# Sagnac(1913) completed by Dufour & Prunier(1942)

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**Abstract**

The 1913 Sagnac test proved to be a critical experiment that refuted Special Relativity (as Sagnac intended) and supported a model of aether that could be entrained like material fluids. But it also generated more questions, such as:

What is the Speed of Light(SoL) in the lab frame?

What if the optical components of the interferometer were moving relative to each other..some in the lab frame, some in the rotor frame…testing the emission model of light transmission?

What if the half beams were directed above the plane of the rotor?

All these questions were answered in an extension of the Sagnac test done

29 years after the SagnacX by D&P.

An analytic review of

**On a Fringe Movement Registered on a Platform in Uniform Motion (1942)**. Dufour and F. Prunier J. de Physique. Radium 3 , 9 (1942) P 153-162

On a Fringe Movement Registered on a Platform in Uniform Motion (1942).

## A Review

> .. we used an **optical circuit entirely fixed to the rotating platform, as did Sagnac**. Under these same conditions we found that the movement of fringes observed are similar within 6%, whether the light source and photographic receiver be dragged in the rotation of the platform, as in the experiments of Sagnac, or **they remain fixed in the laboratory**.

Sagnac and D&P both found SoL = c +- v in the rotor frame.

D&P found SoL = c +- v also, in the lab frame (optical bench at rest, empty platform spinning below it)

This alone disproves Special Relativity, as SoL <> c

The second series of experiments described here was aimed to explore the fringe displacement due to rotation, in entirely new conditions where the optical circuit of the two superimposed interfering beams is composed of **two parts in series**, **one of which remains fixed in relation to the laboratory while the other is attached to the rotating platform**. Moving fringes, obtained under these new conditions, were the same one that allows for the classical Galilean theory.

The frame is determined by the location of the detector(film). So parts of the optical system were in relative motion…yet the same result was seen…

SoL = c +- rω = c +- v

This alone rejects the Ritz emission model, since the last reflection before the detector would determine SoL. But it doesn't; SoL is always Galilean, as above.

## I. -- Experiments in which the Optical circuit is entirely supported on a Rotary platform.

1. Preliminary experiments. – …we first of all have repeated the experience of Sagnac [1] in which all the optical apparatus is moving with the disk in uniform rotation. We used the same mirrors as Sagnac in his experiment, but the platform was twice as large as his. …. This material arrangement has remained the same for all experiments that will be discussed here. Figure 1 gives the layout of optical apparatus straddling the entire disc and used in these preliminary tests. It is close to identical to that of Sagnac and does nothing original.

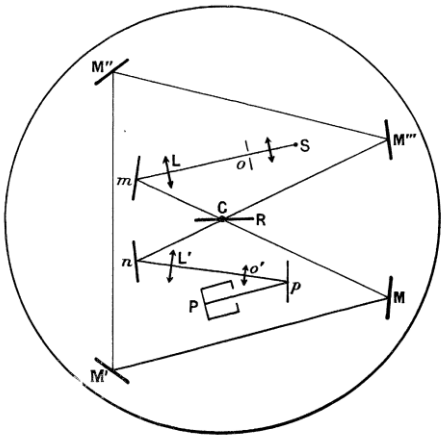


Fig. 1.

In spite of some imperfections, the significance of the results obtained remains whole here from the qualitative point of view. Moreover, even from the quantitative point of view, the greatest variations of the numerical results of even one series of recordings never exceeded 13 per 100 of the median value.

## 2. **Experiments made with a source of light remaining fixed in the laboratory.**

The first question that we considered was to determine if **the movement of the source that creates the light is essential to the production of the phenomenon.** We then constructed the apparatus as shown in figure 2.

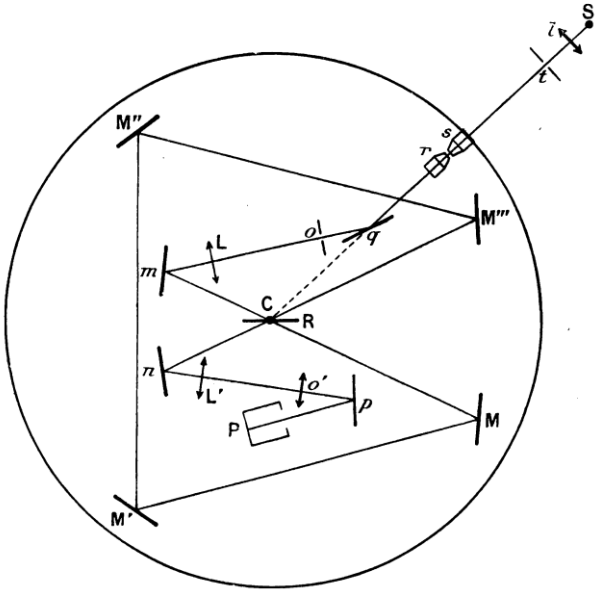


Fig. 2.

The characteristics of this assembly are to use the light of a fixed source in the laboratory and to **send this light on the optical courses fixed to the platform in rotation**. … the light resulting from the source S will traverse the lens l, the diaphragm t and the microscope objective s, **all these bodies being maintained fixed to the laboratory**. Another microscope objective r identical to the first, is fixed to the revolving platform

The recordings which we carried out thus show **a net shift of the fringes completely comparable with that provided by the traditional assembly of Sagnac.**

That is, SoL = c +- v

It is seen that to 5 or 6 per 100 precision, **the average shift observed is of the same value here than that obtained above with the ordinary assembly of Sagnac**.

…. these last experiments show that it is possible to practically use the light emitted by a **source not belonging to the mobile disc system**, …. **for an induced observer in rotation.**

## 3. Experiments made by using a source and a photographic recorder remaining fixed in the laboratory.

One could ask whether the interferential phenomenon remains **the same as for the observer fixed in rotation and for an observer maintained fixed in the laboratory frame?** To carry out this study, the device represented schematically in figure 2 underwent the following modifications: the mirror p was removed, the objective lenses L` and the eyepiece o' as well as the photographic chamber P were removed from the platform and fixed to a support motionless with the wall of the laboratory. In this arrangement, the source of light and the observer operating the photography of the fringes with the lenses and photographic chamber, are both fixed in the laboratory. … the fringes obtained on the photographic plate underwent a light modification because the lens and plate are motionless, while the interferometer is turning.

The average of the two values for opposite rotations is 0.091 of the distance between interference fringes, differing only from 3 to 4 /100 of the number obtained previously if the source of light were fixed in the laboratory.

SoL = c +- v  does remain the same , with 3 or 4% error

## I I. - Experiments in the which optical circuit includes, in series, a fixed part in the laboratory and, a part pulled by the platform in rotation.

2. Device actually used. – Fig 6

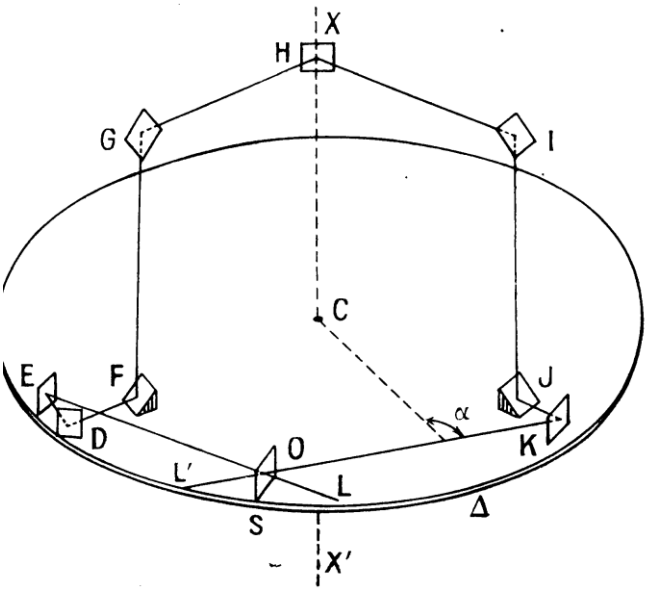


Fig. 6.

The preceding disadvantages resulted owing to the fact that the two interfering beams followed distinct paths. They disappeared when we obliged the two beams to follow the same course in opposite directions. Figure 6 gives, in perspective, the diagram of the apparatus construction which was useful to us. …. 8 Mirrors G, H, I remain fixed in the laboratory. the source (not drawn), is fixed in the laboratory.

Note that the 2 half-beams reflect to 20 cm above the rotor and then travel 2 radii….

## 3. Experimental results. –

…These experiments highlight the existence, under these conditions, of a shift of the fringes of approximately 0.056 distance between interference fringes in white light, for the two directions of rotation and an angular speed of 1 turn/second. ….. **the phenomenon is beyond doubt** and its **cause must be sought in the influence of the number of revolutions of the platform on the propagation of light**, using the various possible interpretations. That is what we are going to consider now.

## III. - Interpretation of the experimental results.

Classical Galilean theory supposes that for the observer linked (fixed) to the disc, the speed of the light in a point of the revolving disc differs from the speed C of the light in the laboratory, in a quantity equal to + /- v, if v represents in value the absolute projection of the linear velocity of the disk at the point considered on the platform.

That is, SoL = c +- v

Part of the optical circuit is fixed to the revolving disc, the other part of the optical circuit remains fixed compared to the laboratory. Under these conditions, which are those of our experiments, the shift of the fringes is due obviously to the optical course fixed to the revolving disc. We will calculate the values which return to us according to the two theories, classical and relativity. …

The relativistic value is approximately ten times smaller. The relativistic theory thus seems to be in complete dissention with the classical theory and also with the result provided by this experiment.

## Summary of D&P test

*'We have shown (1) that the experiment provides the same result for the Sagnac effect, whether the observer is entrained or not by the disc. The interpretation of this result appeared to us to present difficulties in relativistic theory.' D&P*

When rotor is at rest in lab frame: SoL = c in both reference frames

When rotor moves at v in lab frame: SoL = c +- v in both reference frames

Special Relativity is disproven

Emission theory is disproven.

Aether entrainment(full dragging) is supported

Galilean relativity is supported….conditionally!

Consider the lab frame results with CW platform rotation and the CW half beam that produces SoL = c + v.

If the rotor drags the surrounding aether at its speed v, then Galilean addition predicts SoL = c + v , as measured. This was Sagnac's insight.

**Sagnac's test interpretation** in '*quotes*'

> The interference of light in a rotating interferometer of a special kind proves to depend on the rotation (with respect to an inertial frame). Sagnac announced this result as a proof of the existence of the ether. Although there still were, in 1913, many physicists to welcome such a claim, the increasingly powerful adepts of relativity theory brushed it away. The Sagnac experiment soon became a textbook classic, and experts in relativity theory felt compelled to explain it both in special and in general relativity. Numerous variants of the experiment have been performed from the interwar period to these days. Interest in the Sagnac effect grew enormously when laser technology turned it into an efficient gyroscopic device.

The inertial frame for measuring rotation must be the ECEF or lab frame, as the ALFA theory proves.

> *'I showed that an interferometer using a closed optical path enclosing a given area and rotating in the plane of the path, detects the movement of the system relative to the* ***ether*** *in space.'*

Relative motion of aether and optical system does not mean that aether is fixed, but that the system could be fixed and the aether in motion (fluid aether/ALFA model)

> *'The outcome of these measurements shows that in ambient space, light propagates with speed Vo independent of the motion of the apparatus, the light source and the optical system. This property of space describes the luminiferous ether experimentally.'*

'*This is the experimental proof of* the whirling relative ether wind *that the rotating system creates through its motion.'*

Modern description would call this an 'aether vortex'.

'*In Fresnel's hypothesis of the ether, the half beams CW and CCW to rotation propagate in the ether with a speed Vo independent of the motion of the interferometer. The phase of the CCW beam gives, according to the expression C λVo , a lag x in the phase of the CCW beam , and advances by the same amount the phase of the CW beam propagating in the reverse direction.'*

The Sagnac effect shows the light beams are independent of the motion of the system components…but NOT of the aether motion.

*'We may describe luminous phenomena without mentioning the ether. But that is not a satisfactory description. . . . It does not give the satisfaction we feel by eliminating direct action at a distance. '*

Sagnac's interpretation makes physics local, s the aether and platform motion interact; no action at a distance

*"The observed interferential effect proves to be the optical whirling effect caused by the motion of the system with respect to the ether, and it directly manifests the existence of the ether, necessary carrier of the luminous waves of Huygens and Fresnel."*

In the new experiment, motion with respect to the ether had a measurable effect, and this effect was of first order in the implied velocities. Sagnac believed he had struck a fatal blow on relativity theory by proving the existence of the ether.

*"The luminous ether is proved by the effect of the relative ether wind in a uniformly rotating interferometer."*

Sagnac never ceased to see his experiment as a proof of a relative ether whirling.

*".. your experiment will always remain a fundamental experiment, even one of the most fundamental experiments of physics. Yet it will not suffice to convince the staunch relativists of the existence of the ether. For the relativists are men who purport to imagine waves that propagate in a medium whose existence they deny."*

Bjerknes in a letter to Sagnac.

## **ALFA interpretation** (Absolute Lab Frame and Fluid Aether)

Consider first the <u>lab frame</u> results:

SoL = v rotor off SoL = c +- v rotor on

Just as a headwind or a tail wind will add to or subtract from a plane's speed, the light beams obey the Galilean law of velocity addition. But why is the change in light speed v the same as the rotor speed v(at the radius of measurement)? This exhibits full aether dragging by the rotor's mass , producing v = rw in aether speed. …sometimes called kinematic entrainment, since dynamics ins not involved.

The generalization of this phenomenon would require all motion of matter through aether to drag aether at the same speed – full or co-moving drag.

Now the rotor frame results:

SoL = v rotor off SoL = c +- v rotor on

The same as the lab frame. But this raises a logical impasse …which is:

If the aether is being dragged with the rotor, then it is always co-moving with rotor. The aether frame of reference is at rest relative to the rotor frame.

So the aether speed should be measured as v= 0 in the rotor frame. Rotor and aether are co-moving, yet the light speed changes by v!

In the lab frame aether speed was measured in that frame and aether drag correctly predicted the measured light speed. If aether speed is always measured in the lab frame, then light speed would again be SoL = c +- v!

Consistent with other tests( Sagnac(1913) and the Wang FOC test(2005) and Newton's Bucket (1687) , the explanation of the D&P rrotor frame result is the absoluteness of the lab frame.

All predictions of motion in dynamics must use the lab frame as inertial frame, since inertial frame(s) are defined as those in which the laws of dynamics are valid.

But there are not multiple inertial frames, since all reference frames at rest relative to the lab frame are equivalent to it, such as the surface, the interior volume and the geostationary satellites.

> **The enigma of the Sagnac/D&P results is solved by making the Earth the universal frame for predicting future motion using Newton's and Maxwell's laws**.

## References


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