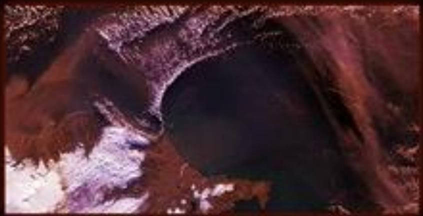
National Aeronautics and Space Administration

NASA Science

Weekly Highlights
September 13, 2013



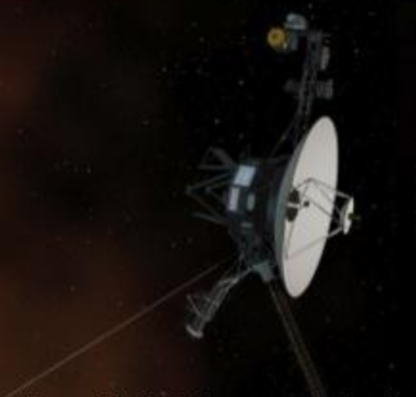
EARTH SCIENCE

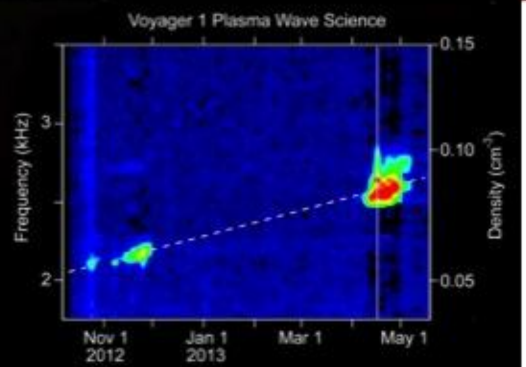
HELIOPHYSICS

PLANETARY SCIENCE

ASTROPHYSICS

NASA's Voyager 1 Spacecraft is in Interstellar Space





Above left: Artist's concept showing the Voyager 1 spacecraft entering interstellar space, which is dominated by plasma, ionized gas (illustrated here as brownish haze), that was thrown off by giant stars millions of years ago. Credit: NASA/JPL-Caltech.

Above right: Voyager 1's plasma wave instrument detected the vibrations of dense interstellar plasma, or ionized gas, from October to November 2012 and April to May 2013. The graphic shows the frequency of the waves, which indicate the density of the plasma. Colors indicate the intensity of the waves, or how "loud" they are. Red indicates the loudest waves and blue indicates the weakest. Credit: NASA/JPL/U. of Iowa

- NASA's Voyager 1 spacecraft officially is the first human-made object to venture into interstellar space. The 36-year-old probe is currently about 12 billion miles (19 billion kilometers) from our sun.

- New and unexpected data indicate Voyager 1 has been traveling for about one year through plasma, or ionized gas, present in the space between stars. Voyager is in a transitional region immediately outside the solar bubble, where some effects from our sun are still evident.

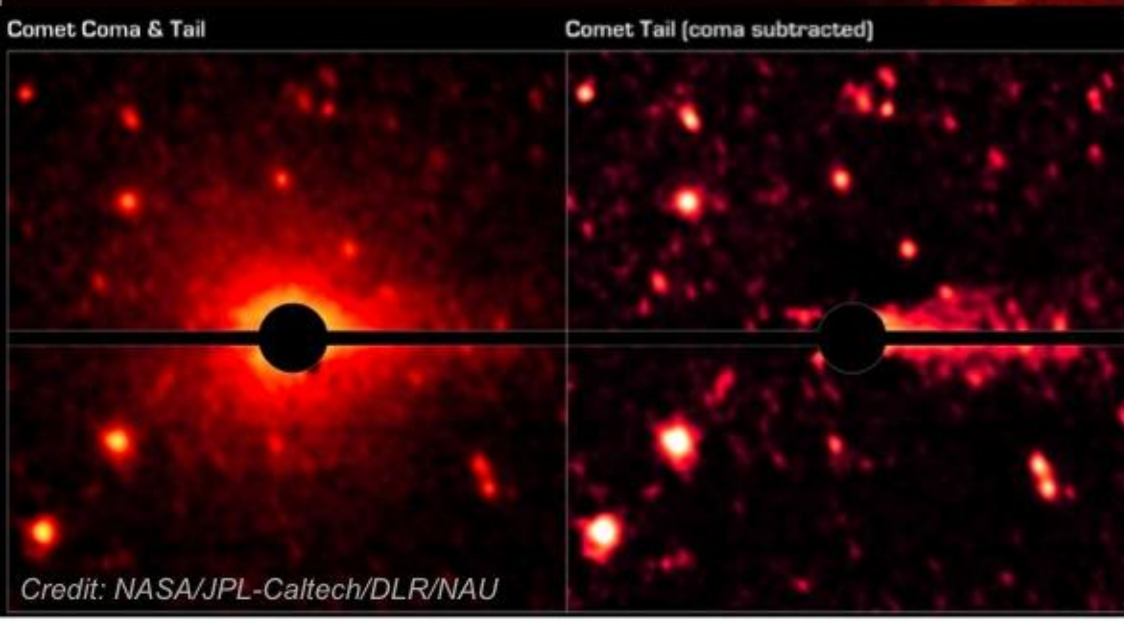
- Voyager 1 first detected the increased pressure of interstellar space on the heliosphere, the bubble of charged particles surrounding the sun that reaches far beyond the outer planets, in 2004. Scientists then ramped up their search for evidence of the spacecraft's interstellar arrival, knowing the data analysis and interpretation could take months or years.

- Since Voyager 1's plasma sensor is no longer operating, scientists needed a different way to measure the plasma environment to make a definitive determination of its location. It came in the form of a coronal mass ejection (CME), or a massive burst of solar wind and magnetic fields, that erupted from the sun in March 2012. When the CME eventually arrived at Voyager 13 months later, the plasma around the spacecraft began to vibrate like a violin string. On April 9, Voyager 1's plasma wave instrument detected the movement. The pitch of the oscillations helped scientists determine the density of the plasma. The particular oscillations meant the spacecraft was bathed in plasma more than 40 times denser than what it had encountered in the outer layer of the heliosphere. Density of this sort is to be expected in interstellar space.

- The new plasma data suggested a timeframe consistent with abrupt, durable changes in the density of energetic particles that were first detected on Aug. 25, 2012. The Voyager team generally accepts this date as the date of interstellar arrival.

- Scientists do not know when Voyager 1 will reach the undisturbed part of interstellar space where there is no influence from our sun. They also are not certain when Voyager 2 is expected to cross into interstellar space, but they believe it is not very far behind. The end of Voyager 1's journey in our heliosphere, marks the beginning of its exploration of interstellar space.

Comet Found Hiding in Plain Sight



The left image shows Don Quixote's coma and tail -- features of comets -- as revealed in infrared light by Spitzer. The coma appears as a faint glow around the center of the body, caused by dust and gas. The tail, which appears more clearly in the right image, points towards the right-hand side of Don Quixote, into the direction opposite of the sun.

The right image represents a more elaborate image processing step, in which the glow of the coma has been removed based on a model comet coma. Bright speckles around Don Quixote are background stars; the horizontal bar covers image artifacts caused by the image processing.

- For 30 years, a large near-Earth asteroid wandered its lone, intrepid path, passing before the scrutinizing eyes of scientists armed with telescopes while keeping something to itself. The object, known as Don Quixote, whose journey stretches to the orbit of Jupiter, now appears to be a comet.
- The discovery resulted from an ongoing project coordinated by researchers at Northern Arizona University, Flagstaff, Ariz., using NASA's Spitzer Space Telescope. Through a lot of focused attention and a little luck, they found evidence of comet activity, which had evaded detection for three decades.
- The results show that Don Quixote is not a dead comet, as previously believed, but it has a faint coma and tail. In fact, this object, the third-biggest near-Earth asteroid known, skirts Earth with an erratic, extended orbit and is "sopping wet," said David Trilling of Northern Arizona University, with large deposits of carbon dioxide and presumably water ice. Don Quixote is about 11 miles (18 kilometers) long.
- The implications have less to do with a potential impact, which is extremely unlikely in this case, and more with "the origins of water on Earth," Trilling said. Impacts with comets like Don Quixote over geological time may be the source of at least some of it, and the amount on Don Quixote represents about 100 billion tons of water -- roughly the same amount that can be found in Lake Tahoe, Calif.

Seasonal Ice Surface Elevation Change Measurements

IceBridge deployment to Greenland with C-130/LVIS
September 9 – 27, 2013

Goals

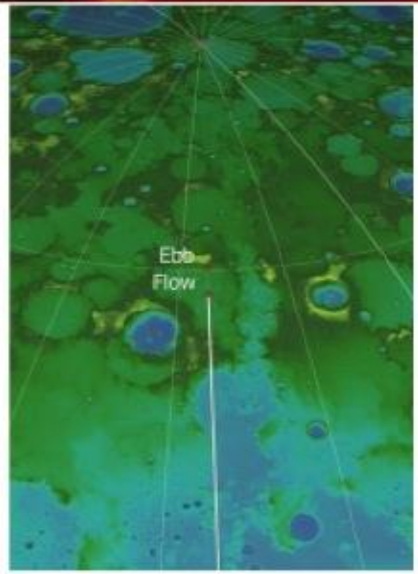
1) CryoSat-2 cal/val: Comparing LVIS (Land, Vegetation and Ice Sensor) and LVIS-GH (aboard the GlobalHawk) data collected along ESA's CryoSat-2 ground tracks during the melt season to improve understanding of how the latter's unique interferometric synthetic aperture radar (InSAR) mode is affected by melt ponds on the ice sheet surface and changing firn conditions. The data can be used to developing a prototype processor for unwrapping of the phase around the Point of Closest Approach (POCA) with the goal of producing surface elevation DEMs from InSAR data. The data will also help improve estimates of sea-ice thickness and volume, which have proved difficult to obtain from CryoSat-2 sea-ice elevation measurements during this time of year.
Two CryoSat-2 underflights, one over land ice and one over sea ice have the highest priorities of the planned flights for this campaign.

The CryoSat-2 Validation and Retrieval Team (CVRT) has reviewed and commented on the flight plans proposed by the IceBridge Science Team and agrees with the proposed measurements in general and in particular for CryoSat-2 support. The CryoSat-2 Operations Center in Darmstadt, Germany will be in contact with the field team to coordinate orbit maneuvers and work on the SIRAL radar (Synthetic Aperture Interferometric Radar Altimeter - airborne simulator for CryoSat-2) during the field deployment.

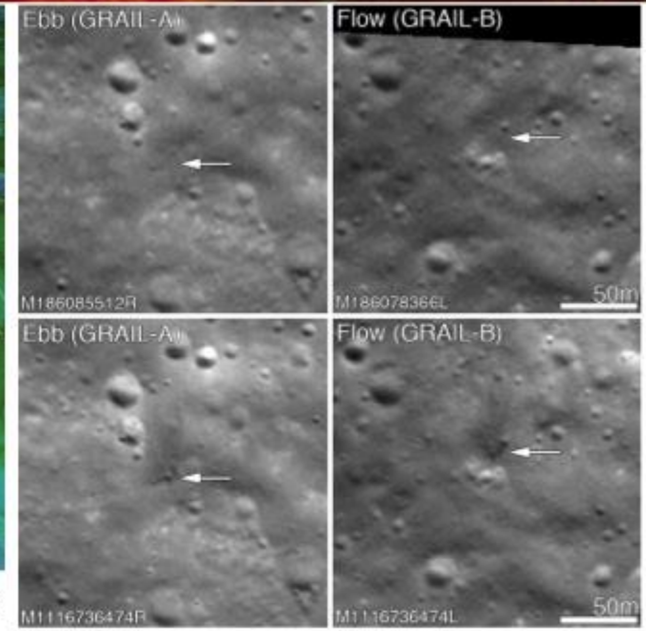
2) ICESat time series: These will be the first measurements of surface elevation change over a yearly melt cycle, and flight lines overlap with ATM (Airborne Topographic Mapper - airborne laser altimeter used on IceBridge) flight lines from March. Data will also help interpret early ICESat-2 measurements, understanding the relationship between seasonal processes and ice dynamics, and will help to constrain the model-based surface melt approximations that are used when working with satellite laser altimetry.
C-130 deployment: LVIS and LVIS-GH installed on C-130 to almost double the swath width. The C-130 will deploy to Greenland from Sept 9 -27, operating from Kangerlussuaq and Thule Air Base (right) and will collect about 80 hours of science data.

LRO Observations of the GRAIL Impacts: Lasting Impressions of Two Spacecraft

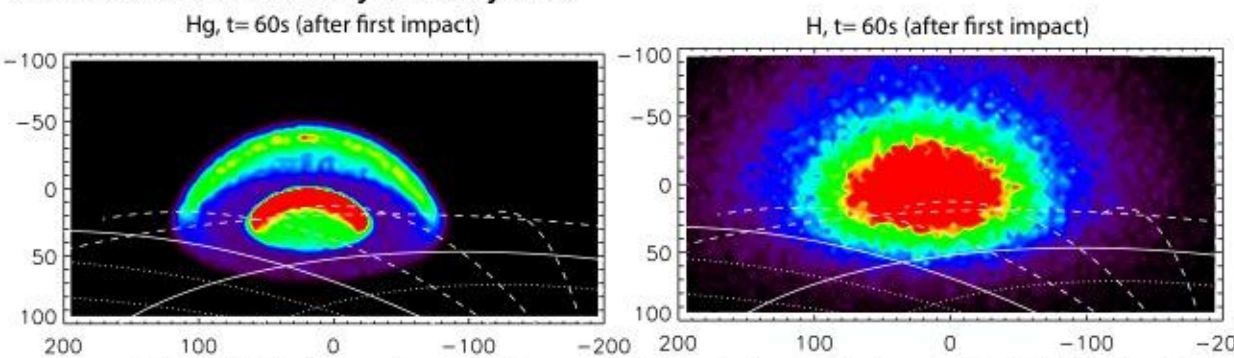
- The twin GRAIL spacecraft impacts on Dec. 17, 2012 provided a unique opportunity to observe the formation of two craters at a non-polar location.
- LRO's LAMP instrument detected the GRAIL A impact plume, measuring mercury [Hg] (also previously observed in the LCROSS impact and Apollo samples) and, for the first time, atomic hydrogen [H]. Atomic hydrogen may have formed in the same process that creates surficial lunar hydration.
- Although charged particles will be removed by the solar wind, any neutral material from this plume may be detected by LADEE.
- In February, LROC imaged the Sally Ride site (GRAIL A and B impact sites), observing small craters surrounded by dark ejecta.



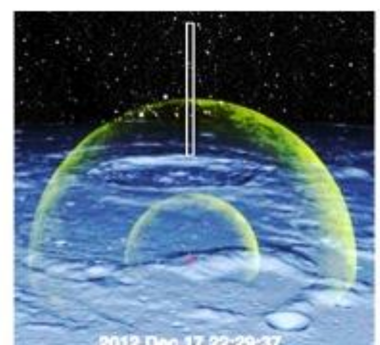
Visualization of GRAIL A (Ebb) and B (Flow) flight path, moments before impacting into a small lunar mountain. (NASA/ GSFC/SVS)



LRO Narrow Angle Camera (NAC) views of the GRAIL impact sites before (left, top) and after (left, bottom) the impact of the twin spacecraft. The two sites are approximately 1 km apart. The after images were taken on Feb. 28, 2013. (NASA/ GSFC/ASU)



Maps of the LAMP observations of Mercury (left) and atomic Hydrogen (right) following the impact of GRAIL A and B. (NASA/GSFC/SwRI, from Hurley et al., in preparation)



Visualization of GRAIL A (outer) and B (inner) impact plumes as seen from LRO roughly 60 seconds after impact of GRAIL A. Rectangle represents LAMP viewing slit. (NASA/GSFC/SVS)

NASA All-Stars Program – University of Chicago
July 15-30, 2013

The **NASA All-Stars** program brought together a diverse group of 9 teachers and 13 students from the Chicago Public Schools and an Islamic School as co-learners using our NASA-funded Multiwavelength Astronomy website, which presents story-based lessons on the science, history, tools, and impact of astronomy across the spectrum featuring NASA missions and multimedia.

Four teacher-mentors led small-group morning sessions with their peers, joined by Professor Don York. In the afternoon, students joined the teachers for science talks given by University of Chicago scientists. Skype sessions were arranged with guest speakers (including Dr. Harvey Moseley of NASA) who participated in the interviews for the story-based lessons.

Each participant received an iPad Mini to use for exploring the lessons, doing research, presenting their work, and blogging. The Minis were given to the participants on the final day, after teachers presented their lesson plans using the Multiwavelength Astronomy resources and students presented short research projects using data from the Sloan Digital Sky Survey. Each student also received a family membership to the Adler Planetarium and Astronomy Museum.

The program provided the opportunity for participants to meet a NASA scientist and use NASA educational resources for in-depth content learning.