# Experiments of Lorentz non-invariance

Partha Nag

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## 1 Introduction

Lorentz invariance is a fundamental structure for special Relativity.But it is possible that some Lorentz non invariance exists and so this should be tested for. Here I present two such experiments to detect the same.

## 2 Modern Kennedy Thorndike Experiment

The original Kennedy Thorndike experiment[1] was a Michelson Morley experiment with unequal lengths and it nullified Lorentz-fitzgerald's hypothesis that the null result of Michelson Morley experiment was due to contraction of length because of motion relative to ether. In this modern form of the experiment Hils and Hall[2] used two He-Ne lasers,one locked to molecular absorption line of $I_2$ and the other locked to a stable Fabry Perot's reference cavity.There frequencies were compared to obtain beats. In the RMS framework, CMBR frame was considered as the preferred frame $\mathbf{\Sigma}$ (Capital coords) and earth the other frame (small coords) having velocity $v$ in $\mathbf{\Sigma}$.The coordinate transformation between these two frames is given by

$$t = a \times T + e \times x, x = b \times (X - v \times T), y = d \times Y, z = d \times Z$$

where $v$ is along $x$-axis and

$$a = 1 + \alpha(\frac{v}{c})^2, b = 1 + \beta(\frac{v}{c})^2, d = 1 + \delta(\frac{v}{c})^2$$

The beat frequencies in the two frames were compared to obtain limits on Lorentz non invariance as $\beta = -\frac{1}{2} \pm 7 \times 10^{-5}$ using the known data of $\alpha = \frac{1}{2} \pm 1 \times 10^{-7}$ from a modern MM experiment.

## 3 Clock Comparison Test

If space is anisotropic then Zeeman hyperfine frequency will depend on the orientation of the quantization axis in space [3]. Thus, such experiments consisting of atomic clocks in space can be used to detect Lorentz non invariance by surveying all the directions.

## References

[1] R.J.Kennedy and E.M. Thorndike,Phys.Rev.B **42**, 400(1932)

[2] D. Hils and J.L. Hall, Phys. Rev. Lett. **64**, 1697(1990)

[3] R. Bluhm et.al, Phys. Rev. Lett. **88**, No.9(2002)