Chapter II
Tests of special relativity

2.1 Introduction.

Our purpose in this chapter is to look into various experimental tests of special relativity.

We will look at tests of the invariance of the speed of light. We need to distinguish whether we are dealing with absolute quantum space (the vacuum) or propagation of light in a medium. The temperature of absolute space is also a relevant feature determining the propagation velocity. We will estimate bounds on the rest mass of the photon, if this exists. In conventional accounts the photon has energy and momentum, but no rest mass.

We look at the evidence on the Michelson-Morley experiment to determine motion through the ether, and further experiments by Miller at Mt Wilson and by others. A particular hypothesis we wish to test is whether time dilation and the contraction of measuring rods is nullified in the presence of bulk matter.

We investigate various effects predicted in the theory of relativity and their agreement or otherwise with experiment. These are the relativistic Doppler effect, the Sagnac effect, and relativistic effects due to the equivalence principle, which equates the acceleration of inertial mass with its counterpart as gravitational mass.

We put these ideas together in giving an expanded account of *Relativistic effects in the global positioning system* (GPS satellites) given by Neil Ashby [NA06].

The relativistic increase of inertial mass with velocity ($E = mc^2$) is discussed in the sections looking at theory and experiment in special relativistic dynamics.

2.2 Tests of speed of light invariance.

Light slower in cool vacuum or not in vacuum. Light with rest mass.

2.3 The Lorentz transformations and the Michelson-Morley experiment.

They did not claim a null result. Modern interpretations of their experiment do. Modified and direct Lorentz transformations. From our chapter I. Experiments. Cosmic rays – decay rates.

2.4 The hypothesis of space-time localisation near bulk matter.

Feasible under the assumptions of the GPS satellite calculations.

2.5 The Miller experiment.

Mt Wilson. An ‘anomaly’ result.

2.6 Doppler shifts.

2.7 Relativistic effects due to the equivalence principle.

Einstein introduced this prior to the introduction of general relativity. The question of its meaning. If a mass is not accelerating due to gravity (say it is balanced by electromagnetic

forces or quantum effects) is there a red shift due to gravitation? I say not. This has implications for the result on GPS satellites. text

2.8 The Sagnac effect.

text

2.9 Earth's motion relative to the cosmic background radiation.

COBE. Acceleration or Doppler?

2.10 GPS satellites.

remaining text

2.11 Special relativistic dynamics.

$E = mc^2$.

2.12 Tests of mass increase with velocity.

Particle accelerators.