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1. Telescopes Give Shape to Furious Black Hole Winds

NASA's NuSTAR and ESA's XMM-Newton telescope are showing that fierce winds from a supermassive black hole blow outward in all directions -- a phenomenon that had been suspected, but difficult to prove until now.

This discovery has given astronomers their first opportunity to measure the strength of these ultra-fast winds and prove they are powerful enough to inhibit the host galaxy's ability to make new stars.

"We know black holes in the centers of galaxies can feed on matter, and this process can produce winds. This is thought to regulate the growth of the galaxies," said Fiona Harrison of the California Institute of Technology (Caltech) in Pasadena, California. Harrison is the principal investigator of NuSTAR and a co-author on a new paper about these results appearing in the journal Science. "Knowing the speed, shape and size of the winds, we can now figure out how powerful they are."

Supermassive black holes blast matter into their host galaxies, with X-ray-emitting winds traveling at up to one-third the speed of light. In the new study, astronomers determined PDS 456, an extremely bright black hole known as a quasar more than 2 billion light-years away, sustains winds that carry more energy every second than is emitted by more than a trillion suns.

"Now we know quasar winds significantly contribute to mass loss in a galaxy, driving out its supply of gas, which is fuel for star formation," said the study's lead author Emanuele Nardini of Keele University in England.

NuSTAR and XMM-Newton simultaneously observed PDS 456 on five separate occasions in 2013 and 2014. The space telescopes complement each other by observing different parts of the X-ray light spectrum: XMM-Newton views low-energy and NuSTAR views high-energy.
Previous XMM-Newton observations had identified black hole winds blowing toward us, but could not
determine whether the winds also blew in all directions. XMM-Newton had detected iron atoms, which are
carried by the winds along with other matter, only directly in front of the black hole, where they block X-rays.
Combining higher-energy X-ray data from NuSTAR with observations from XMM-Newton, scientists were able
to find signatures of iron scattered from the sides, proving the winds emanate from the black hole not in a
beam, but in a nearly spherical fashion.

"This is a great example of the synergy between XMM-Newton and NuSTAR," said Norbert Schartel, XMM-
Newton project scientist at ESA. "The complementarity of these two X-ray observatories is enabling us to
unveil previously hidden details about the powerful side of the universe."

With the shape and extent of the winds known, the researchers could then determine the strength of the
winds and the degree to which they can inhibit the formation of new stars.

Astronomers think supermassive black holes and their home galaxies evolve together and regulate each
other's growth. Evidence for this comes in part from observations of the central bulges of galaxies -- the more
massive the central bulge, the larger the supermassive black hole.

This latest report demonstrates a supermassive black hole and its high-speed winds greatly affect the host
galaxy. As the black hole bulks up in size, its winds push vast amounts of matter outward through the galaxy,
which ultimately stops new stars from forming.

Because PDS 456 is relatively close, by cosmic standards, it is bright and can be studied in detail. This black
hole gives astronomers a unique look into a distant era of our universe, around 10 billion years ago, when
supermassive black holes and their raging winds were more common and possibly shaped galaxies as we see
them today.

"For an astronomer, studying PDS 456 is like a paleontologist being given a living dinosaur to study," said
study co-author Daniel Stern of NASA's Jet Propulsion Laboratory (JPL) in Pasadena. "We are able to
investigate the physics of these important systems with a level of detail not possible for those found at more
typical distances, during the 'Age of Quasars.'"

NuSTAR is a Small Explorer mission led by Caltech and managed by JPL for NASA's Science Mission Directorate

Source: Spaceref.com
2. NASA’s Orion Flight Test Yields Critical Data as Engineers Improve Spacecraft for Next Mission

NASA’s Orion spacecraft continues on the agency’s journey to Mars as engineers analyze data from the spacecraft’s December flight test and make progress developing and building the spacecraft for its first mission atop NASA Space Launch System (SLS) heavy-lift rocket. On future missions, Orion will send astronauts to an asteroid and onward toward the Red Planet.

At machine houses across the country, elements of the primary structure for the next Orion to fly in space are coming together. Avionics components are being built and simulators for the ESA (European Space Agency)-built service module that will house the spacecraft’s propulsion and solar arrays are being delivered. By the end of the year, engineers hope to have the primary structure for Orion’s next mission to NASA’s Kennedy Space Center in Florida for processing. Meanwhile, every piece of data and each element of the spacecraft flown in the December test is being analyzed and compared to pre-flight models to improve Orion’s design.

“Orion’s flight test was a big success and what we learned is informing how we design, develop and build future Orions that will help us pioneer deep space destinations,” said Mark Geyer, NASA’s Orion Program manager. “Taking a look at all the flight test data is a huge part of the development process and a key part off in why we flew a test flight. We have critical work happening this year, both on the data analysis and development side, to keep us moving toward our first mission with SLS.”

Engineers and technicians at Kennedy, where Orion was assembled and returned after its flight test, recently took off the back shell and heat shield that protected Orion during its reentry to Earth’s atmosphere, to unload unused propellants and allow for a close-up analysis of the spacecraft’s systems.

One of the main objectives of Orion’s flight, which sent the vehicle 3,600 miles into space during a two-orbit, 4.5-hour test, was to test how the spacecraft would fare returning to Earth at high speeds and temperatures.

“The heat shield looks in great shape,” said Michael Hawes, Orion Program manager for Lockheed Martin, NASA’s prime contractor for the spacecraft. “The char on the shield is consistent. If you look at it now, you’d see a few big holes because we’ve taken core samples. We’ve also done a total laser scan of the surface of the heat shield. That’ll give us a very detailed engineering base of knowledge of what the heat shield did.”

In March, the heat shield will be shipped to NASA’s Marshall Space Flight Center in Huntsville, Alabama, where the ablative material on the heat shield will be taken off. From there, the heat shield structure will be shipped to the agency’s Langley Research Center in Hampton, Virginia, where it will be reused on a test capsule for water impact testing. NASA and Lockheed Martin also are taking a look at potential modifications to the heat shield’s design to make it even stronger.

Evaluating how the thermal protection system fared during Orion’s reentry wasn’t the only critical objective of the flight. The test also provided important insight into key separation events, including whether the Launch
Abort System and protective fairings came off at the right times, how the parachutes assisting Orion during its descent fared and how the operations to recovery Orion from the Pacific Ocean progressed.

According to Hawes, all of the spacecraft separation events happened within fractions of a second of when predictive models said they would occur; Orion’s 11 parachutes worked to allow the spacecraft to touchdown in the Ocean relatively gently; and the recovery team of NASA, U.S. Navy and Lockheed Martin personnel recovered it within about six hours.

The flight also examined the performance of a 3-D printed vent. It performed well, so teams will be looking at other hardware that could be made using the additive manufacturing process.

Engineers are taking a closer look at the crew module uprighting system airbags on top of the crew module, which help keep Orion stable in the water after splashdown. Only two of five of the bags properly inflated during the December flight test. Initial analysis of the gas and plumbing system for the bags came up clean, and engineers suspect a possible issue with the bags themselves.

“We’re in the midst of troubleshooting that now,” Hawes said.

Orion’s flight test yielded millions of elements of data, every piece of which is providing unique insight into how to improve the spacecraft’s design so that it can safely send astronauts on their way to Mars and return them home.

Source: NASA
NASA’s MAVEN Spacecraft Completes First Deep Dip Campaign

NASA’s Mars Atmosphere and Volatile Evolution has completed the first of five deep-dip maneuvers designed to gather measurements closer to the lower end of the Martian upper atmosphere.

“During normal science mapping, we make measurements between an altitude of about 150 km and 6,200 km (93 miles and 3,853 miles) above the surface,” said Bruce Jakosky, MAVEN principal investigator at the University of Colorado’s Laboratory for Atmospheric and Space Physics in Boulder. “During the deep-dip campaigns, we lower the lowest altitude in the orbit, known as periapsis, to about 125 km (78 miles) which allows us to take measurements throughout the entire upper atmosphere.”

The 25 km (16 miles) altitude difference may not seem like much, but it allows scientists to make measurements down to the top of the lower atmosphere. At these lower altitudes, the atmospheric densities are more than ten times what they are at 150 km (93 miles).

“We are interested in the connections that run from the lower atmosphere to the upper atmosphere and then to escape to space,” said Jakosky. “We are measuring all of the relevant regions and the connections between them.”

The first deep dip campaign ran from Feb. 10 to 18. The first three days of this campaign were used to lower the periapsis. Each of the five campaigns lasts for five days allowing the spacecraft to observe for roughly 20 orbits. Since the planet rotates under the spacecraft, the 20 orbits allow sampling of different longitudes spaced around the planet, providing close to global coverage.

This month’s deep dip maneuvers began when team engineers fired the rocket motors in three separate burns to lower the periapsis. The engineers did not want to do one big burn, to ensure that they didn’t end up too deep in the atmosphere. So, they “walked” the spacecraft down gently in several smaller steps.

“Although we changed the altitude of the spacecraft, we actually aimed at a certain atmospheric density,” said Jakosky. “We wanted to go as deep as we can without putting the spacecraft or instruments at risk.”
Even though the atmosphere at these altitudes is very tenuous, it is thick enough to cause a noticeable drag on the spacecraft. Going to too high an atmospheric density could cause too much drag and heating due to friction that could damage spacecraft and instruments.

At the end of the campaign, two maneuvers were conducted to return MAVEN to normal science operation altitudes. Science data returned from the deep dip will be analyzed over the coming weeks. The science team will combine the results with what the spacecraft has seen during its regular mapping to get a better picture of the entire atmosphere and of the processes affecting it.

One of the major goals of the MAVEN mission is to understand how gas from the atmosphere escapes to space, and how this has affected the planet’s climate history through time. In being lost to space, gas is removed from the top of the upper atmosphere. But it is the thicker lower atmosphere that controls the climate. MAVEN is studying the entire region from the top of the upper atmosphere all the way down to the lower atmosphere so that the connections between these regions can be understood.

MAVEN is the first mission dedicated to studying the upper atmosphere of Mars. The spacecraft launched Nov. 18, 2013, from Cape Canaveral Air Force Station in Florida. MAVEN successfully entered Mars’ orbit on Sept. 21, 2014.

MAVEN's principal investigator is based at the University of Colorado's Laboratory for Atmospheric and Space Physics. The university provided two science instruments and leads science operations, as well as education and public outreach, for the mission. NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the MAVEN project and provided two science instruments for the mission. Lockheed Martin built the spacecraft and is responsible for mission operations. The University of California at Berkeley's Space Sciences Laboratory also provided four science instruments for the mission. NASA's Jet Propulsion Laboratory in Pasadena, California, provides navigation and Deep Space Network support, as well as the Electra telecommunications relay hardware and operations.

Related Link:  [NASA's MAVEN website](https://nasa.gov/maven)
The Night Sky

Friday, February 20

Venus, the thin crescent Moon, and little Mars form a tight bunch in the west-southwest during and after dusk, as shown at right. They fit in a circle just 2° across at the times of dusk for most of North America. Think photo opportunities! See our article, Venus and Mars Pair Tightly at Dusk.

We have just a few more days to follow Comet Lovejoy, still 5th magnitude, high in a moonless evening sky this month.

Saturday, February 21

Venus and Mars are in conjunction 0.4° apart at dusk, with the Moon now looking on from above.

Two mutual events among Jupiter's moons. Watch Europa pass in front of Io this evening, from 9:05 to 9:11 p.m. EST. Their combined light dims by 0.6 magnitude (not quite half) at the center of this time.

Then less than an hour later, Europa casts its shadow onto Io from 9:41 to 9:49 p.m. EST, dimming Io by 0.9 magnitude at the mid-time.

Watch Christopher Go's highly magnified videos of Europa occulting Io and then Europa eclipsing Io on February 18th. (The gray spot at the center of each satellite is a processing artifact.)

Sunday, February 22

Jupiter blazes in the east after dark this week. High above it are Pollux and Castor. Look about half as far to Jupiter's right for the dim head of Hydra, the Sea Serpent, about the width of your thumb at arm's length.

Before the Moon starts brightening the evening sky too much, take a telescopic tour through some of the Melotte star clusters with Sue French's Deep-Sky Wonders column, charts, and photos in the March Sky & Telescope, page 58.

Monday, February 23

Spot the Pleiades high above the Moon after dark. Look to the Moon's right, just a little less far, for the brightest stars of Aries lined up nearly vertically.

Source: Sky & Telescope
ISS Sighting Opportunities

For Denver:

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Sighting information for other cities can be found at NASA’s Satellite Sighting Information page.

NASA-TV Highlights
(all times Eastern Daylight Time)

**Friday, February 20**

- 5 a.m., Replay of ISS Expedition 42 Spacewalk Preview Briefing (2/18) (all channels)
- 3:30 p.m., No way back: Charting Irreversible Climate Change with Jason-3 – Von Karman Lecture (all channels)
- 5 p.m., Replay of ISS Expedition 42 Spacewalk Preview Briefing (2/18) (all channels)
- 8:30 p.m., No way back: Charting Irreversible Climate Change with Jason-3 – Von Karman Lecture Series (all channels)
- 10 p.m., Replay of ISS Expedition 42 Spacewalk Preview Briefing (2/18) (all channels)

**Saturday, February 21**

- 4:30 a.m., Replay of ISS Expedition 42 Spacewalk Preview Briefing (2/18) (all channels)
- 6 a.m., Coverage of U.S. Spacewalk # 29 (Spacewalk scheduled to begin at 7:10 a.m. ET; Wilmore and Virts) (all channels)

Watch NASA TV on the Net by going to the NASA website.
Space Calendar

- Feb 20 - Garpun Proton-M/Briz-M Launch
- Feb 20 - [NEW] Comet P/2015 C1 (TOTAS-Gibbs) At Opposition (1.962 AU)
- Feb 20 - Comet 156P/Russell-LINEAR At Opposition (2.196 AU)
- Feb 20 - Asteroid 416151 (2002 RQ25) Near-Earth Flyby (0.051 AU)
- Feb 20 - Asteroid 163693 Atira Closest Approach To Earth (0.524 AU)
- Feb 20 - Asteroid 8256 Shenzhou Closest Approach To Earth (1.130 AU)
- Feb 20 - Asteroid 7919 Prime Closest Approach To Earth (1.693 AU)
- Feb 20 - Asteroid 18024 Dobson Closest Approach To Earth (2.140 AU)
- Feb 20 - George Smoot's 70th Birthday (1945)
- Feb 21 - Cosmos-Bars N1 Soyuz U Launch
- Feb 21 - Venus Passes 0.5 Degrees From Mars
- Feb 21 - Comet 206P/Barnard-Boattini At Opposition (1.586 AU)
- Feb 21 - Comet 249P/LINEAR At Opposition (2.381 AU)
- Feb 21 - Comet C/2013 UQ4 (Catalina) Closest Approach To Earth (2.589 AU)
- Feb 21 - Asteroid 3192 A'Hearn Closest Approach To Earth (0.989 AU)
- Feb 21 - Galaxy Forum Southeast Asia, Bandung, Indonesia
- Feb 21 - Catalina State Park Star Party, Tucson, Arizona
- Feb 21 - Tom Gehrels' 90th Birthday (1925)
- Feb 22 - Comet P/2015 A3 (PANSTARRS) Perihelion (1.154 AU)
- Feb 22 - Comet 299P/Catalina-PANSTARRS Perihelion (3.142 AU)
- Feb 22 - Comet C/2014 A5 (PANSTARRS) At Opposition (4.069 AU)
- Feb 22 - Comet C/2013 PE67 (Catalina-Spacewatch) At Opposition (4.094 AU)
- Feb 22 - Comet 267P/LONEOS At Opposition (4.158 AU)
- Feb 22 - Asteroid 2008 HU4 Closest Approach To Earth (0.881 AU)
- Feb 22 - Asteroid 3162 Nostalgia Closest Approach To Earth (1.978 AU)
- Feb 22 - 15th Anniversary (2000), Galileo, Io 27 Flyby
- Feb 23 - Comet 295P/LINEAR Closest Approach To Earth (2.279 AU)
- Feb 23 - Asteroid 2015 CA40 Near-Earth Flyby (0.016 AU)
- Feb 23 - Asteroid 2015 DU Closest Approach To Earth (0.021 AU)
- Feb 23 - Asteroid 2014 EK24 Near-Earth Flyby (0.041 AU)
- Feb 23 - Asteroid 9766 Bradbury Closest Approach To Earth (1.304 AU)
- Feb 23 - Asteroid 51826 Kalpanachawla Closest Approach To Earth (2.071 AU)
- Feb 23 - Asteroid 1539 Borrelly Closest Approach To Earth (2.410 AU)
- Feb 23 - Asteroid 6639 Marchis Closest Approach To Earth (2.450 AU)
- Feb 23 - Svetlana Gerasimenko's 70th Birthday (1945)

Svetlana Gerasimenko, co-discoverer of comet 67P/Churyumov-Gerasimenko

Source: JPL Space Calendar

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Food for Thought

ESA’s BIOMASS Satellite Goes Ahead

Following the initial selection in 2013 for Biomass to become ESA’s seventh Earth Explorer mission and the completion of preparatory activities, ESA Member States yesterday gave the green light for its full implementation for launch in 2020.

The mission addresses one of the most fundamental components in the Earth system: the status and dynamics of tropical forests. Its primary scientific objectives are to determine the distribution of above-ground biomass in these forests and to measure annual changes in this stock over the period of the mission.

The amount of biomass and forest height will be measured at a resolution of 200 m, and forest disturbances such as clear-cutting at a resolution of 50 m, providing an important tool for sustainable forest management.

Studying the world’s tropical biomass is key to our understanding Earth’s climate.

The mission will provide the first opportunity to explore Earth’s surface at the ‘P-band’ radar frequency from space. In addition to studying forests, the data are expected to be used for monitoring the ionosphere, glaciers and ice sheets, and for mapping subsurface geology in deserts and surface topography below dense vegetation.

Source: ESA
John Glenn During the Mercury-Atlas 6 Spaceflight

**Explanation:** On Feb. 20, 1962, astronaut John H. Glenn, Jr., became the first American to orbit Earth. Launched from Cape Canaveral Launch Complex 14, Glenn's Mercury-Atlas 6 "Friendship 7" spacecraft completed a successful three-orbit mission, reaching a maximum altitude (apogee) of approximately 162 statute miles and an orbital velocity of approximately 17,500 miles per hour. The flight lasted a total of 4 hours, 55 minutes, and 23 seconds before the spacecraft splashed down in the ocean. This photograph of John Glenn during the Mercury-Atlas 6 spaceflight was taken by a camera onboard the spacecraft.

*Image Credit: NASA*

Source: [NASA Image of the Day](https://nasa.gov/image-of-the-day)