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Critique of a paper by A.A. Faraj

A.A. Faraj claims in his paper http://www.wbabin.net/physics/faraj6p.pdf that The Emission Theory of light correctly predicts the fringe shifts observed in the Sagnac experiment.
Let's see if this is correct.

Quote from http://www.wbabin.net/physics/faraj6p.pdf begins -------------

2. The Case of Rotating Source and Detector

The initial beam, emitted by the source S towards the beam splitter P, moves with the resultant velocity c',

$$c' = \sqrt{c^2 + v^2 + 2cvc\cos\theta} \qquad [2.1],$$

Where v is the tangential velocity of S, and θ is the direction of the incident beam relative to the normal of P, and equal to 45^o. The incident beam is split by P into beams, A and B. Beam A is transmitted by P towards the mirror M_1 with the resultant velocity c_A,

$$c_A = c' = \sqrt{c^2 + v^2 + 2cv\cos\theta} \qquad [2.2].$$

Beam B is reflected by P towards the mirror M_3 with the vectors sum of the velocity of the initial beam with respect to P and the tangential velocity of P relative to the laboratory,

$$c_B = \sqrt{c^2 + v^2 - 2cv\cos\theta} \qquad [2.3].$$

Because M_1, M_2, and M_3 have normal lines at right angles to the vectors of their tangential velocity, they would not change the speeds of incident beams upon reflection. This passive role of the mirrors simplifies calculations considerably. Only S, P, and O, have to be taken into account in computations based on the Emission Theory.

Let t_A and t_B denote the total travel time for the beam A and the beam B, respectively.

$$t_A = \frac{l + t_A v\cos\theta}{c_A} = \frac{l}{c_A - v\cos\theta} \qquad [2.4],$$

Where l is the length of the total path, and ($t_A v\cos\theta$) the projection of the detector displacement, during the travel time t_A, onto the polygon path of the beam A.
For the beam B,

$$t_B = \frac{l - t_B v\cos\theta}{c_B} = \frac{l}{c_B + v\cos\theta} \qquad [2.5];$$

Where ($t_B\, v\cos\theta$) is the projection of the detector displacement, during the travel time t_B, onto the polygon path of the beam B.

Using Equations #[2.4] and #[2.5], we compute the time difference Δt,

$$\Delta t = t_A - t_B = \frac{l}{c_A - v\cos\theta} - \frac{l}{c_B + v\cos\theta} = l\left[\frac{c_B - c_A + 2v\cos\theta}{(c_A - v\cos\theta)(c_B + v\cos\theta)}\right] \qquad [2.6].$$

For ($v << c$), we can use as an approximation, ($c_A = c_B$) and [$(c^2 - v^2\cos^2\theta) \approx c^2$], in the above equation:

$$\Delta t = 2l\left[\frac{v\cos\theta}{c^2}\right] \qquad [2.7].$$

From the design of the Sagnac Experiment, we have,
($l = 4[2]^{1/2}r$), ($v = \omega r$), and ($\theta = 45^o$), where r is the radius of the Sagnac loop. By substituting in Eq. #[2.7], we obtain,

$$\Delta t = \frac{8\omega r^2}{c^2} \qquad [2.8].$$

Using ($A = 2r^2$) in the last equation, we obtain,

$$\Delta t = \frac{4\omega A}{c^2} \qquad [2.9];$$

Where (A) is the area enclosed by the light path.
Finally, we multiply (Δt) by the factor (c/λ) to calculate the interference fringe shift Δz,

$$\Delta z = \frac{4\omega A}{c\lambda} \qquad [2.10];$$

Where (λ) is the wavelength of the light used in the experiment.

Quote ends ---

My comments:
A rather glaring error can be found in this statement (below equation [2.6]):
"For (v << c), we can use an approximation ($c_A = c_B$).."
When this approximation is used, everything that is specific for the Emission Theory Of Light is removed, and the analysis becomes equal to the analysis of The Special Theory of Relativity. That is, "The speed of light in the non-rotating frame of reference is c."

Correct first order approximations are:

$$c_A = \sqrt{c^2 + v^2 + 2cv\cos\theta} = c\sqrt{1 + \left(\frac{v}{c}\right)^2 + 2\frac{v}{c}\cos\theta} \simeq c\left(1 + \frac{v}{c}\cos\theta\right) = c + v\cos\theta$$

$$c_B = \sqrt{c^2 + v^2 - 2cv\cos\theta} = c\sqrt{1 + \left(\frac{v}{c}\right)^2 - 2\frac{v}{c}\cos\theta} \simeq c\left(1 - \frac{v}{c}\cos\theta\right) = c - v\cos\theta$$

eq. [2.6] then becomes:

$$\Delta t = t_A - t_B = \frac{l}{c_A - v\cos\theta} - \frac{l}{c_B + v\cos\theta} \simeq \frac{l}{c} - \frac{l}{c} = 0$$

The Emission Theory of Light predicts no fringe shifts in the Sagnac experiment.

See also: https://paulba.no/pdf/four_mirror_sagnac.pdf