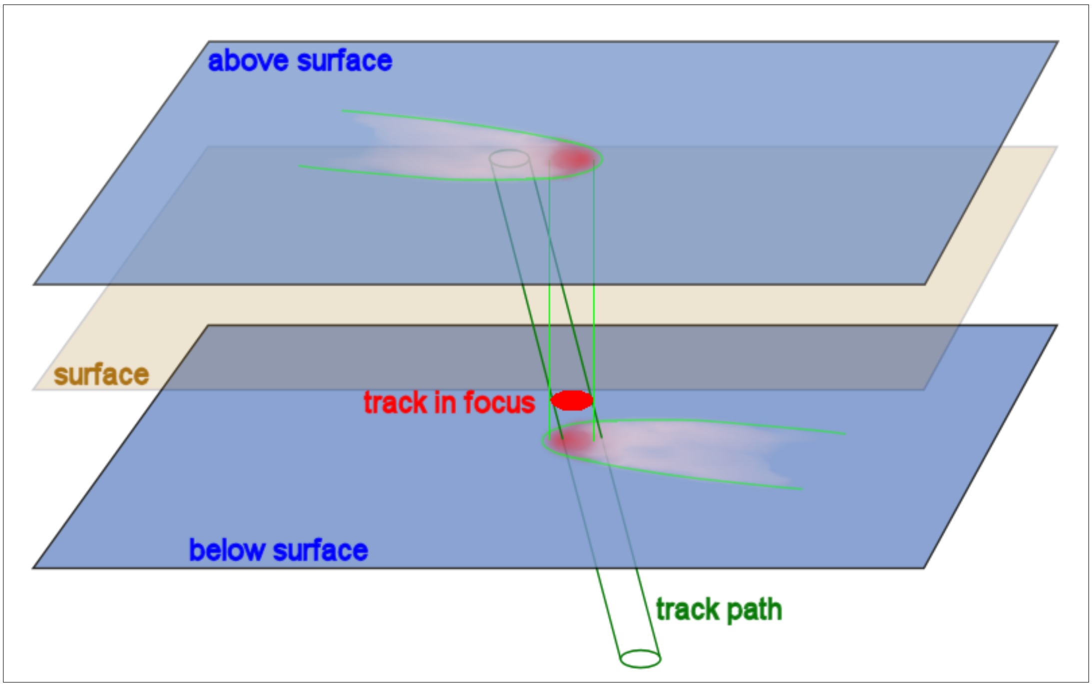
img 11b/3D



It should be noted that in most of cases, as represented in the img 11b/3D, the shadow due to out of focus always lies inside a circle, even when a part of this shadow is hardly visible.

In the next image 13b/3D is showed the way to go in and out of focus of a very small track of the same type as represented in 13b.

Img 13b/3D



In the img 13b/3D blurring is so widespread making difficult, and sometimes impossible, to identify the circle that encloses it entirely.

4 THE TRACK

4.1 The origin of the track

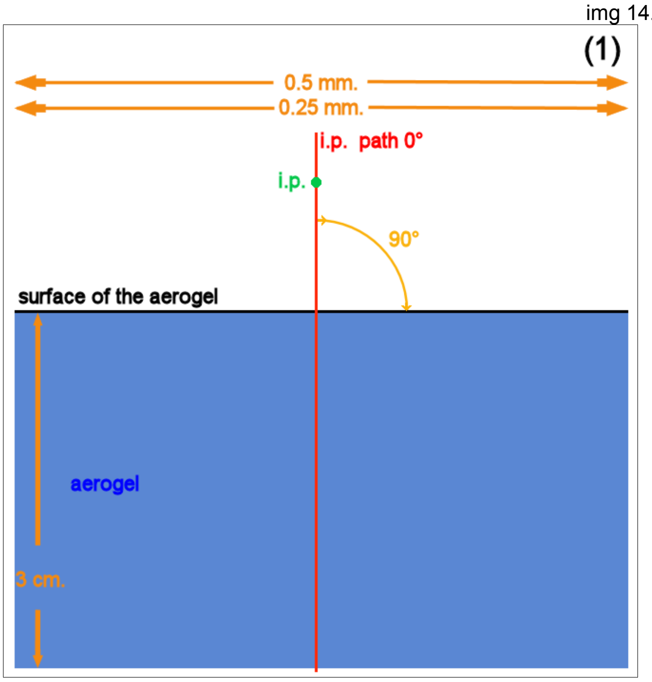
Conditions: # 1 the areogel is homogeneous;

2 absence of scratches, inclusions.

Hypothesis: # 1 incident particle (i.p.) path is is perpendicular to the surface;

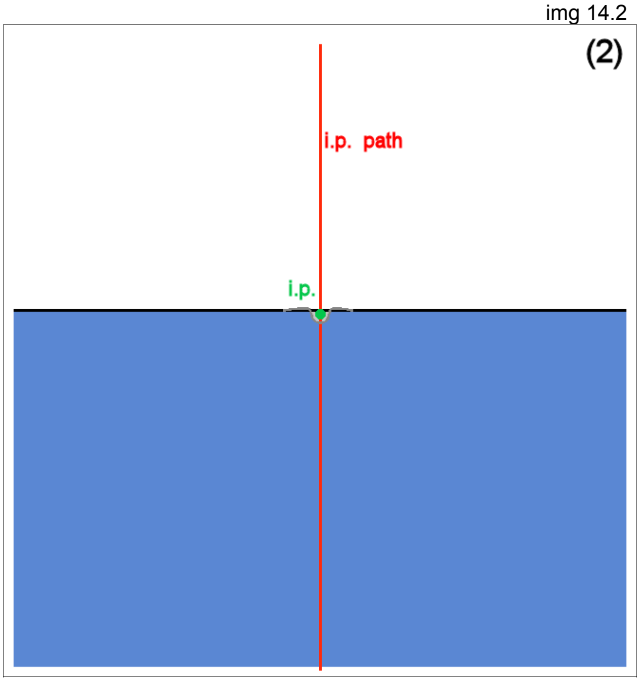
2 i.p. path is not modified after the impact.

img 14.1



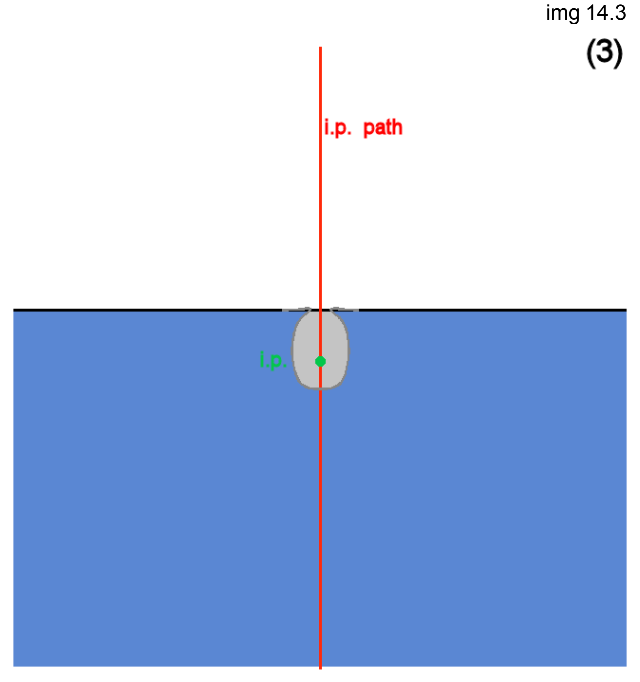
i.p. impact on the surface:

img 14.2



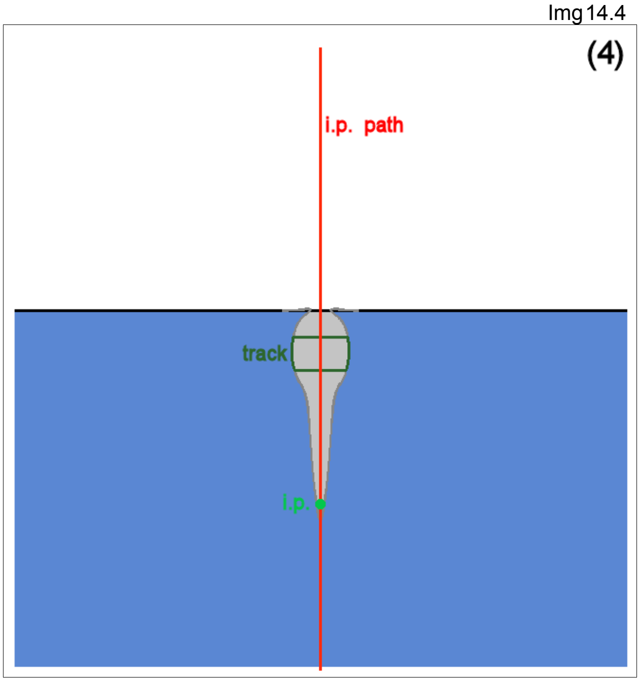
The shock wave of i.p. causes a compression on the aerogel that deforms it with radial pattern.
Since i.p. continues its rush the deformation of the aerogel will not have a spherical shape but it will take the characteristic appearance of "barrel shaped".

img 14.3



The i.p. should lose speed at least inversely proportional to the square of the distance covered by the moment of impact.
The abrupt reduction in speed leads to a subsequent deformation of the aerogel with shaped cone.

Img 14.4

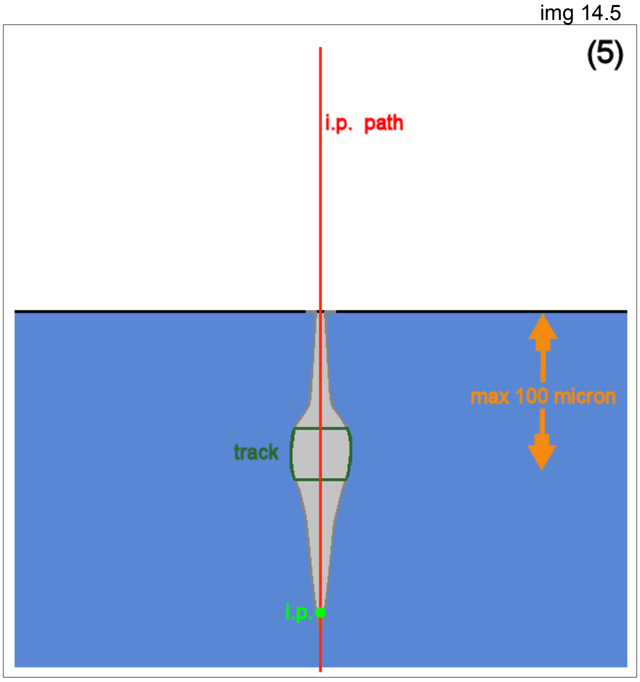


So, one can assume that i.p. continues its rush from the point represented in img 14.4, leaving a sign practically invisible.

Remarks: *a) only i.p. paths perpendicular to the surface will produce tracks of circular shape (ie Tutorial # 18);*
b) when the angle of impact is >0° the track will have an elliptical projection on the focus plane (ie Tutorial # 1, 2) ;
c) when the angle of impact is >0° the right and left sides of the track, which lie on the same plane, will go in focus on different levels (ie Tutorial # 2);
d) the superior side of the "barrel" form a shadow covering the track (ie Tutorial # 2).

Changing the i.p. mass and speed you can even figure out that the track will begin far from the surface.

img 14.5



Remarks: a) the mouth of the track can be hardly detectable;
b) the track will go in focus quite far from the surface.

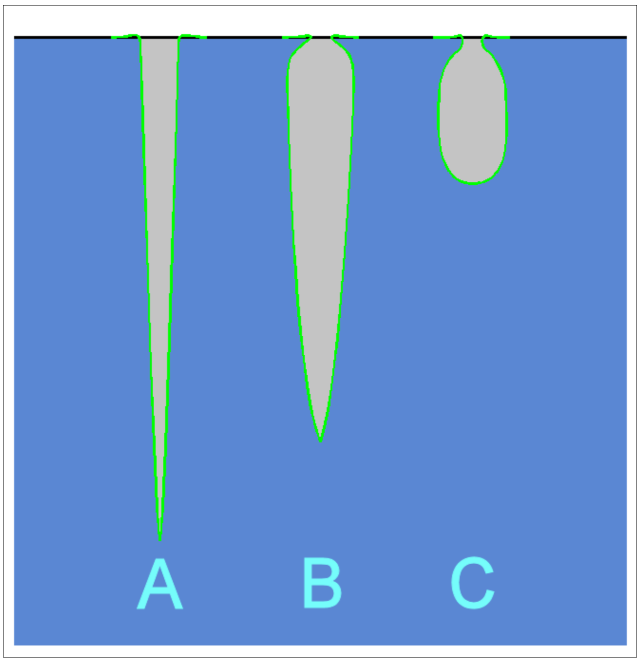
The beginning of the track is usually detectable within the first 100μ of the aerogel.

4.2 The shapes of the track

Three typical shapes of the track:

A) CONE; B) CARROT; C) BULB.

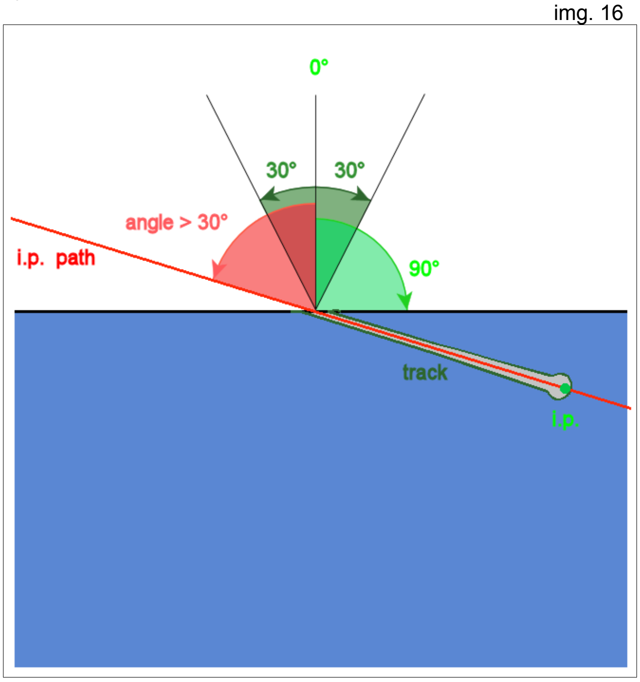
img 15



4.3 The high angle track

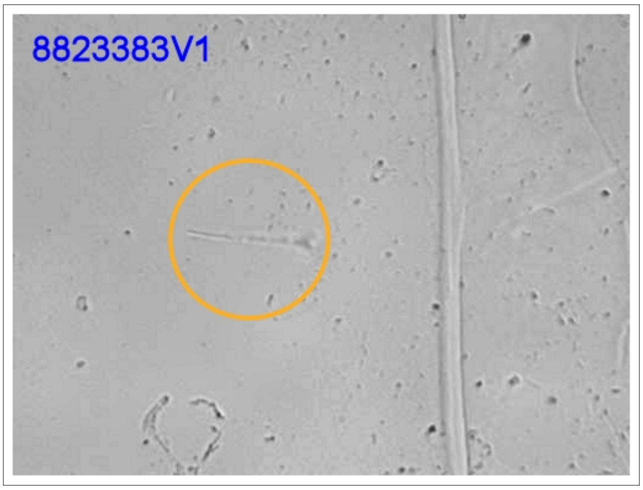
The track formed by an i.p. colliding with the aerogel with an impact angle greater than 30 degrees is called "high angle track" (h.a.t.).

img. 16



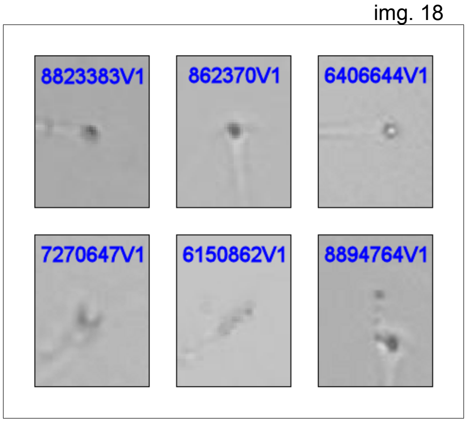
The h.a.t. takes the form of a band, more or less long, and ends with a bulb (img. 17).

img. 17



The bulb can take different shapes and sometimes appears raveled in various ways (img. 18).

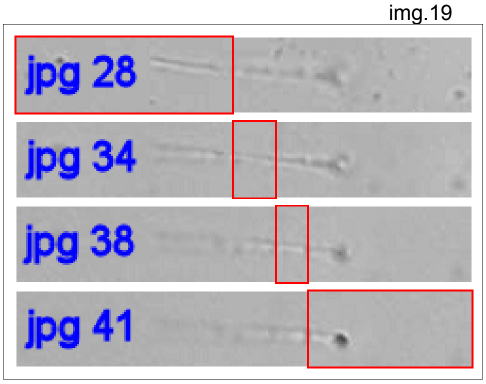
img. 18



An h.a.t. of course, begins and ends on different focus planes, and then you can easily distinguish it from waves and scratches because these, usually, go in focus just on one plane (except those stored on tilted movies).

In the image 19 are highlighted four focus planes of h.a.t. in the movie 8823383V1.

img.19

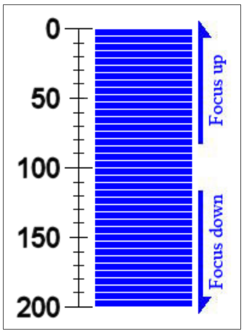


5 THE PERSISTENCE OF THE TRACK

5.1 “BLUE BAR”

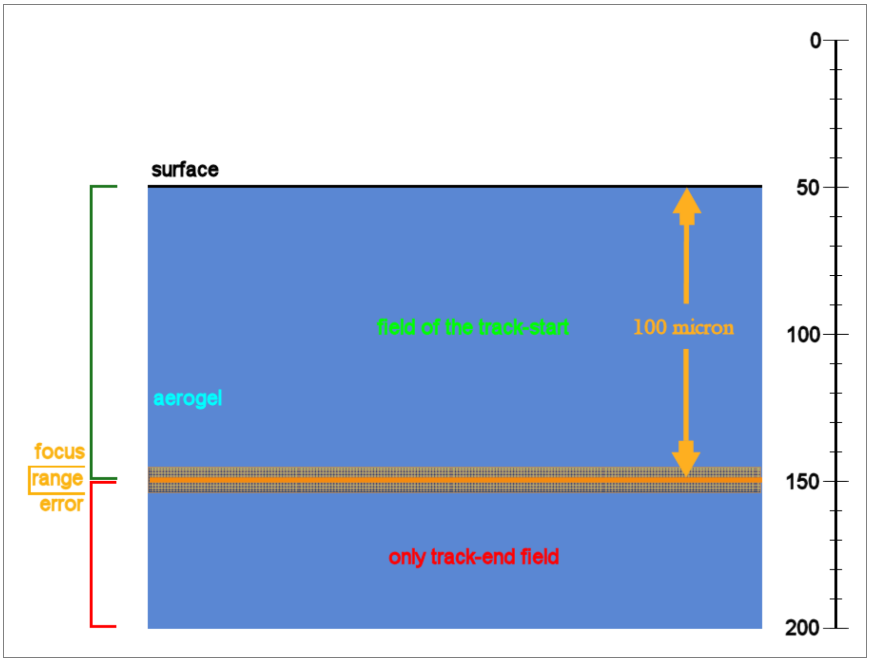
The focus field covered by the blue bar is 200 microns deep.
Let's assume that there is a margin of error of 10 microns.
It is possible to add a graduated scale to the blue bar indicating how far the focus goes "inside" the aerogel.

img. 20



In many cases, it is possible to have the conditions showed in img. 21; the surface has its own focus to about 50 microns deep.

img. 21



Each movie is composed of a variable number of jpgs.
On average the number of jpgs that make up a movie is reported to be 43.
We take into account a movies made up 45 jpgs.

Since the explorable depth of the aerogel is 200 microns, this space is divided by the 45 jpgs in 44 intervals of 4.54 microns each.

From these considerations, it emerges that is possible, very roughly, to determine the length of a track inside the aerogel.

5.2 A trivial exercise

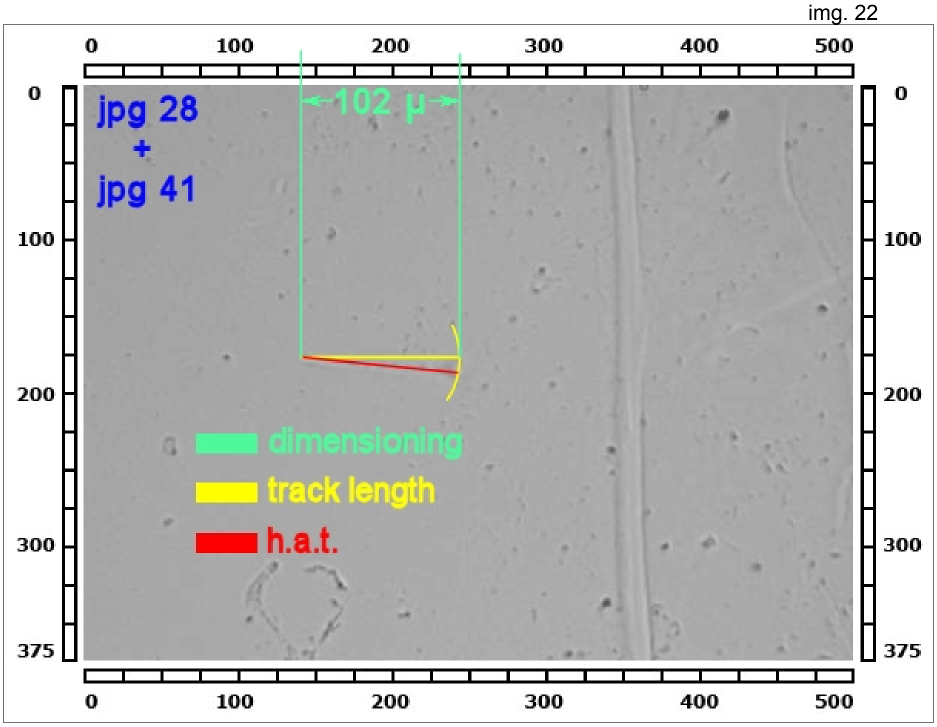
Let’s find the approximate length of a track inside the aerogel.

Just for our convenience, let’s take as an example the h.a.t. that has the beginning and the end within the movie 8823383V1, which is composed of 45 jpgs

The beginning of track has its own focus in the jpg 28, while its end (that is, the bulb) has the focus in the jpg 41.

First of all, we merge jpg 28 with jpg 41. Now we can determine in this merged jpg the length of our track, as described in img. 22.

img. 22



Also we know the difference in depth that exists between the beginning and end of the track, because between jpg 28 and 41 there are 13 intervals each of 4.54 microns.

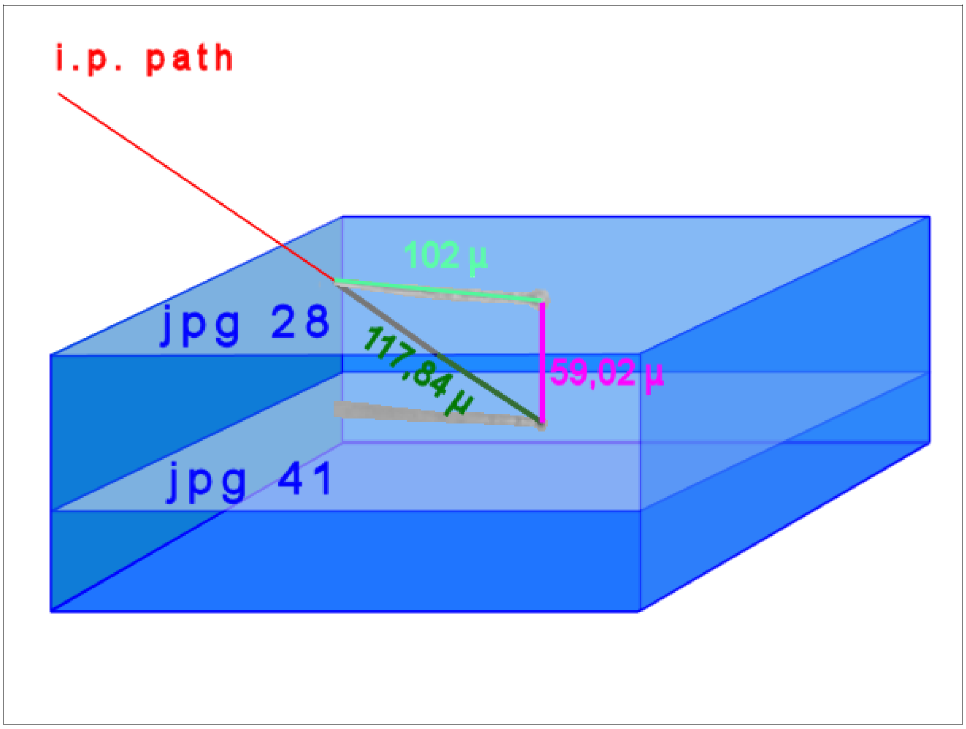
At this point we have all the elements we need:

1. the length of the track on the plan amounted to 102 μ;
2. the difference in depth between the mouth and the bulb amounted to 59.02 μ.

According to the precepts of a dear friend of us, unfortunately disappeared (2498 years ago!), the length of track is equivalent to 117.84 μ.

The method used is showed in the next img.23.

img.23



As mentioned above, this method is not correct and the extent of about 118 μ is very approximate.

This is not only for the method used, but also for a number of other considerations.
For example: a more precisely focusing of the beginning may stay between the jpg 27 and 28 and that of the end between the jpg 41 and 42. This could add to the length found an additional amount of about 10 μ.

However, even if inaccurate, this method is able to indicate the order of magnitude of the track that we are observing.

5.3 The other face of the Blue Bar

The real reason why we have dwelt on the trivial exercise is certainly not for its usefulness (very close to zero), but because it has helped us to consider the blue bar not only as our unique tool for focusing the movies, but also as **"the place of ordered sections that cut the aerogel at predefined and constant intervals"**.

Therefore it is able to tell us the quantity of jpgs in which an object is always in focus and consequently the length of this object.

This observation may, in most cases, help us to determine whether we are observing a track or a grain or an inclusion.

A small grain of dust lying on the surface, in a movie composed of 45 jpgs, may ultimately not have an exact representation of his point of focus, because, apart from the lucky case in wich the plane of one of the jpgs fully cut it , its point of focus will be in a position variable between ± 4.54 μ related to the jpg that represents the best focus.

Certainly in the previous and in the subsequent jpg the grain will go out of focus (img.11a) but it could also disappear completely if at that point there was a minor aerogel transparency, due, for example, to a non-perfect lighting.

5.4 The persistence of the track

Thanks to aerogel transparency we can follow the focusing of a feature.

Thus a track can be identified long before it is in focus. And after, its shadow, will be visible out of focus in various other jpgs below.

Ultimately we can say that a track may be detectable thanks to the number of its projections along a substantial part of the blue bar.

This also applies to the shorter tracks.

Let's consider the movie 9471219V1 made up only by 35 jpgs . The surface is in focus over ¾ of the blue bar (very low) at jpg 31.

It contains the track (discovered by magickestrel) that is just 20 μ long, and until now remains one of the shorter track identified.

It has its point of maximum focus at jpgs 34-35. However we can appreciate its projections (out of focus) from the beginning of the blue bar (jpg 1). As consequence, the track is present throughout the entire blue bar.

Thus, it seems possible to assume the "persistence of the track" as a key element to recognize a track.

Moreover, this phenomenon of the persistence of the track has been represented, with varying degrees of intensity, in almost all the calibration movies that the “Stardust@home Team” submitted to us.

6 CALIBRATION MOVIES

Joy and sorrow of all dusters, the Calibration Movies (CM) give us those points so much desidered for rising in rankig. The CM are a fifth of the images submitted to us.

On average thery are a hundred every 600 movies.
They can be: with track and without tracks (blanks).

But I want to focus on another aspect of CM.

They represent the most important source of information that we have in our research.
Much of the tutorial itself.

When we fall in a CM with track (when we see a track at 99.99% is a CM) and we get the related point, I suggest to return back to CM.
Let 's watch other forms present in the movie, their difference in behaviour in relation to track, their different way of developing, their different way of going in and out of focus.

I do not think that in the end we have lost time in watching very carefully the CM.
Indeed we have acquired a wealth of knowledge that will increase our speed of judgement and will prevent us to report as track any other feature.

7 CONCLUSIONS

The basic rules

Rule # 1: a track never goes in focus in the above surface.

Rule # 2: a track never goes in focus on the surface.

Rule # 3: a track goes in focus only in the below surface.

Rule # 4: a track shows always a remarkable persistence.

Rule # 5: the beginning and the end of a h.a.t. have their focus on different levels.

Rule # 6: the end (the bulb) of a h.a.t. can not have the focus on the surface.

8 ACKNOWLEDGEMENTS

This is only a sort of my notes.

I wish to dedicate it to those who start now or to have just started their activities like "duster", hoping to shorten their learning and provide some answers to simple questions.

A grateful thanks to my dear friend Andrea Tsanos, for his useful contradictory;
and to my dear friend Rosa Serio, without her help this work would never have seen the light.

A special thanks to Dr. A. J. Westphal, for the patience that he had towards me, for his fundamental suggestions, and for the friendly encouragement to put this script in our forum.

"I am sure that I found many tracks, but I am even more sure that with particles, which have produced the tracks that I have not found, one could assemble an entire planet."

McAngus

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10 APPENDIX

A small set

Below is a series of features that should not be mistaken for tracks.
They are all reported from CM with track.
The red squares show the focus of the surface.