Fun Template 2

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Contents

Conventions

$\mathbb{F}$ denotes either $\mathbb{R}$ or $\mathbb{C}$.

$\mathbb{N}$ denotes the set $\{1, 2, 3, \ldots\}$ of natural numbers (excluding 0).

Inner products are taken to be linear in the first argument and conjugate linear in the second.

The Einstein summation convention is used for tensors unless otherwise specified.

Foreword

1 Introduction

1.1 Scale, Speed, Units

1.2 Galiliean Relativity, Speed of Light, Postulates of SR

** Galiliean relativity is NOT applicable in higher speeds, near speed of light..

1.3 Phenomena of SR

1.3.1 Time Dilation

1.3.2 Length Contraction

1.3.3 Relativity of Simultaneity

[1]

2 Foundations of Special Relativity

2.1 Relativity of Simultaneity

2.2 Time Dilation

2.2.1 Train example

2.2.2 Moving mirrors

2.2.3 Derivation

2.3 Length Contraction

2.4 Paradoxes of Simultaneity

2.5 Lorentz Transformations

2.5.1 Prperties

2.5.2 Addition of velocities

3 Spacetime Diagrams

3.1 Introduction

3.1.1 Speed of light invariants, rest, constant velocity

3.2 Cause and Effect

3.3 Invariants

3.4 Examples

3.4.1 Addition of velocities

3.4.2 Algebric treatment - as in David Tong's Notes

3.4.3 Lorentz transformations as an "exotic" rotation

4 Paradoxes of SR

4.1 Pole in Barn

Discuss the two approaches, the spacetime diagrams and the issue of locking the doors (simultaneity)

4.2 Twin Paradox

3 approaches: Without acceleration, relativistic Doppler effect and communication between twins (Spacetime diagram)

4.3 Dr. Jawad's Train Tunnel paradox

It is the same as pole in barn paradox, but here the new this is a bomb is fixed on the train and it will explode if the train is in the tunnel.

5 Relativistic Kinematics

5.1 Relativistic Mass

5.2 Momentum

5.3 Force and Energy

5.4 Solved Example: Compton Scattering

Afterword

Maxwell's equations in SR, GR, the loose ends.

A Appendix A

This appendix about the 4-vectors (Momentum, forces, energy). Check David Tong's and Joe's notes.

References

[1]   Joseph L. Taylor. *Complex Variables*. AMS, 2011. ISBN: 978-0-8218-6901-7.