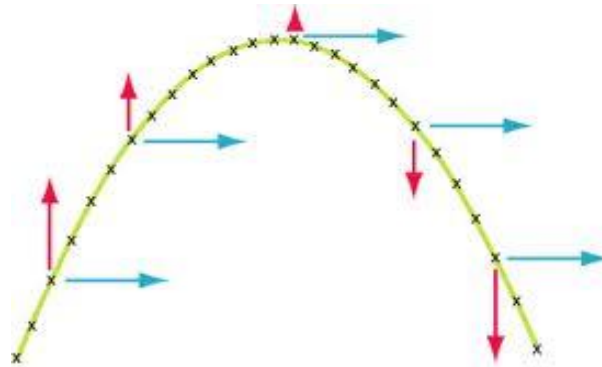


- 2) Many factors have to be taken into account to achieve a successful rocket launch, maintain a stable orbit and return to Earth –

2.1 Describe the trajectory of an object undergoing projectile motion within the Earth's gravitational field in terms of horizontal and vertical components

- A projectile is an object upon which the only force acting is gravity
- They are subject to their own inertia as well as to the gravitational force of the planet
 - ❖ Inertia of the object causes it to continue moving in the direction of its motion, which is in a straight line (Newton's 1st Law)
 - ❖ The gravitational force attracts the object towards the centre of the planet
- Combining both, the object follows a parabolic path, whereby the horizontal motion (V_x) experiences constant velocity and the vertical motion is uniformly accelerated.
- Rockets are not projectiles, because they are powered on thrust force
- Thus, the trajectory of a projectile in the Earth's gravitational field is parabolic, assuming that air resistance is ignored, and acceleration due to gravity is uniform

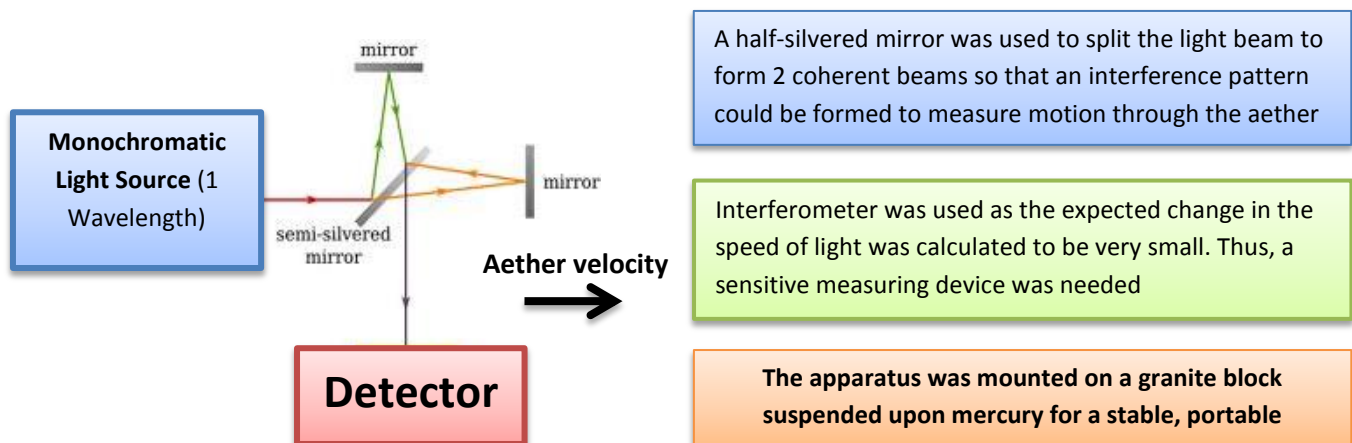


4.2 Describe and evaluate the Michelson-Morley attempt to measure the relative velocity of the Earth through the aether & interpret the results of the Michelson-Morley experiment

Background: was believed the Earth was moving against the aether causing an 'aether wind' as the Earth moves. Since c is constant relative to aether, light was thought to be moving faster in one direction than another, when viewed from Earth (faster when travelling in same direction as aether).

MM Aim: To measure the relative velocity of the Earth through the aether (detect the aether wind)

MM Hypothesis: The interference pattern observed through the eyepiece would have varied in position as the apparatus was rotated (there will be an observed shift in fringe hairs)



MM Method:

1. A monochromatic beam of light was directed into an interferometer, which included a half-silvered mirror, which split the beam into 2 perpendicular beams.
2. Each beam was then reflected off equally spaced mirrors, and recombined at the centre of the apparatus again.
3. The monochromatic beam then passed into a detector, which measured the interference pattern.
4. The apparatus was then rotated through 90° to swap the rays' direction through the aether thus affecting their velocity. They believed that the speed of light would change and hence a change in the interference pattern would be produced (aether wind would be detected)

MM Results & Evaluation:

- **NO MOTION OF THE EARTH RELATIVE TO THE AETHER WAS DETECTED!** (i.e. no relative velocity of the earth through the aether)
- I.e. a **null result** was achieved → did not produce the expected result
- **Less than 0.01 fringe shifts were detected and thus no significant difference between the 2 lights rays was detected, so no change in interference pattern was detected.**
- The results **supported** the idea that the aether did not exist.
- **Note:** Interference is the interaction of 2 or more waves producing regions of maximum amplitude (constructive interference) and zero amplitude (destructive interference)

How Einstein's Theory of Relativity Helps Explain the Null Result:

- MM experiment was dependent on the speed of light changing as the direction of light travelling relative to the aether was changed
- Einstein's special theory of relativity states that the speed of light is constant for all observers within an inertial frame of reference, and so even if the aether was present, the experiment was not valid for measuring the relative velocity of Earth through it
- Hence, the null result can be seen as "supporting" Einstein's theory of relativity

4.4 Outline the nature of inertial frames of reference

Inertial Frames of Reference:

- They are FOR that are either at rest or moving with constant velocity
- Thus there are no fictitious forces present and no acceleration is experienced
- Motion of the frame of reference cannot be detected from within it
- Newton's 1st Law of Inertia holds true
- Laws of physics are the same in all inertial frames of reference

Non-Inertial Frames of Reference:

- They are FOR that experience acceleration (do not have constant velocity) and thus fictitious forces are present
- Newton's 1st Law of Inertia does not hold true
- Motion of the frame of reference can be detected from within it