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The Fizeau Experiment

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According to the reference paper (see reference (3) at the end of this paper for a URL) the phase shift seen in the Fizeau experiment is due to two effects occurring simultaneously:

(1) Different optical path lengths due to the moving water.

(2) Two waves of unequal wavelength entering a tube in phase will arrive at the end of the tube out of phase.

But I think their analysis & maths is wrong. I calculate it like this:

The fringe shift is caused only by the travel time difference between the two paths, due to the upstream path length being longer that the downstream path length. However, the amount it is delayed is not by the speed of the water (v), but by a fraction of it's speed (v'), determined by the Fresnel dragging coefficient:

$$v' = v\left(1 - \frac{1}{n^2}\right) \qquad (1)$$

The reason for this dragging coefficient is explained in my paper titled "Fresnel Dragging Explained" (see reference (1) at the end of this paper).

$$c_n = \frac{c}{n} \qquad (2)$$

$$t_1 = \frac{2L + v't_1}{c_n} \qquad (3a) \qquad t_2 = \frac{2L - v't_2}{c_n} \qquad (4a)$$

$$c_n t_1 - v' t_1 = 2L \qquad (3b) \qquad c_n t_2 + v' t_2 = 2L \qquad (4b)$$

$$t_1 = \frac{2L}{c_n - v'} \qquad (3c) \qquad t_2 = \frac{2L}{c_n + v'} \qquad (4c)$$

$$\Delta t = t_1 - t_2 = \frac{2L}{c_n - v'} - \frac{2L}{c_n + v'} = 2L\frac{c_n + v' - c_n + v'}{c_n^2 - v'^2} = \frac{4v'L}{c_n^2 - v'^2} = \frac{4v'L}{\frac{c^2}{n^2} - v'^2} \quad (5)$$

$$\delta = \frac{c\Delta t}{\lambda_0} = \frac{4cv'L}{\lambda_0\left(\frac{c^2}{n^2} - v'^2\right)} \quad (6)$$

Conclusion

The resultant fringe shift (in number of wavecrests) is:

Using the same parameters as used in the original experiment:

$c = 299792458$	metres/sec
$n = 1.333$	
$v = 7.069$	metres/sec
$L = 1.487$	metres
$\lambda_0 = 526\times10^{-9}$	meters

Gives a result of:

$$\delta = 0.207148344452753660440929288064 76 \quad (7)$$

This fringe shift is approximately the average value obtained from the Fizeau and Michelson-Morley experiments.

See my paper titled “Fresnel Dragging Explained” (see reference (1) at the end of this paper) for a detailed explanation of the Fresnel dragging coefficient.

Additional notes:

I think of light as a disturbance in the field of energy that is comprised of charged particles - so at any point in space there is a sum of energy due to all charged particles, both near and far, with the nearby ones contributing a greater wave amplitude than the far away ones.

Therefore there is an energy field due to charged particles in the vacuum (from all of the stars etc) and an energy field in the water due to all the electrons/protons in the water.

Light is a wave supported by the sum of these two energy fields.

In the Fizeau experiment, when the fields are summed (including their velocities), the local field is strongest when the wave disturbance is within the water molecules themselves, and so the wave disturbance is dragged with the water molecules. However, in the space

between the molecules, where the force is transmitted between molecules (thereby passing on the wave disturbance), the background field is strongest & so the wave travels with respect to the background field rather than the moving water. All of the complications about the details of the absorption & re-emission processes as the light enters & exits the molecules are included in the refractive index factor n.

Another idea I had to explain the result was having two distinct component waves, one that travels through the space field at c, and the other that travels with full convection trough the water field - with the outcome being the sum of these two waves. However, I don't think this can be correct, as one wave would emerge from the water before the other, and the summed waves would travel through the water not as a simple sine wave, but as a composite of two sine waves of different frequencies (neither effect is observed).

Note: The original historical idea of aether dragging explaining the result is not correct, as the effect is explained by conventional means. However, there would be a very slight ether dragging effect due to the "Frame Dragging" due to the gravitational potential of the water's mass, but this would be too small an effect to be detected in the experiment.

References

(1) "Fresnel Dragging Explained"
2008, Declan Traill
http://www.wbabin.net/traill/traill14.pdf

(2) "Relatively Simple? An Introduction to Energy Field Theory"
2001, Declan Traill
http://www.wbabin.net/traill/traill.pdf

(3) http://renshaw.teleinc.com/papers/rs98fi1/rs98fi1.stm