One-way-Light speed measurement

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A simple and cheap device is used to check whether the light propagates at the same speed in all directions.
It remains to be hoped that the astonishing measurement result is based on a measurement error.

I. Introduction

The constancy of the speed of light is a fundament of modern physics and should therefore always be verified again.

The measurement is usually done by runtime sum of an outward and return path. However, different light velocities could compensate each other and pretend a constant average light velocity.

The desire for a robust "one-way" measurement [1] inspired this work.

The solution is simple. Two parallel laser beams of different lengths are interfered with each other.

A 0.3m -wave train consists of:

a = 500,000.0 oscillations.

A 0.6 mm longer wave train has:

b = 501,000.0 oscillations.

Both waves interfere constructively.

A change of the speed of light by only 0.05% (= 150 km/s) causes the following numbers of oscillations:

a = 500.250,0

b = 501.250,5

Both wave trains interfere destructively

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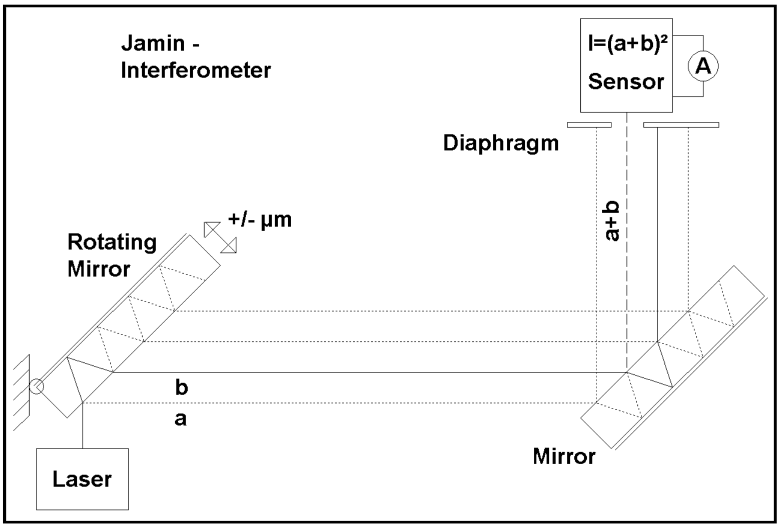
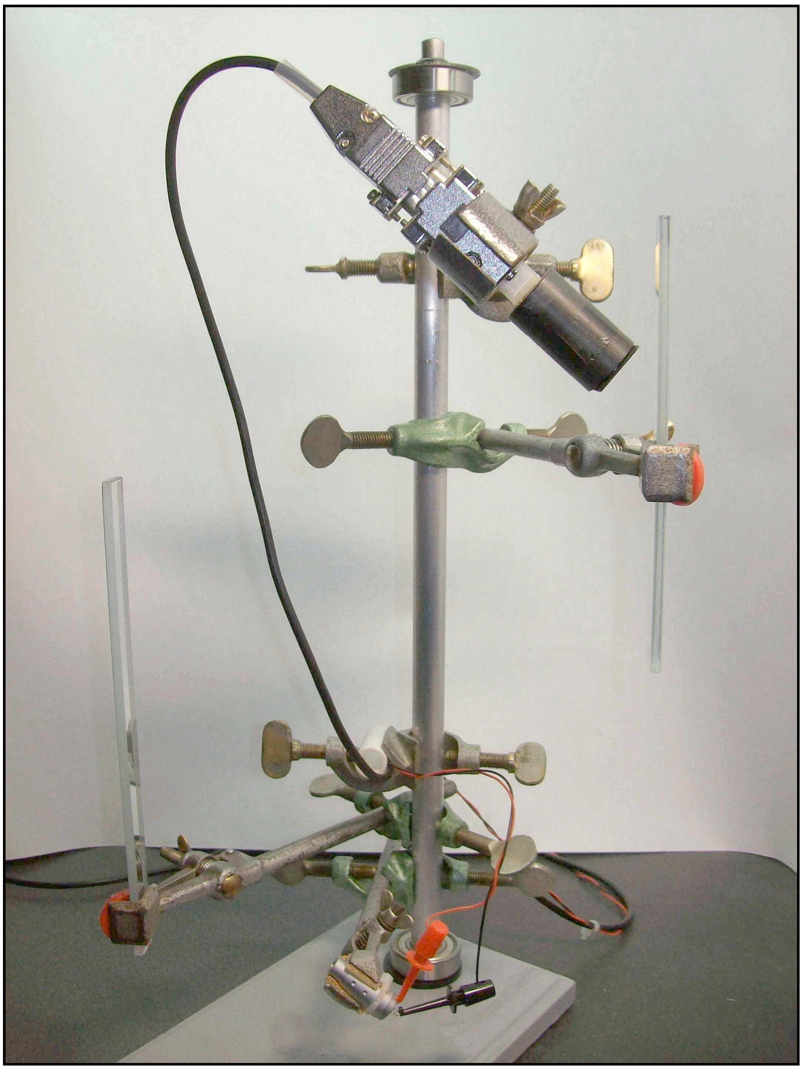
II. Setup



The Jamin interferometer consists of two mirrors, a laser pointer and a photodiode with a diaphragm.

The distance between both mirrors is 0.3 m. Both mirrors were adjusted for best possible parallelism, which never quite succeeds. 600 µm was assumed as error.

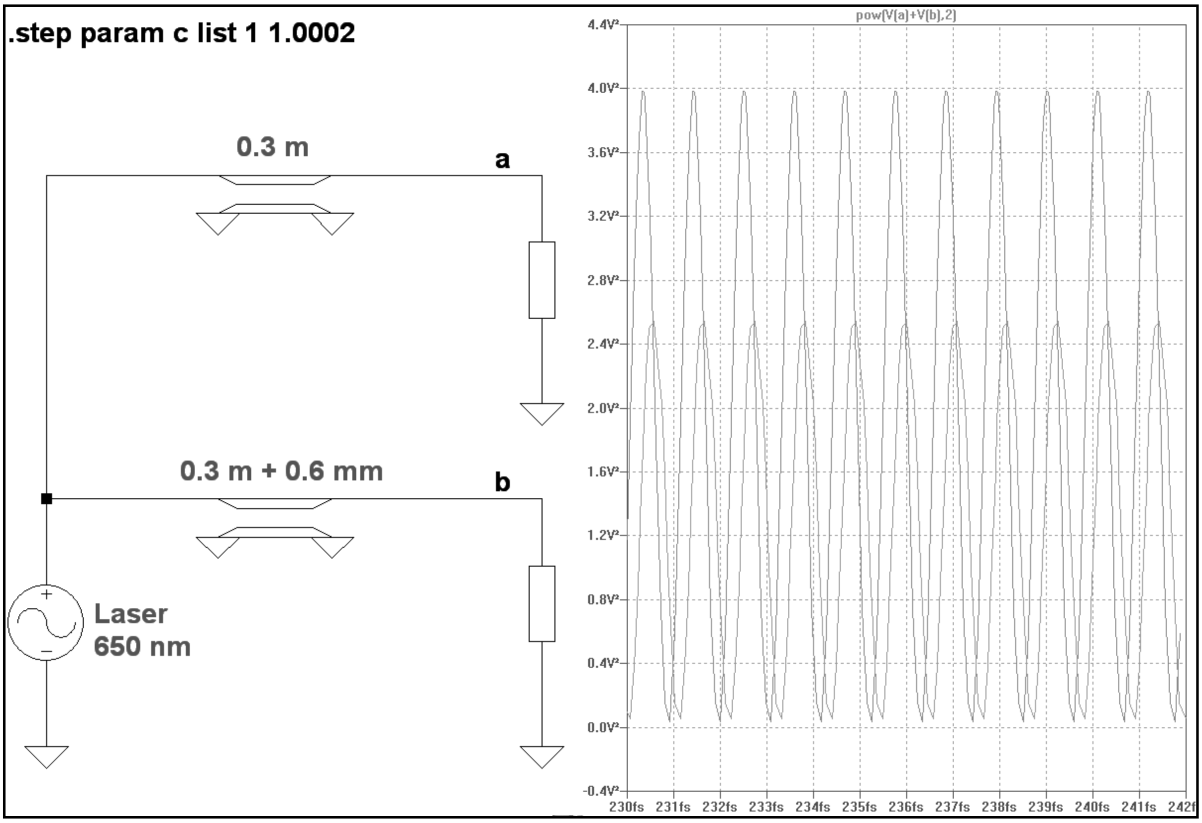


For practical reasons, the beam path was arranged diagonally and the whole very robust interferometer was designed to rotate 360°.

The 650 nm laser light falls diagonally on the first mirror from below, is split there into the "a" and "b" beams, and then superimposes in the second mirror to form the output beam, whose intensity is measured.

Note: Since we are working close to the Brewster angle, the laser must be rotated so that its polarization matches the mirror surfaces.

An LTSpice simulation of the instrument confirms the correctness of the preliminary considerations:

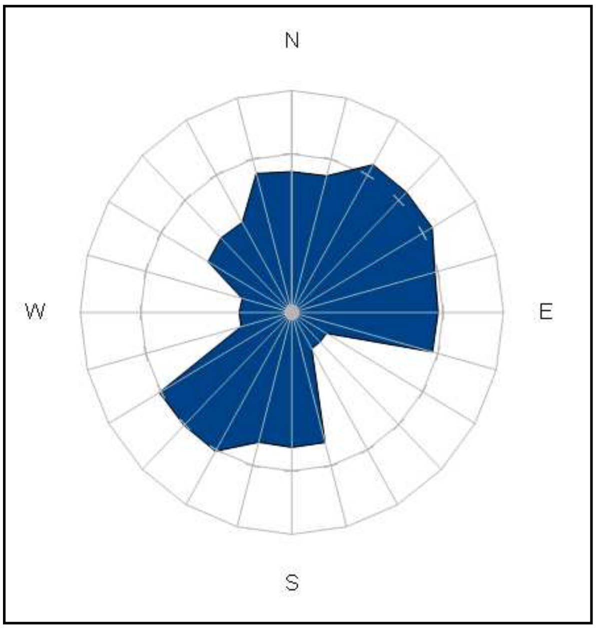


A small change of 0.02% (= 60 km/s) of the speed of light for both wave trains "a" and "b" (simulated as travel time distances) halves the light intensity measurable at the output.

III. Result

Because of the constancy of the speed of light, a constant output brightness was expected in all cardinal directions.

The actual measurement result, on the other hand, is astonishing! There are two significant anomalies. In western direction and in southeastern direction. For clarification represented as a circle diagram.



IV. Discussion

Measurement errors (e.g. due to the earth's magnetic field or other EM influences) were checked to the best of our knowledge. A pulse measurement technique was used to evaluate the photodiode current, which is even more precise than a lockin amplifier with respect to interference and laser instabilities. The Jamin principle places very low demands on the coherence length of the laser.

The rotating device would be equipped with ball bearings and tested at different angles of inclination. Always the same diagram resulted, whereby with "anomaly" however not always the range of lowest brightness must be meant. The displayed brightness is not proportional to the speed of the light. It is only a relative measurement. Equal brightnesses show that there are equal velocities of light. Unequal brightnesses only say that unequal light velocities exist there. A micrometer screw, which was mounted at the beginning, could therefore be omitted.

Nevertheless, a measurement error must have occurred somewhere. If the result were correct, the consequences would be unimaginable.

[1] Gabriel-Claudiu Grama, Measuring the One-Way Speed of Light https://vixra.org/abs/2112.0068