The experiment of Fizeau

Fresnel introduced the drag factor to explain or rather to compensate for the fact, that the earth seemed to be at rest in the ether. Obviously they were looking for proof of the absolute ether. If there was no ether it would be inexplicable how light, fields and forces like gravity, electrostatic and magnetic fields could be propagated through space. The urge to prove the existence of the absolute ether was imminent. Without the ether, physical characteristics like the transportation of light in vacuum, became inconceivable and mysterious. Proving the existence of Fresnel's drag factor was necessary. Demonstrating the drag factor was not easy because of the extreme velocity of the speed of light with approx. 300,000 km/s.

In 1851 Fizeau devised an experiment with unknown accuracy that was able to measure Fresnel's assumed drag factor.

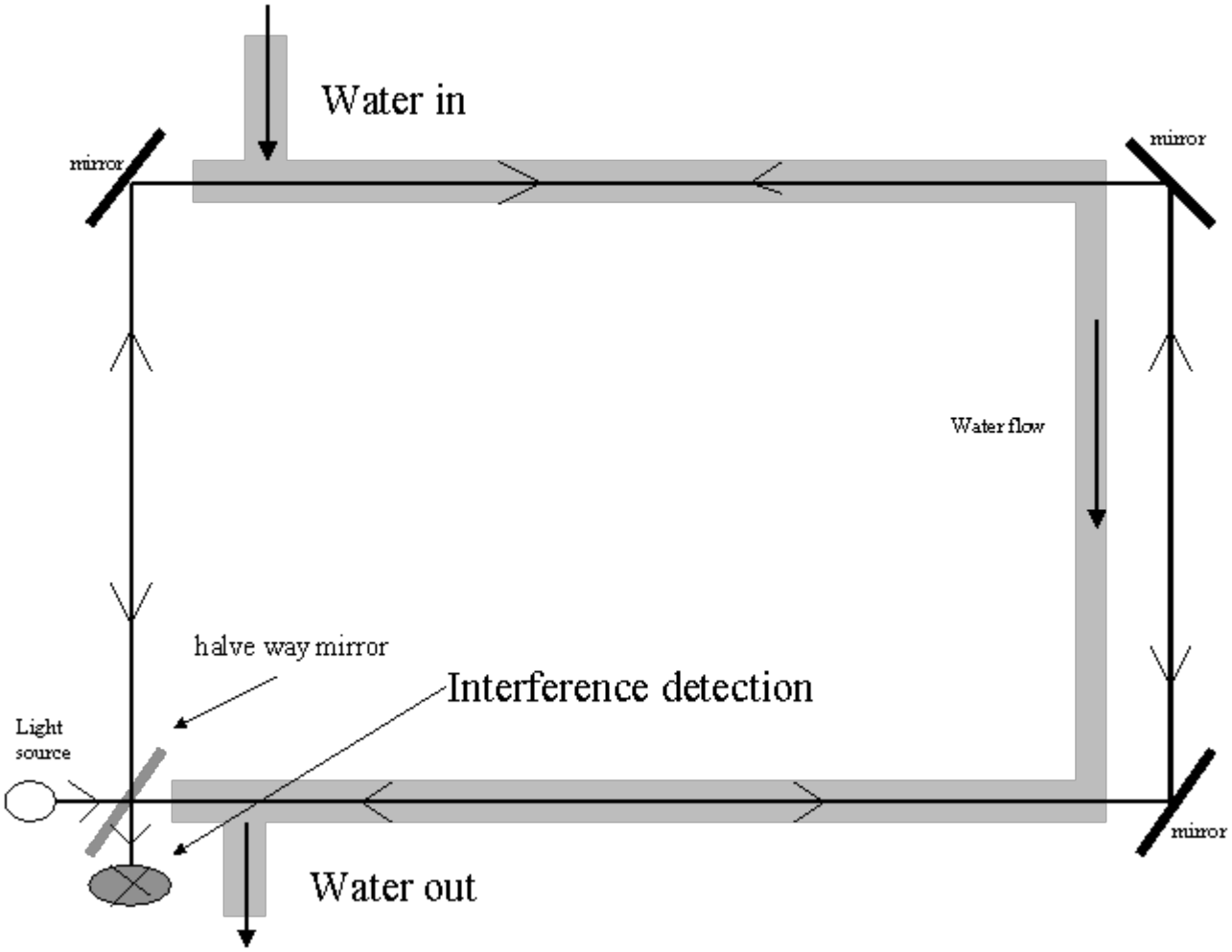

Figure 6. The experiment of Fizeau.

The light of source is divided up into two beams. One beam goes with the flow of water and the other beam against the flow. When the light in the water is dragged the light traveling against the water flow will need more time to travel through the tubes than if the light goes with the flow. This is comparable with the time difference a swimmer needs to swim with or against the current. The difficulty here is that the speed of the "swimmer" is so high that it takes him only 1/100,000,000 of a second to finish. The difference between with or against the flow is even much smaller.

Light is vibration with a very short wavelength. Vibrations are able to fortify or tone down each other when they meet. The difference between extinguishing and fortifying, a bright and a dark line in the interference pattern, is about 1/40 of a millionth of a meter. The interference of light is characterized by bright and dark stripes: the interference lines. The whole picture of dark and light stripes is called the interference pattern.

The experiment of Fizeau is called an optical interferometer and was devised to measure very small differences in time or distance. The drag coefficient of Fresnel, $1 - (1/n^2)$ (where n is the index of diffraction of a transparent medium, believed by Fresnel to be the ratio of the velocity with which ether was dragged along in the medium to the velocity of the medium itself.) **,** implies in the experiment of Fizeau a drag of interference lines.

(λ the wavelength of the light, v the flow speed of the water and L the length). Fizeau registered during his experiment a shift of δ=0.23 interference lines; which implicates a drag factor f=0.48; the empirical value. The theoretical value of the drag factor is calculated from and is f=0.43. **So within an error of approx. 10%, the experiment of Fizeau confirmed Fresnel's drag factor**.

When we consider the experiment of Fizeau in the light of a vacuum containing dragged ether the following physics should be expected. The ether in the water molecules is most under influence by the Oxygen en Hydrogen atoms. Although the Moon and Sun have gravity influences these effects are small compared to the effects of the magnetic- and electric fields in the water molecules.

When the water moves in Fizeau's experiment the ether between the water molecules is dragged by the water. Light travels through the moving water as if the water were at rest. For the observer at rest with the water it is not the water that moves but the laboratory of Fizeau.

This is also the case for light traveling through the water when dragged ether is assumed. The speed of light in water is c/n: the speed of light divided by index of water. The light in the water

has no conception of the movement of the water. The ether moves through the water as if the water stand still and the laboratory were moving. The ether is under the influence of the water and therefore moves like the water. The light has no idea whether it moves against or with the current. Only for the observer outside the water in rest with the laboratory there is movement of water.

Assuming the presence of dragged ether, light traveling in the direction of the water has a distance to overcome *L* minus the distance the water is traveling during this time. And reversed, against the direction of the water, the path through the water is comparably longer.

Calculating the theoretical drag in this way one calculates a "drag" of:

$$\delta = 2n^2 vL/(\lambda c)$$

The theoretical shift in interference lines is calculated at δ=0.23; exact the value measured by Fizeau. The experiment of Fizeau matches perfectly with the theoretical assumption of dragged ether.

The measurements of Fizeau

The dimensions of the Fizeau experiment are:

L=1.5 m *v*=7 m/sec λ=5.310^-7 m *n*=1.33 $f = 1 - 1/n^2$ *c*=299792458 m/sec

With *L* the length, *n* the index for water, λ the wavelength of the light, *v* the current speed, *f* the drag factor of Fresnel and *c* the speed of light. The calculated time difference with Fresnel's drag factor is:

$$\Delta t = 2L/(c/n - fv) - 2L/(c/n + fv)$$

Because $c^2 \rhd\rhd v^2(n^2 - 1)$ we find approximately:

$$\Delta t = 4n^2 fvL/c^2$$

The optical difference in interference lines is:

$$\delta = 4n^2 fvL/\lambda c$$

According to Fresnel's theory the drag factor is f=0.435 and therefore the theoretical shift lines has to be δ=0.203.

The measured values by Fizeau are: f=0.48 δ=0.23

The difference between the theoretical and the measured value is 10%.

When we determine the theoretical values according to the existence of dragged ether, the path decreases/increases in accordance with the distance the water is flowing during the time the light travels through the water. We derive the equations:

$$t_1 = (L - vL/(c/n))/(c/n) \qquad t_2 = (L + vL/(c/n))/(c/n) \qquad \Delta t = 2Ln^2 v/c^2$$

The first formula *t1* gives the time the light needs to travel through the water with the current. The time needed for going against the flow is given by formula *t2*. The theoretical difference in interference lines is then calculated at:

$$\delta = 2Ln^2 v/c\lambda \qquad \delta=0.23$$

The theoretical shift with dragged ether and the experiment of Fizeau is a perfect match with the measured values. **The experiment of Fizeau becomes therefore strong empirical evidence for dragged ether.**