

New Horizons

Pluto/KB Mission

Status Report for OPAG

PI Alan Stern

SwRI

New Horizons/New Frontiers 1

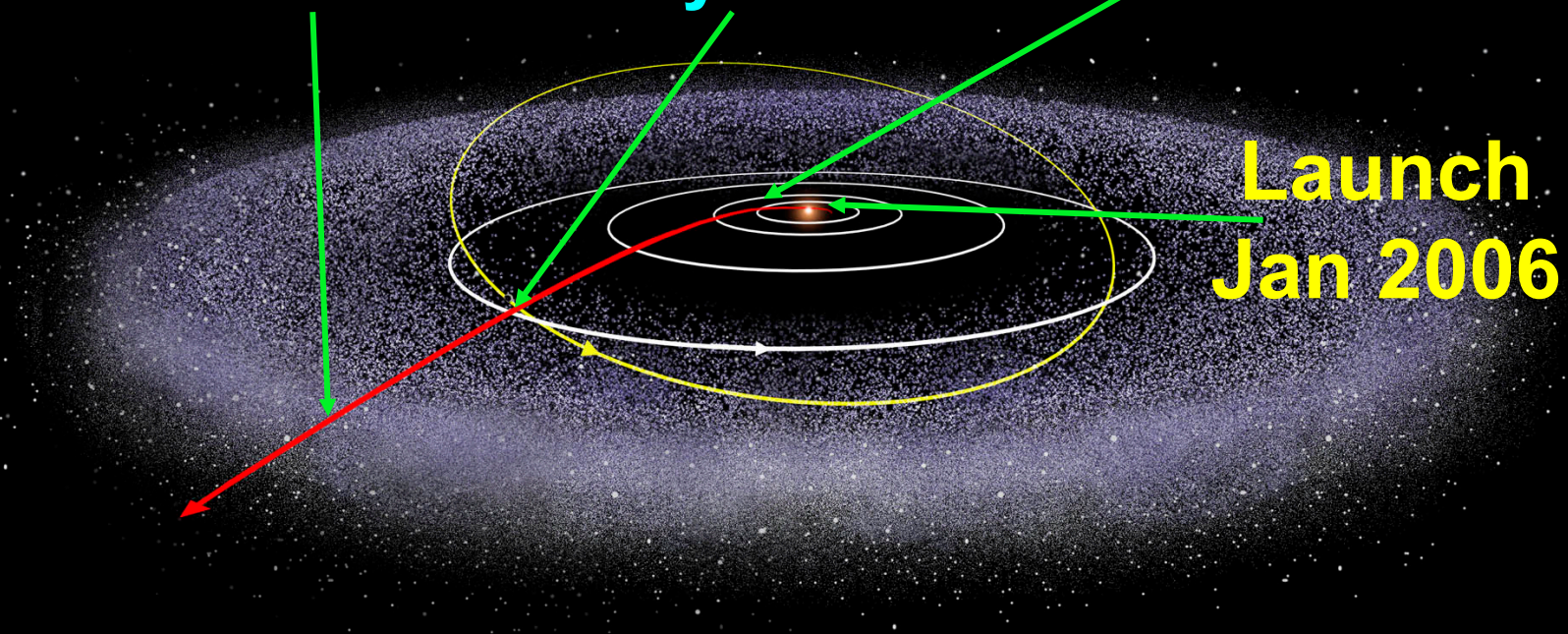
**Making an Initial Reconnaissance of The Solar System's
"Third Zone"**

**KBOs
2016-2020**

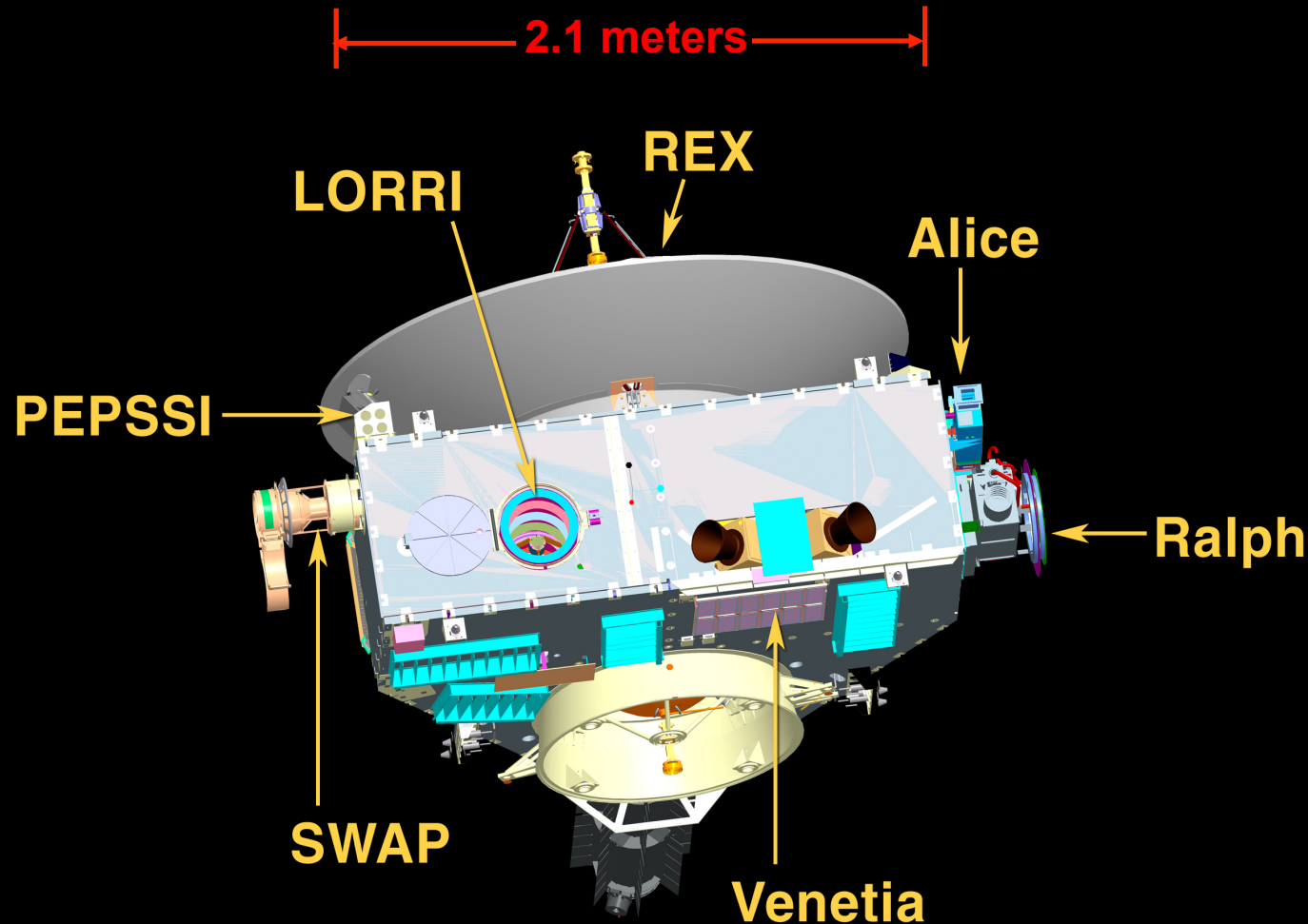
**Pluto-Charon
July 2015**

**Jupiter System
Feb-March 2007**

**Launch
Jan 2006**



NH SPACECRAFT AND PAYLOAD



Science Team:

PI: Alan Stern
Fran Bagenal
Rick Binzel
Bonnie Buratti
Andy Cheng
Dale Cruikshank
Randy Gladstone
Will Grundy
Dave Hinson
Mihaly Horanyi
Don Jennings
Ivan Linscott
Jeff Moore
Dave McComas
Bill McKinnon
Ralph McNutt
Scott Murchie
Cathy Olkin
Carolyn Porco
Harold Reitsema
Dennis Reuter
John Spencer
Darrell Strobel
Mike Summers
Len Tyler
Hal Weaver
Leslie Young

Both spacecraft and payload are performing well.

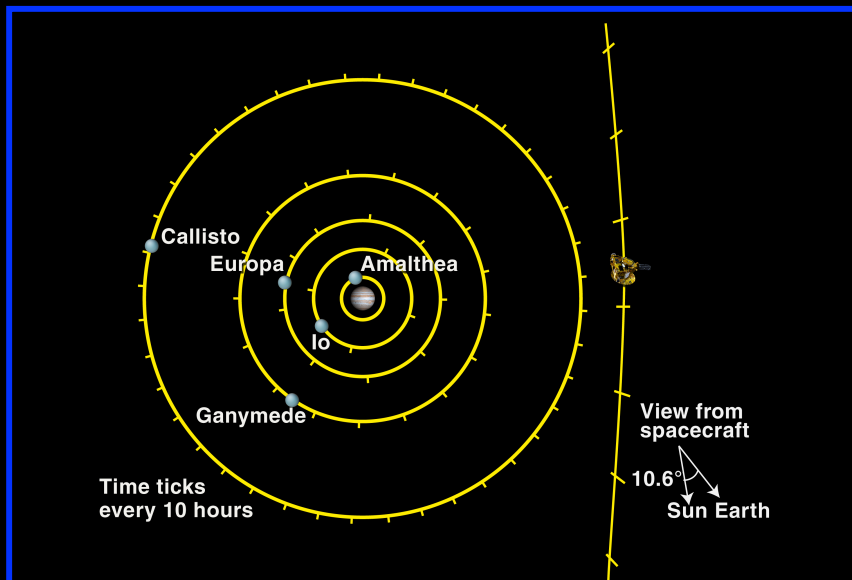
HIGH PAYLOAD FUNCTIONAL REDUNDANCY

AO Objective	Primary Sensor(s)	Fallback	Supporting	Fidelity of Fallback + Supporting	
Group 1					
Geology/ Geophysics	pan	MVIC pan	LORRI, MVIC color	LEISA	High
	color	MVIC 4-color	MVIC 2-color	LEISA	High
Surface composition	LEISA 4 quadrants	LEISA 2 of 4 quadrants	MVIC CH4 mapping	High	
Neutral atmosphere	Both ALICE and REX	Either ALICE or REX	SWAP, PEPSSI, MVIC	Medium	
Group 2					
Surface and atmospheric variability	MVIC, LORRI, LEISA, ALICE, REX	Any of MVIC, LORRI, LEISA, ALICE, or REX	SWAP, PEPSSI	High	
Stereo	MVIC pan	MVIC color, LORRI		High	
Hi-res terminator maps	MVIC pan	MVIC color, LORRI		High	
Hi-res composition maps	LEISA 4 quadrants	LEISA 2 of 4 quadrants	MVIC CH4 mapping	High	
Ionosphere/solar wind	Both REX and SWAP	Either REX or SWAP	ALICE	High	
Other atmospheric species	ALICE		SWAP, PEPSSI, [LEISA]	Low	
Charon atmosphere	ALICE		REX, LEISA	High	
Bond albedos	MVIC pan	MVIC color	LORRI, LEISA	Medium	
Surface temperatures	REX and LEISA 4 quadrants	LEISA 2 of 4 quadrants or REX		High	
Group 3					
Energetic particles	PEPSSI		SWAP	Low	
Bulk parameters	MVIC, LORRI, LEISA, REX	Any of MVIC, LORRI, LEISA, or REX		High	
Satellite and ring search	MVIC pan	MVIC color, LORRI	ALICE, REX	High	

[] implies indirect measurement requiring modeling

JUPITER SUCCESS!

**WITH A BEVY
OF NEW
SCIENCE**



Crossed Uranus orbit

2011-March-18

(Same day MESSENGER entered Mercury orbit)

Crossing Neptune orbit

2014-August-25

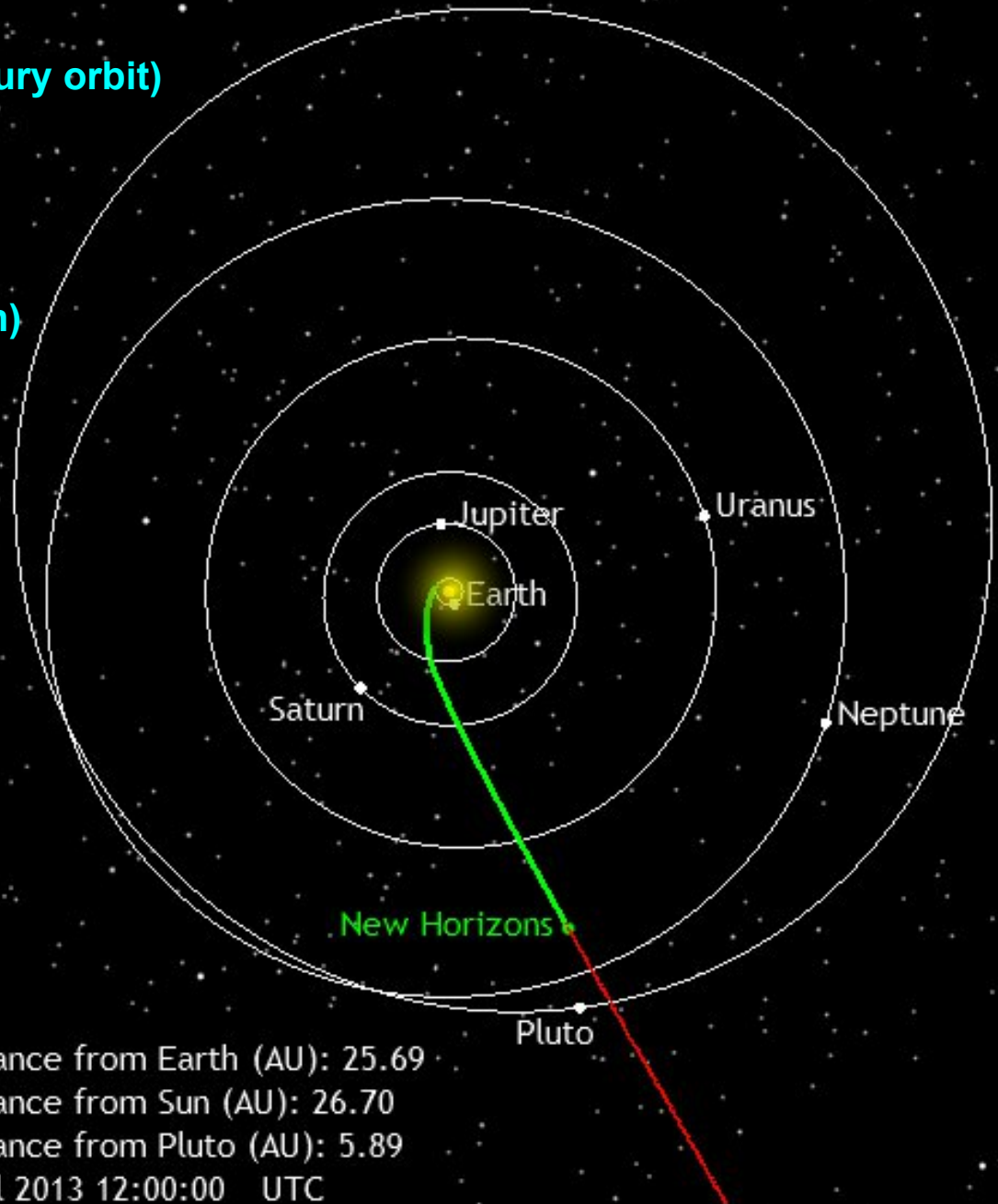
(Exactly 25 years after Voyager 2/Triton)

Pluto Closest Approach

2015-July-14

(Exactly 50 years after Mariner 4/Mars)

New Horizons Full Trajectory - Overhead View



PLUTO SYSTEM ENCOUNTER: SCIENCE OBJECTIVES

Group 1 Objectives: REQUIRED

Specified by NASA	Added and ranked by New Horizons Science Team
Characterize the global geology and morphology of Pluto and Charon	None
Map surface composition of Pluto and Charon	
Characterize the neutral atmosphere of Pluto and its escape rate	

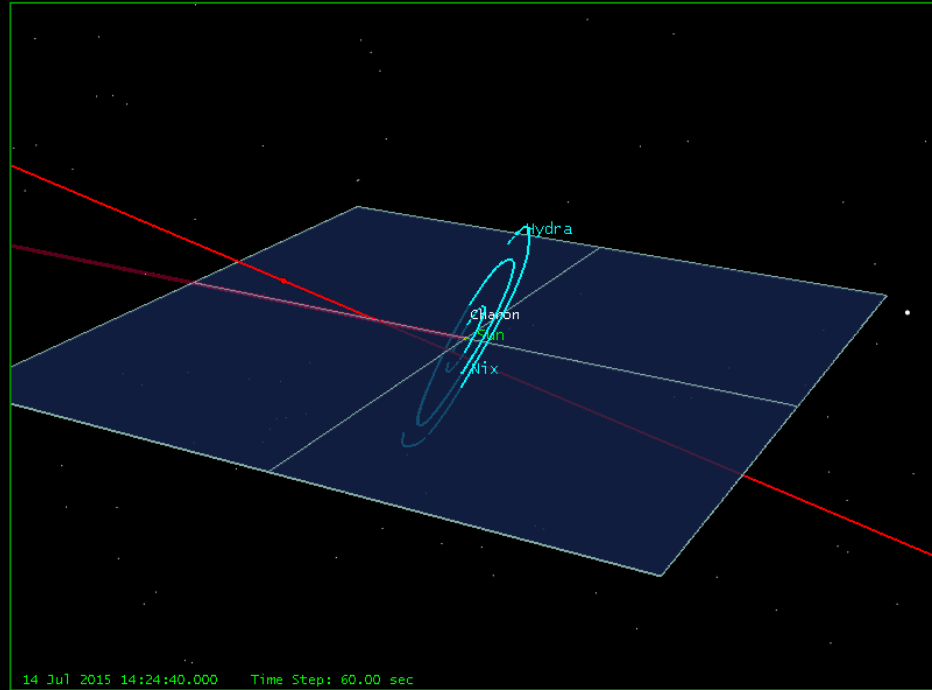
Group 2 Objectives: STRONGLY DESIRED

Specified by NASA	Added and ranked by New Horizons Science Team
Characterize the time variability of Pluto's surface and atmosphere	Composition of dark surfaces on Pluto
Image Pluto and Charon in Stereo	"Far-side" imaging of Pluto and Charon
Map the terminators of Pluto and Charon with high resolution	"Far-side" color and composition of Pluto and Charon
Characterize Pluto's ionosphere and solar wind interaction	High resolution imaging of Nix and Hydra
Search for neutral species including H, H ₂ , HCN, and C _x H _y , and other hydrocarbons and nitriles in Pluto's upper atmosphere	Composition of Nix and Hydra
Search for an atmosphere around Charon	Shapes of Nix and Hydra
Determine bolometric Bond albedos for Pluto and Charon	
Map the surface temperatures of Pluto and Charon	

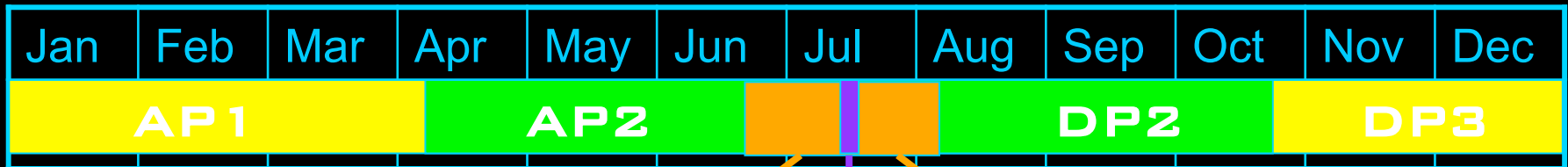
Group 3 Objectives: DESIRED

Specified by NASA	Added and ranked by New Horizons Science Team
Characterize the energetic particle environment of Pluto and Charon	Surface microphysics of Pluto and Charon
Refine bulk parameters (radii, masses, densities) and orbits of Pluto & Charon	Measure the surface temperatures of Nix and Hydra
Search for magnetic fields of Pluto and Charon	Measure the phase curve of Nix and Hydra
Search for additional satellites and rings	Image Nix and Hydra in stereo
	Education/Public Outreach

ENCOUNTER GEOMETRY AND NOMENCLATURE



2015



AP3 NEP DP1

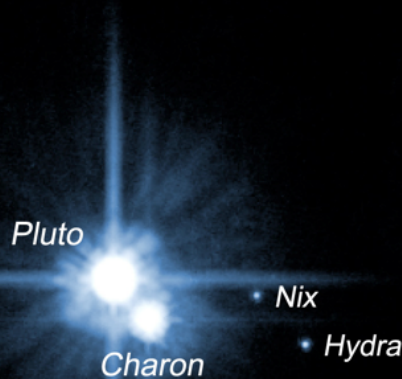
AP - Approach Phase, DP - Departure Phase, NEP - Near Encounter Phase

MISSION STATUS

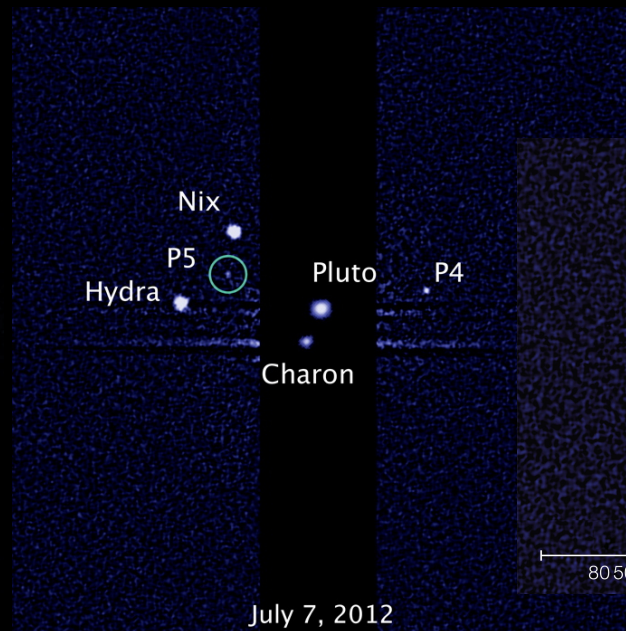
- New Horizons is healthy and remains on track
 - The science objectives should be achieved or *exceeded*
 - Nix, Hydra, Kerberos (P4), and Styx (P5) added (new discoveries)
 - More data to be collected than originally planned (~7x larger)
 - Robust encounter timeline with built-in redundancy to ensure success
 - Largely complete.
- Encounter Rehearsals Completed
 - Most intense 22 hr flyby segment successfully conducted in May 2012 (“stress test”)
 - P-7 to P+2 “Core Sequence” just completed successfully (July 5-14)!
- Hazard Concerns Largely Mitigated (see next slides)
- Conducting intensive search for KBOs that are targetable by New Horizons during extended mission
 - Using large ground based telescopes with Hubble follow-up

PLUTO'S PLETHORA OF SATELLITES: GOOD NEWS AND BAD

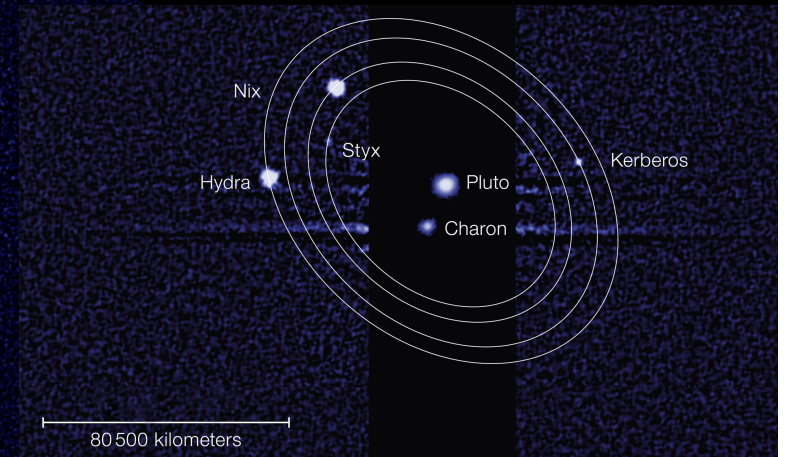
Hubble: May 2005



Hubble: July 2012



Pluto + 5 Moons
With Names!



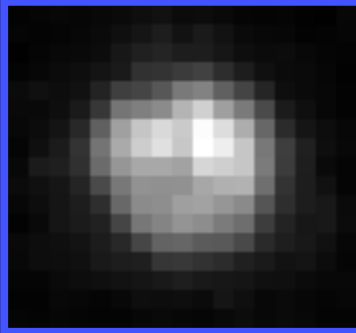
Six for the price of one, but with strings attached. Where there are small satellites, there will be debris. A collision between mm-sized particles and the NH spacecraft moving at ~14 km/s could result in a loss of mission, *but we think NH is safe on current trajectory.*

Names: P4 = Kerberus, P5 = Styx

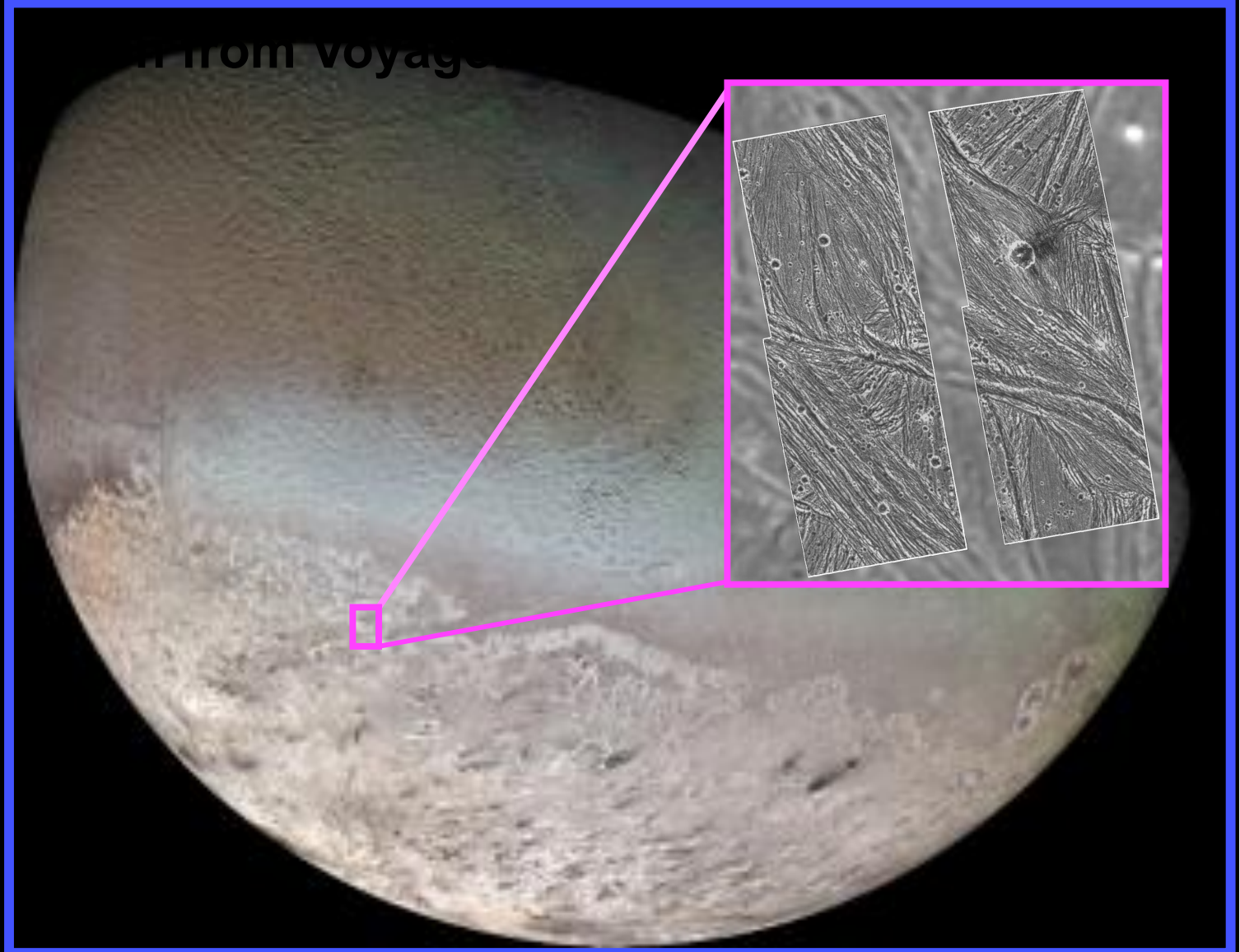
CONCERNS

- Impact Hazards Owing to Satellite Ejecta in the System
 - *Largely mitigated: Probability of LOM is estimated now at <0.3%*
 - *Two alternate encounters being planned (“SHBOTs”)*
- Pluto heliocentric ephemeris error
 - Recent analysis shows systematic error in ephemeris derived from visible light astrometry
 - This is a KBO accessibility (propellant) risk, not a mission risk
 - *Plan to use ALMA to measure Pluto’s position relative to quasars*
 - Reanalysis of Lowell historical plates will also help

A REVOLUTION IN KNOWLEDGE IS IN STORE

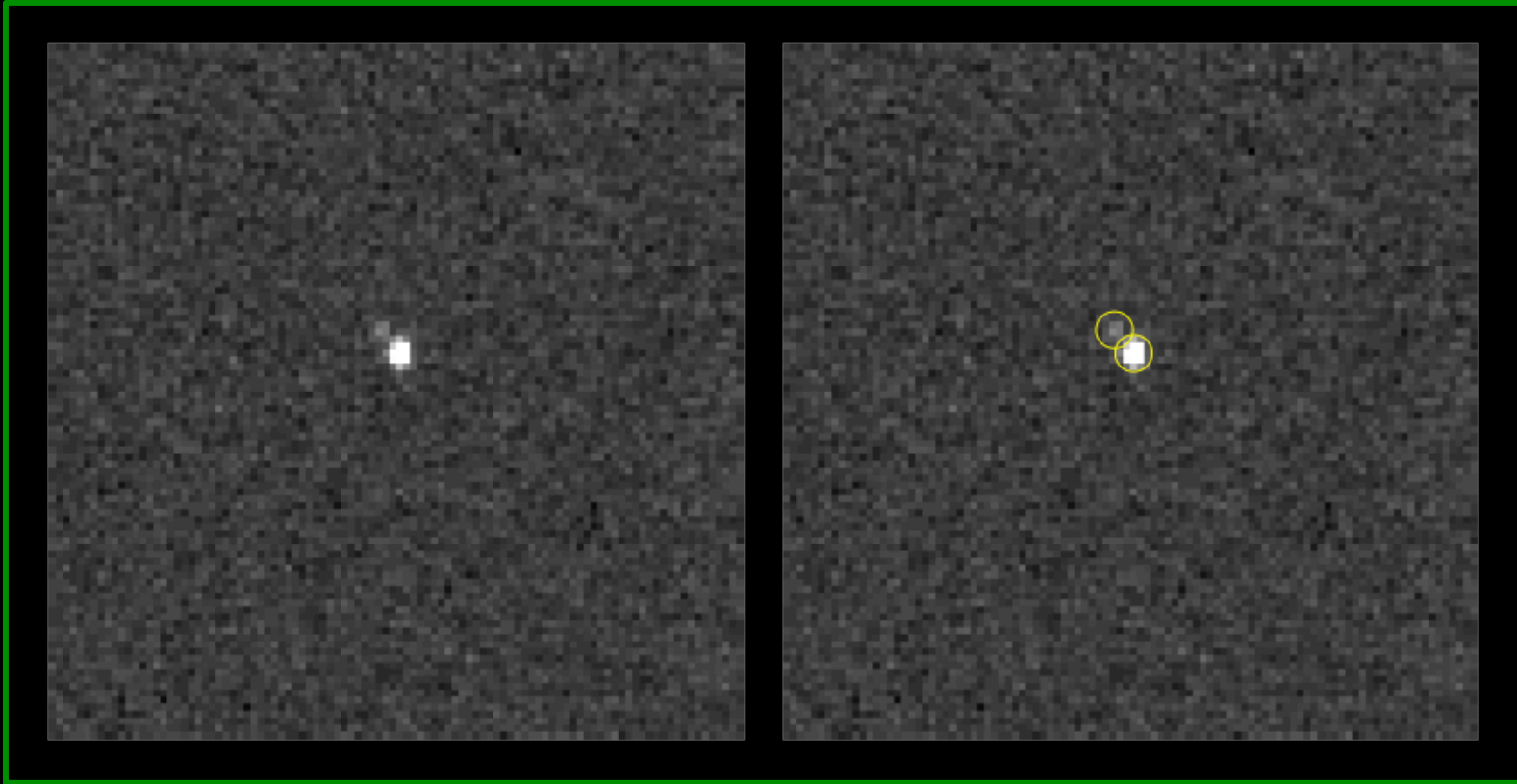


**Triton & Pluto
At Best HST
Resolution**



from voyage

TYAN

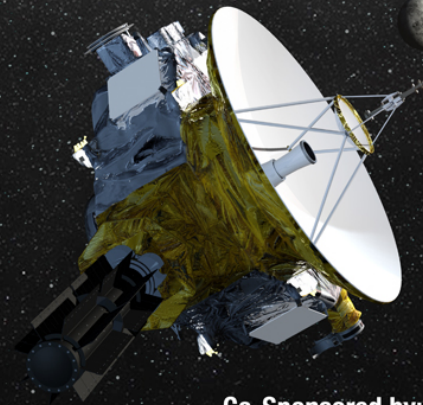


Charon Detection July 2013

NEW Shedding Light on Frontier Worlds
HORIZONS

**The Pluto System on the Eve of
Exploration by New Horizons:
Perspectives and Predictions**

**A Scientific Conference
July 22–26, 2013**



**Co-Sponsored by:
The Johns Hopkins University Applied Physics Laboratory
and
The Southwest Research Institute**

To be held at the Applied Physics Laboratory, Laurel, MD

Local Organizing Chair: Hal Weaver, New Horizons Project Scientist
Program Committee Chair: Alan Stern, New Horizons Principal Investigator

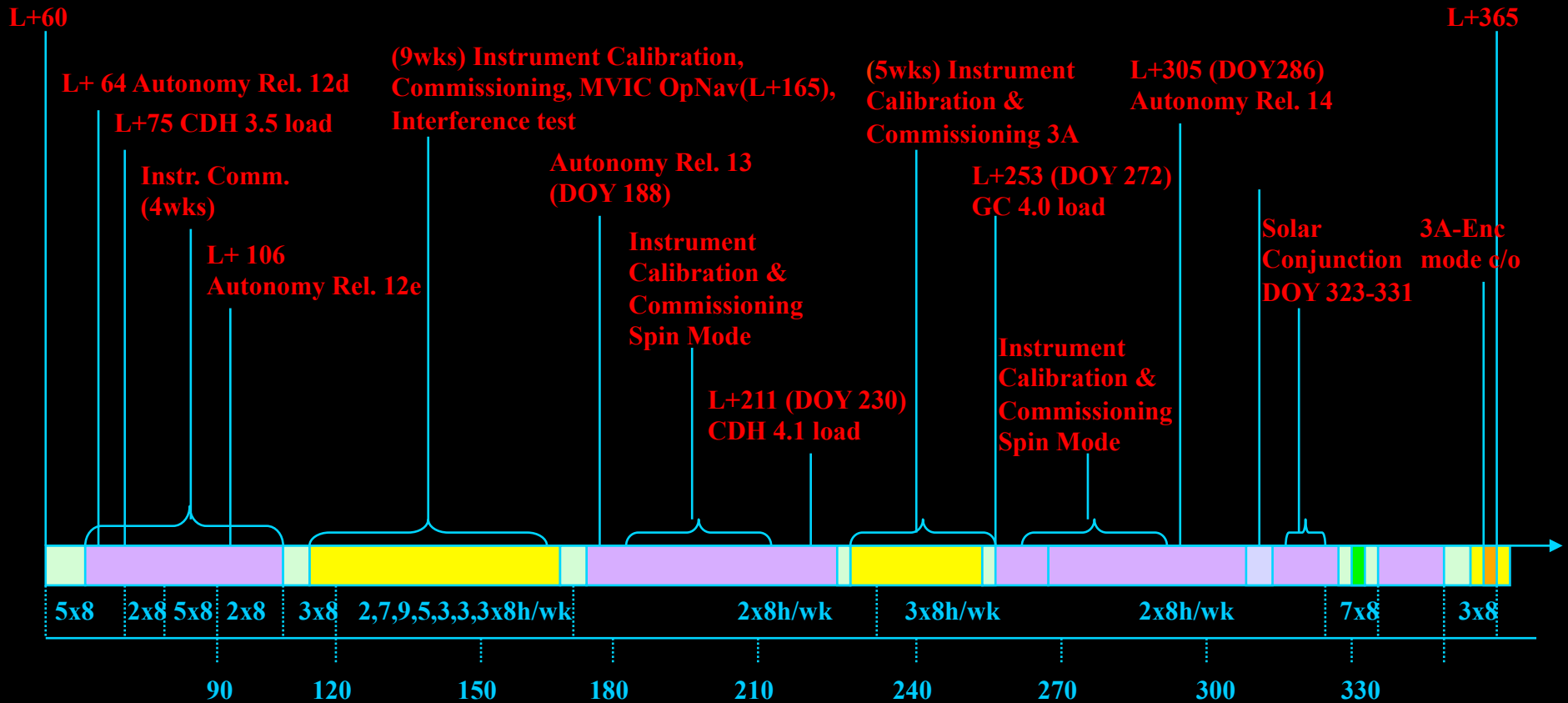
<http://pluto.jhuapl.edu/conference/index.php>

**Next Week,
At APL**

Registration remains open! <http://plutoscience.jhuapl.edu>

Backups

CRUISE 1: TO JUPITER

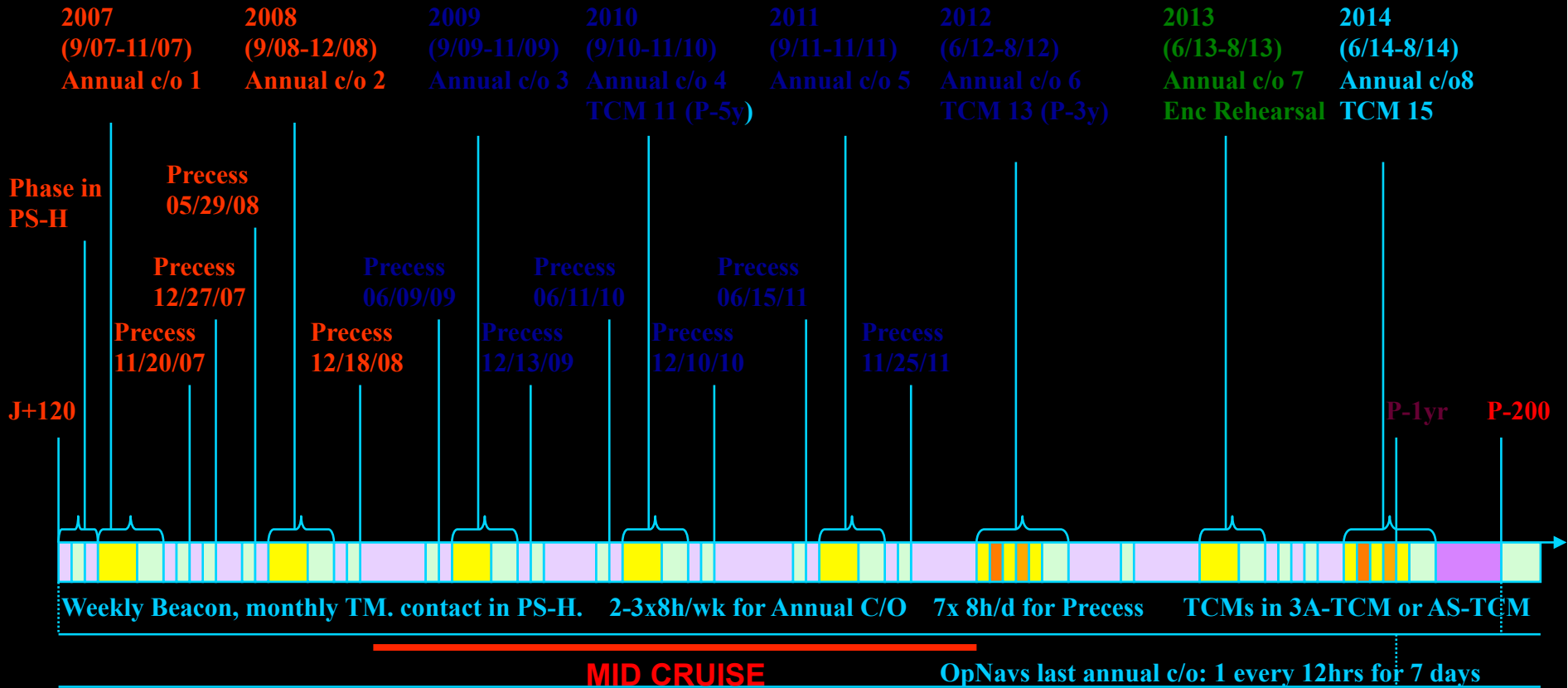


PS-Hibernation
PS-Normal
PS-TCM

AS-Normal
AS-TCM
AS-EA
AS-SA

3A-Normal
3A-Encounter
3A-TCM

CRUISE 2: ACROSS THE DEEP

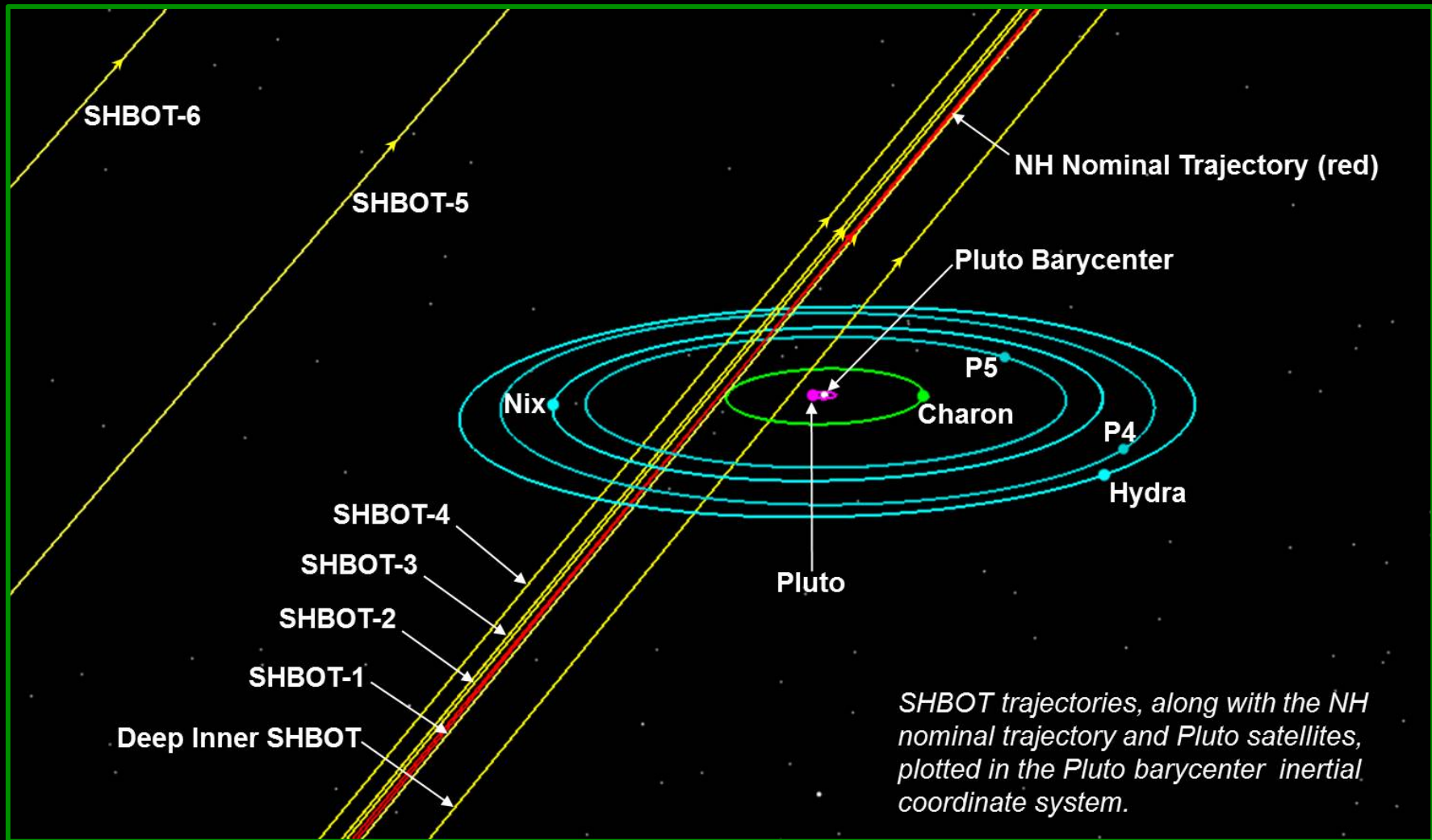


PS-Hibernation
 PS-Normal
 PS-TCM

AS-Normal
 AS-TCM
 AS-EA
 AS-SA

3A-Normal
 3A-Encounter
 3A-TCM

SHBOT TRAJECTORIES



CLOSEST APPROACH

