TIME AND FREQUENCY ACTIVITIES AT THE JHU APPLIED PHYSICS LABORATORY

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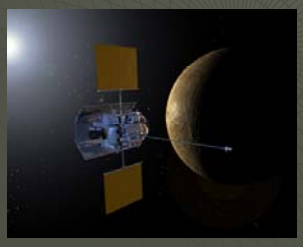
Abstract

The Time and Frequency Laboratory at the Johns Hopkins University Applied Physics Laboratory (JHU/APL) provides support to multiple current and upcoming NASA/APL missions that span our solar system, from the study of the Sun's coronal mass ejections to the examination of the outer planets and the Kuiper Belt objects. This support includes providing precise time and frequency to the integration and testing of new hardware, frequency reference for spacecraft ranging and communications via the APL satellite communications facility, and the time-stamping of ground-receipt telemetry packets from various spacecraft. The Lab's ensemble of three high-performance cesium standards and three hydrogen masers are integrated to form the APL time scale, which is the basis for estimating UTC – UTC (APL) and for evaluating the performance of our clocks. Traceability to USNO, NIST, and UTC is maintained via GPS common-view and all-in-view time transfer. The Lab's clocks are also incorporated into the computation of International Atomic Time (TAI).

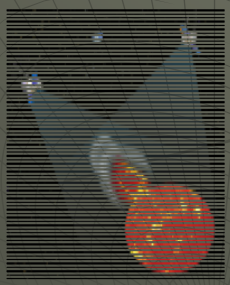
APL Space Science Missions

- TIMED – **T**hermosphere **I**onosphere **M**esosphere **E**nergetics and **D**ynamics



- MESSENGER – **ME**rcury **S**urface, **S**pace **EN**vironment, **GE**ochemistry, and **R**anging

APL Space Science Missions (continued)



- STEREO – **S**olar **TE**rrestrial **RE**lations **O**bservatory

- New Horizons

Lab Facilities

- Located in standard laboratory room
- Temperature maintained at 68 degrees +/-3 degrees Fahrenheit
- Humidity maintained at 60% maximum
- AC power is on building UPS plus local UPS for critical systems

APL Time and Frequency Lab

Time and Frequency Lab Hardware

- 3 High Performance Cesium Standards
- 4 Hydrogen Masers
- 5 MHz measurement system
- 1 PPS clock monitor system
- 2 Microphase-steppers
- 2 GPS Time Transfer Receivers

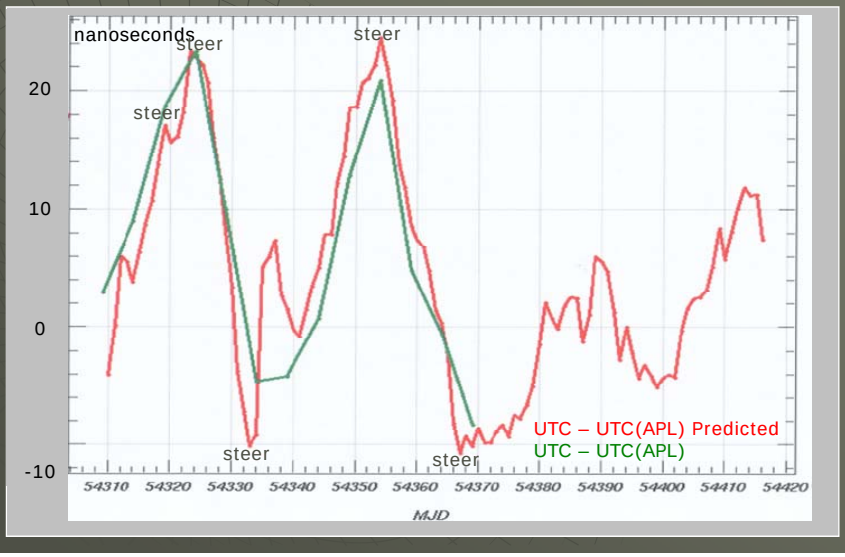
Time and Frequency Dissemination

- 1 MHz, 5 MHz, 10 MHz, 100 MHz
- 1 PPS
- IRIG-B APL Local Time
- IRIG-B UTC
- Common View GPS Time Transfer
  - NIST, USNO, BIPM

UTC(APL)

- Output of a Microphase-stepper
- Microphase-stepper driven by a High Performance Cesium
- Microphase-stepper adjustments are based on prediction of UTC-UTC(APL)
- Adjustments are made as needed

UTC – UTC(APL) Prediction with Microphase-stepper Adjustments



APL Timescale

- 3 Hydrogen Masers
- 3 High Performance Cesiums
- Clocks are selectively weighted
- Referenced to UTC(APL)

APL Timekeeping System