

The background features a dark gray grid pattern on a spherical surface, resembling a globe or a dome. A small, dark microphone icon is positioned above the main title. The text is centered and rendered in a light gray, sans-serif font.

Report from APL

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54th CGSIC Meeting – Timing Subcommittee
September 8, 2014

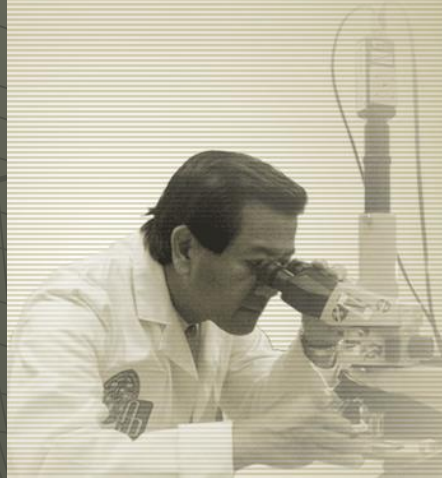
APL in Brief

What Are We?



- Division of Johns Hopkins University
- University Affiliated Research Center

Who Are We?



- Technically skilled and operationally oriented
- Objective and independent

Who Are Our Sponsors?



- DoD
- NASA
- DHS
- IC

What Is Our Goal?



- Critical Contributions to Critical Challenges

Laboratory Statistics

- 400 acre campus in Laurel, MD
- Employees: ~5,000 Staff
- Revenues: ~\$1.0B

Time & Frequency Lab Mission

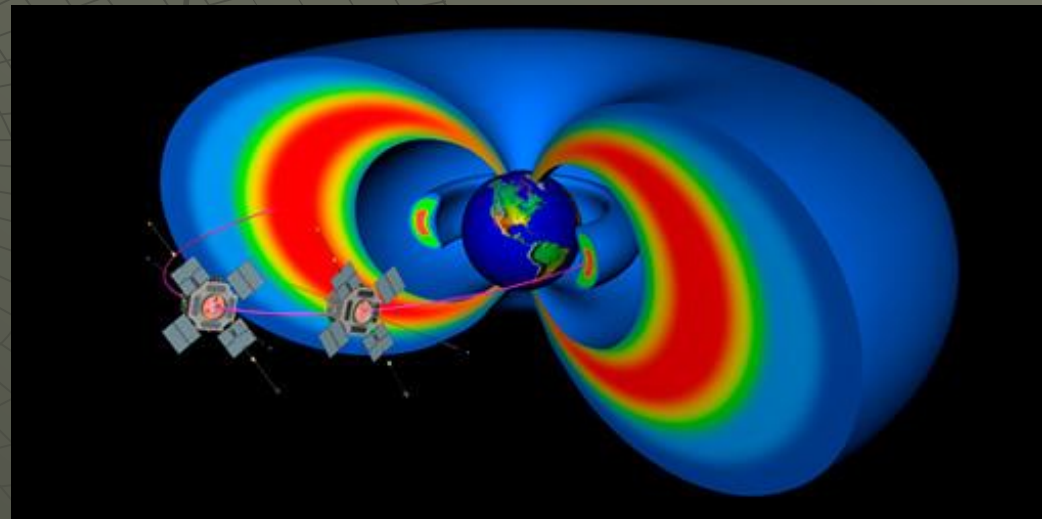
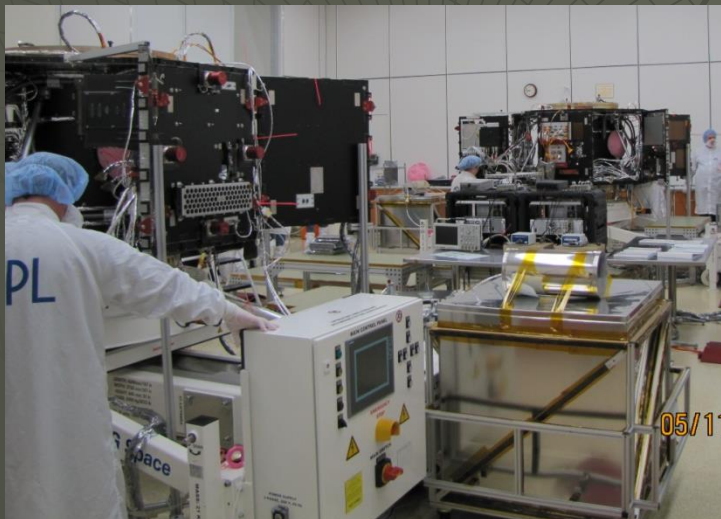
Provide precise time and frequency in support of critical APL projects and maintain traceability to U.S. and international timing laboratories.

T & F Lab Mission Support

- ◆ Integration and testing of flight hardware
- ◆ Frequency reference for spacecraft ranging and communications
- ◆ Time-stamping of ground receipt telemetry packets
- ◆ R & D of time and frequency devices and distribution systems

Support of APL Space Science Missions

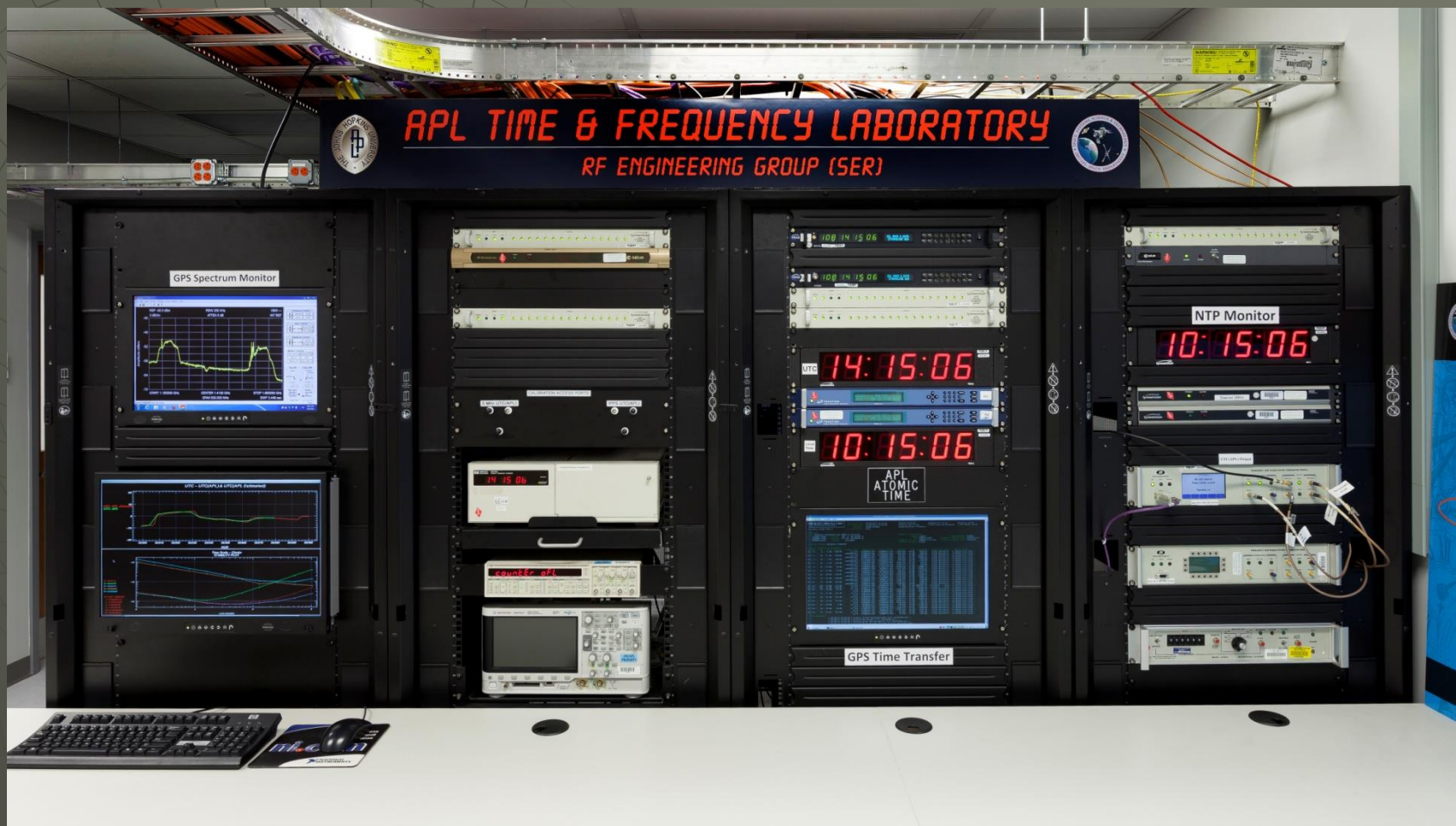
- ◆ Continued mission operations support for:
 - TIMED – **T**hermosphere **I**onosphere **M**esosphere **E**nergetics and **D**ynamics
 - STEREO – **S**olar **T**Errestrial **R**elations **O**bservatory
 - New Horizons, mission to Pluto and Kuiper Belt Objects
 - MESSENGER – **M**ercury **S**urface, **S**pace **E**Nvironment, **G**Eochemistry, and **R**anging
- ◆ New mission launched Aug 2012, Van Allen Probes (formally Radiation Belt Storm Probes)



Time and Frequency Laboratory

- ◆ Located in new building on south campus
- ◆ Separate environmental chamber for clocks
- ◆ Fiber-optic signal distribution system to all APL laboratories beyond the new Space Dept. building
- ◆ Novatel PROPAK6 receiver tracks GPS, GLONASS and GALILEO
 - Enables Precise Point Positioning (PPP) time transfer

Time & Frequency Laboratory



Clock Vault



Lab Facilities

- ◆ Dedicated entirely to Time & Frequency operations with restricted access
- ◆ Clock vault temperature maintained at 68 degrees \pm 0.5 degrees Fahrenheit and humidity maintained at 50% \pm 1%
- ◆ AC power is on building UPS plus back-up local UPS for critical systems
- ◆ Isolated network for sharing GPS and clock data

Time and Frequency Lab Hardware

- ◆ 3 High Performance Cesiums & 1 Standard Performance Cesium
- ◆ 3 Hydrogen Masers
- ◆ 1 5MHz measurement system
- ◆ 1 1PPS clock monitor system
- ◆ 2 High Resolution Offset Generators
- ◆ 3 GPS Time Transfer Receivers

Time and Frequency Dissemination

- ◆ 5 MHz, 10 MHz, 1PPS via copper wire to internal labs and via fiber optic to other buildings on APL campus
- ◆ IRIG-B APL local time
- ◆ IRIG-B UTC
- ◆ IRIG-B input to APL NTP server
- ◆ GPS signal via distribution amp

GPS Time Transfer

- ◆ Receiver operations
 - Precise Point Positioning (PPP)
 - Multi-Channel Common-View
- ◆ Common-View with NIST & USNO
- ◆ GPSPPP with BIPM

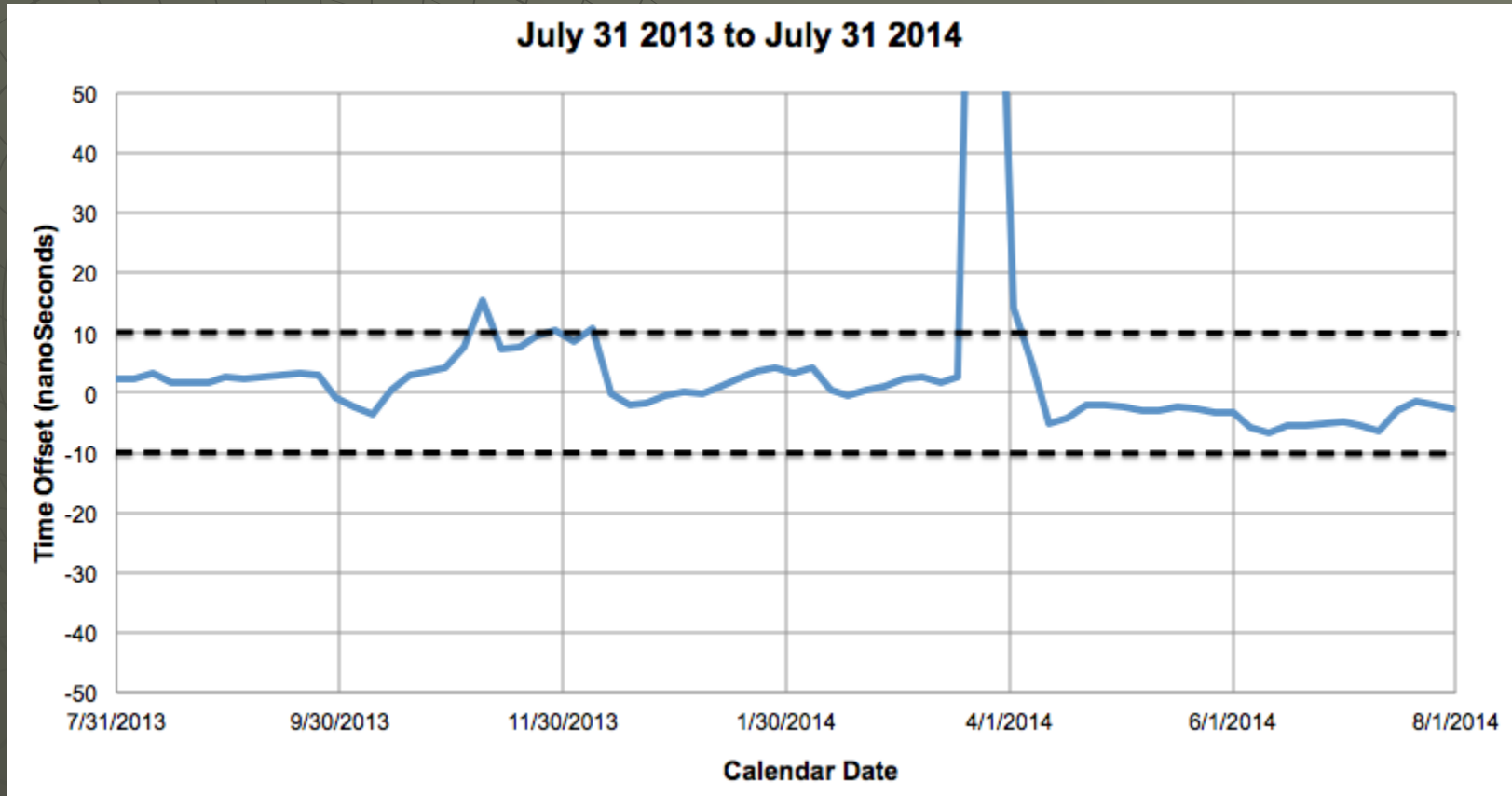
APL Timescale

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

UTC(APL)

- ◆ Output of Offset Generator
- ◆ Offset Generator driven by a Hydrogen Maser
- ◆ Offset Generator adjustments are based on estimation of $UTC - UTC(APL)$
- ◆ Adjustments are made daily

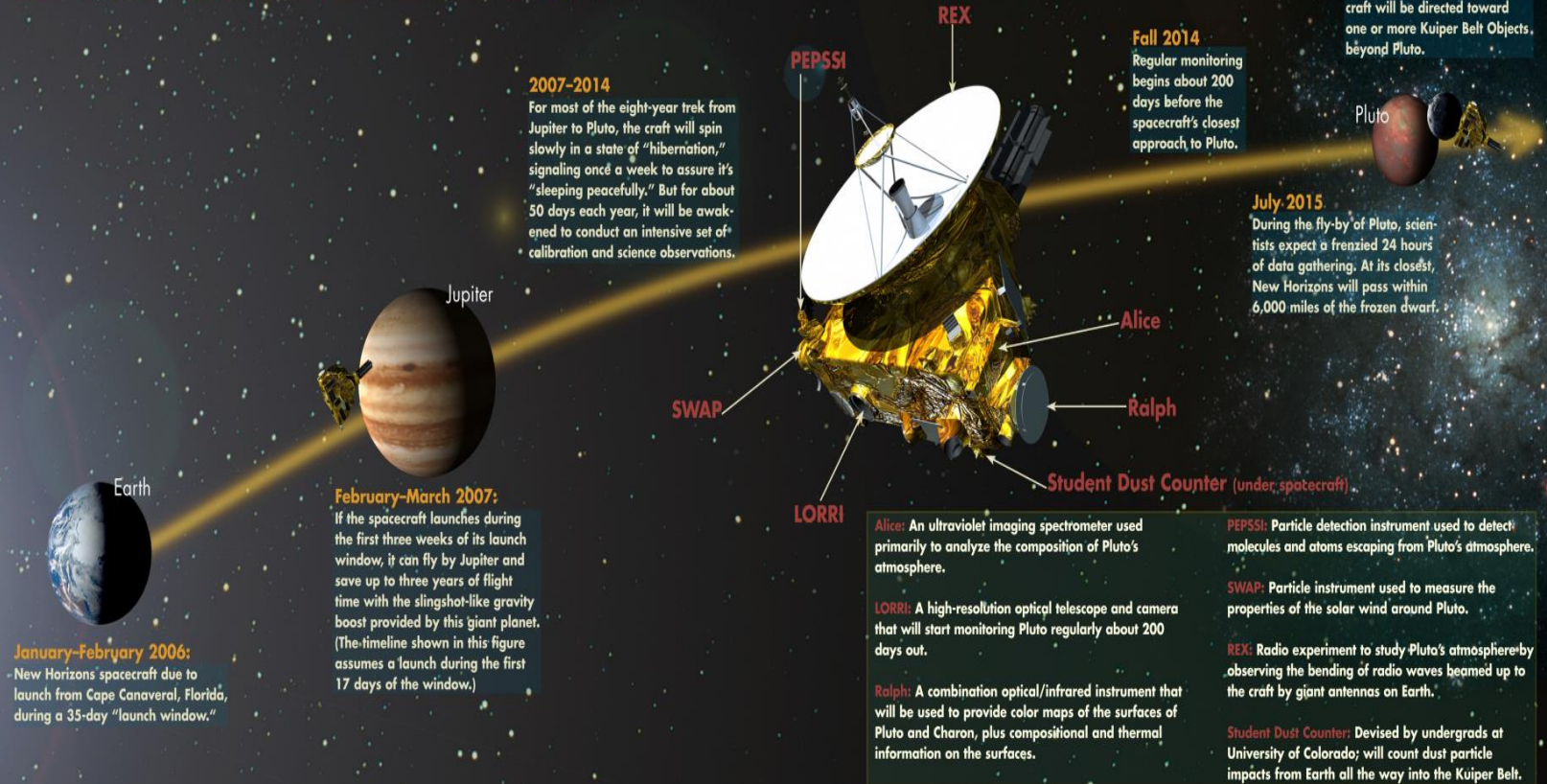
UTC – UTC(APL)



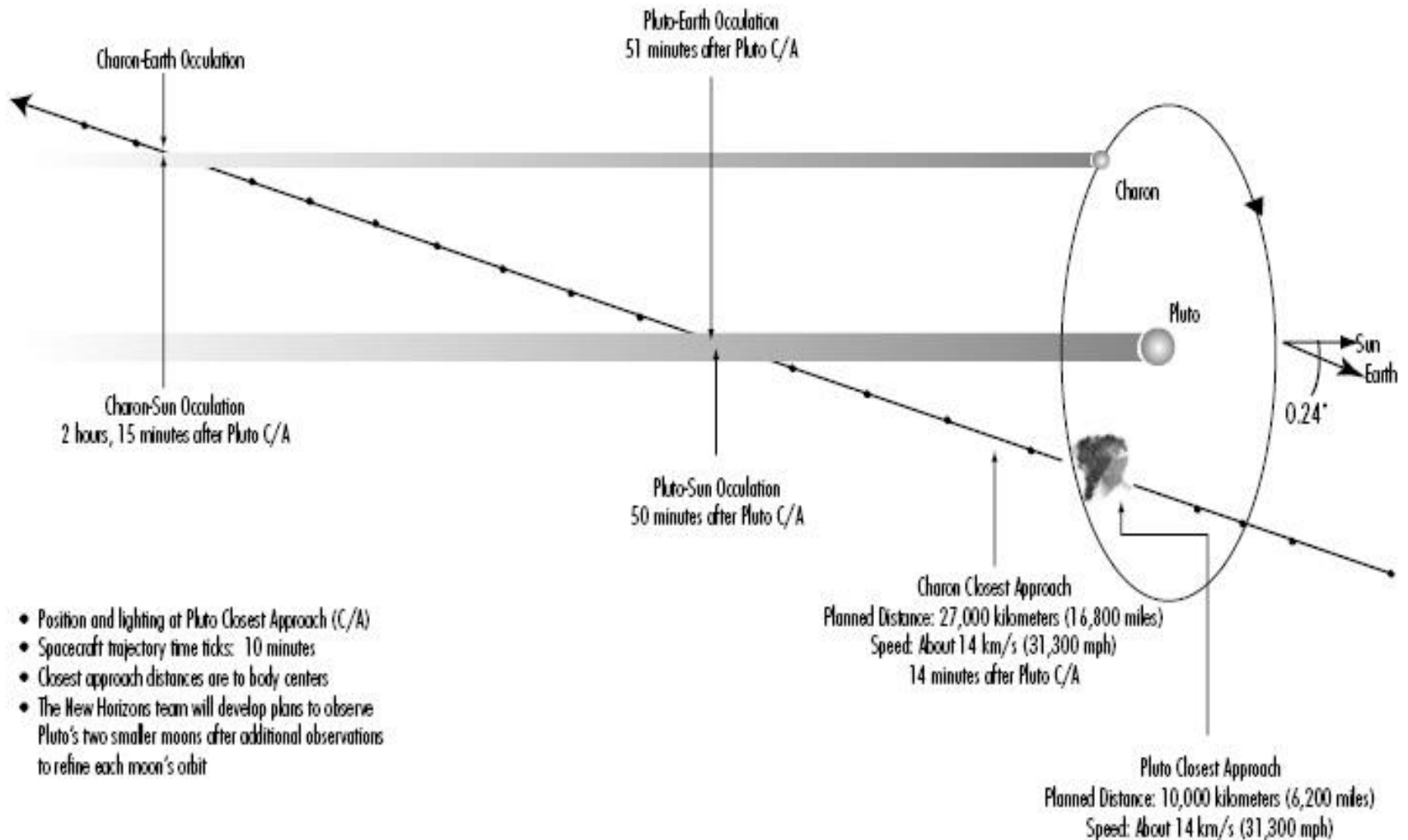
New Horizons

Launched: January 19, 2006
Pluto Closest Approach: July 14, 2015

Ten Years and Three Billion Miles . . .



Pluto-Charon Flyby: Closest Approach (July 2015)



- Position and lighting at Pluto Closest Approach (C/A)
- Spacecraft trajectory time ticks: 10 minutes
- Closest approach distances are to body centers
- The New Horizons team will develop plans to observe Pluto's two smaller moons after additional observations to refine each moon's orbit

New Horizons Weekly Operations Status Report

August 13, 2014 – August 19, 2014

DOY 225 – 231

Mission Statistics (at 231:11:00:00 UTC)

- Round trip light time (RTLTL) is 29363 seconds (8hrs 9min 23secs) (↑)
- Sun distance is 30.16 AU (↑)
- Earth distance is 29.43 AU (↑)
- Pluto distance is 2.62 (↓) AU
- Sun Probe Earth angle is $\sim 1.35^\circ$ (↑)
- Sun Earth Probe angle is $\sim 135.42^\circ$ (↓)

New Horizons news is posted on the Pluto website:

<http://pluto.jhuapl.edu/>