

RESPONSE TO THE REVIEWERS (MANUSCRIPT [14])

Thank you for your reviews, remarks and suggestions. Here is my response about what I changed in the manuscript, and what I left as before.

Reviewer 1:

1. **Fresnel's equations.** I added Fresnel's equations (formulas) in the manuscript, in the section Theory, in the third paragraph, along with the explanations of the variables used.

I reformulated all the strange phrases and I wrote about Fresnel's equations more clearly. I reformulated the third paragraph in Theory, explained reflection and refraction and the ratio of intensities all over again, to make it more clear. I added a new picture and a graph for easier understanding of the text. I also reformulated the last paragraphs in Experiment and Results, to avoid strange phrases mentioned by the reviewer.

2. **Angles.** In the section Theory, third paragraph, I added a new picture showing the connection between the angles relevant for our calculations (for this part of the problem). On the old pictures, I improved symbols of angles and the other parameters. All the angles important for this problem were derived using Snell's law, Snell's law for total internal reflection and simple trigonometrical relations. I think it is unnecessary to write it all in the text because it is not complicated and I did my best to describe it as simply as possible, so that it can be easily understandable.

3. **Critical angle.** In Results, in the second paragraph, I added the calculated and experimentally obtained values of critical observing angle.

4. **Indices of refraction.** Indeed, on the graph there are only 4 values of indices of refraction. The final value differed too much from the other indices so I left it out since it is allowed to do it if one value is very different from the others. I deleted the index number 5 from the table and left the graph with 4 values in the manuscript.

5. **Introduction.** I reformulated Introduction by replacing second and the third paragraph. At first that order seemed to me like a natural one, but now I think that replacing the paragraphs is a good idea and that it is actually more logical to read it in the new order.

Conclusion. I do not prefer writing conclusions in points. I also really believe that the conclusion is written in good order and that the sentences in Conclusion follow the flow of the experiments done. This is why I apologize for not accepting your suggestion and not changing Conclusion.

Reviewer 2:

The quality of pictures. There were some problems with transferring the Word document into Pdf version. It can also happen that, if read in Word, all the pictures seem messed up and added symbols and lines appear on completely wrong place. Luckily, this problem does not exist in Pdf version. Also, after the first manuscript was sent, I already made some corrections and the new Pdf version is be much more readable and the pictures are good.

Names of the angles. Indeed, it can be complicated to keep track of all the angles mentioned in the problem. Unfortunately, I have to mention all of them since they are important for the occurrence of fingerprint pattern on the glass. I corrected the symbols for the angles and made them more consistent. There is no two different angles with the same name in the paper anymore. Also, α_{CL} was used as proposed by the reviewer.

Readability of the equations.

Critical index $n_c = \sqrt{2}$. Indeed, this is a very interesting condition and it seems that a nonsense is obtained if index has a greater value. Well, what actually happens for the greater indices is not that shocking. This condition was tested using vegetable oil instead of the water, since the oil has index $n_{OIL} \approx 1.47$ (<http://physics.info/refraction/>). In this case, critical angles simply do not exists! For the first formula ($\sin \alpha_{ic} = \sqrt{n_L^2 - 1}$), the light will always be totally reflected in liquid-air interface and will never get to the observers eye. And for the second formula ($\cos \alpha_0 = \sqrt{n_L^2 - 1}$), if a too high index is used, the observer will always see fingerprint pattern, there will be no critical angle under which a whole finger would be observed. This was experimentally examined and the experiment matches the theoretical predictions. But unfortunately, we were not able to record this with the camera and make proves of theoretical expectations (The fingerprint pattern is not that perfectly seen as when there is water in the glass, because the oil is blurred). Since I do not have any pictures, I did not even mentioned it in my paper. I do not think people would appreciate if I wrote "Trust me, I have seen it, although I have no pictures to prove it". Indeed, a physical interpretation of this is really interesting, and I am glad you mentioned it. I am sorry I did not put it in my paper, but once again, I do not think that writing without "proves" is good.

Relation between α_0 to H,L and D. The formula derived for α_0 only has a theoretical meaning for us, i.e. for a given index of refraction of liquid we can say what should be the critical observing angle, but we can not confirm it with measurements, except if we do not relate α_0 to H,L and D. Thus, the other part of the α_0 determination is connected to experimental approach. And that is important because we can later compare the experimental results with the theoretical values. And this comparison is crucial for validating the theory.

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Index of refraction measurements. I made a correction and quoted the refractive indices and uncertainties in more consistent manner. This experiment is simple and common and I explained how it was done. What I had to measure were the lengths of the "rays" drawn on the paper underneath the vessel. I used a big paper and measured great lengths in order to minimize the error as much as possible, since the results are very similar. Although it is generally easy to do this experiment, it has to be done really precisely in order to obtain such small errors, which I did, and later suffered from headaches and eye-pain, but it was worth it.

The slope of the graph. Although it may seem as a significant error when talking about theoretical slope 1 and experimental slope 1.3, that is actually not such a huge error. The point is in the fact that this error was determined for square cosine of the angles. When we calculate the values of the angles, we can see that the differences are small, the order of magnitude 1° . I mentioned this in the second paragraph in section Results, to make it more clear how the theoretical critical angle and experimental one differ. Talking about theoretical angle and experimental angle, the error is not that big and I think that the agreement between theoretical approach and the experiment is satisfactory.

Nature of fingerprints. The phenomenon was studied in a way it made it possible to determine when and why the fingerprint pattern will be seen. Total internal reflection obviously plays a very important role here and that is why it was more geometrically studied and the geometrical experiment was made to validate the theory. The nature of finger is very important in this phenomenon and was explained in Introduction, paragraph 2, and Theory, paragraph 2. The relief structure is important for the occurrence of optical tunneling. The order of magnitude of the grooves was explored on the articles online (10^{-4}m). The order of magnitude of the distance between the ridges and the glass (10^{-7}m) is speculative, but that is not extremely important for our problem. It was taken to be 10^{-7}m as a general situation, if the ridges and the glass do not touch. But, since there always something exists between the finger and the glass (grease, sweat), we can basically say that the ridges and the glass are actually connected. In this case, we do not have the phenomenon of optical tunneling, but the ordinary refraction from glass to grease and then to ridge, where the light gets scattered and reemitted, which is basically the same thing that happens if the optical tunneling occurs. Thus, optical tunneling is the general explanation, in perfect conditions with small amount of liquid on the fingers. In real life, the ridges and the glass are even better connected than just by 10^{-7}m distance, there is grease, sweat between them, that makes the light passes through the glass even easier, while on the grooves it gets totally reflected.

Editorial request

I corrected the list of references and added the volumes and journals where they were missing. I also put in the manuscript which reference is cited in which part of the work.