

# Frame of reference

Dr. Sunil Kumar Yadav

*Department of Physics, Maharaja College, Arrah, Bihar 802301, India.*

(Dated: July 9, 2020)

*“The scientist does not study nature because it is useful; he studies it because he delights in it, and he delights in it because it is beautiful. If nature were not beautiful, it would not be worth knowing, and if nature were not worth knowing, life would not be worth living.”*

— Jules Henri Poincaré (1854-1912)

---

---

A frame of reference is a set of coordinates which are used to specify an *event* [\*] such as collision of two objects, turning on a flashlight, etc. There are two categories of reference frames: Inertial and Non-inertial. Here we discuss very basic definition of inertial and non-inertial frames with examples.

## A. Inertial reference frame

- An inertial system can be treated as a frame of in which *Newton’s first law which is also known as the law of inertial*, holds. These frames are called as *inertial reference reference*.
- An unaccelerated system, i.e., a system *moving with constant velocity* with respect to an inertial frame is also called as inertial reference frame.
- Some more examples of inertial reference framea are as follow:

---

[\*] An event is described by a point in space-time, i.e.,  $(x,y,z,t)$ .

- A set of axes fixed on earth[†] is treated as the inertial coordinate system.
- Any set of axes moving with constant velocity with respect to earth is treated as inertial frame. For example, a train/car/taxi/bus/van/tractor/motorcycle/boat/ship/helicopter/airplane moving with constant velocity with respect to ground is inertial reference frame.

### B. Non-inertial reference frame

A frame of reference *accelerating* with respect to an inertial system is called as *non-inertial reference frame*. Example of non-inertial frame is an accelerating car, two sphere tied with a string and rotating about each other, etc.

- 
- [1] R. Resnick, *Introduction to Special Relativity*, Wiley-VCH, (1968) .
- [2] A. Beiser, *Concepts of modern physics*, Tata McGraw-Hill Education, (2003).

---

[†] There is small acceleration effect due to rotation (around its axis) and orbital motion of the earth around the sun. Generally, this small contribution to acceleration is neglected and earth is treated as the inertial system.