Contents

In the News

Story 1:
NASA moves forward with mission using spy satellite telescope

Story 2:
The sleeping giant

Story 3:
Footprints of a Martian Flood

Departments

The Night Sky
ISS Sighting Opportunities
Space Calendar
NASA-TV Highlights
Food for Thought
Space Image of the Week
1. NASA moves forward with mission using spy satellite telescope

NASA has formally approved plans — a year ahead of schedule — for an infrared space telescope launching around 2024 to record unique wide-angle views of the cosmos, seeking answers to questions about mysterious dark energy and searching for habitable worlds around other stars, the space agency announced Thursday.

The Wide-Field Infrared Survey Telescope is projected to cost approximately $2.3 billion and should operate for at least six years. Its observing post is baselined to be at the L2 Lagrange point, a gravitationally neutral location nearly a million miles from Earth in the direction away from the sun.

WFIRST’s centerpiece is a 7.9-foot (2.4-meter) telescope originally built to allow U.S. intelligence officials to spy on adversaries. Instead of turning the powerful telescope toward Earth for a clandestine surveillance mission, NASA plans to repurpose the hardware for cosmic research.

The National Reconnaissance Office, the U.S. government agency responsible for spy satellites, donated two telescope units to NASA in 2012. The spy organization’s gift to NASA did not include other costly items required for a space mission, such as detectors, a spacecraft and a launcher.

NASA decided to use one of the telescopes for WFIRST, an observatory that was already under discussion when the NRO gave the equipment to the space agency.

Scientists recommended such a mission to NASA in a decadal survey report in 2010, but the surprise availability of the spy optics allowed designers to double the size of WFIRST’s telescope, giving the next-generation observatory vision comparable to the Hubble Space Telescope.

But WFIRST has one advantage over Hubble: It will see a swath of the sky 100 times larger than NASA’s current flagship observatory.

“Telescopes generally come in two different flavors: Really powerful, big telescopes that see a tiny part of the sky, or telescopes that are smaller — so they lack that power — but they can see big parts of the sky. WFIRST is the best of both worlds,” said Jason Kalirai, an astronomer at the Space Telescope Science Institute.

The new observatory is NASA’s next flagship-class, multibillion-dollar astronomy mission after the James Webb Space Telescope due for liftoff in 2018. With spending on JWST declining as it nears launch, NASA’s budget now has room to take on the start of a new astrophysics project.

Wednesday’s decision to officially make WFIRST a NASA mission was expected. Agency officials in January said WFIRST would be formally approved for development this year, and not in 2017 as previously planned, after Congress appropriated extra funding for the project over the last three years.

WFIRST will see the cosmos in near-infrared wavelengths, overlapping with a segment of of the spectrum observed by Hubble and JWST, which is even more sharp-eyed in narrow vision than WFIRST.

NASA officials approved the first stage of WFIRST’s development in a meeting Wednesday, a milestone that officially adds the infrared surveyor to the agency’s mission portfolio.
“WFIRST has the potential to open our eyes to the wonders of the universe, much the same way Hubble has,” said John Grunsfeld, astronaut and associate administrator of NASA’s science mission directorate, in a press release. “This mission uniquely combines the ability to discover and characterize planets beyond our own solar system with the sensitivity and optics to look wide and deep into the universe in a quest to unravel the mysteries of dark energy and dark matter.”

Scientists plan to install two instruments aboard WFIRST — a coronagraph and a wide field instrument — and use the telescope’s observations to directly image planets around other stars and study the effects of dark energy and dark matter on the universe.

Dark energy is a mysterious force accelerating the expansion of the universe.

“WFIRST will allow us to potentially make groundbreaking discoveries in finding out what dark energy is,” said Yun Wang, a senior research scientist at the California Institute of Technology. “So this will tell us if dark energy is an unknown form of energy, or if it’s a modification of general relativity.”

Astronomers using WFIRST’s wide field-of-view will detect thousands of bright supernovae — a giant explosion at the end of a star’s life — to measure how the rate of the universe’s expansion has changed over time, according to NASA.

Scientists expect WFIRST to find up to 20,000 exoplanets orbiting other stars, building on the planet-hunting capabilities of NASA’s Kepler telescope.

For the first time ever on a space mission, WFIRST will carry a coronagraph to block out the bright light of other stars in the Milky Way galaxy. WFIRST will demonstrate the coronagraph’s performance, which could allow astronomers to directly see faint starlight reflected off of planets lurking near stars.

Direct imaging is a key step toward measuring the structure and composition of exoplanets, and in determining whether the worlds are habitable.

Current technology primarily relies on detecting exoplanets as they pass between their parent star and an observing telescope near Earth. This “transit” technique is used by the Kepler mission, but it limits the amount of information astronomers can learn about the planet, and it only works for planetary systems with worlds serendipitously passing in front of a star’s disk as viewed from Earth.

Scientists will also use a novel imaging technique with WFIRST to find undiscovered worlds as small as a tenth the mass of Earth, giving astronomers data to build a census of exoplanets across the galaxy, and helping them determine how common Earth-like planets might be around other stars.
“What we’re looking for is gravitational microlensing events,” said Scott Gaudi, an exoplanet astronomer at Ohio State University. “These are cases when another star passes through our line-of-sight to a background star, and it makes that background star get a little bit brighter due to the gravity of that foreground star, and that allows us to find planets.”

“In addition to its exciting capabilities for dark energy and exoplanets, WFIRST will provide a treasure trove of exquisite data for all astronomers,” said Neil Gehrels, WFIRST project scientist at NASA’s Goddard Space Flight Center in Greenbelt, Maryland. “This mission will survey the universe to find the most interesting objects out there.”

Source: Spaceflight Now
2. The sleeping giant

Located about 300 million light-years away in the Coma Cluster, the giant elliptical galaxy NGC 4889, the brightest and largest galaxy in this image, is home to a record-breaking supermassive black hole. Twenty-one billion times the mass of the Sun, this black hole has an event horizon — the surface at which even light cannot escape its gravitational grasp — with a diameter of approximately 130 billion kilometres. This is about 15 times the diameter of Neptune’s orbit from the Sun. By comparison, the supermassive black hole at the centre of our galaxy, the Milky Way, is believed to have a mass about four million times that of the Sun and an event horizon just one fifth the orbit of Mercury.

But the time when NGC 4889’s black hole was swallowing stars and devouring dust is past. Astronomers believe that the gigantic black hole has stopped feeding, and is currently resting after feasting on NGC 4889’s cosmic cuisine. The environment within the galaxy is now so peaceful that stars are forming from its remaining gas and orbiting undisturbed around the black hole.

When it was active, NGC 4889’s supermassive black hole was fuelled by the process of hot accretion. When galactic material — such as gas, dust and other debris — slowly fell inwards towards the black hole, it accumulated and formed an accretion disc. Orbiting the black hole, this spinning disc of material was accelerated by the black hole’s immense gravitational pull and heated to millions of degrees. This heated material also expelled gigantic and very energetic jets. During its active period, astronomers would have classified NGC 4889 as a quasar and the disc around the supermassive black hole would have emitted up to a thousand times the energy output of the Milky Way.

The accretion disc sustained the supermassive black hole’s appetite until the nearby supply of galactic material was exhausted. Now, napping quietly as it waits for its next celestial snack, the supermassive black hole is dormant. However its existence allows astronomers to further their knowledge of how and where quasars, these still mysterious and elusive objects, formed in the early days of the Universe.

Although it is impossible to directly observe a black hole — as light cannot escape its gravitational pull — its mass can be indirectly determined. Using instruments on the Keck II Observatory and Gemini North Telescope, astronomers measured the velocity of the stars moving around NGC 4889’s centre. These velocities — which depend on the mass of the object they orbit — revealed the immense mass of the supermassive black hole.

Source: ESA
3. Footprints of a Martian Flood

Water has left its mark in a variety of ways in this martian scene captured by ESA's Mars Express.

The region lies on the western rim of an ancient large impact basin, as seen in the context map. The image shows the western part of the Arda Valles, a dendritic drainage system 260 km north of Holden Crater and close to Ladon Valles. Vast volumes of water once flowed from the southern highlands, carving Ladon Valles and ponding in the large Ladon Basin seen in this image.

The plain views show the striking dendritic drainage pattern of the valleys (left). Many contributing streams merge into tributaries of the main channels before flowing down into the smooth-floored impact basin towards the right.

In the upper centre of the main image also clearly identified in the topography and anaglyph images a large mound is seen with an 8.5 km-wide impact crater at its foot. The mound is possibly the remnant of an older impact basin but may also have been influenced by sediments transported by the surrounding streams, building up a fan deposit.

In the centre right of the image, a large 25 km-wide impact crater has also been filled by thick muddy sediments that later collapsed into the chaotic terrain seen in the crater floor. The jumbled nodules in the crater rim probably indicate the former level of the infilling sediments.

To the top right of the scene, the surface has also broken up into a number of giant polygons, likely linked to the loss of underground ice and the slow evaporation of water that was once ubiquitous in this area.

The more concentric fracture-like features seen within the smooth floor of the large basin are likely also related to stresses in the surface resulting from the compaction of the vast amount of sediments that infill the basin.

Some of the fractures seem to join the central crater to the smoother basin floor, particularly evident in the perspective view. They could be a later manifestation of stresses due to subsidence or compaction of surface materials.

Finally, in the lower centre of the image, just above the crater at the bottom of the scene and towards the end of the dendritic channels, light-toned and layered deposits have been identified. These are clay minerals, known to be formed in the presence of water.

Source: [SpaceRef.com](https://www.space-ref.com)
The Night Sky

Tuesday, February 23

• The Moon and Jupiter shine together after they rise around the end of twilight tonight. Although they appear paired, Jupiter is currently 1,700 times farther away. And, it's 40 times larger in diameter.

Use binoculars to spot some of Jupiter's own four big moons; the easiest will be Callisto to the planet's east. They're pinpoints in binocs but roughly as big as our own Moon in reality.

Watch the Moon pull away eastward from Jupiter through the rest of the night.

Wednesday, February 24

• Sirius blazes its highest in the south on the meridian by about 8 or 9 p.m. now. Using binoculars, examine the spot 4° south of Sirius (directly below it when on the meridian). Four degrees is somewhat less than the width of a typical binocular's field of view. Can you see a little patch of gray haze there? That's the open star cluster M41, about 2,200 light-years away. Sirius, by comparison, is only 8.6 light-years away.

Thursday, February 25

• Have you ever seen Canopus, the second-brightest star after Sirius? In one of the many interesting coincidences that devoted skywatchers know about, Canopus lies almost due south of Sirius: by 36°. That's far enough south that it never appears above your horizon unless you're below latitude 37° N (southern Virginia, southern Missouri, central California). And there you'll need a flat south horizon. Canopus crosses the south point on the horizon just 21 minutes before Sirius does.

When to look? Canopus is due south when Beta Canis Majoris — Mirzim the Announcer, the star a few finger-widths to the right of Sirius — is at its highest point due south (roughly 8:00 p.m. now, depending on how far east or west you are in your time zone). Look straight down from Mirzim then.

Friday, February 26

• After dinnertime at this time of year, four carnivore constellations stand upright in a row from the northeast to south. They're all seen in profile with their noses pointed up and their feet (if any) to the right. These are Ursa Major in the northeast (with the Big Dipper as its brightest part), Leo in the east, Hydra the Sea Serpent in the southeast, and bright Canis Major in the south.

Source: Sky & Telescope

Return to Contents
ISS Sighting Opportunities

For Denver:

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Sighting information for other cities can be found at NASA's [Satellite Sighting Information](https://nasa.gov/)

NASA-TV Highlights
(all times Eastern Daylight Time)

11 a.m., Wednesday, February 24 - ISS Expedition 46 Round-Robin Interviews for U.S. Television Networks with Commander Scott Kelly of NASA (preempts Space Station Live) (starts at 11:10 a.m.) (all channels)

1 p.m., Wednesday, February 24 - Smithsonian’s National Air and Space Museum Presents “STEM in 30” -- WWII and Tuskegee Airmen: A look at the Role African Americans Played during the War and how World War II changed Aviation History (NTV-1 (Public), NTV-2 (Education))

10 a.m., Thursday, February 25 - Video File of the ISS Expedition 47-48 Crew Qualification Training at the Gagarin Cosmonaut Training Center in Star City, Russia (Ovchinin, Skripochka, J. Williams) (all channels)

12 p.m., Thursday, February 25 - ISS Expedition 46 News Conference for U.S. Media with Commander Scott Kelly of NASA (starts at 12:05 p.m.) (all channels)

6 a.m., Friday, February 26 - Live Media Interviews “Tracking El Niño: New NASA Satellites Observe Impact of El Niño” (NTV-3 (Media))

10 a.m., Friday, February 26 - Live Media Interviews “Tracking El Niño: New NASA Satellites Observe Impact of El Niño” (NTV-3 (Media))

3 p.m., Friday, February 26 - Replay of the ISS Expedition 47-48 Crew News Conference at the Gagarin Cosmonaut Training Center in Star City, Russia (Ovchinin, Skripochka, J. Williams) (all channels)

3:30 p.m., Friday, February 26 - Video File of the ISS Expedition 46-47 Crew’s Ceremonial Visit to the Gagarin Museum at the Gagarin Cosmonaut Training Center and their Visit to Red Square and the Kremlin in Moscow (Ovchinin, Skripochka, J. Williams) (Starts at 3:45p.m.) (all channels)

Watch NASA TV on the Net by going to the [NASA website](https://nasa.gov/).
Space Calendar

- Feb 23 - Apollo Asteroid 2016 CY30 Near-Earth Flyby (0.033 AU)
- Feb 23 - Apollo Asteroid 2016 CO246 Near-Earth Flyby (0.041 AU)
- Feb 23 - Apollo Asteroid 2009 DZ Near-Earth Flyby (0.084 AU)
- Feb 23 - Asteroid 5277 Brisbane Closest Approach To Earth (1.031 AU)
- Feb 23 - Asteroid 4115 Peternorton Closest Approach To Earth (1.911 AU)
- Feb 23 - 55th Anniversary (1961) Ras Tanura Meteorite Fall (Hit Loading Dock in Saudi Arabia)
- Feb 23 - 75th Anniversary (1941), Discovery of Plutonium
- Feb 23 - 80th Anniversary (1936), 1st US Rocket Airmail Launch (1936)
- Feb 23 - Ruth Rowland Nichols' 115th Birthday (1901)
- Feb 24 - SES-9 Falcon 9 Launch
- Feb 24 - Comet 113P/Spitaler At Opposition (2.028 AU)
- Feb 24 - Comet 73P-AT/Schwassmann-Wachmann Closest Approach To Earth (2.182 AU)
- Feb 24 - Asteroid 253 Mathilde Occults UCAC4-518-045085 (12.0 Magnitude Star)
- Feb 24 - [Feb 18] Apollo Asteroid 2016 CK248 Near-Earth Flyby (0.012 AU)
- Feb 24 - Apollo Asteroid 2016 CB31 Near-Earth Flyby (0.027 AU)
- Feb 24 - Aten Asteroid 326290 Akhenaten Closest Approach To Earth (0.225 AU)
- Feb 24 - Asteroid 2575 Bulgaria Closest Approach To Earth (1.261 AU)
- Feb 24 - Asteroid 3066 McFadden Closest Approach To Earth (1.828 AU)
- Feb 24 - Asteroid 7079 Baghdad Closest Approach To Earth (1.963 AU)
- Feb 24 - 5th Anniversary (2011), STS-133 Launch (Space Shuttle Discovery, International Space Station)
- Feb 24 - Pyotr Lebedev's 150th Birthday (1866)
- Feb 25 - Comet 102P/Shoemaker At Opposition (4.129 AU)
- Feb 25 - Comet P/2000 R2 (LINEAR) At Opposition (4.313 AU)
- Feb 25 - Apollo Asteroid 2016 CE32 Near-Earth Flyby (0.062 AU)
- Feb 25 - Apollo Asteroid 2011 OJ45 Near-Earth Flyby (0.076 AU)
- Feb 25 - Aten Asteroid 2012 BF86 Near-Earth Flyby (0.080 AU)
- Feb 25 - Asteroid 7042 Carver Closest Approach To Earth (1.016 AU)
- Feb 25 - Asteroid 2952 Lilliputia Closest Approach To Earth (1.451 AU)
- Feb 25 - Asteroid 10389 Robmanning Closest Approach To Earth (1.688 AU)
- Feb 25 - Teleconference: Astronomy and Astrophysics Advisory Committee (AAAC) Meeting
- Feb 26 - Kanopus V N2/ Landmapper BC 1 & 2/SatByul/ Corvus BC 1 & 2/ Lemur+/ AISSat 3/ Flock 2/ Tyvak Rokot KM Launch
- Feb 26 - [Feb 22] Comet P/2016 A7 (PANSTARRS) Perihelion (2.175 AU)
- Feb 26 - Comet P/2013 T2 (Schwartz) At Opposition (4.152 AU)
- Feb 26 - Apollo Asteroid 2008 CE119 Near-Earth Flyby (0.071 AU)
- Feb 26 - Asteroid 5382 McKay Closest Approach To Earth (1.416 AU)
- Feb 26 - Asteroid 3581 Alvarez Closest Approach To Earth (3.035 AU)
- Feb 26 - Plutino 90482 Orcus At Opposition (47.116 AU)
- Feb 26 - 50th Anniversary (1966), Apollo CSM-009 Saturn 1B Launch (Unmanned)
- Feb 26 - 120th Anniversary (1896), Henri Becquerel's Radioactivity Discovery
- Feb 26 - Francois Arago's 230th Birthday (1786)
- Feb 26 - Niccolo Cabeo's 430th Birthday (1586)

Source: JPL Space Calendar
New research suggests there could be a layer of iron-rich meteorites hidden just under the Antarctic ice.

The churning of glaciers spews many space rocks out on to the surface in Antarctica, but compared to elsewhere on Earth, few of them are made of iron.

Based on modelling and lab experiments, scientists say the missing metallic rocks might be burying themselves, by melting the ice as sunlight heats them.

To prove their idea, the team now wants to look for the rocks themselves.

"The study is proposing a hypothesis - these samples should be there. We just have to go and locate them," said Dr Katherine Joy from the University of Manchester, a co-author of the paper published in Nature Communications.

The idea is, they never make it to the surface - they're forever trapped, 50-100cm or so below the ice.

Dr Katherine Joy, University of Manchester

Antarctica is known by meteorite specialists as a fruitful hunting ground, because the rocks are collected from their landing sites by glacial flows and transported to concentrated dumping-grounds.

"The great thing about Antarctica is they fall on the ice, and then the ice progressively moves away from the plateau. And where it hits these barriers, along the Transantarctic Mountains, the ice gets moved up," Dr Joy told the BBC.
"So this continuous conveyor belt has delivered meteorites from the interior fall sites to the 'meteorite stranding zones' for the past couple of million years or so."

Among this Antarctic haul, however, researchers have noticed that iron-rich meteorites - whether partly or wholly made of the metal - are surprisingly scarce, compared to the percentage collected in other places around the world.

Dr Joy and her colleagues think they may have discovered why.

They froze two small meteorites of similar size and shape, one made of iron and the other rocky and non-metallic, inside blocks of ice. A special lamp was trained on the ice from above, to mimic the rays of the Sun.

Both meteorites, on repeated trials, melted their way downward through the ice block. But because the metal conducts heat more efficiently, the iron meteorite sank further, faster.

The researchers then expanded that observation using a mathematical simulation. Their model showed that this Sun-driven burrowing would be enough to cause iron-rich rocks to sink so much during the long summer days that, over the course of the year, it would account fairly precisely for the lack of iron space rocks welling their way to the surface of the Antarctic "stranding zones".

"The idea is, they never make it to the surface. They're forever trapped, 50-100cm or so below the ice," Dr Joy explained.

That means, if the team's findings are to be believed, that the hunt is on.

**Failed planets**

As Dr Joy's Manchester colleague Geoffrey Evatt put it: "The challenge is now set - to be the first team to locate this reserve of meteorites and retrieve samples from it."

Of all the meteorites gathered from Antarctica, only a handful - so far - have been pulled out from beneath the ice. This is mostly for practical reasons, Dr Joy said.

"When it's very cold... picking up the sample in a controlled way is difficult enough with things sitting on the surface. To access ones that are subsurface - nobody's really tried to do that so far."

So it will not be easy, but the team hopes that radar and metal detectors might help target the search. And the potential rewards are high.

"Every meteorite we find tells us something new about the Solar System," Dr Joy said.

Some are carbon-rich or rocky remnants from long before any planet clumped together; others - like iron and rocky-iron meteorites - offer clues from a more intermediate stage, when baby planets with cores, mantles and crusts were trying to form.

"The iron group represents meteorites that were once the cores and the internal structures of different planetesimals.

"We think there were probably hundreds of these early planets that formed in the solar system but never really got big enough and were broken up in collision events."

Source: [BBC](https://www.bbc.com)
Three Times the Fun

Three of Saturn's moons -- Tethys, Enceladus and Mimas -- are captured in this group photo from NASA's Cassini spacecraft.

Tethys (660 miles or 1,062 kilometers across) appears above the rings, while Enceladus (313 miles or 504 kilometers across) sits just below center. Mimas (246 miles or 396 kilometers across) hangs below and to the left of Enceladus.

This view looks toward the sunlit side of the rings from about 0.4 degrees above the ring plane. The image was taken in visible light with the Cassini spacecraft narrow-angle camera on Dec. 3, 2015.

The view was acquired at a distance of approximately 837,000 miles (1.35 million kilometers) from Enceladus, with an image scale of 5 miles (8 kilometers) per pixel. Tethys was approximately 1.2 million miles (1.9 million kilometers) away with an image scale of 7 miles (11 kilometers) per pixel. Mimas was approximately 1.1 million miles (1.7 million kilometers) away with an image scale of 6 miles (10 kilometers) per pixel.

Image Credit: NASA/JPL-Caltech/Space Science Institute

Source: NASA