Brief Introduction to Optical Interferometry Techniques

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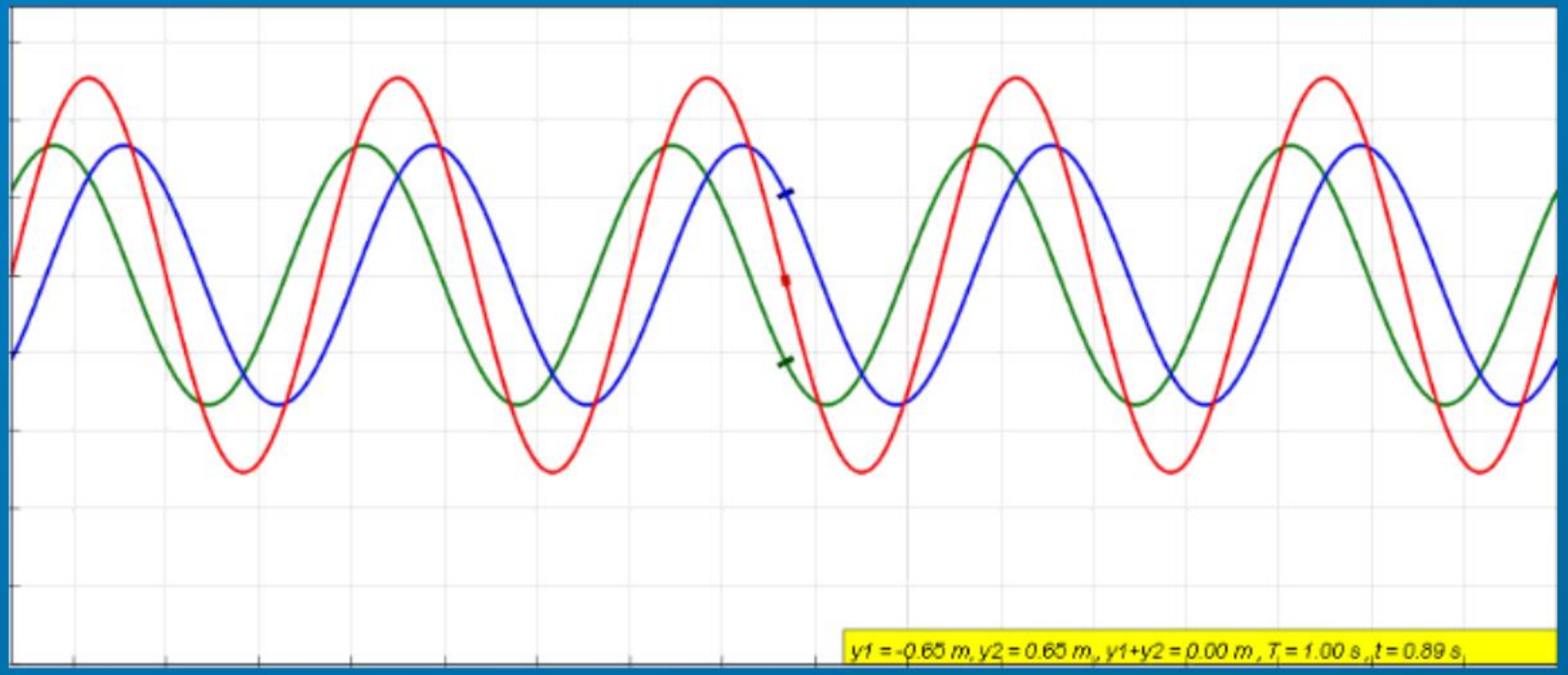
The Interferometers

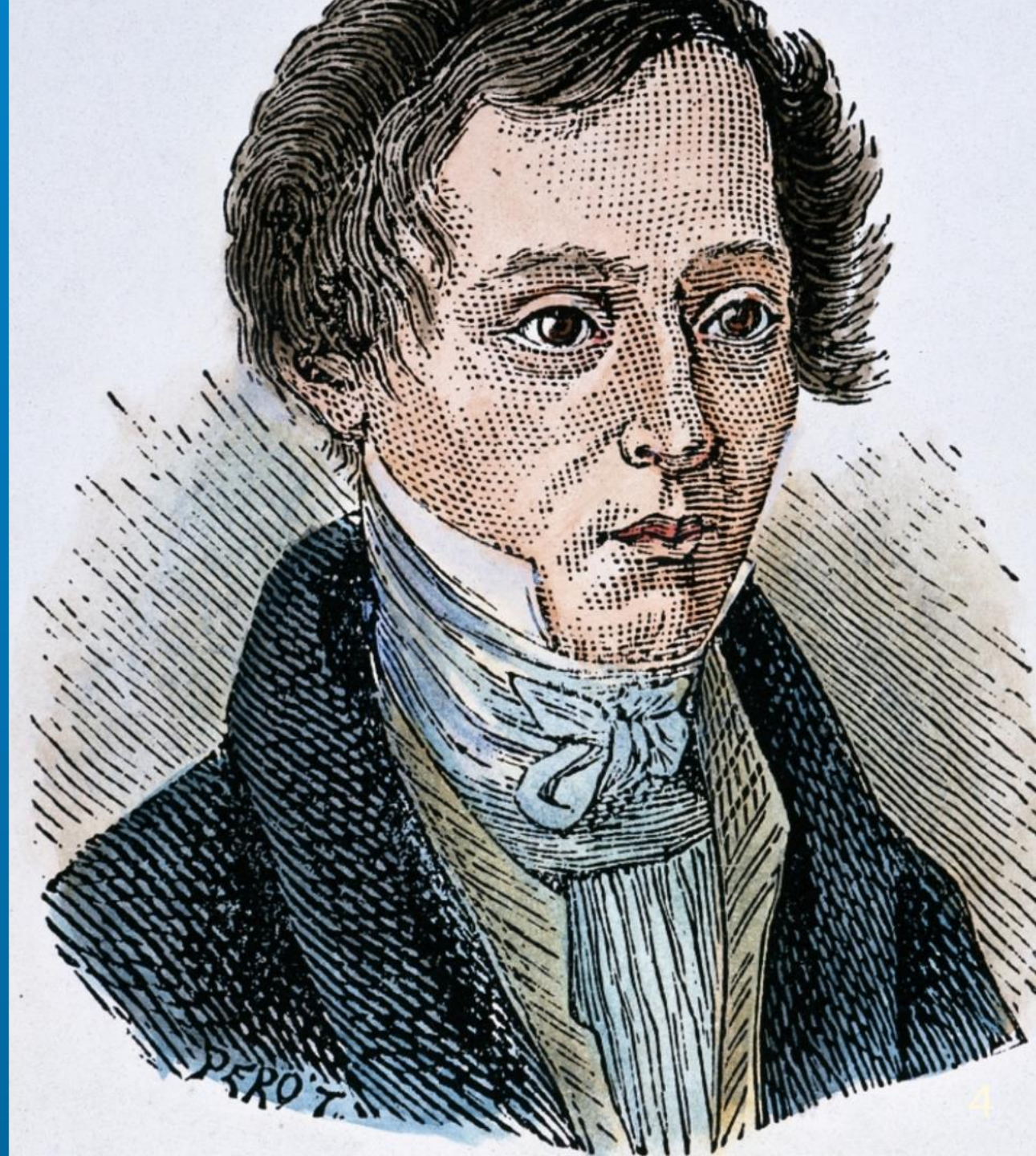
- Fizeau interferometer (1851)
- Michelson interferometer (1887)
- Sagnac interferometer (1913)

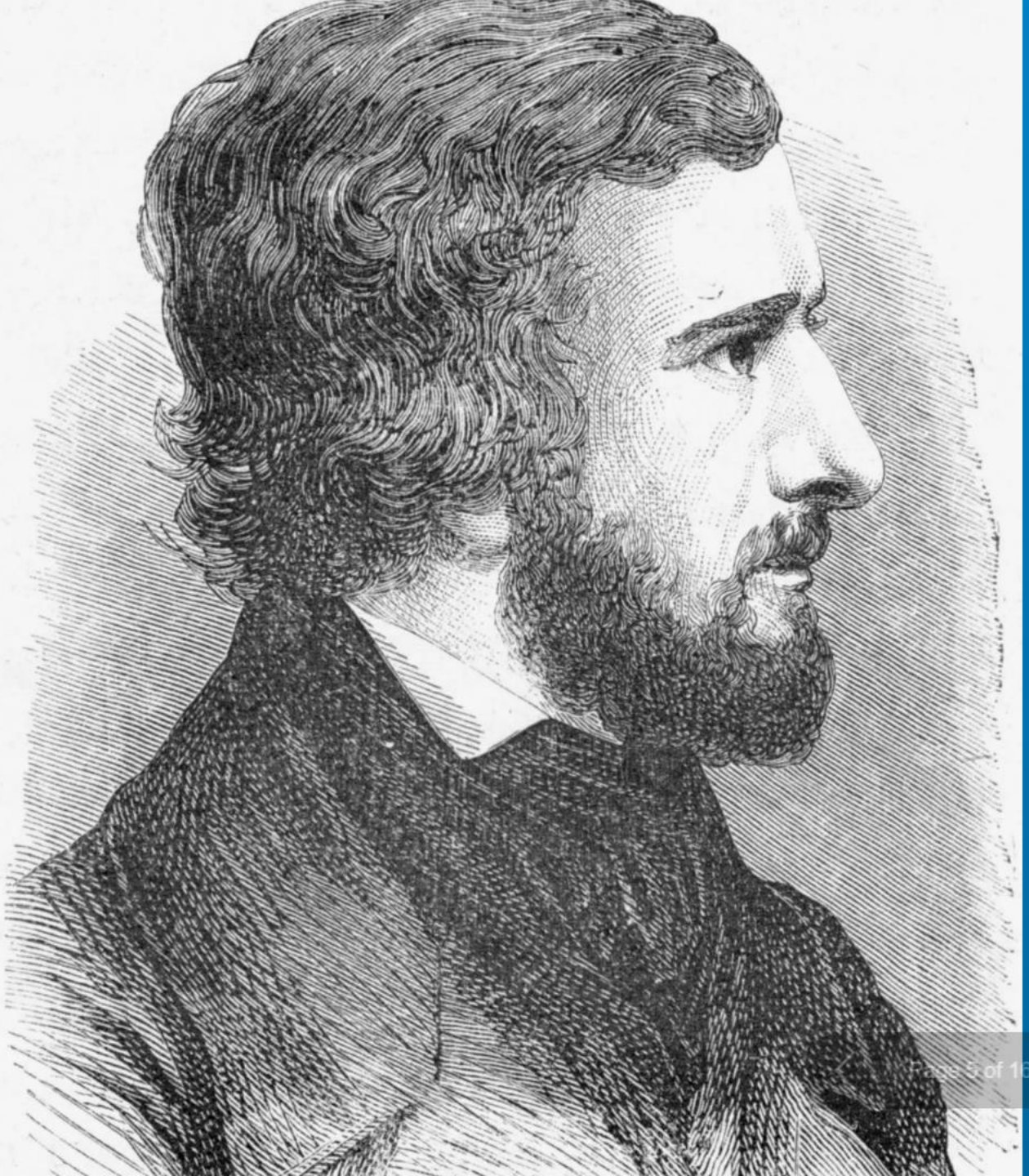
What is interference?



Introduction

- Mid 1800s - wave theory was dominant - all fields can be expressed in terms of wave
- Young's double slit experiment
- light require a medium for propagation
- Fresnel proposed *luminiferous ether*

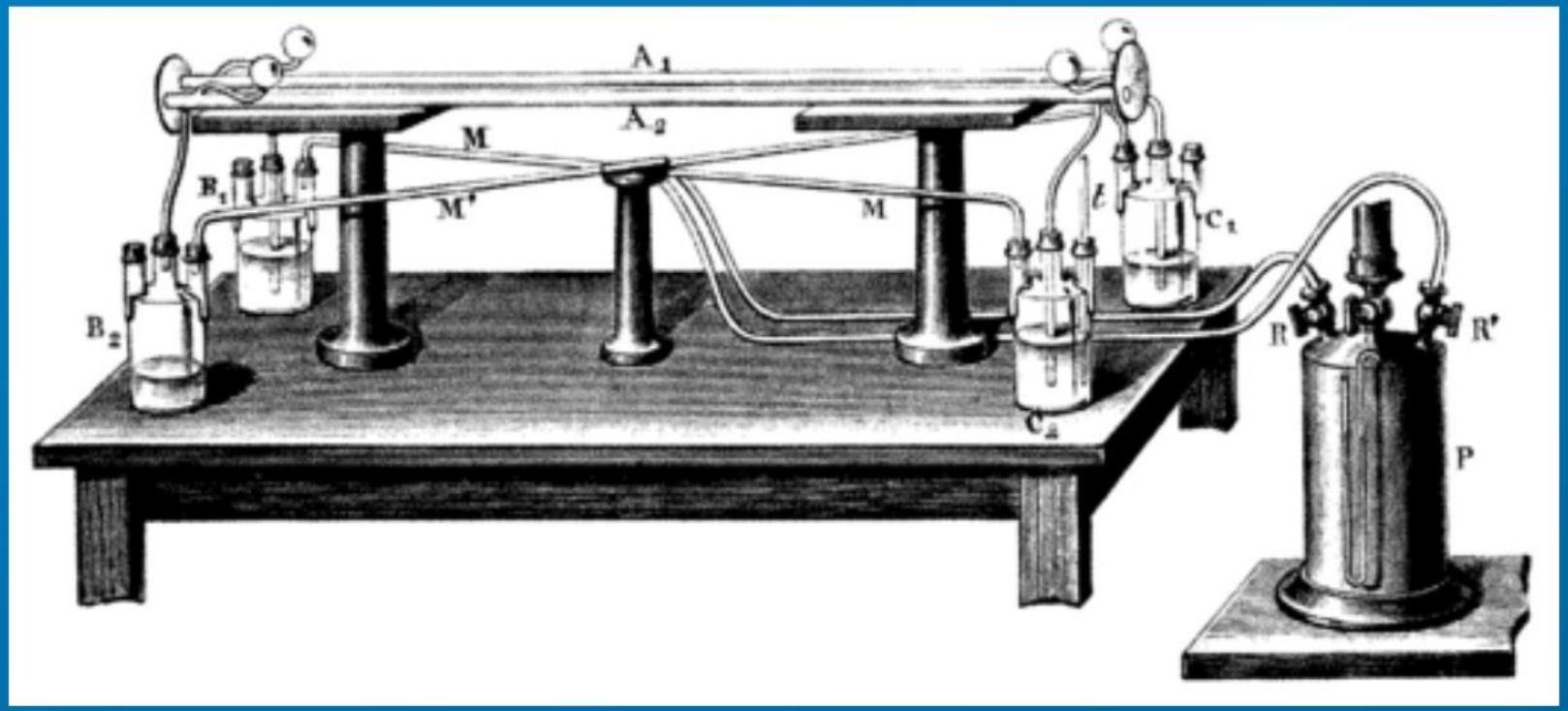




Interferometry to prove 'Ether'

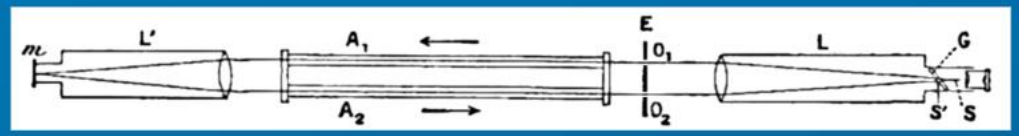
- many experimens tried to prove 'ether'
- interferometry techniques
- expected a ether-drag as earth rotates
- Fizeau's experiment: velocity of the medium alters the speed of light

Fizeau's experiment (1851)



Partial ether theory!

- Fizeau do observed a drag while using **water**
- lower magnitude
- not obeyed in air



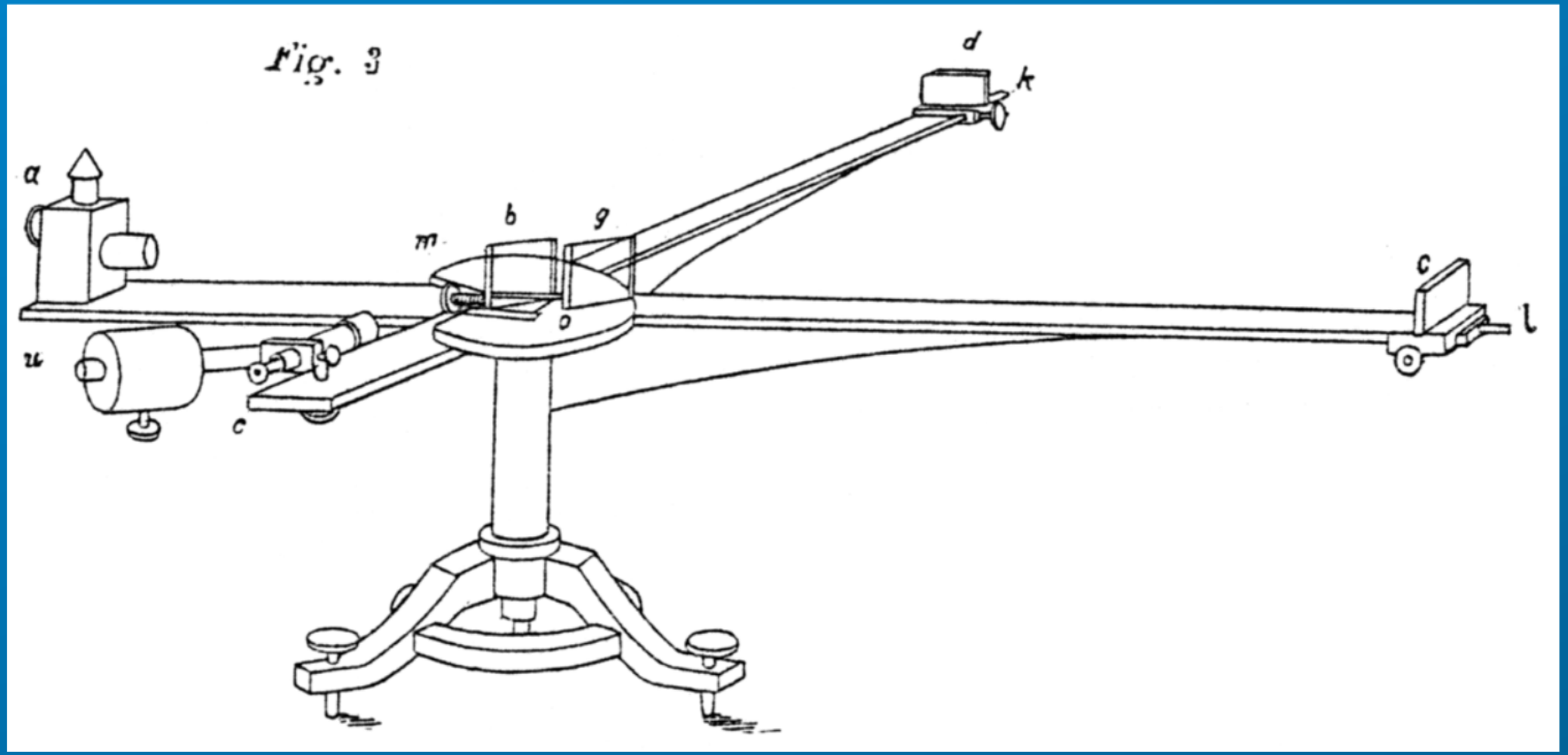
The double transit of the light was for the purpose of augmenting the distance traversed in the medium in motion, and further to compensate entirely any accidental difference of temperature or pressure between the two tubes, from which might result a displacement of the fringes, which would be mingled with the displacement which the motion alone would have produced; and thus have rendered the observation of it uncertain.

– Fizeau

Michelson Morley Experiment

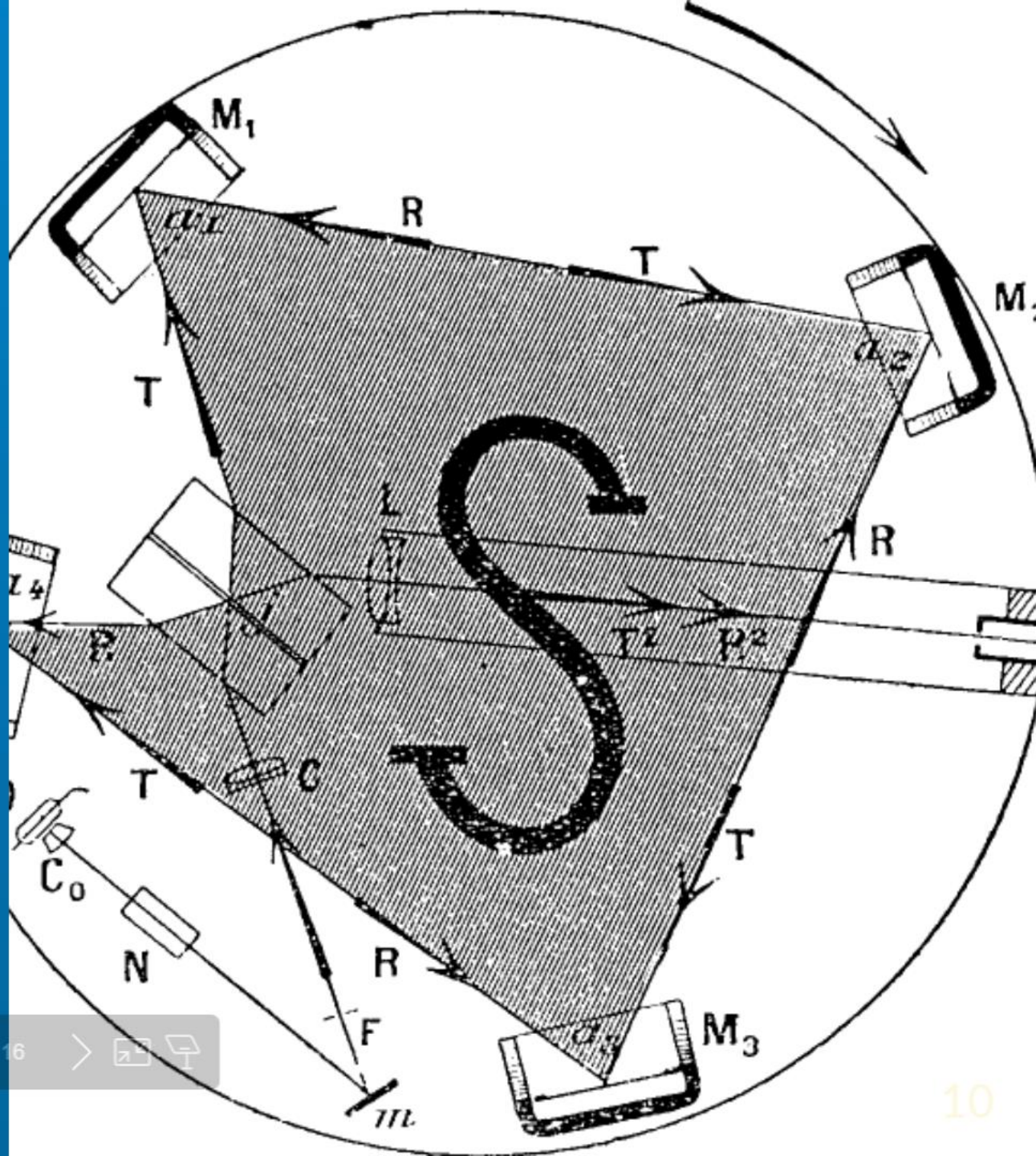
- In 1887, between April and July, two American Physicists - Albert A. Michelson and Edward W. Morley conducted a series of experiments to detect ether
- They attempted to measure speed of light in two different arms, perpendicular to each other
- But the result was negative and considered as the strong evidence against 'ether theory'
- In fact over the years, the experiment was performed with improved accuracy - at the level of 10^{-17} - still a big '**NO!**'

Michelson Interferometer



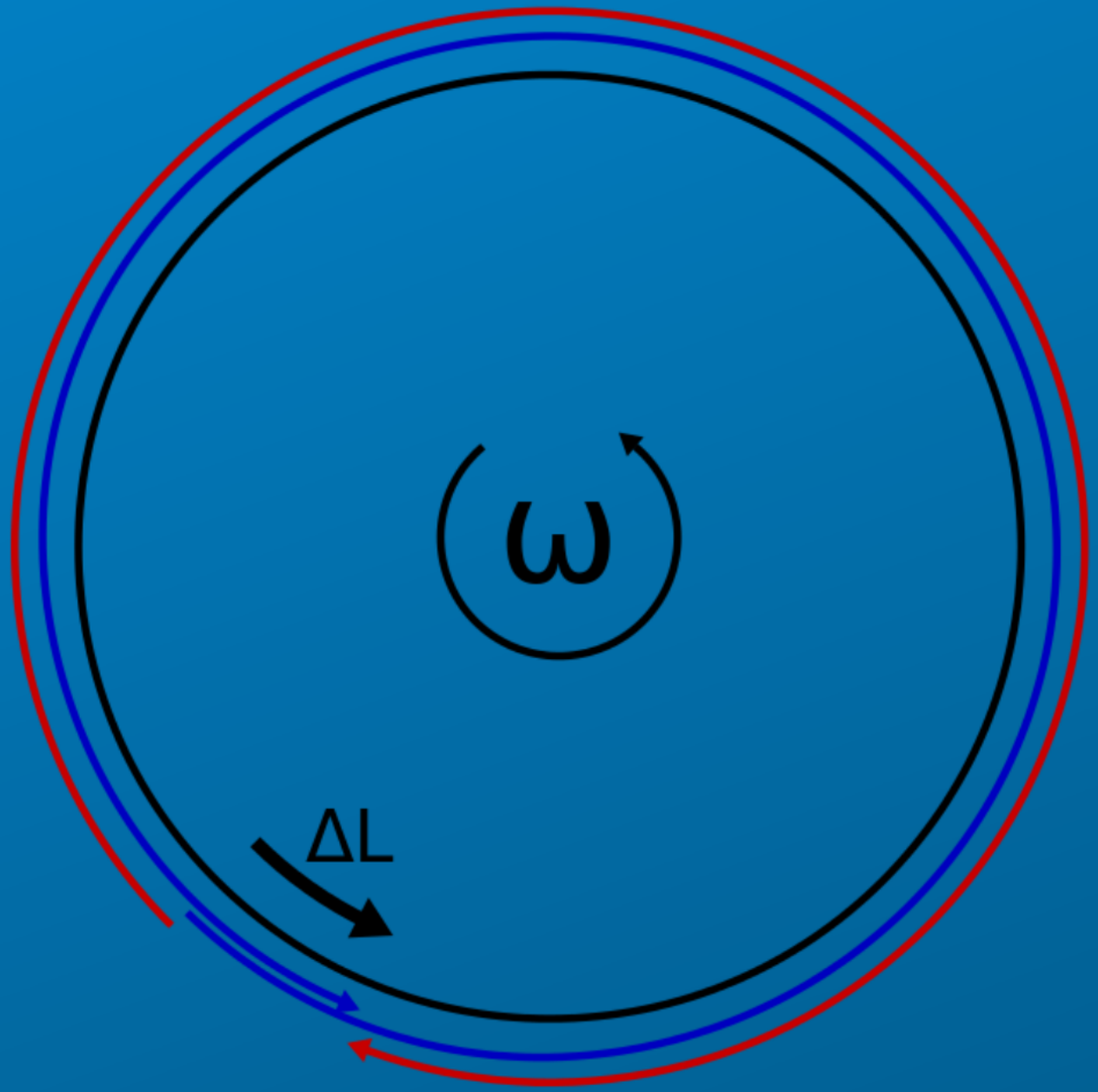
Sagnac Interferometer (1913)

- Sagnac interferometer - last attempts
- ring interferometer - travel in the common path - opposite directions
- fringe positions vary w.r.t angular velocity



Sagnac Effect

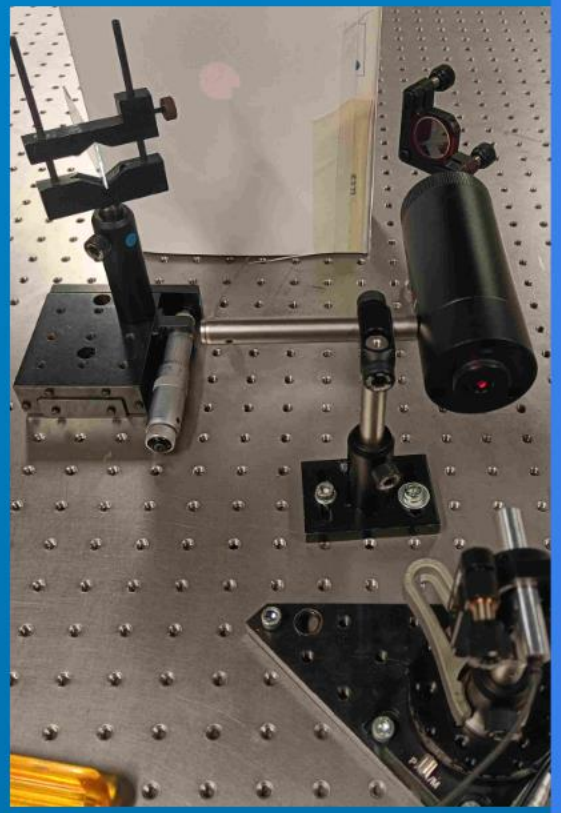
- Sagnac do observed a shift thought to proved the existence of stationary ether
- 1911 Max von Laue's theoretical work
- Michelson–Gale–Pearson experiment (1925)



Significance of these interferometers today

- Michelson - LIGO - Detect gravitational waves!
- Fizeau - Optical quality testing
- Sagnac - Angular corrections in satellites

Fizeau setup



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Michelson setup

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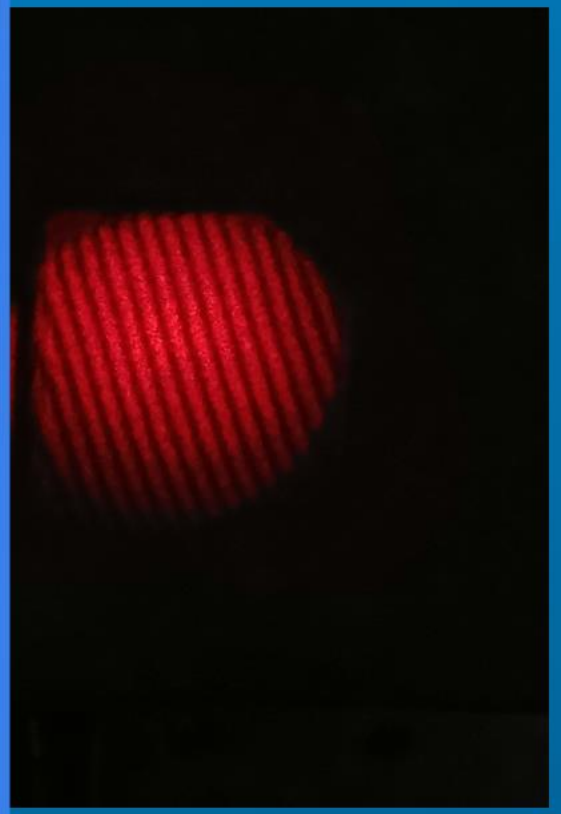
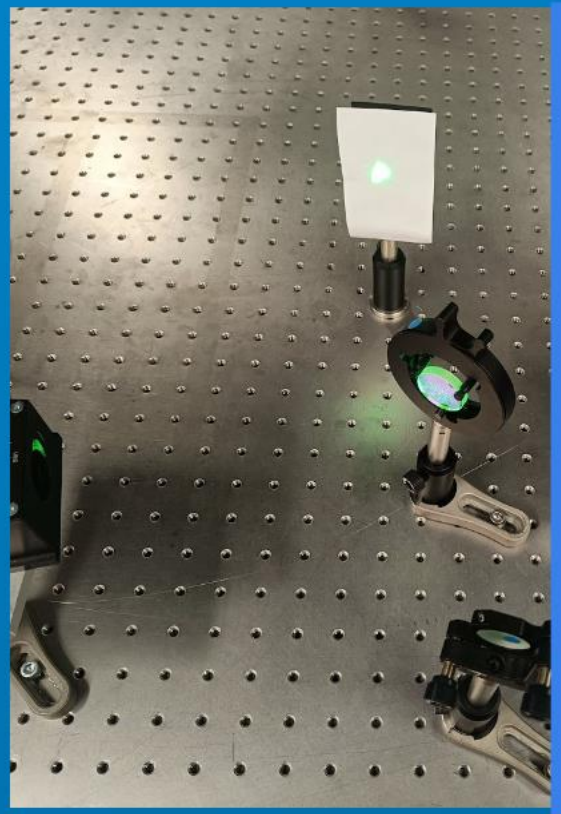


Sagnac setup



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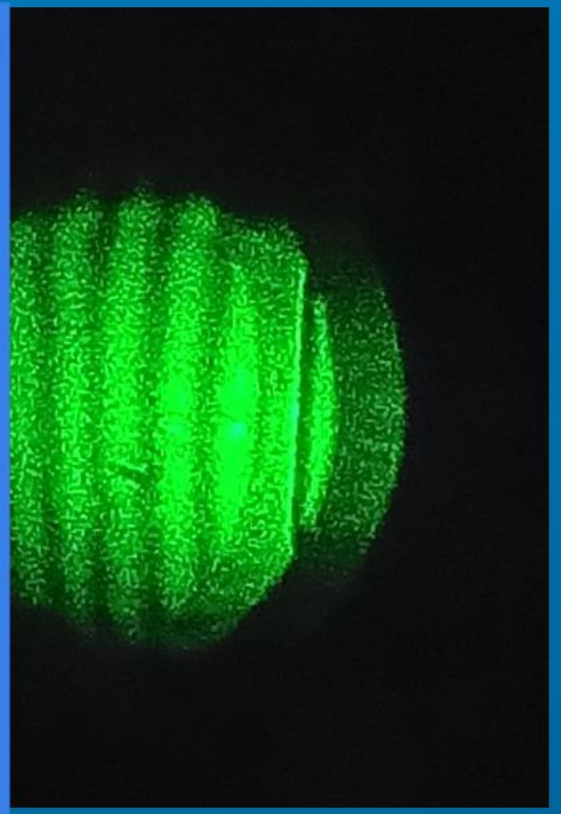

Questions?