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 (JHL/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 timescale, 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).

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
NOV 2009		**00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Time and Frequency Activities at the JHU Applied Physics Laboratory	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Johns Hopkins University,Applied Physics Laboratory,11100 Johns Hopkins Road,Laurel,MD,20723**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
41st Annual Precise Time and Time Interval (PTTI) Systems and Applications Meeting, 16-19 Nov 2009, Santa Ana Pueblo, NM

14. ABSTRACT
see report

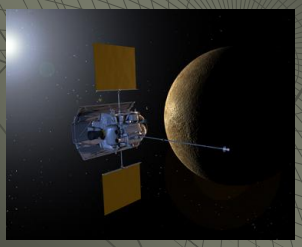
15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**8**	

APL Time and Frequency Lab

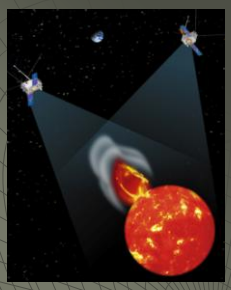
APL Space Science Missions

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

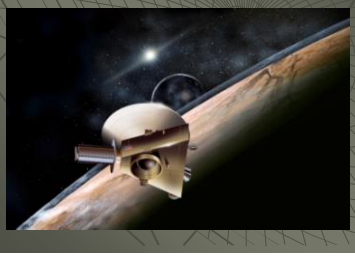


- MESSENGER – **ME**rcury **S**urface, **S**pace **EN**vironment, **GE**ochemistry, and **R**anging

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

Time and Frequency Lab Hardware

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

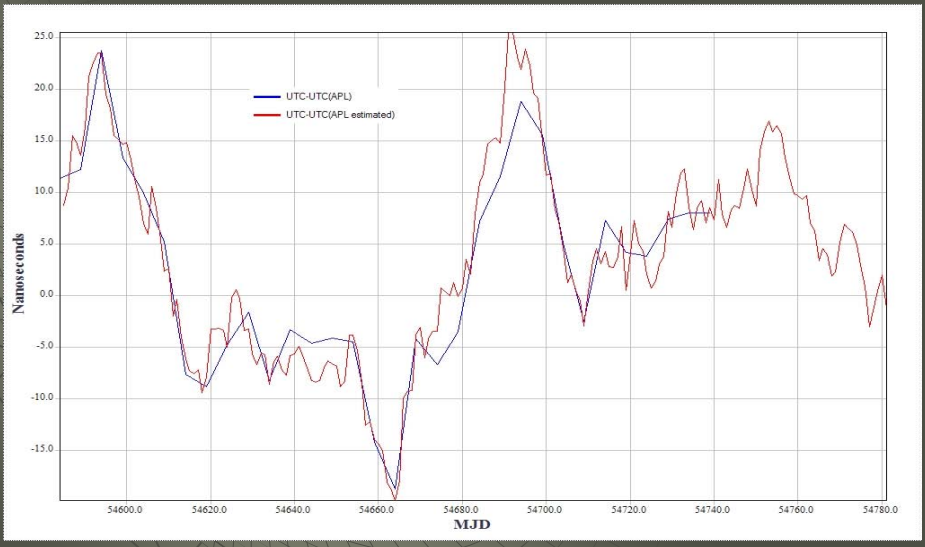
Time and Frequency Dissemination

- 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 estimate of UTC-UTC(APL)
- Adjustments are made as needed

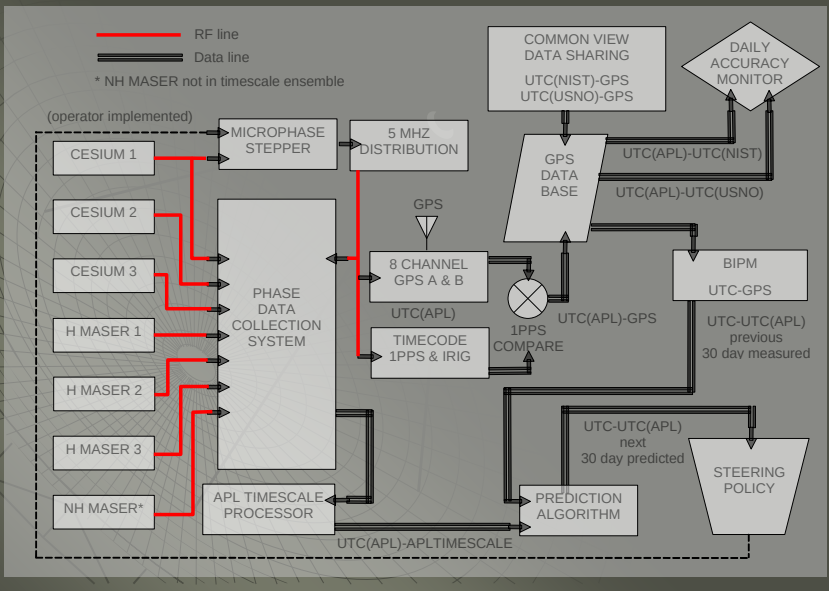
UTC – UTC(APL) & UTC – UTC(APL estimated)



APL Timescale

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

APL Timekeeping System



Note: In above slide, "NH MASER" should be "NR MASER"

Future Improvements

- UTC(APL) will be the output of the Offset Generator (Dec. 2009)
- Offset Generator will be driven by a hydrogen maser (Dec. 2009)
- Offset Generator adjustments will be automated and made daily based on estimation of UTC–UTC(APL) (Dec. 2009)
- T&F Lab move to New Space Department building (2011)

Upgrade to Automated Steering