

## **Seminar**

# **The Physics of Satellite Navigation System (like GPS) and its Atomic Clocks**

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Satellite based navigation systems like the Global Positioning System (GPS) are now part of everyday mobile life. They rely on the “local time” measured by high precision atomic clocks and the propagation of RF electromagnetic waves to mark the “position in space”, with remarkable accuracy. Crucial to the arrangement are our theories and beliefs about the propagation of light that “connects” the different clocks. GPS assumes that the speed of light is an invariant constant, as postulated in the special theory of relativity. Changes in time due to gravity, as well as the motional changes prescribed by the special theory of relativity, amount to several meters of navigation error within seconds, unless corrected and they are corrected carefully, in the clocks and in the algorithms that manage the system. However, factually, these corrections turned out to be insufficient, as realized only after the GPS was partially put in place. While the gravitational correction follows elementary general relativity, the needed motional corrections are more subtle. I will discuss the principle and technology of GPS and its clocks, the relativistic corrections demanded by our fundamental theories, and the mysterious clock correction that falls “outside the syllabus”. Finally, I will show the true nature of the extra correction, revealing a surprise in physics.

***Monday, Sep 9<sup>th</sup> 2019***

***4:00 PM (Tea/Coffee at 3:30 PM)***

***Auditorium, TIFR-H***